INFLUENCE OF WEATHER AND REARING TECHNIQUES ON MULBERRY SILK WORM CROPS IN KERALA

BY

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "Influence of weather and rearing techniques on Mulberry silkworm crops in Kerala" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title,of any other University or Society.

Vellayani

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CERTIFICATE

Certified that this thesis, entitled "Influence of weather and rearing techniques on Mulberry silkworm crops in Kerala" is a record of research work done independently by sri. R. Krishna kumar under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship, or associateship to him.

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INTRODUCTION

INTRODUCTION

Sericulture finds a place among the most competitive agro-based enterprises with the commercialization of farming in India. Silk industry has grown from its traditional status and cultural bondage to a commercial venture in the past few decades. Competitive edge in terms of quality and price is the deciding factor in the new market economy. There is a gradual shift of production area in sericulture from temperate to tropical zones and new challenges have been encountered in the quality aspects. So it is for the tropical countries to upgrade the productivity and quality of silk to compete in the international market.

For countries with farming base, high population and small holdings, sericulture is a boon and tailor-made enterprise. Because of its small initial investments, short gestation period, labour intensiveness and high domestic demand, sericulture can be properly exploited for rural development. Multiple cropping and integrated farming approach are areas of interest which contribute sustainability to the living standards. Sericulture, Diarying, Horticulture, Fisheries, Poultry etc. need to be integrated with agriculture so as to derive maximum benefit from the available internal resources and also through recycling them for organic farming, byproduct utilization etc. so that value addition will be possible at production site itself. 'Silk Milk' partnership, Horti-Seri plantations, multi-canopy cropping system are well accepted patterns. As tropical sericulture is affected by crop instability, poor productivity and inferior quality, investigations are to be continued on the identified seasons based on temperature and humidity, breeds, rearing conditions, rearing technology and mulberry crop.

The upper limits of temperature, rainfall and humidity in Kerala are much higher than in the sericulture tracts of Karnataka and Tamil Nadu. Therefore the techniques evolved elsewhere have to be modified to suit the stress conditions in the state. The stress factors and seasons are to be identified for suggesting any improvements in the technology. In addition, the high wage rate prevailing in the state cuts down the profit to a marginal level. Hence the strategy is to be oriented towards small scale rearing utilizing family labour. The number of rearings in an year, rearing seasons, rearing techniques and economics in rearings are therefore important areas of research to promote a sustainable sericulture programme for the state.

Researchers in sericulture have already undertaken a lot of research programmes for the successful rearing of silkworms. Importance of rearing under controlled conditions (Tanaka, 1964), requirement of optimum conditions for faster growth of young silkworms (Akapanthul and Ngamprasith 1973), the effect of excessive humidity on larval duration (Rahman, 1989), possible improvements of larval growth and cocoon characters under favourable temperature in rearing house (Krishnaswamy *et. al*, 1976), ill effects of high temperature on larvae and cocoon characters (Raj 1988), impact of rearing house, hygienic conditions and larval density (Rangaswamy *et. al*,1976 and Krishnaswamy *et. al*, 1988) have been studied.

Information on such factors under the particular ecological situations prevailing in Kerala are essential for improving the rearing practices to produce quality cocoons and higher yield. Hence the present programme namely 'Influence of Weather and Rearing techniques on Mulberry silkworm crops in Kerala' was identified as a topic of research in order to give a package of practices recommendations for a small scale rearing. The programme envisages research on three different aspects

- Effect of climatic factors on the mulberry silkworm crop
- Identifying rearing technology for stress seasons of temperature and humidity
- Manipulation of feeding schedule with reference to stress seasons and types of rearing houses

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Effect of climatic factors on the mulberry silkworm crop

The climatic conditions influence the silkworm rearing and the success of silkworm crop largely depends on the type of rearing house ensuring hygienic conditions, rearing space and with proper scope for manipulation of environmental conditions (Tanaka, 1964 and Krishnaswami et al. 1976). Kumararaj (1969) observed that silkworms urinate more during spinning period in the rainy season when temperature is low and the humidity is high.

Sakaguchi (1978) reported that the silkworm *Bombyx mori L* was highly sensitive to environmental conditions. Liu Shixian (1984) reported that bivoltine races were more susceptible to grasserie during summer. Benchamin and Jolly (1986) found that the ideal humidity during moulting was 60 – 70per cent. Mathur and Jayaswal (1987), Basu et al. (1991) and Roy Choudhary et al. (1991) observed that the susceptibility of silkworms to the diseases and subsequent yield reduction in the plains of West Bengal was due to high temperature coupled with high humidity and their fluctuations during the fourth and fifth larval period. Raj (1988) studied effect of high temperature on silkworm rearing and found that the cocoon quality was reduced when the temperature was between 30-36 ^{0}C.

Bhat et al. (1989) did preliminary assessment of four populations of bivoltine breeds of silkworm and found that the breeds gave lower yields in rainy season. Rahman (1989) worked on the effect of humidity on silkworm growth and found that higher humidity decreased larval duration in late stage. Sekharappa and Gururaj (1989) studied the management of silkworm rearing during summer and according to them mulberry leaf harvested when leaf moisture was at maximum was condusive. The studies also revealed that proper preservation of leaves in humid conditions, regulation of temperature and humidity in the rearing house, feeding pattern, and maintenance of hygienic conditions in and around the rearing house were the important factors influencing success in silkworm crops.

Giridhar et. al. (1990) observed that higher melting percentage was noticed in NB_4D_2 than NB_7, KA and NB_{18} in all seasons viz summer, winter and rainy. Samson et al.(1990) reported that the use of soiled leaves, poor quality leaves and tender leaves during humid seasons led the diseases infecting silkworms. He also found that overcrowding of larvae in the rearing bed and use of contaminated hired rearing appliances also predisposed the larvae to the disease. Samson et al (1990) and Savanurmath et al (1992) reported that fluctuation in day and night temperature and relative humidity prevailing in the rearing house was the important cause for NPV infection in silkworm larvae. Singh et al (1990) reported that NB_4D_2 was highly susceptible to diseases where as pure mysore showed least incidence of diseases under natural conditions. Dhinakar et al (1991) suggested higher size of silk gland in winter larvae to be responsible for higher cocoon weight and thereby silk yielding capacity. The dry weight of the silk gland was low with high water content during winter season in comparison with summer.

Gangavar and Somasundaram (1991) studied influence of abiotic factors with larval duration and cocoon yield and found that the mud house with thatched roof having cooler climatic conditions than tiled house and RCC building enhanced the larval duration and cocoon yield and among the weather parameters the relative humidity had alone reflected its influence on larval duration. Giridhar and Reddy (1991) reported that the NB_7 registered highest ERR by number and weight than NB_4D_2, KA and NB_{18} in summer, winter and rainy seasons. According to them weight of larvae, weight of cocoon and shell weight were more in rainy season. Samson (1991) observed that apart from the high temperature and the high humidity in the rearing house, the fluctuations in the diurnal temperature and humidity, the poor hygenic conditions such as excessive moisture in the rearing bed, lack of separate rearing house and poor ventilation were the pre-disposing factors for the different diseases affecting silkworm.

Upadhyay and Misra (1991) found that the rate of larval mortality, rate of consumption of food, efficiency of digestion and gain in body weight were higher in fifth instar larvae of *Bombyx mori* than fourth instar at 30-34^{0}C.

According to them the role of various ecological factors like temperature, humidity and photoperiod (Misra and Upadhyaya; 1992) had been proved to be influencing the nutritive capability of bivoltine mulberry silkworms. Barman (1992) found that humidity had a close relationship with the feeding frequency and the outbreak of viral diseases; three feedings in 24 hours in low humidity caused the highest incidence.

Singh Deo et al. (1992) studied the performance of four bivoltine breeds in Koraput, Orissa during different seasons and found that the mean performance of the four breeds (P5, KPG-B, NB_7 and NB_{18}) was significantly high in larval weight, effective rearing rate, single cocoon weight, yield per 100 dfls and absolute silk content during September-October season. Fecundity was quite high in all seasons except in July-August. Hatching was significantly higher in May–June, July-August and September-October. Effective rearing rate in number was significantly more in March-April and in September-October. Single cocoon weight was found significantly higher in January, July-August, September – October and November-December where as the cocoon shell ratio was more in March-April, May-June and September-October rearings. The rearings of all the four breeds could be conducted successfully throughout the year in Koraput district except in May-June months.

Gangavar et al (1993) observed that higher temperature and lower humidity prevailing during hot hours of the day accelerated leaf withering leading to lower rate of leaf ingestion of silkworms during the hot periods of the day. According to Kobayashi (1993) effective thermal inhibition of viral disease occurred at temperatures higher than 35^0C. The phenomenon of thermal inhibition was applicable for preventing viral diseases in sericulture farms.

Sivaprakasam (1994) stated that the incidence of grasserie was maximum during summer (Feb-May) followed by premonsoon season (June-Sept) and minimum during winter season (Oct-Jan).

. Chaluvachari and Bongale (1995) found that during rainy season, larval duration and larval weight recorded significantly higher values and summer season recorded lower values of larval duration and larval weight. Chun la poon et al. (1995) studied the effect of humidity on delayed brushing and found that brushing could be delayed if required for the unavoidable reasons for 12 hours and 48 hours at 90 per cent and 70 per cent relative humidity. Raju and Krishnamoorthy (1995) observed that cross breeds PM x KA, PM x NB_7, PM x NB_{18} and PM x NB_4D_2 performed better than multi x multi hybrids in pre monsoon ,monsoon and post monsoon seasons.

Savanurmath et al (1995) found that the physical factors like ambient temperature, relative humidity and the combined effect of temperature and relative humidity demonstrated a significant correlation with the incidence of infections; flacherie and grasserie. He also reported that the summer season was more disastrous particularly when the dry season followed by rainy and winter seasons. Sivakumar et al (1995) found that the rearing house with thick mud wall and thatched roof or country tiled roof was ideal for rearing during summer season. Sivaprakasham and Rabindra (1995) observed that the high temperature and low humidity prevailing during summer months were the reasons for higher incidence of grasserie.

Larval Spacing

The technique of increasing the rearing bed space in relation to the body growth based on constants was suggested in temperate sericulture countries by Masui (1929). Larval crowding due to inadequate rearing seat space was found to increase the duration of larval life and mortality, reduce the larval, pupal and imaginal weights and affected morphology, longevity, fecundity and fertility of the resulting adults in several representatives of the order Lepidoptera (Iwao, 1968; Mansour and Dimetry, 1972; Hinton, 1981; Fescemyer and Hammond, 1988).

Sen Gupta and Yusuf (1974) noted that in multivoltine breeds of silkworm larger spacing improved the growth and vigour of larvae. Rangaswami et al. (1976), Jolly (1987) and Krishnaswami (1988) demonstrated that the larval growth of silkworm was always related to larval rearing space. According to them, the density of population in the rearing bed should be maintained in such a way that the ideal microclimatic conditions of the bed was ensured. The present recommendation of spacing for improved cross breeds is 360 square feet for 100 layings (Krishnaswami et al. 1973, Benchamin et al. 1983).

Peters and Barbosa (1977) reported that density of larval population had great impact on biology, morphology and physiology of insects. Insect growth and development proceed optimally under certain population densities, though caterpillars adjusted to a wide range of population densities (Sehnal, 1985).

In order to study the practical rearing density for profitable silkworm rearing, three rearing densities of 140, 160, 180 silkworms per 0.1 m^2 compared with standard density of 110 silkworm per same area for autumn and spring rearing was done by Lee et al. (1990) and found that the safe limit of practical rearing density per 0.1 m^2 at the fifth instar was 160 silkworms for spring rearing and 150 silkworms for autumn rearing.

Roy Choudary (1991) found that the wider spacing as per Chinese recommendation played a significant positive role for improvement of larval, pupal and imaginal weight, fecundity and hatching performance.

Haque et al (1992) observed that the spacing of worms had a direct effect on cocoon production. The studies showed that 300 square feet for 100 dfls in the case of local races and 400 square feet for 100 dfls in the case of improved and bivoltine races had been recommended for commercial rearing. Talukdar et al.(1992) studied the effect of five different larval densities viz 75, 100, 125, 150 and 175 per 0.09 m^2 with three multivoltine races on cocoon production rates and adult longevity in controlled conditions. It had been observed that with the increase in larval density, the cocoon production as well as the adult longevity decreased. Population density of 100 worms per 0.09 m^2 area was recommended for increased cocoon production, longer adult longevity and economic rearing.

Das et al (1993) observed that low densities of larvae, diet rationing and bed cleaning twice a day were preferable in all conditions except high temperature.

Feeding frequencies

Through a series of feeding trials, Legay (1951; 1955 & 1958) observed that the continuous feeding did not favor the growth and development as compared to the fixed interval feeding. He also revealed that less number of feeding frequencies than four feedings per day did not affect the development of the worms up to third molt and the worms fed six times per day ate less quantity than the worms given two or four feedings per day. He also pointed out that if the nutritional qualities of the mulberry leaves were maintained properly, the larvae could be fed at leisure. Hakim Ali (1952) studied the feeding frequencies in silkworm rearing and according to him the required number of feeding times for the first age was seven to eight per day and for the second, third and fourth age five per day while the fifth age had to be fed five times for the first three days and seven-eight times for the last three days.

Sharada and Bhat (1957) mentioned that more food consumed by the silkworm larvae at low humidities was in order to build up unit body weight. Golsanki(1959) found that feeding of worms at night times was more favorable than that done in day time. Narayanan and Chawla (1965) reported that the effect of different frequencies of feeding *viz* three, four and five feedings per day had no significant differences on single cocoon weight, floss percentage, filament length and denier. They also pointed out that the reduction in the number of feeds was advantageous as it reduced manual labour and time.

Aruga and Tanada(1971) and Samson et al(1981) reported that two times feeding caused starvation and therefore led to higher incidence of diseases and poor cocoon characters. According to Takamiya,(1974); Sumimota, (1974); krishnaswami et al.(1973) and Nijhout, (1981); the length of the larval period could be reduced or prolonged by combined effect of temperature, photoperiod and nutrition which affected feeding frequencies during the embryonic and the young larval stages. Gabriel and Rapusas,(1976); Venugopala Pillai,(1979);

and Kuruda et al.(1981) observed restricted feeding at fifth instar had affected growth rate and it extended larval duration. Krishnaswami et al.(1976) found the superiority of feeding chopped leaves over entire leaf feeding; four feedings over three feedings and preserved leaves over fresh leaves in terms of larval weight, cocoon weight, shell weight and shell ratio.

According to Jolly et al. (1981) though all the feeding times were important, missing of feeding at 10 AM was found less detrimental. Venugopala Pillai et al. (1983) found that the larvae reared with two or three feeds from first instar upto third instar followed by four feedings per day in later stages improved the economic characters. Geetha Devi et al. (1986) studied the effect of different feeding frequencies and pointed out that two, three and four feeding frequencies were not significantly different in terms of single cocoon weight, single shell weight, shell ratio and absolute silk content.

According to Krishnaswami (1986) during wet seasons the number of feeds to be given in a day could be reduced while during summer months increased number of feeding was desirable to build up necessary humidity in the rearing bed. Karaivanan (1990) compared different feeding frequencies and inferred that feeding twice at the fifth instar providing necessary quantities of mulberry leaves could be successfully applied in rearing silkworms.

Bora et al (1994) studied the effect of different feed frequencies (16 – 32 feeds) during fifth instar of cross breeds and found that larvae starved after 18 feeds only produced cocoons. Das et al (1994) found that when the daily required quantities of leaves were provided in two equal halves from the third instar onwards and the freshness of leaves was maintained, the bivoltine rearing was good in favorable season. Feeding the worms twice a day showed good economic potentiality than the traditional four feedings in saving the manpower resulting in higher net profit.

Benchamin (1995) noted that during rainy seasons two to three leaf feedings and two shoot feedings were adequate for late age rearing. Haque (1995) studied effect of feeding frequencies in the different races of silkworm during different seasons in Bangladesh. According to him two time feeding affected rearing programmes in all seasons whereas four time feeding showed best results and three time feeding per day exhibited better result. Benchamin (1997) suggested that four to five leaf feedings and three to four shoot feedings per day was required for late instars during summer months.

MATERIALS AND METHODS

3. MATERIALS AND METHODS

The research programme for the thesis forms a part of the central silk board project entitled 'Standardising sericultural practices for the agroclimatic conditions of Kerala' carried out in the department of Agricultural Entomology at the college of Agriculture, Vellayani during 1991-96. The facilities available in the sericulture section of the department of Entomology were utilized for carrying out the research work. The study was covered in three different experiments *viz*

1. Effect of climatic factors on the mulberry silkworm rearing in different seasons.
2. Identifying rearing technology for unfavourable seasons due to stress conditions of temperature and humidity.
3. Manipulation of feeding schedule with reference to stress seasons and types of rearing houses.

3.1 Rearing of Silkworms

3.1.1 Disinfection of rearing houses and equipment

The rearing rooms and the rearing equipment were thoroughly cleaned off the dead larvae, pupae, cocoons, used paper bits and other debris. The rearing equipment were washed with 5 per cent bleaching powder solution and sundried and were stacked in the rearing rooms to be disinfected. The cracks and crevices in the low cost rearing rooms were sealed. The windows and doors in the rearing houses were closed and sealed by pasting paper.

Two per cent formalin solution was prepared from the 35-40 per cent commercial formaldehyde having a specific gravity of 1.081 and 1.087 by diluting with water. The quantity of water required for this was worked out by applying the formula (Jolly,1987).

Strength of commercial formaldehyde – Strength of formalin solution required/ Strength of formalin solution required

This gives the ratio of water to be added to 1 part of formalin to prepare the required strength of disinfectant. All the rearing equipment, walls, ceilings and the roof of the rearing rooms were sprayed using a rocker sprayer. After spraying, the rooms were kept closed for 24 hours. Then the doors and windows were opened and air circulation was allowed in the room for 24 hours for the traces of formaldehyde to disappear. The disinfection was carried out two to three days prior to the incubation of the eggs.

3.1.2 Incubation

The silkworm eggs were incubated properly to promote uniform hatching. For this the egg sheets were spread in chawky trays on paraffin paper, and the moist foam pads were kept all around the egg sheet so as to maintain relative humidity at 80-85 per cent. The egg sheets and foam pads were covered by paraffin paper and were kept for incubation.

On the previous day of the expected day of hatching the individual layings were kept apart covered with black paper in small wooden trays treatment wise.

3.1.3 Brushing of larvae

At 8 AM next day the incubated layings were taken out of the black paper and exposed to diffused sunlight in the rearing room. By 10 AM 85 per cent of the eggs hatched out. Mulberry leaves chopped into 0.5 x 0.5cm size were sprinkled over the layings to facilitate easy transfer of the worms to the rearing bed. The worms from each layings were brushed on to the previously prepared rearing bed in chawki trays in accordance with the treatments, sufficient chopped mulberry leaves were sprinkled and the bed was compactly surrounded with paraffin paper and trays staked one over the other on the chawki stants.

3.1.4 Feeding silkworms

The silk worms were fed with good quality mulberry leaves chopped into the size required for different larval stages to satisfy their appetite, to ensure their healthy and uniform growth. The leaves were harvested in the morning and brought to the rearing house in the moist gunny bags and kept in the leaf chamber. The early instars were fed with young and tender leaves while the late instars larvae were fed with the coarse leaves. In the first and second experiment, four feedings were given at 6 AM, 11 AM, 3 PM and 8 PM and for the third experiment the feeding schedule was arranged according to the treatments.

3.1.5 Bed cleaning

The rearing bed was cleaned to remove the leaf waste and faecal matter once during the first and second instar larval stages just before setting for moult. During the third instar two cleanings were given ie. just after the moult and in the middle of the larval duration. In the fourth instar stage, the rearing beds were cleaned on alternate days and the fifth instar larvae were cleaned daily before the first feed.

For bed cleaning purpose, nylon nets were used. The nets were spread over the bed and one or two feedings were given. The nets were lifted with fresh leaves and larvae were transferred to a new clean and disinfected tray.

3.1.6 Larval spacing

The larval spacings given for the first and third experiments were according to the package of practices recommendations of the central silk board. The spacing schedules adopted for the second experiment was as per the treatments.

3.1.7 Moulting

During the moulting stages, the worms were handled with utmost care. The paraffin cover was removed and the rearing beds were widened and spread to facilitate more aeration in the bed to facilitate uniform moulting. A thin layer of lime was dusted after the last feeding to keep the rearing beds dry. Once new worms come out of moult, Resham Keet Oushadh powder was dusted in the rearing bed and on the larvae to prevent fungal infecion.

3.1.8 Young age silkworm rearing

The rearing practices for the first and second instar larvae are similar. They were fed four times a day with tender leaves chopped to 0.5 to 1.0 cm^2 during first instar and 1 to 2 cm^2 during the second instar. The humidity requirement for these instars was 85 per cent and it was provided in the rearing bed by keeping moist foam pads and covered with paraffin papers. The temperature maintained was 27^0C for both of these instars. At moulting the practices mentioned earlier were followed.

3.1.9 Late instar rearing

The third, fourth and fifth instars are considered as late instar larvae. These instars were reared in bamboo or wooden rearing trays in which the news papers were used at the bottom of the tray as support. The newspaper was changed during cleaning of each instar. The third instar larvae were fed with leaves cut to a size of 3 cm x 6 cm and for the fourth and fifth instar larvae entire leaves were given.

For all these instars four feedings per day were provided. Three bed cleanings were given for the third instar larvae and during the fourth and fifth instar larval stages daily bed cleanings were done. The leaves of medium maturity were fed to the third and fourth larval stages and coarse mature leaves were fed to the fifth stage. The rearing trays were kept in the rearing stand. During each feeding, the trays were taken from the stand and placed over the feeding stand to provide the weighed quantity of mulberry leaves. The bed cleanings were performed with the help of nylon nets at the frequencies mentioned earlier.

During moulting periods, the beds were widened to facilitate more aeration in the rearing beds and RKO powder was dusted after moulting.

3.1.10 Mounting

At the end of the fifth instar the mature worms were hand picked from the rearing trays and placed in the bamboo mountage for spinning the cocoons. The density of the mature worms mounted was 40-45 worms per sq. ft in the mountage.

3.1.11 Harvesting of cocoons

The cocoons were harvested on the fifth day in the case of cross breed and on the sixth day in the case of bivoltine race. The harvesting was done by collecting the cocoons from the mountage. The cocoons were then sorted into good, double, flimsy and melted cocoons. The good cocoons were weighed after cleaning by removing the faecal pellets or any other extraneous materials sticking on to its surface. Samples were taken from these cocoons for recording cocoon weight, shell weight and pupal weight. Samples were taken from each treatment to assess the reelability and filament length.

3.2 Mulberry Leaves used for rearing silkworms

Mulberry crop raised as an intercrop in coconut garden was maintained throughout the period of investigation in the Instructional Farm, College of Agriculture, Vellayani. The recommended variety Kanva-2 was cultivated. The mulberry crop was raised and managed following the package of practices of the Central Silk Board (1989).

The leaves were harvested daily in the morning and evening. Diseased and poor quality leaves were rejected. The harvested leaves were transported immediately to the rearing houses in leaf baskets without much exposure to the sunlight to keep the leaf quality. The collected leaves were stored inside the leaf chamber to prevent any loss of moisture.

3.3 Effect of climatic factors on the mulberry silkworm reared in different seasons

3.3.1 Identification of different seasons

Five rearing seasons were identified based on the comparative study of the weather data comprising temperature, relative humidity and rainfall for the fifteen years from 1977 to 1991 (Appendix-I) maintained in the meteorological station attached to the department of Agronomy, College of Agriculture, Vellayani. The seasons thus identified for this study were August-September, October-November, December-January, February-April and May-July.

For each season three crops of silkworms were reared at fortnightly intervals in rearing house with brick walls and tiled roof. Three rearings during a particular season were treated as brushing frequencies and thus fifteen such rearings conducted in five seasons in an year (1993-94, Appendix- II).

3.3.2 Treatments

Silkworm types		-	2
(i)	CB - PM x NB_4D_2	-	R1
(ii)	Bivoltine - NB_4D_2	-	R2

Brushing frequencies in each season		-	3
	(At fortnightly intervals)		
(i)	F1	-	First brushing
(ii)	F2	-	Second brushing
(iii)	F3	-	Third brushing

Treatment combinations in each season

F1R1	F1R2
F2R1	F2R2
F3R1	F3R2

Number of Replications	-	Four
Mulberry variety used	-	Kanva - 2
Design of Experiment	-	C R D

3.3.3 Recording of weather parameters

(i) Temperature

The maximum and minimum temperature inside the rearing room and outside the rearing house were recorded by using a maximum and minimum thermometer. The temperature was recorded at 7.22 A.M and at 2.20 P.M inorder to get the particular day's minimum and maximum temperature in accordance with IMD recommendations(Appendix-III).

(ii) Relative humidity

Relative humidities inside the rearing room and outside the house were recorded by using Dimple wet and dry bulb thermometer .The recordings were done twice a day; during early morning hours at 7.00 AM and at 2.20 PM for getting the day's minimum and maximum relative humidity readings. For computing the relative humidity; readings in the wet and dry bulb columns of the thermometer were recorded in celcius scale and the difference was interpolated in the hygrometeric tables and expressed in percentage.

(iii) Rainfall

The rainfall on each day was recorded using the raingauge kept at the meteorological station, College of Agriculture, Vellayani.

3.4 Observations recorded in different experiments

3.4.1 Feeding duration

Instar wise feeding duration in hours was recorded in log sheet as the interval between the time of moulting out from the preceding instar and time of setting for the next moult. Separate log sheets were maintained for all replications of a treatment.

3.4.2 Moulting duration

Moulting duration was recorded in log sheets as the interval between the setting for moulting and subsequent moult out in hours.

3.4.3 Larval weight

The larval weight was recorded by weighing ten worms one day prior to setting for moulting using a top loading Metler-electronic balance for the third and fourth instars. In the fifth instar the weight of ten full grown larvae one day prior to spinning was taken and the average was worked out.

3.4.4 Growth rate

The growth rate of the larva at a particular instar was found out by using the equation (Rahman, 1989)

(Weight of larvae at a particular instar—Weight of larvae at previous instar) / Weight of larvae at the previous instar

3.4.5 Growth index

The growth index of the larvae at a particular instar was found out by using the following equation (Rahman, 1989)

(Weight of larvae at a particular instar --Weight of larvae at the time of hatching) / Weight of larvae at the time of hatching

3.4.6 Leaf consumption

The worms were fed four times a day with known quantity of mulberry leaves. The left over leaves and the leaf waste due to preferential feeding of the worms, were weighed during the bed cleaning and the quantity of leaf consumed was worked out by deducting the weight of waste from the total quantity of leaves fed to the worms. It was expressed in grams per 100 worms

3..4.7 Weight of silk glands

The weight of silk glands in fifth instar prior to spinning were assessed by dissecting out the silk glands from five numbers of randomly selected ripe larvae, when the silk glands reach maximum growth and the average weight per larvae was worked out.

3.4.8 Fecundity

A sample of twenty sexed pupae from each replication were selected at random and kept for assessing the fecundity. The moths emerged from these pupae were allowed to mate and the females were separated and after 24 hours kept in cellules for egg laying. The eggs laid were counted and recorded and average worked out.

3.4.9 Percentage of missing larvae

Percentage of missing larvae was worked out after the second moulting of silkworm larvae using the formula

Percentage of missing larvae = number of brushed larvae-number of larvae survived after second moult / total number of larvae brushed x100

3.4.10 Single cocoon weight

Ten cocoons from each replication of the treatments were collected at random and their weight was recorded using a Metler-electronic precision balance and from these, the average single cocoon weight was computed

3.4.11 Shell weight

The above sample cocoons were cut open, the pupa and exuviae were removed and the shell was weighed in an electronic balance. The average shell weight was computed.

3.4.12 Shell ratio

The shell ratio was determined by using single cocoon weight and shell weight

Shell ratio = Weight of single shell / Weight of cocoon x 100

3.4.13 Reelability

The reelability of 100 numbers of cocoons from each treatment at the rate of 25 numbers per replication was assessed by reeling it in a multi end reeling machine at the reeling centre, Mithranikethan, Vellanad. After reeling the cocoons, the number of total castings, unreeled cocoons, three fourth reeled cocoons, half reeled cocoons and quarter reeled cocoons were counted. From these values, the reelability was worked out using the equation

Reelability = (Total number of cocoons – calculated number of unreeled cocoons – calculated number of reeled cocoons)/(Total castings – calculated number of reeled out cocoons) x 100

3.1.14 Filament length

The filament length of each sample cocoon was assessed using an euapprovite in the silkworm reeling center, Mithranikethan, Vellanad.

3.4.15 Effective Rearing Rate (ERR by number)

(Rahman, 1989)

ERR (By Number) = Number of cocoons harvested / Number of worms brushed x 10,000

3.4.16 Effective Rearing Rate (ERR by weight)

(Rahman, 1989)

ERR (By Weight) = Number of cocoons harvested / Number of worms brushed x 10,000 x single cocoon weight

3.4.17 Pests and Disease incidence

Incidence of silkworm diseases viz. pebrine, flacherie, grasserie and muscardine were recorded as and when noticed and the infected larvae were removed from the rearing bed. Damage due to predators like lizards were also recorded during each instar.

3.5 Identifying rearing technology for stress conditions of temperature and humidity.

To overcome the ill effects of the adverse climatic conditions prevailed in the stress seasons for the silkworm rearing, the treatments listed below were incorporated in the rearing during all the three stress seasons in 1995 and 1996.

3.5.1 Treatments

3.5.1.1 Rearing houses

Three low cost rearing houses having two rooms of size 12'x10'x7' and portions of CSB rearing house and the insectary of the depatment of Entomology with following constructions were used.

(i) Sun dried brick wall and thatched roof - H1 (plate 1-A)

(ii) Burnt brick wall and thatched roof - H2 (plate 1-B)

(iii) Sun dried brick wall and light roof - H3 (plate 1-C)

(iv) Burnt brick wall and RCC roof - H4 (plate 1-D)

(v) Burnt brick wall and tiled roof - H5 (plate 1-E)

3.5.1.2 Larval density/spacing

Three spacings *viz*

(i) Higher larval density of 2.7 sq.ft for a laying of fifth instar larvae. (S-1)

(ii) Recommended larval density of 3.6 sq.ft for a laying of fifth instar larvae. (S-2)

(iii) Lower larval density of 4.5 sq.ft for a laying of fifth instar larvae. (S-3) (Appendix- IV)

3.5.1.3 Silkworm types

Two types were used.

(i) Bivoltine - $NB_4 D_2$ (R1)

(ii) CB - PM x $NB_4 D_2$ (R2)

Design : Factorial CRD

Replication : 2

Plate 1

Different types of silkworm rearing houses

A. Thatched house with sundried mudbrick wall (H1)

B. Thatched house with burnt brick wall (H2)

C.Light roof house with sundried brick wall (H3)

D. RCC roof house with burnt brick wall (H4)

E. (H5) Tiled roof house with burnt brick wall

PLATE 1

A

B

C

D

E

3.5.1.4 Observations Recorded

As described in para 3.4

3.5.1.5 Manipulation of feeding schedule with reference to seasons and types of rearing house.

Three feeding frequencies were tried in this experiment with a view to reducing the labor requirement and to find out the optimum number of feeding during the different seasons having higher humidity due to high rainfall rate, and higher temperature prevailing in summer season in combination with the five types of rearing houses during 1995 and 1996.

3.5.1.6 Rearing houses

Five types (vide para 3.5.1.1)

3.5.1.7 Feeding schedules

(i) Two feedings a day at 8 AM and 8 PM. (F-1)

(ii) Three feedings a day at 8 AM, 2 PM and 8 PM. (F-2)

(iii) Four feedings a day at 6 AM, 10 AM, 3 PM and 8 PM. (F-3)

The feeding schedules were tried without any change in the recommended quantity of leaf to be fed to the worms per day. The total feed requirement for each stage was given in two, three, or four feeds as per the treatment.

3.5.1.8 Silkworm types

Two types of silkworms were used

(i)	Bivoltine	-	$NB_4 D_2$	(R-1)
(ii)	CB	-	PM x $NB_4 D_2$	(R-2)

Design of the experiment - Factorial CRD

Mulberry variety used - Kanva- 2

Replications - 2

3.5.1.9 Observations recorded

Same as in para 3.4

3.6 Statistical analysis of data

The data collected in the various experiments were analysed statistically using either completely randomised design or factorial completely randomised design and the CD values are given where ever the values are significant statistically. Correlations between the climatic parameters with some important characters of silkworm and cocoon were worked out as described by Panse and Sukhatme (1957). Path analysis devised by Wright (1921) was used to study the direct and indirect effects of weather parameters on shellratio and cocoon weight.

RESULTS

4. RESULTS

4.1 Effect of climatic factors on the mulberry silkworm crop

The data pertaining to the different parameters under this experiment recorded during five rearing seasons are presented in Table 1 to Table 13.

4.1.1 Feeding duration of different instars

4.1.1.1 First instar

The active feeding duration of the first instar larvae of the different races till they set for moulting are presented in Table 1. The duration varied from 57.00 to 84.00 hours during the different seasons and brushing intervals. The mean first instar larval duration was longer in October-November season (78.67 hours) followed by 75.33 hours in December-January season, 73.50 hours during February-April season which is statistically on par with the feeding duration of 62.67 hours in August-September season.

In the case of different brushing intervals the mean first instar larval duration was highest (73.50 hours) in the third brushing followed by 69.50 hours during first brushing and 68.90 hours in the second brushing. The third brushing during Ocober-November season recorded the highest value of 84 hours and the second brushing period during the February-April season recorded the least duration of 57 hours.

Table 1 Influence of seasons and brushing intervals on the **feeding duration of different larval instars (hours)** of crossbreed and bivoltine race of mulberry silkworm

First instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F/R)	CD(0.05)
F1	77.00	63.00	71.50	62.00	74.00	69.50	F-0.32
F2	71.00	57.00	74.50	64.00	78.00	68.90	FS-0.73
F3	78.00	69.00	74.50	62.00	84.00	73.50	
Mean (S)	75.33	63.00	73.50	62.67	78.67	-	S-0.42
Races (R)							
R1-PMxNB_4D_2	69.33	62.00	70.33	73.33	81.33	71.27	R-0.27
R2-NB_4D_2	81.33	64.00	76.67	52.00	76.00	70.00	RS-0.59

Second instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F/R)	CD
F1	72.00	60.00	71.50	49.00	65.38	63.58	F – 0.82
F2	84.00	72.00	67.50	67.00	81.00	74.30	FS –1.83
F3	90.00	63.00	96.50	62.63	78.00	78.00	
Mean (S)	82.00	65.00	78.50	59.54	74.79	-	S –1.06
Races (R)							
R1-PMxNB_4D_2	76.00	56.00	70.33	53.00	73.58	65.78	R – 0.67
R2-NB_4D_2	88.00	74.00	86.67	66.08	76.00	78.15	RS –1.50

Third instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F/R)	CD
F1	96.00	93.25	72.50	83.50	98.25	88.70	F-0.30
F2	99.00	81.00	86.00	77.00	93.00	87.20	FS-0.68
F3	99.00	66.00	89.00	98.50	90.00	88.50	
Mean (S)	98.00	80.08	82.50	86.33	93.75	-	S-0.39
Races (R)							
R1-PMxNB_4D_2	94.00	76.00	69.53	86.00	85.50	82.17	R-0.25
R2-NB_4D_2	102.00	84.17	95.67	86.67	102.00	94.10	RS-0.55

Fourth instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F/R)	CD
F1	110.00	105.00	98.50	120.00	117.00	110.10	F – 0.80
F2	120.00	138.00	106.00	120.00	126.00	122.00	FS – 1.79
F3	117.00	108.00	114.00	142.25	117.00	19.65	
Mean (S)	115.67	117.00	106.17	127.42	120.00	-	S-1.03
Races (R)							
R1-PMxNB_4D_2	111.33	126.00	91.83	120.00	120.00	113.73	R – 0.65
R2-NB_4D_2	120.00	108.00	121.00	134.83	120.00	120.77	RS – 1.46

Fifth instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F/R)	CD
F1	150.00	174.00	184.00	180.00	135.00	164.50	F – 1.06
F2	150.00	156.00	166.00	180.00	135.00	157.40	FS – 2.37
F3	150.00	135.00	154.00	174.00	144.00	151.40	
Mean (S)	150.00	155.00	168.00	178.00	138.00	-	
Races (R)							
R1-PMxNB_4D_2	136.00	156.00	172.00	176.00	124.00	152.80	R – 1.08
R2-NB_4D_2	164.00	154.00	164.00	180.00	152.00	162.80	RS – 1.37

Total feeding duration (hours)

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F/R)	CD
F1	505.00	495.00	498.00	514.00	489.88	500.38	F – 0.27
F2	523.00	507.00	500.00	518.00	507.00	511.00	FS – 1.73
F3	534.00	464.00	528.00	539.38	516.00	516.28	
Mean (S)	520.67	488.67	508.67	523.79	504.29	-	S - 1.00
Races (R)							
R1-PMxNB_4D_2	486.67	491.33	473.33	511.33	484.58	489.45	R – 0.22
R2-NB_4D_2	554.67	486.00	544.00	536.25	524.00	528.98	RS – 1.41

Duration of the crossbreed silkworm recorded was longest (81.33 hours) in October-November and the shortest duration was recorded in February-April (62 hours). The NB_4D_2 race recorded highest duration during December-January (81.33 hours) and the least value of 52 hours during August-September.

4.1.1.2 Second instar

The feeding duration of the second instar (Table 1) was found to vary from 48 hours to 97 hours in different races during the different seasons and brushing intervals. The mean feeding duration of the second instar larvae was longest (82 hours) in first season, followed by third (78.50 hours), fifth (74.79 hours), second (65.00 hours) and fourth (59.54 hours) seasons. The mean feeding duration recorded in the third brushing was highest (78 hours) followed by second (74.30 hours) and the first brushings (63.58 hours). The longest feeding duration was 96.50 hours in the third brushing during May-July season and was shortest in the first brushing of August-September season (49.00 hours). The cross breed recorded longest feeding duration of 76.00 hours in first season followed by 73.58 hours in fifth season, 70.33 hours in third season, 65.00 hours in second season and 59.54 hours in fourth season. The bivoltine race had highest duration of 88.00 hours in first season which was statistically on par with the third season (86.67 hours) and was followed by fifth season (76.00 hours), second season (74.00 hours) and fourth season (66.08 hours).

4.1.1.3 Third instar

The mean feeding duration (Table 1) of the third instar was found to be highest in first season (98.00 hours) followed by fifth season (95.75 hours), fourth (86.33 hours), third (82.50 hours) and second (80.08 hours) seasons. The mean feeding duration recorded in the different brushings varied from 88.70 hours in the first brushing and was on par with third brushing (88.50 hours) followed by the second brushing (87.20 hours). Among the brushings the third brushing during February-April season recorded shortest duration of 66.00 hours and the second and third brushing periods during December-January has recorded the highest value of 99.00 hours. Both the crossbreed and the bivoltine race recorded longest duration in first season. But the shortest duration for crossbreed was in third season and for the bivoltine race was in second season.

4.1.1.4 Fourth instar

The duration of the fourth instar larvae (Table 1) was found to vary from 82.00 hours to 144.00 hours during the different seasons and brushing intervals. The feeding duration was highest in fourth season (127.42 hours) followed by fifth season (120.00 hours), second season (117.00 hours), first season (115.67 hours) and the third (106.17 hours). In the case of brushing intervals, the longer duration was recorded in second brushing (122.00 hours) followed by third brushing (119.65 hours) and first brushing (110.10 hours). The third brushing during August-September recorded highest feeding duration (142.25 hours) and the minimum was recorded in first brushing during May-July season (98.50 hours). The crossbreed has shown longer feeding duration during February-April season (126.00 hours) and shorter period in May-July season (91.83 hours). The bivoltine race has recorded longer feeding duration of 134.83 hours during August-September season and shorter duration of 108.00 hours during February-April season.

4.1.1.5 Fifth instar

While comparing the seasons (Table 1) the maximum duration of 178.00 hours was recorded during fourth season followed by 168.00 hours in third season, 155.00 hours in second season, 150.00 hours in first season and 138.00 hours in fifth season. The crossbreed recorded longer duration of 176.00 hours during fourth season and least duration of 124.00 hours during fifth season and the bivoltine race recorded highest duration of 180.00 hours during August-September and least duration during October-November (152.00).

The feeding duration of the fifth instar larvae of the different races varied from 120.00 hours to 192.00 hours in different brushings. The mean feeding duration was highest in the first brushing (164.50) followed by 157.40 hours during the second brushing and 151.40 hours during the third brushing. The feeding duration in third brushing during February-April and first and second brushings in October-November was shorter(135.00) and the longer duration was recorded during first brushing of May-July (184.00 hours).

4.1.1.6 Total Feeding duration

The total feeding duration of the larvae (Table 1) was found to vary from 464.00 hours to 539.38 hours during different seasons and brushing dates. The mean total feeding duration was longer during August-September (529.79) and shorter during February-April (488.67). The mean feeding duration of the larvae was 516.28 hours during third brushing, 511.00 hours in second brushing and 500.38 hours during the first brushing. The duration was highest during the third brushing in August-September (539.38 hours) and was least in the third brushing of February-April (464.00).

The crossbreed larvae recorded highest feeding duration during August-September (511.33 hours) and least during May-July season (473.33 hours). The bivoltine race recorded higher feeding duration in December-January (554.67 hours) and lower duration of 486.00 hours during February-April.

4.1.2. Moulting duration of the different larval instars

4.1.2.1. First moulting

The moulting duration of the first instar larva of the different races (Table 2) was found to vary from 18.00 hours to 27.00 hours in different brushings and 19.50 hours to 23.00 hours in different seasons. The moulting duration varied from 19.50 hours in August-September to 23.00 hours in October-November and February-April seasons. In December-January the moulting duration was 21.00 hours and during May-July it was 22.33 hours. The moulting duration recorded was 20.80 hours during third brushing, 21.90 hours in the second brushing and 22.60 hours in first brushing period. During October-November season the crossbreed has shown longer duration of 24 hours and during August-September duration was shorter (15 hours). The bivoltine race recorded the higher duration of 24 hours during August-September and December-January and least duration of 22.00 hours was recorded in February-April and October-November seasons.

4.1.2.2 Second moulting

The moulting duration of the second instar larvae (Table 2) of the two different races was found to vary from 20 to 26 hours in the different seasons

Table 2 Influence of seasons and brushing intervals on the **moulting duration of different instars and total larval duration (hours)** of crossbreed and bivoltine race of mulberry silkworm

First instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F R)	CD
F1	21.00	24.00	21.50	19.50	27.00	22.60	-
F2	21.00	21.00	24.00	19.50	24.00	21.90	-
F3	21.00	24.00	21.50	19.50	18.00	20.80	
Mean (S)	21.00	23.00	22.33	19.50	23.00	-	-
Races (R)							
R1-PMxNB_4D_2	18.00	24.00	22.33	15.00	24.00	20.67	-
R2-NB_4D_2	24.00	22.00	22.33	24.00	22.00	22.87	-

Second instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F R)	CD
F1	24.00	24.00	21.50	25.00	21.00	23.10	-
F2	21.00	21.00	24.00	24.00	24.00	22.80	-
F3	21.00	24.00	19.00	19.50	27.00	22.10	
Mean (S)	22.00	23.00	21.50	22.83	24.00	-	-
Races (R)							
R1-PMxNB_4D_2	20.00	24.00	20.67	21.00	22.00	21.53	-
R2-NB_4D_2	24.00	22.00	22.33	24.67	26.00	23.80	-

Third instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F R)	CD
F1	32.00	27.00	21.50	25.00	21.00	25.30	-
F2	27.00	24.00	24.00	24.00	24.00	24.60	-
F3	27.00	24.00	24.00	24.00	21.00	24.00	
Mean (S)	29.67	25.00	23.17	24.33	22.00	-	-
Races (R)							
R1-PMxNB_4D_2	27.33	24.00	22.33	24.00	22.00	23.93	-
R2-NB_4D_2	30.00	26.00	24.00	24.67	22.00	25.33	-

Fourth instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F R)	CD
F1	30.00	33.00	24.00	25.00	27.00	27.80	-
F2	27.00	36.00	24.00	24.00	30.00	28.20	-
F3	30.00	27.00	24.00	24.00	27.00	26.40	
Mean (S)	29.00	32.00	24.00	24.33	28.00	-	-
Races (R)							
R1-PMxNB_4D_2	26.00	32.00	24.00	24.00	30.00	27.20	-
R2-NB_4D_2	32.00	32.00	24.00	24.67	26.00	27.73	-

Total moulting duration

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F R)	CD
F1	107.00	103.00	91.00	89.00	96.00	97.20	F-0.32
F2	99.00	105.00	93.50	89.00	102.00	97.70	FS-0.73
F3	99.00	100.00	88.50	87.00	93.00	93.50	
Mean (S)	101.67	102.67	91.00	88.33	97.00	-	S-0.42
Races (R)							
R1-PMxNB_4D_2	91.33	101.33	87.67	79.33	98.00	91.53	R-0.27
R2-NB_4D_2	112.00	104.00	94.33	97.33	96.00	100.73	RS-0.59

Total larval duration (hours)

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan (1)	Feb-Apr (2)	May-Jul (3)	Aug-Sep (4)	Oct-Nov (5)	Mean (F R)	CD
F1	612.00	603.00	589.00	603.00	583.63	598.13	F – 1.22
F2	622.00	606.00	593.50	607.00	597.00	605.10	FS – 2.73
F3	633.00	549.38	616.50	626.38	612.00	607.45	
Mean (S)	622.33	586.13	599.67	612.13	597.54	-	S – 1.58
Races (R)							
R1-PMxNB_4D_2	578.00	578.00	561.00	590.67	575.08	576.55	R – 1.00
R2-NB_4D_2	666.67	594.25	638.33	633.58	620.00	630.57	RS – 2.33

brushed at different intervals. The mean moulting duration was 24.00 hours in October-November season followed by 23.00 hours in February-April, 22.83 hours in August-September, 21.50 hours in May-July and 22.00 hours in December-January. In the case of different brushing intervals, the moulting duration was higher (23.10 hours) in the first brushing. The moulting period was least (19.00 hours) during the third brushing period of May-July season and the higher duration of 27.00 was recorded during the third brushing period of October-November.

The cross breed recorded higher duration (24 hours) in February-April season and lower of 20 hours in December-January season. The bivoltine race registered higher moulting duration of 26.00 hours during October-November season and lower of 22.00 hours during February-April season.

4.1.2.3 Third moulting

The third moulting duration (Table 2) of different races was observed to be between 18.00 hours and 30.00 hours. The mean moulting duration was highest in first season (29.67 hours) followed by second season (25.00 hours), fourth season (24.67 hours), third season (24.00 hours) and fifth season (22.00 hours). The moulting duration in the first brushing was 25.30 hours followed by 24.60 hours in second brushing and in third brushing highest (24.00 hours). The crossbreed recorded highest moulting duration in first season (27.33 hours) followed by 24.00 hours in the second season and fourth seasons. In the third season the moulting duration recorded was 22.33 hours and in fifth season, it was 22.00 hours. The bivoltine race recorded longest duration during first season (30.00 hours) followed by second season (26.00 hours) fourth season (24.67 hours), third season (24.00 hours) and fifth season (22.00 hours).

4.1.2.4 Fourth moulting

The duration of fourth moulting (Table 2) recorded varied from 24.00 hours to 36.00 hours in different seasons. The longest duration was 32.00 hours in the second season and shortest 28.00 hours in fifth season. In the first season, the moulting duration recorded was 29.00 hours followed by 24.33 hours in the fourth season and 24.00 hours in third season. The moulting duration recorded in the first brushing was 27.80 hours and that the second brushing was the longest 28.20 hours and of the third brushing was 26.40 hours. The crossbreed recorded the longest duration in second season (32.00 hours) and shortest of 24 hours during third and fourth seasons. The bivoltine race recorded the longest duration of 32.00 hours in first and second seasons followed by 26.00 hours in fifth season, 24.67 hours in fourth and 24.00 hours in third season.

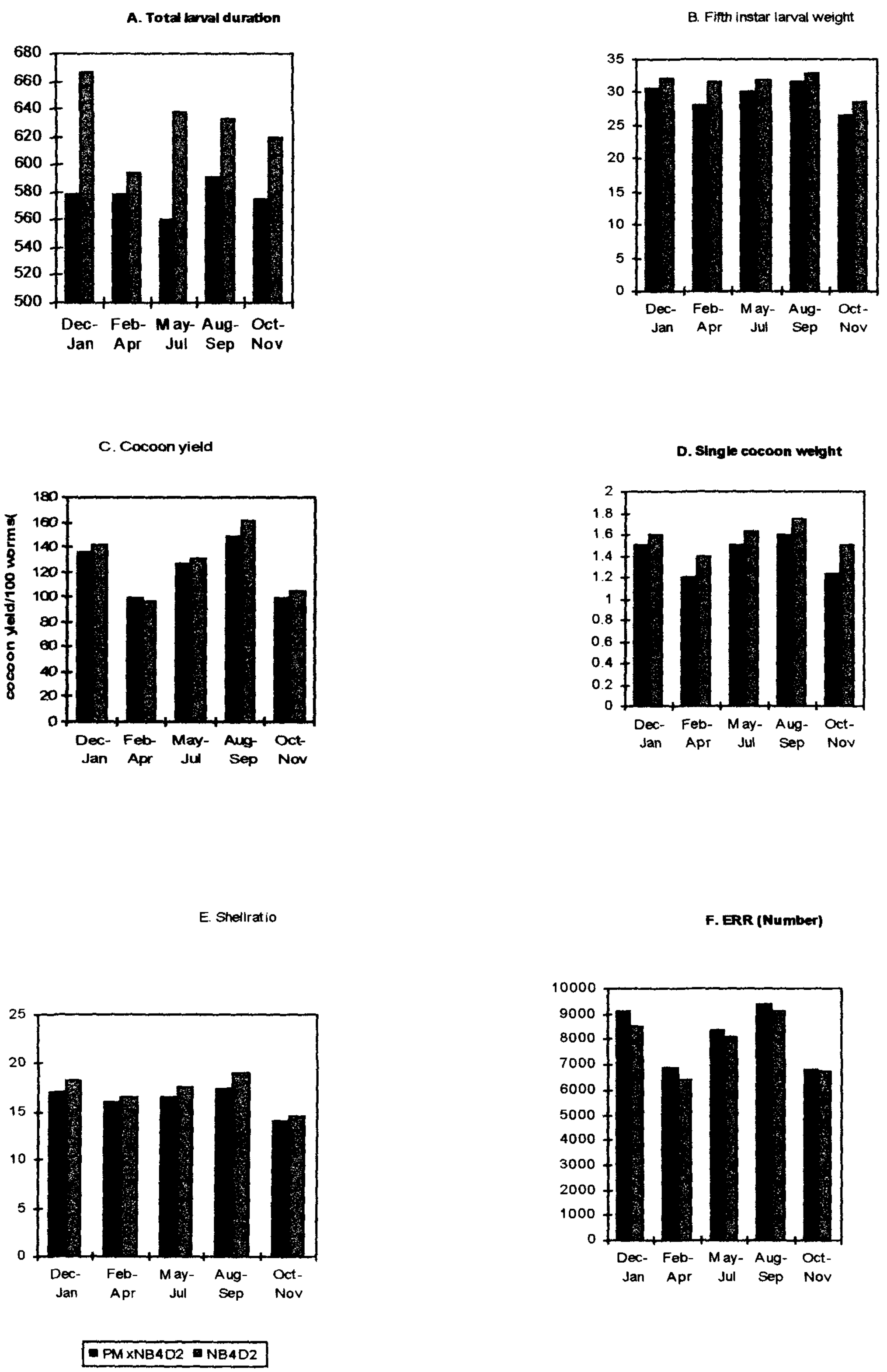
4.1.2.5 Total moulting duration

The total moulting duration (Table 2) of the different races was found to vary from 78.00 hours to 114.00 hours in the different seasons and brushing dates. Total duration was longest in second season (102.67 hours) followed by first season (101.67 hours), fifth season (97.00 hours), third season (91.00 hours) and fourth season (81.33 hours). With regard to brushing intervals, the mean moulting duration was longer in the second brushing (97.70 hours) followed by the first brushing (97.20 hours) and third brushing (93.50 hours). The shortest moulting duration was recorded in the third brushing of fourth season (87.00 hours) and the longest was recorded in the first brushing of first season (107.00 hours). The crossbreed had the longest moulting duration in second season (101.33 hours) and shortest in fourth season (79.33 hours) whereas bivoltine race has recorded longest moulting duration during first season (112.00 hours) and the lowest duration during third season (94.33 hours).

4.1.3 Total larval duration

The total larval duration (including the total feeding and moulting durations) for the seasons and brushing intervals (Table 2 and Fig 1) was found to vary from 549.38 hours to 633.00 hours during the different seasons and brushing dates. The longest larval duration (633.00 hours) was recorded during

Fig. 1 Influence of seasons on the important aspects of silkworm rearing



December-January in the third brushing with the bivoltine race and shortest was during May-July in the first brushing with the crossbreed larvae. The total larval duration for the seasons varied from 586.13 hours in February-April to 622.33 hours in December-January. In October-November, the duration was 597.34 hours, 599.67 hours in May-July and 612.13 hours in August-September. The mean total larval duration for the first brushing was shortest (598.13 hours) followed by 603.10 hours for the second and 607.45 hours with the third brushing. The crossbreed larva recorded longest larval duration during August-September season (590.67 hours) and least during October-November (575.08 hours). In the case of bivoltine race the longest duration was recorded in December-January (666.67 hours) and shortest duration in February-April (594.25 hours).

4.1.4 Larval weight

4.1.4.1 First instar

The larval weight of the first instar larvae (Table 3) was highest in third season (0.087 gm) and was on par with first and fourth seasons. The crossbreed larvae had highest weight in August-September (0.089 gm) followed by December-January (0.085 gm), October-November (0.082 gm), May-July (0.082 gm) and February-April (0.081 gm) seasons. The bivoltine had recorded highest larval weight in August-September and May-July (0.093 gm) followed

Table 3 Influence of seasons and brushing intervals on the **weight of different larval instars (gm/10 larvae)** of crossbreed and bivoltine race of mulberry silkworm

First instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F R)	CD
F1	0.085	0.083	0.088	0.086	0.083	0.085	**F – 0.001**
F2	0.086	0.081	0.086	0.086	0.084	0.084	**FS – 0.001**
F3	0.086	0.083	0.088	0.088	0.083	0.086	
Mean (S)	0.086	0.082	0.087	0.086	0.083	-	**S – 0.001**
Races (R)							
R1-PMxNB_4D_2	0.085	0.081	0.082	0.089	0.082	0.084	**R – 0.001**
R2-NB_4D_2	0.086	0.082	0.093	0.093	0.085	0.088	**RS – 0.001**

Second instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F R)	CD
F1	.210	.175	.217	.230	.230	.212	**F – 0.003**
F2	.200	.179	.216	.227	.229	.210	**FS – 0.004**
F3	.238	.193	.234	.224	.230	.224	
Mean (S)	.216	.182	.223	.227	.230	-	**S – 0.003**
Races (R)							
R1-PMxNB_4D_2	.210	.180	.216	.224	.230	.212	**R – 0.002**
R2-NB_4D_2	.212	.184	.230	.230	.230	.217	**RS – 0.004**

Third instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F R)	CD
F1	.958	.910	1.07	1.17	1.25	1.072	**F – 0.006**
F2	.930	.871	1.08	1.13	1.20	1.042	-
F3	.951	.930	1.09	1.15	1.21	1.066	
Mean (S)	.946	.904	1.08	1.15	1.22	-	**S – 0.08**
Races (R)							
R1-PMxNB_4D_2	.945	.900	1.00	1.10	1.20	1.029	**R – 0.05**
R2-NB_4D_2	.948	.908	1.16	1.20	1.24	1.091	-

Fourth instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F R)	CD
F1	10.22	8.50	9.50	11.20	11.00	10.08	-
F2	10.12	9.00	9.50	11.50	11.60	10.34	-
F3	10.40	9.50	10.00	12.00	12.00	10.78	
Mean (S)	10.24	9.00	9.66	11.55	11.57	-	S – 0.07
Races (R)							
R1-PMxNB_4D_2	10.20	9.00	9.00	11.10	11.14	10.09	**R – 0.45**
R2-NB_4D_2	10.28	9.00	10.35	12.00	12.00	10.73	**RS – 0.01**

Fifth instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F R)	CD
F1	31.49	30.30	31.42	31.56	27.93	30.54	-
F2	31.06	29.44	30.80	32.66	27.58	30.31	FS – 0.50
F3	31.51	29.78	31.10	32.68	26.94	30.40	
Mean (S)	31.35	29.84	31.11	32.30	27.49	-	S – 0.29
Races (R)							
R1-PMxNB_4D_2	30.59	28.06	30.24	31.76	26.47	29.42	**R – 0.18**
R2-NB_4D_2	32.12	31.63	31.98	32.84	28.50	31.41	**RS – 0.41**

by December-January (0.086 gm), October-November (0.085 gm) and February-April (0.082 gm) seasons.

The weight recorded during the third brushing period was highest (0.086 gm) followed by first brushing period is 0.085 gm and the second brushing (0.084 gm) followed by 0.083 gm in October-November and 0.082 gm during February-April seasons.

4.1.4.2 Second instar

The larval weight of the second instar larvae (Table 3) in different treatments varied from 0.230 gm/10 larvae to 0.175 gm. The mean larval weight was highest in October-November (0.230 gm) followed by 0.227gm in August-September, 0.216 gm in December-January, 0.223 gm in May-July and 0.182 gm in February-April.

The mean larval weight in the third brushing was 0.224 gm followed by the second brushing (0.211 gm) and first brushing (0.210 gm). The crossbreed had the highest weight in October-November (0.230 gm) followed by August-September (0.224 gm), May-July (0.216 gm), December-January (0.210 gm), and February-April (0.180 gm). The bivoltine race recorded the same weight in October-November, August-September and May-July season (0.230 gm). The weight during December-January was 0.212 gm and was 0.184 gm during February-April.

4.1.4.3 Third instar

The larval weight of third instar larvae are presented in Table 3. It varied from 0.886 gm to 1.24 gm in different treatments. The mean larval weight was highest (1.22 gm) in October-November, 1.15 gm in August-September, 1.08 gm in May-July, 0.946 gm in December-January and 0.904 gm in February-April. The mean larval weight was highest in first brushing (1.072 gm) and least in second brushing period (1.042 gm). The third brushing recorded 1.066 gm.

The crossbreed larvae recorded highest weight of 1.20 gm in October-November followed by 1.16 gm in August-September, 1.00 gm in May-July, 0.945 gm in December-January and 0.900 gm in February-April. Similar trend was also noticed in the bivoltine race and it recorded 1.24 gm during October-November followed by 1.20 gm in August-September, 1.16 gm in May-July, 0.948 gm in December-January and 0.908 gm in February-April.

4.1.4.4 Fourth instar

The fourth instar larval weight (Table 3) varied from 8.75 gm to 12.50 gm in different treatments. The mean larval weight was highest in October-November (11.57 gm) followed by 11.55 gm in August-September, 10.24 gm in December-January, 9.66 gm in May-July and 9.00 gm in February-April. The mean larval weight was highest in third brushing (10.78 gm) followed by second brushing (10.33 gm) and the first brushing (10.08 gm).

The crossbreed recorded the same trend as in the second and third instar larvae. The larval weight was highest in October-November followed by August-September (11.10 gm), December-January (10.20 gm), May-July and February-April (9.00 gm). The bivoltine race also had the same trend and the weight recorded were 12.00 gm in October-November and August-September, 10.35 gm in December-January,10.28 gm in May-July and 9.50 gm in February-April.

4.1.4.5 Fifth instar

The mean weight of fifth instar larvae (Table 3 and Fig 1) during August-September was maximum (32.30 gm) followed by December-January (31.55 gm) which is statistically on par with May-July (31.11 gm). In February-April the larval weight recorded was 29.84 gm and in October-November it was

27.49 gm. The highest mean weight in the third brushing recorded by the bivoltine race was 32.84 gm in the fourth season and the lowest was in the fifth season (26.47 gm) by the crossbreed. The mean larval weight recorded during different brushings varied from 30.54 gm to 30.40 gm, but were not statistically significant.

4.1.5 Growth rate of silkworm larvae

The growth rate of silkworm larvae of the two races observed in different seasons are presented in Table 4.

4.1.5.1 Second instar

The growth rate of the second instar (Table 4) indicated that the optimum season was October-November (1.77) followed by August-September (1.64), May-July (1.56) and February-April (1.22) seasons. Of the different brushing intervals, difference in the growth rate was not significant, but highest (1.60) in third brushing followed by second brushing (1.50) and first brushing (1.49).

The crossbreed larvae had highest growth rate during October-November (1.80) followed by August-September and May-July (1.52), December-January

Table 4 Influence of seasons and brushing intervals on the **growth rate of different larval instars** and **leaf consumption (kg/100 larvae)** of crossbreed and bivoltine race of mulberry silkworm

Second instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F R)	CD
F1	1.47	1.11	1.47	1.67	1.77	1.49	-
F2	1.33	1.21	1.51	1.64	1.73	1.50	**FS – 0.04**
F3	1.77	1.33	1.66	1.55	1.77	1.60	
Mean (S)	1.51	1.22	1.56	1.64	1.77	-	**S – 0.03**
Races (R)							
R1-PMxNB$_4$D$_2$	1.47	1.22	1.63	1.52	1.80	1.52	**R – 0.02**
R2-NB$_4$D$_2$	1.47	1.24	1.47	1.47	1.71	1.47	**RS – 0.04**

Third instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	CD
F1	3.56	4.20	3.93	4.09	4.43	4.06	**F – 0.04**
F2	3.65	3.87	4.00	3.98	4.24	3.96	**FS – 0.08**
F3	3.00	3.82	3.66	4.13	4.26	3.76	
Mean (S)	3.38	3.97	3.84	4.07	4.30	-	**S – 0.05**
Races (R)							
R1-PMxNB$_4$D$_2$	3.50	4.00	3.63	3.91	4.22	3.85	**R – 0.03**
R2-NB$_4$D$_2$	3.47	3.93	4.04	4.22	4.39	4.03	**RS – 0.07**

Fourth instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	CD
F1	9.67	8.34	7.41	8.57	7.80	8.40	-
F2	9.88	9.33	7.80	9.18	8.67	8.92	**FS – 0.13**
F3	9.94	9.22	8.17	9.43	8.92	9.11	
Mean (S)	9.82	8.96	8.72	9.04	8.48	-	**S – 0.07**
Races (R)							
R1-PMxNB$_4$D$_2$	9.79	9.00	8.00	9.09	8.28	8.81	-
R2-NB$_4$D$_2$	9.84	8.91	7.92	9.00	8.68	8.84	**RS – 0.10**

Fifth instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	CD
F1	2.08	2.56	2.49	1.82	1.54	2.03	-
F2	2.07	2.27	2.24	1.84	1.38	1.93	**FS – 0.15**
F3	2.03	2.13	2.11	1.72	1.25	1.82	
Mean (S)	2.06	2.32	1.96	1.80	1.38	-	**S – 0.09**
Races (R)							
R1-PMxNB$_4$D$_2$	2.00	2.12	2.36	1.86	1.38	1.92	**R – 0.05**
R2-NB$_4$D$_2$	2.12	2.51	2.09	1.74	1.38	1.93	**RS – 0.12**

Leaf consumption (kg/100 larvae)

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F R)	CD
F1	1.75	1.76	1.75	1.76	1.79	1.79	**F – 0.01**
F2	1.75	1.78	1.76	1.76	1.77	1.77	**FS – 0.02**
F3	1.76	1.78	1.81	1.78	1.78	1.78	
Mean (S)	1.76	1.77	1.78	1.77	1.78	-	**S – 0.01**
Races (R)							
R1-PMxNB$_4$D$_2$	1.71	1.73	1.71	1.72	1.74	1.72	-
R2-NB$_4$D$_2$	1.80	1.82	1.84	1.82	1.83	1.82	**RS – 0.01**

(1.47) and February-April (1.22). In the case of bivoltine race highest growth rate was recorded in October-November (1.71) followed by August-September, May-July, December-January (1.47) and February-April (1.24) seasons. But the variations were not statistically significant.

4.1.5.2 Third instar

The growth rate of the third instar (Table 4) larvae computed was highest in October-November (4.30) followed by August-September (4.07), 3.97 in February-April, 3.84 in May-July and 3.38 in December-January. The growth rate was highest in first brushing (4.06), 3.96 during second brushing and lowest in third brushing. Among the different races, the crossbreed larvae had higher growth rate in chawki instars and the condition was reverse later. With a growth rate of 4.22 in October-November followed by 4.00 in February-April, 3.91 in August-September, 3.63 in May-July and 3.50 in December-January seasons. The bivoltine had 4.39 in October-November, 4.22 in August-September. During May-July, the growth rate was 4.04 and during December-January and February-April seasons the rate was 3.93.

4.1.5.3 Fourth instar

The growth rate of the fourth instar larvae (Table 4) was highest of all the instars. In the third brushing, the growth rate was 9.11, in the second brushing it was 8.92 and in the first brushing it was 8.40, the difference being nonsignificant. The growth rate in December-January season was highest (9.82) followed by August-September (9.07), February-April (8.96), May-July (8.72) and October-November (8.48). The crossbreed and bivoltine did vary significantly in growth rate, but each race varied significantly in seasons. The crossbreed had maximum of 9.79 growth rate in December-January, 9.09 in August-September, 9.00 in February-April, 8.28 in October-November and 8.00 during May-July. The bivoltine race had a growth rate of 9.84 in December-January, 9.00 in August-September, 8.90 in February-April, 8.68 in October-November and 7.92 in May-July seasons.

4.1.5.4 Fifth instar

The fifth instar larvae (Table 4) had growth rate of 2.32 in February-April followed by 2.06 in December-January, 1.96 in May-July, 1.80

in August-September and 1.38 in October-November. In the case of different brushing intervals, the growth rates were 2.03 in the first brushing, 1.93 in the second brushing and 1.82 in the third brushing. Regarding the races, the crossbreed recorded a growth rate of 2.36 in May-July, 2.12 in February-April, 2.00 in December-January, 1.86 in August-September and 1.38 in October-November. The bivoltine race had maximum growth rate in February-April (2.51) followed by December-January (2.12), May-July (2.09), August-September (1.74) and October-November (1.38) seasons.

4.1.6 Growth index

The growth indices of different larval instars are presented in Table 5.

4.1.6.1 First instar

The growth index of first instar larvae (Table 5) had the highest value (6.91) in May-July season. In August-September and December-January, the mean growth index was 6.82. In October-November it was 6.55 and February-April recorded the lowest index (6.45). With regard to dfferent brushings, the third brushing had the highest index of 6.82 followed by 6.74 in first brushing and 6.64 in second brushing. The crossbreed recorded the highest index during

Table 5 Influence of seasons and brushing intervals on the **growth index of different larval instars** of crossbreed and bivoltine race of mulberry silkworm

First instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F R)	CD
F1	6.73	6.55	7.00	6.82	6.55	6.73	**F – 0.01**
F2	6.82	6.36	6.82	6.82	6.64	6.64	**FS – 0.03**
F3	6.82	6.55	7.00	7.00	6.55	6.82	
Mean (S)	6.82	6.45	6.91	6.82	6.55	-	**S – 0.01**
Races (R)							
R1-PMxNB$_4$D$_2$	6.73	6.36	6.45	7.09	6.45	6.64	-
R2-NB$_4$D$_2$	6.82	6.45	7.45	7.45	6.73	7.00	**RS – 0.02**

Second instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F R)	CD
F1	18.09	14.91	18.73	19.91	19.91	18.27	-
F2	17.18	15.27	18.64	19.64	19.82	18.09	-
F3	20.64	16.55	20.27	19.36	19.91	19.36	
Mean (S)	18.64	15.55	19.27	19.64	19.91	-	**S – 0.04**
Races (R)							
R1-PMxNB$_4$D$_2$	18.09	15.36	18.64	19.36	19.91	18.27	**R – 0.03**
R2-NB$_4$D$_2$	18.27	15.73	19.91	19.91	19.91	18.73	**RS – 0.06**

Third instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F R)	CD
F1	86.09	81.73	96.27	105.36	112.64	96.45	**F – 0.09**
F2	83.55	78.18	97.18	101.73	108.09	93.73	**FS – 0.21**
F3	85.45	83.55	98.09	103.55	109.00	95.91	
Mean (S)	85.00	81.18	97.18	103.55	109.91	-	**S – 0.12**
Races (R)							
R1-PMxNB$_4$D$_2$	84.91	80.82	89.91	99.00	108.09	92.55	**R – 0.08**
R2-NB$_4$D$_2$	85.18	81.55	104.45	108.09	111.73	98.18	**RS – 0.17**

Fourth instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F R)	CD
F1	928.09	771.73	817.18	1017.18	999.00	915.36	-
F2	919.00	817.18	862.64	1044.45	1053.55	939.00	-
F3	944.45	862.64	908.09	1089.91	1089.91	979.00	
Mean (S)	929.91	817.18	953.55	1049.00	1050.82	-	-
Races (R)							
R1-PMxNB$_4$D$_2$	926.27	817.18	817.18	1008.09	1011.73	916.27	-
R2-NB$_4$D$_2$	933.55	817.18	939.91	1089.91	1089.91	974.45	**RS – 1.53**

Fifth instar

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	CD
F1	2861.73	2753.55	2855.36	2868.09	2538.09	2775.36	-
F2	2822.64	2675.36	2799.00	2968.09	2506.27	2754.45	**FS – 7.76**
F3	2863.55	2706.27	2826.27	2969.91	2448.09	2762.64	
Mean (S)	2849.00	2711.73	2827.18	2935.36	2498.09	-	**S – 4.48**
Races (R)							
R1-PMxNB$_4$D$_2$	2779.91	2549.91	2748.09	2886.27	2405.36	2673.55	**R – 2.83**
R2-NB$_4$D$_2$	2919.00	2874.45	2906.27	2984.45	2589.91	2854.45	**RS – 6.33**

August-September (7.09) followed by December-January (6.75), May-July and October-November (6.45) and February-April (6.36). The bivoltine race recorded maximum index in August-September and may-July seasons (7.45). During December-January, October-November and February-April the indices recorded were 6.82,6.73 and 6.45 respectively. The races did not differ significantly in growth index.

4.1.6.2 Second instar

The growth index of the second instar larvae (Table 5) in response to brushing intervals was maximum in third brushing (19.36) followed by first (18.27) and second (18.09) brushings, but the difference was nonsignificant. During the different seasons, the index was high in October-November (19.91) followed by August-September (19.64), May-July (19.27), December-January (18.64) and February-April (15.55). Among the races, the crossbreed race recorded an index of 19.91 in February-April followed by 19.36 in August-September, 19.27 in October-November, 18.64 in December-January and 15.36 in February-April seasons. The bivoltine race had the index 19.91 in August-September, May-July and October-November. During December-January, the index was 18.27 and was lowest in February-April (15.73).

4.1.6.3 Third instar

The growth index of the third instar larvae (Table 5) was highest in October-November (109.91) followed by August-September (103.55), May-July (91.18), December-January (85.00) and February-April (81.18) seasons. The first brushing had a growth index of 96.45 followed by third brushing (95.91) and second brushing (93.73). In crossbreed race, the highest index was in October-November (108.09) followed by August-September (99.00), May-July (89.91), December-January and February-April (84.91). The bivoltine race had the highest index in October-November (111.73) followed by August-September (108.09), May-July (104.45), December-January (85.18) and February-April (81.55) seasons. Bivoltine race had significantly more growth index than crossbreed.

4.1.6.4 Fourth instar

The growth index of the fourth instar larvae (Table 5) though had no significant variation, it was highest in the third brushing (979.00) followed by 939.00 in second brushing and 915.36 in first brushing. The different seasons also had significant variation. It was highest (1052.82) in October-November followed by 1049.00 in August-September, 953.55 in May-July, 929.91 in December-January and 817.18 in February-April seasons. The crossbreed had maximum index in October-November (1011.73) followed by August-September (1008.09), December-January (926.27), May-July and February-April (817.18) seasons. The bivoltine race had maximum index in August-September and October-November seasons (1089.91) followed by May-July (939.91), December-January (933.55) and February-April (817.18) seasons.

4.1.6.5 Fifth instar

Of the different seasons, the growth index of the fifth instar (Table 5) was highest (2933.36) in August-September followed by December-January (2849.00) and May-July seasons (2827.18). In February-April, the index was 2711.73 and 2498.00 in October-November. During the different brushing intervals, the first brushing had the highest index (2775.36) followed by third brushing (2762.64) and second brushing (2714.45). In crossbreed, the index was maximum in August-September (2886.27) followed by December-January (2779.91) and May-July (2748.09). The index in February-April was 2549.91 and 2405.36 in October-November. In the case of bivoltine race, the index was 2984.45 in August-September season, 2919.00 in December-January, 2906.27

in May-July, 2589.00 in October-November and 2874.45 in February-April seasons.

4.1.7 Leaf consumption

The quantity of mulberry leaves consumed by100 worms are presented in Table 4. It varied from 1.75 to 1.81 kg in the different seasons and in different treatments. The mean quantity of leaf consumed per 100 worms was highest during May-July and October-November (1.78 kg) and was on par with August-September and February-April season (1.77 kg) which in turn was on par with December season (1.76 kg). The leaf consumption was highest in the bivoltine race (1.84 kg) compared to crossbreed larvae (1.74 kg) but was statistically not significant. The leaf consumption was highest in October-November and February-April seasons (1.74 kg) in crossbreed and in the case of bivoltine race it was high in May-July season and October-November seasons. The mean leaf consumption was high in the first brushing (1.79 kg) followed by the third brushing (1.78 kg) and in the second brushing (1.77 kg).

4.1.8 Missing larvae

The missing larval percentage (Table 6) varied from 4.13 to 26.88 during the different seasons and brushing dates. The lowest was during August-

Table 6 Influence of seasons and brushing intervals on the **missing larval percentage, spinning percentage and cocoon yield / 100 worms (gm)** of crossbreed and bivoltine race of mulberry silkworm

Missing larval percentage

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	**CD**
F1	6.75	26.75	13.38	4.13	23.13	14.83	-
F2	7.75	24.88	14.00	4.25	25.13	15.20	-
F3	8.00	24.75	13.50	5.00	26.88	15.63	
Mean (S)	7.50	25.46	13.63	4.46	25.04	-	**S – 1.49**
Races (R)							
R1-PMxNB$_4$D$_2$	5.92	25.58	15.67	4.33	24.58	15.22	-
R2-NB$_4$D$_2$	9.08	25.33	11.58	4.58	25.50	15.22	**RS – 2.11**

Spinning percentage

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	**CD**
F1	91.38	76.83	81.63	93.50	62.75	81.18	-
F2	92.38	73.50	81.88	95.13	65.25	81.63	**FS – 1.66**
F3	91.88	74.38	81.75	95.38	63.50	81.38	
Mean (S)	91.88	74.83	81.75	94.67	63.83	-	**S – 0.96**
Races (R)							
R1-PMxNB$_4$D$_2$	94.00	75.67	84.00	95.92	65.50	83.02	**R – 0.61**
R2-NB$_4$D$_2$	89.75	74.00	79.50	93.42	62.17	79.77	**RS – 1.36**

Cocoon yield / 100 worms

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	**CD**
F1	137.00	99.75	122.38	150.63	100.88	122.13	**F – 1.79**
F2	142.13	91.00	128.50	156.88	101.25	123.95	**FS - 4.01**
F3	138.38	104.00	132.50	156.75	105.75	127.48	
Mean (S)	139.17	98.25	127.79	154.75	102.63	-	**S – 2.32**
Races (R)							
R1-PMxNB$_4$D$_2$	135.92	99.92	125.58	148.92	99.75	122.02	**R –1 .46**
R2-NB$_4$D$_2$	142.42	96.58	130.00	160.58	105.50	127.02	**RS - 3.28**

September (4.46) for the three brushings and the highest was during October-November (25.04) and February-April seasons (25.46). The May-July season had an intermediate value of 13.63 percent.

During different brushing intervals, the mean missing larval percentage was highest during the third brushing (15.63) followed by second brushing (15.20) and first brushing (14.83). The crossbreed recorded highest missing larval percentage in February-April (25.58) followed by October-November (24.58), May-July season (15.67), December-January season (5.92) and August-September (4.33). The bivoltine race recorded highest missing larval percentage in February-April (25.33) followed by October-November (25.50), May-July (11.58), December-January (9.08) and August-September (4.58).

4.1.9 Spinning percentage

The spinning percentage of larvae (Table 6) brushed at different intervals had no significant variation as the range was only from 81.18 to 81.63. But it varied during different seasons and the largest spinning percentage (94.67) was recorded in August-September followed by December-January (91.88), May-July (81.75), February-April (74.83) and October-November (63.83). The crossbreed race recorded significantly higher spinning percentage in August-

September (95.92) and lowest was in October-November (65.50). The bivoltine also recorded highest spinning percentage in the same season, but with a lesser percentage (93.42) and least was in October-November (62.17).

4.1.10 Cocoon yield

The cocoon yield per hundred worms (Table 6 and Fig 1) varied from 91.00 to 156.88 gm. The highest mean cocoon yield was recorded in August-September (154.75 gm) followed by December-January (139.17 gm), May-July (127.79 gm), October-November (102.63 gm) and February-April (127.48 gm) seasons.Among the different brushing intervals the third brushing recorded highest (127.48 gm) yield followed by the second (123.95) and first (122.13) brushings which are statistically on par.

The crossbreed larvae had the highest yield in August-September (148.92 gm) followed by December-January (135.92 gm) May-July (125.58 gm), February-April (99.92 gm) and October-November (99.75 gm) seasons. The bivoltine race had the highest yield of 160.58 gm in August-September followed by December-January (135.92 gm), May-July (125.58 gm), February-April (99.92 gm) and October-November (99.75 gm). The bivoltine race recorded highest yield of 160.58 gm in August-September followed by December-January (42.42 gm), May-July season (130.00 gm), October-

November season (105.50 gm) and February-April (96.58 gm). The bivoltine race was superior to crossbreed in all the seasons except February-April.

4.1.11 Weight of silkgland

The weight of silkgland disected out from the fifth instar larvae are presented in Table 7. The highest weight (0.79 gm) was recorded in the bivoltine race reared in the fourth season and the least in the crossbreed reared in the fifth season (0.43 gm). The mean silkgland weight during the different seasons varied from 0.72 gm in fourth season to 0.48 gm in fifth season. The others were in intermediate order. The mean silkgland weight in the first brushing was 0.61 gm, the lowest weight was 0.59 gm in second brushing and highest was in the third brushing (0.62 gm). The crossbreed had more weight during August-September (0.64 gm) followed by December-January (0.61 gm), May-July (0.58 gm), February-April (0.46 gm) and October-November (0.43 gm) seasons. The bivoltine race recorded highest weight during August-September (0.79 gm) followed by May-July (0.76 gm), December-January (0.71 gm), February-April (0.56gm) and October-November (0.54 gm) seasons.

4.1.12 Pupal weight

The mean pupal weight recorded in different seasons (Table 7) varied from 1.39 gm in August-September to 1.08 gm in October-November. The pupal weight recorded in May-July season was 1.33 gm and in December-January it was 1.28 gm. The crossbreed larvae recorded highest pupal weight in October-November (1.32 gm) and was statistically on par with August-September, December-January and February-April seasons. The least pupal weight of crossbreed was recorded in May-July season. Similarly the bivoltine race recorded highest pupal weight in October-November (1.46 gm) followed by August-September (1.36 gm), December-January (1.30 gm), February-April and May-July (1.15 gm). In general, the bivoltine race had higher pupal weight than crossbreed in all the seasons. The mean pupal weight recorded at different brushing intervals were 1.31 gm in first brushing, 1.20 gm in second brushing and 1.19 gm in third brushing.

4.1.13 Fecundity

The fecundity of moths emerged from the cocoons in the different treatments (Table 7) varied from 362.00 eggs per moth to a maximum of 455.88 eggs per moth during different seasons. Moths from crossbreed larvae has shown least fecundity during February-April (353.58 eggs/moth) and

Table 7 Influence of seasons and brushing intervals on the weight of silkgland (gm/larvae),pupal weight (gm/pupae) and fecundity (number of eggs/moth)of crossbreed and bivoltine race of mulberry silkworm

Weight of silkgland (g/larvae)

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	CD
F1	0.65	0.53	0.67	0.69	0.51	0.61	**F – 0.01**
F2	0.66	0.47	0.63	0.72	0.48	0.59	**FS – 0.03**
F3	0.66	0.53	0.69	0.74	0.47	0.62	
Mean (S)	0.66	0.51	0.67	0.72	0.48	-	**S – 0.02**
Races (R)							
R1-PMxNB$_4$D$_2$	0.61	0.46	0.58	0.64	0.43	0.54	**R – 0.01**
R2-NB$_4$D$_2$	0.71	0.56	0.76	0.79	0.54	0.67	**RS – 0.02**

Pupal weight (gm/pupae)

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	CD
F1	1.34	1.26	1.33	1.47	1.15	1.31	**F – 0.03**
F2	1.25	1.01	1.33	1.38	1.07	1.20	**FS – 0.06**
F3	1.26	1.01	1.32	1.33	1.05	1.19	
Mean (S)	1.28	1.09	1.33	1.39	1.08	-	**S – 0.03**
Races (R)							
R1-PMxNB$_4$D$_2$	1.27	1.27	1.04	1.30	1.32	1.05	**R – 0.02**
R2-NB$_4$D$_2$	1.30	1.30	1.15	1.36	1.46	1.11	**RS – 0.05**

Fecundity (number of eggs/moth)

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	CD
F1	430.50	400.13	425.25	450.88	391.00	419.55	**F – 5.39**
F2	435.25	362.00	425.00	442.75	382.75	409.55	**FS – 12.06**
F3	430.13	398.38	425.13	445.00	390.38	417.80	
Mean (S)	431.96	386.83	425.13	446.21	388.04	-	**S – 6.96**
Races (R)							
R1-PMxNB$_4$D$_2$	416.83	353.58	404.92	411.25	368.08	390.83	**R – 4.40**
R2-NB$_4$D$_2$	447.08	420.08	445.33	481.17	408.00	440.33	**RS – 9.85**

highest during December-January (416.83 eggs/moth). The fecundity of the seasons December-January and August-September (412.25 eggs/moth) were statistically on par. The bivoltine race showed highest fecundity during August-September season (481.17 eggs/moth) and minimum during October-November (408.00 eggs/moth).

During different seasons, the mean fecundity was highest in August-September (446.21 eggs/moth) and lowest in February-April (386.83). The fecundity in different brushing periods was 419.55 eggs/moth in the first brushing, 417.80 eggs/moth during the third brushing and 405.55 eggs/moth during the second brushing.

4.1.14 Cocoon weight

The single cocoon weight (Table 8 and Fig 1) varied significantly during different seasons. The least weight 1.30 gm was in October-November season and highest (1.68 gm) in August-September season. The mean cocoon weight recorded in May-July (1.60 gm) was statistically on par with December-January (1.56 gm) followed by February-April (1.32 gm) and on par with October-November (1.30 gm) season. In the first brushing, mean cocoon

Table 8 Influence of seasons and brushing intervals on the economic traits of crossbreed and bivoltine race of mulberry silkworm

Single cocoon weight (gm/cocoon)

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F.R)	CD
F1	1.62	1.48	1.60	1.77	1.41	1.41	**F – 0.03**
F2	1.53	1.23	1.61	1.69	1.26	1.46	**FS – 0.07**
F3	1.54	1.29	1.59	1.63	1.23	1.44	
Mean (S)	1.56	1.32	1.60	1.68	1.30	-	**S – 0.04**
Races (R)							
R1-PMxNB$_4$D$_2$	1.54	1.25	1.56	1.62	1.24	1.44	**R – 0.03**
R2-NB$_4$D$_2$	1.59	1.39	1.64	1.74	1.36	1.54	-

Shell weight (gm/shell)

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F.R)	CD
F1	0.28	0.22	0.27	0.30	0.21	0.26	-
F2	0.27	0.22	0.27	0.29	0.18	0.25	-
F3	0.24	0.24	0.27	0.30	0.20	0.25	
Mean (S)	0.26	0.23	0.27	0.30	0.20	-	**S – 0.02**
Races (R)							
R1-PMxNB$_4$D$_2$	0.26	0.21	0.26	0.29	0.19	0.24	**R – 0.01**
R2-NB$_4$D$_2$	0.27	0.24	0.28	0.30	0.20	0.26	-

Shell ratio

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F.R)	CD
F1	17.55	14.62	17.21	18.67	14.68	16.54	**F – 0.39**
F2	17.39	16.67	17.15	17.88	13.78	16.57	**FS – 0.86**
F3	17.90	17.28	16.92	18.18	15.06	17.07	
Mean (S)	17.61	16.19	17.09	18.24	14.51	-	**S – 0.50**
Races (R)							
R1-PMxNB$_4$D$_2$	16.96	15.91	16.62	17.42	14.33	16.25	**R – 0.32**
R2-NB$_4$D$_2$	18.27	16.47	17.57	19.06	14.68	17.21	-

Filament length of silk (meters)

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F.R)	CD
F1	954.38	865.63	760.63	969.38	731.25	856.25	-
F2	959.38	868.13	770.63	961.25	722.50	856.38	-
F3	959.75	871.88	764.38	976.25	734.00	861.25	
Mean (S)	957.83	868.54	765.21	968.96	729.25	-	**S – 9.76**
Races (R)							
R1-PMxNB$_4$D$_2$	758.17	717.92	614.17	783.75	614.25	697.65	**R – 6.18**
R2-NB$_4$D$_2$	1157.50	1019.17	916.25	1154.17	844.25	1018.27	**RS – 13.81**

Reelability

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F.R)	CD
F1	78.38	72.13	62.75	81.75	62.50	71.50	**F – 0.31**
F2	77.25	72.63	63.13	82.75	62.63	71.68	**FS – 0.68**
F3	77.50	73.38	65.38	82.50	62.88	72.33	
Mean (S)	77.71	72.71	63.75	82.33	62.67	-	**S – 0.40**
Races (R)							
R1-PMxNB$_4$D$_2$	75.58	70.58	62.42	80.17	60.25	69.80	**R – 0.25**
R2-NB$_4$D$_2$	79.83	74.83	65.08	84.50	65.08	73.87	**RS – 0.56**

weight was 1.41 gm and in second brushing it was 1.46 gm followed by 1.44 gm in the third brushing.

The crossbreed larvae had the maximum cocoon weight (1.62 gm) in August-September followed by May-July (1.56 gm) and December-January (1.54 gm). The least cocoon weight was recorded in October-November (1.24 gm) was on par with February-April (1.25 gm). The bivoltine race had higher cocoon weight than the crossbreed in August-September (1.74 gm) followed by that of May-July (1.64 gm) and December-January (1.59 gm). The least cocoon weight was observed in October-November (1.36 gm) and was on par with February-April (1.39 gm) season.

4.1.15 Shell weight

The shell weight of cocoon (Table 8) recorded during different seasons revealed that shell weight was maximum in August-September (0.30 gm) followed by May-July (0.27 gm), December-January (0.26 gm), February-April (0.23 gm) and October-November (0.20 gm). The shell weight was more in first brushing (0.26 gm) than in second and third brushings (0.25 gm). The crossbreed recorded maximum shell weight in August-September (0.29 gm) followed by December-January and May-July (0.26 gm). February-April and October-November seasons had the shell weight 0.21 and 0.19 gm respectively. For the bivoltine race also highest shell weight was in August-September (0.30 gm) followed by May-July season (0.28 gm) and December-January season (0.27 gm). The shell weight in February-April was 0.24 gm and during October-November was the least (0.20 gm).

4.1.16 Shell ratio

The shell ratio (Table 8 and Fig 1) of the different seasons varied significantly seasons and brushing intervals. The mean shell ratio was highest in August-September (18.14) followed by December-January (17.61), May-July (17.09), February-April (16.19) and lowest in October-November. The mean shell ratio in different brushing intervals was 17.07 in third brushing, 16.57 in second brushing and 16.54 in first brushing. The crossbreed larvae recorded lowest shell ratio in October-November (14.33) and highest shell ratio in August-September (17.42) and the other seasons were intermediate in effect. The bivoltine race also showed similar trend with the maximum shell ratio during August-September season (19.06) and lowest during October-November season (14.68) and was superior to crossbreed larvae.

4.1.17 Reelability of cocoons

The reelability of cocoons expressed in percentage are given in Table 8. The reelability was highest in August-September (82.33 percent) followed by December-January (77.71), February-April (72.71), May-July (63.75) and October-November (62.67) seasons. Cocoons of crossbreed larvae spun in August-September had highest reelability (80.17) followed by December-January (75.58), February-April (70.58), May-July (62.42) and October-November (60.25) seasons. In the case of bivoltine it was 84.50 in August-September followed by 79.83 in December-January, 74.83 in February-April and 65.08 during May-July and October-November seasons. Cocoons of the bivoltine race had better reelability than crossbreed cocoons.In the different brushing intervals the reelability varied from 72.33 in the third brushing, 71.08 in second brushing and 71.50 in first brushing.

4.1.18 Filament length of cocoon

The length of silk filament reeled out from single cocoons in different seasons in different treatments are presented in Table 8. The mean length was highest in August-September (968.98 meters) followed by December-January (957.83 meters), February-April (868.54 meters), May-July (765.21 meters) and October-November (729.25 meters). The brushing intervals did not vary significantly in the length of the filament.

The crossbreed had longest filament in August-September (783.75 meters) followed by December-January (758.17 meters), February-April (717.92 meters) and October-November (614.25 meters). In the case of bivoltine the longest filament was observed in December-January (1157.50 meters) followed by August-September (1154.17 meters), February-April (1019.17 meters), May-July (916.28 meters) and October-November (844.25 meters) seasons. The bivoltine was significantly superior to crossbreed in all the seasons and fifty percent increase could be observed in general.

4.1.19 Effective rearing rate (ERR by number)

Effective rearing rate (ERR) number computed is presented in Table 9 and Fig1. ERR was high in August-September season (9125.00) followed by December-January (8808.00), May-July (8233.00), October-November(6783.00) and February-April season(6637.00). The mean ERR was

Table 9 Influence of seasons and brushing intervals on the **effective rearing rate** of crossbreed and bivoltine race of mulberry silkworm

Effective rearing rate (number)

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	**CD**
F1	8750.00	6637.50	8162.50	9175.00	6675.00	7880.00	**F – 78.52**
F2	8850.00	6462.00	8212.00	8312.50	6737.50	7915.00	**FS – 175.59**
F3	8800.00	6812.50	8325.00	9262.50	6937.50	8027.50	
Mean (S)	8800.00	6636.50	8233.33	9250.00	6783.33	-	**S – 101.37**
Races (R)							
R1-PMxNB_4D_2	9091.67	6891.67	8400.00	9375.00	6833.33	8118.33	**R – 64.11**
R2-NB_4D_2	8508.33	6383.33	8066.67	9125.00	6733.33	7763.33	**RS – 143.37**

Effective rearing rate (weight in gm)

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	**CD**
F1	13700.00	9975.00	12237.00	15062.50	10087.50	12212.50	**F – 177.15**
F2	14212.50	9100.00	12850.00	15687.00	10050.00	12380.00	**FS – 396.12**
F3	13837.00	10400.00	13262.00	15675.00	10575.00	12750.00	
Mean (S)	13916.67	9825.00	12783.33	15475.00	10237.50	-	**S – 228.70**
Races (R)							
R1-PMxNB_4D_2	13591.00	9991.67	12558.33	14891.00	9933.33	12193.33	**R – 144.64**
R2-NB_4D_2	14241.67	9658.00	13008.00	16058.33	10541.67	12701.00	**RS – 323.43**

highest in third brushing period (8027.50) followed by second (7915.00) and first (7880.00) brushings.

The crossbreed race had higher ERR in August-September (9375.00) followed by December-January (9091.67), May-July (8400.00), October-November (6733.33) and February-April (6383.33). The bivoltine race also expressed similar trend with 9125.00 in August-September, 8508.33 in December-January, 8066.67 in May-July, 6733.33 in October-November and 6307.33 in February-April season. The crossbreed was significantly superior to bivoltine in all these seasons.

4.1.20 Effective rearing rate by weight (ERR by weight)

The effective rearing rate (by weight) (Table 9) was high in August-September (14400-16150) followed by December-January (13400-14275), May-July (12025-13550), October-November (9675-10825) and February-April (8900-10525).

In the different brushing intervals the effective rearing rate (by weight) varied from 12750.00 gm in the third brushing to 12212.50 gm in first brushing period. The second brushing was intermediate in effect (12380.00 gm). The crossbreed larvae had the highest ERR by weight in August-September (14891.00 gm) followed by December-January (13191.00 gm), May-July (12558.33 gm), February-April (9991.67 gm) and October-November (9933.83 gm). The bivoltine race had highest ERR by weght in August-September (16058.33 gm) followed by December-January (14241.67 gm), May-July (13008.00 gm), October-November (10237.50 gm) and February-April (9825.00 gm) seasons. The bivoltine race was significantly superior to crossbreed in all the seasons.

4.1.21 Disease incidence

Flacherie and grasserie were observed to a limited extent and the data are presented in Table 10

4.1.21.1 Flacherie

The percentage incidence of flacherie varied from 0 to 2.63 in different seasons and methods of rearing. The mean incidence was zero during December-January, 0.63 in August-September, 1.03 in May-July, 1.54 in February-April season and 1.71 in October-November. Among the different brushing intervals the third brushing had the least incidence (0.65). The second

Table 10 Influence of seasons and brushing intervals on the percentage incidence of diseases in crossbreed and bivoltine race of mulberry silkworm

Flacherie

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	**CD**
F1	0.00	2.00	0.88	0.63	2.13	1.13	**F - 0.25**
F2	0.00	2.63	1.63	0.63	1.75	1.23	**FS - 0.55**
F3	0.00	1.28	1.08	0.63	1.38	0.65	
Mean (S)	0.00	1.54	1.13	0.63	1.71	-	**S – 0.32**
Races (R)							
R1-PMxNB$_4$D$_2$	0.00	0.83	0.75	0.25	0.50	0.47	**R - 0.07**
R2-NB$_4$D$_2$	0.00	2.25	1.50	1.00	2.92	1.53	**RS - 0.45**

Grasserie

Treatments	Seasons (S)						
Brushing dates(F)	Dec-Jan 1	Feb-Apr 2	May-Jul 3	Aug-Sep 4	Oct-Nov 5	Mean (F/R)	**CD**
F1	1.50	2.25	0.88	0.00	2.75	1.48	-
F2	1.63	2.25	0.88	0.00	5.00	1.95	**FS - 0.90**
F3	1.50	2.63	1.00	0.00	3.00	1.63	
Mean (S)	1.54	2.38	0.92	0.00	3.50	-	**S – 0.52**
Races (R)							
R1-PMxNB$_4$D$_2$	1.08	2.42	0.58	0.00	3.17	1.45	**R – 0.33**
R2-NB$_4$D$_2$	2.00	2.33	1.25	0.00	4.00	1.92	**RS - 0.33**

brushing (1.23) and first brushing (1.13) were on par. The incidence of flacherie was more in the bivoltine race (1.53) than in crossbreed (0.47). In the bivoltine race the incidence was highest in October-November (2.92) followed by February-April (2.25), May-July (1.50) and August-September (1.50). The December-January season was free of incidence. In the case of crossbreed the incidence was highest (0.83) in February-April followed by August-September (0.75), October-November (0.50) and May-July (0.25). In December-January, the incidence was nil and this was on par with May-July statistically.

4.1.21.2 Grasserie

The incidence of grasserie varied from 0 to 5 in different seasons and brushings. It was higher in October-November (3.50) followed by February-April (2.38), December-January (1.54) and May-June (0.92). August-September was incidence free. In the different brushing intervals the second brushing had incidence (1.95) more than first (1.48) and third (1.63) brushings.

Among the races the crossbreed recorded an incidence of 3.17 in October-November followed by 2.42 in February-April, 1.54 in December-January and 0.92 in May-July seasons. The crossbreed larvae had only a lesser rate of incidence than bivoltine in general. The bivoltine race had the highest incidence (4.00) in October-November followed by 2.33 in February-March, 2.00 in December-January season and 1.25 in May-July seasons. August-September was completely free of incidence of grasserie in all the three brushing intervals for bivoltine and crossbreed.

4.1.22 Correlation between weather parameters and characters of silkworm

The correlation between the important weather parameters and biological characters of silkworm *viz* total larval duration, weight of the fifth instar larvae, silkgland weight and leaf consumption and economic characters like cocoon weight, total cocoon yield, shell ratio and filament length of cocoon are presented in Table 11. The fifth instar larval weight has significant negative correlation with the weather parameters inside the rearing house viz maximum temperature (- 0.5228) and maximum humidity (-0.6778). Leaf consumption had negligible correlation with the weather factors except that of minimum humidity inside the rearing house. The minimum humidity inside the rearing house had strong correlation (-0.6279).

The silkgland weight of bivoltine silkworm had significant negative correlations with maximum, minimum and average temperature inside the rearing house (-0.8310, -0.9254 and –0.9351). The silkgland weight had

Table 11 Correlation between *weather parameters* and important *biological and economic characters* of silkworm

A. Bivoltine - NB_4D_2

Weather parameters	Total larval duration	Larval wt (fifth instar)	Total cocoon yield	Cocoon weight	Silk gland weight	Leaf con-sumption	Shell ratio	Filament length
(Outside)								
Max. Temperature	-0.5950*	.1906	0.4151	-0.2578	-0.3662	.0065	-0.0601	0.1847
Min. Temperature	-0.7026*	-.1956	-0.3151	-0.5701*	-0.6746*	.0148	-0.4426	-0.2546
Avg. Temperature	-0.6294*	.-1156	-0.3245	-0.4953	-0.4341	.0127	0.1389	0.0956
Max. Humidity	-0.6863*	.0409	0.3607	0.6120*	0.4497	-.1637	0.2429	-0.1502
Min humidity	0.3493	.0073	0.5171*	-0.6620*	-0.5871*	.4847	0.2544	0.0423
Avg. Humidity	0.4865	-.0074	-0.5066*	0.0497	0.5881*	.3102	0.2795	-0.0205
Rainfall	-0.3447	-.5551*	0.1947	-0.1288	-0.1172	-.1079	-0.3795	0.5829*
(Inside)								
Max. Temperature	-0.6483*	-.5228*	-0.6982*	-0.7529**	-0.8310**	.0024	-0.7147*	-0.6247*
Min.. temperature	0.5211*	-.6778*	-0.9607**	-0.8120**	-0.9254**	-.2506	-0.7285*	-0.3798
Avg. Temperature	-0.5911*	-.6379*	0.1537	-0.8537**	-0.9351**	-.1804	-0.7571**	-0.4944
Max. Humidity	-0.4513	-.2953	-0.8167**	-0.2610	0.3399	.2057	0.0048	-0.2211
Min. Humidity	-0.1662	.1927	-0.4579	-0.3227	-0.3944	-.6279*	0.0007	-0.4099
Avg. Humidity	-0.5845*	-.2657	-0.9281**	-0.8337**	0.0740	-.4673	-0.0078	0.1530

B. Crossbreed - $PMxNB_4D_2$

Weather parameters	Total larval duration	Larval wt (fifth instar)	Total cocoon yield	Cocoon weight	Silk gland weight	Leaf con-sumption	Shell ratio	Filament length
(Outside)								
Max. Temperature	-0.1406	-0.1763	-0.3474	-0.4134	-0.2937	0.3668	-0.0053	-0.3606
Min. Temperature	0.0712	-0.5680*	-0.7265*	-0.7072*	-0.3709	0.3222	-0.3714	-0.0792
Avg. Temperature	0.0567	-0.2556	-0.4308	-0.4798	-0.3756	0.3637	-0.0788	0.2761
Max. Humidity	-0.1010	-0.3458	-0.5469*	0.5090*	0.4647	-0.1900	0.1661	0.0001
Min humidity	-0.1554	0.3917	0.5700*	0.5645*	0.4544	-0.1448	0.1733	-0.0119
Avg. Humidity	0.1782	-0.4077	0.6076*	0.5907*	0.4902	-0.1691	0.1850	-0.0821
Rainfall	-0.0205	-0.3167	0.1877	0.0500	-0.2115	-0.3198	-0.3959	-0.7516**
(Inside)								
Max. Temperature	0.2390	-0.8234**	-0.9373**	-0.8403**	-0.8896**	0.2070	-0.6421*	-0.4813
Min.. temperature	0.0185	-0.8549**	-0.8334**	-0.8930**	-0.8157**	0.5980*	-0.7075*	-0.1783
Avg. Temperature	-0.3138	-0.8875**	-0.9250**	-0.9169**	-0.9243**	0.4433	-0.2347	-0.3191
Max. Humidity	0.1490	-0.1263	-0.3585	0.3667	0.2349	-0.1391	0.0756	-0.3182
Min. Humidity	-0.0201	-0.1307	-0.3658	-0.3586	-0.1763	0.2421	0.0542	-0.4692
Avg. Humidity	0.5686*	0.0473	-0.4342	0.1689	0.4946	0.0767	-0.5784*	-0.5525*

* significant at 0.05% level ** significant at 0.01% level

positive correlations with maximum and minimum humidity. The total larval duration had got negative correlations with maximum temperature (-0.8310) and average temperature (-0.9351) and also positive correlation with minimum temperature (0.5211) inside the rearing house. The shell ratio of the bivoltine race had significant negative correlation with the maximum temperature (-0.7147), minimum temperature (-0.7285) and average temperature (-0.7571) recorded inside the rearing house and correlations with the other weather parameters were insignificant.

The cocoon weight of the bivoltine race had a negative correlation with maximum temperature (-0.7529), minimum temperature (-0.7285), average temperature (-0.7571) and average humidity (-0.8577) inside the rearing house. The total cocoon yield was negatively correlated with maximum temperature (-0.6982), minimum temperature (-0.9667), maximum humidity (-0.8167) and average humidity (-0.8577) inside the rearing house. All the other correlations were negligible and statistically insignificant at 0.01 and 0.05 levels. The filament length of the bivoltine was found to be negatively correlating with maximum temperature (-0.6247).

The larval weight of cross breed has got negative correlation with maximum (-0.8234) and minimum (-0.8549) and average (-0.8875) temperatures inside the rearing house. All the other correlations are statistically insignificant and negligible. The weight of silkgland has negative correlations with maximum temperature (-0.8896), minimum temperature (-0.8557) and average temperature (-0.9243) inside the rearing house. The silkgland weight is also found to be positively correlating with average humidity inside the rearing house (0.5996).

The total larval duration had no significant correlation with weather parameters inside the rearing house except having positive correlation with average humidity (0.5676). The shell ratio of the cross breed larvae had significant negative correlations with maximum temperature (-0.6471), minimum temperature (-0.7075) and average humidity (-0.5787) inside the rearing house. The cocoon weight of the cross breed larvae had negative correlation with maximum temperature (-0.8403), minimum temperature (-0.8930) and average temperature (-0.9169) inside the rearing house. But the cocoon weight was positively correlated with the maximum humidity inside the rearing house. The correlation between total cocoon yield of cross breed was negative with minimum (-0.8334), maximum (-0.9373) and average (-0.9250) temperatures inside the rearing house. The filament length of the crossbreed larvae had negative correlation with average humidity (-0.5522) inside the rearing house. All the other correlations were negligible and statistically not significant at 0.01 and 0.05 levels of significance.

4.1.22 Path Analysis of weather parameters on cocoon weight and shell ratio

The results of the path analysis of important weather parameters inside the rearing house on cocoon weight and shell ratio of different types of silkworm are presented in Table 12 and 13.

4.1.22.1 Cocoon weight of bivoltine race

The direct and indirect effect of weather parameters on cocoon weight of bivoltine race was presented in Table 12. The correlation between maximum temperature and cocoon weight was negative and significant (-0.7529) and the correlation between minimum temperature and cocoon weight was also negative and significant (-0.8129). The correlation between maximum humidity and cocoon weight was positive but insignificant (0.2610). In the case of correlation between minimum humidity and cocoon weight it was negative and nonsignificant (-0.3227).

Table 12 Direct and indirect effects of *weather parameters* on *cocoon weight* of silkworm

A. Bivoltine - NB_4D_2

Sl. No	Components	Direct effects	Indirect Effects				Total correlation
			X1	X2	X3	X4	
1	Maximum. Temperature X1	-0.8163	-0.8163	-0.1723	0.4359	-0.2202	-0.7529
2	Minimum Temperature X2	-0.2146	-0.6553	-0.2146	0.3074	-0.2493	-0.8129
3	Maximum humidity X3	-0.7467	0.4765	0.0884	-0.7467	0.4428	0.2610
4	Minimum humidity X4	-0.5351	0.3054	-0.0654	0.6178	-0.5351	-0.3227

Residue : 0.370

B. Crossbreed - $PMxNB_4D_2$

Sl. No	Components	Direct effects	Indirect Effects				Total correlation
			X1	X2	X3	X4	
1	Maximum Temperature X1	-0.5712	-0.5712	-0.3847	0.1836	-0.0681	-0.8408
2	Minimum Temperature X2	-0.4791	-0.4587	-0.4791	0.1295	-0.0848	-0.8931
3	Maximum humidity X3	-0.3146	0.3335	+0.1972	-0.3146	0.1506	0.3667
4	Minimum humidity X4	-0.1820	+0.4052	-0.2232	-0.2603	-0.1820	-0.2603

Residue : 0.380

The correlation of direct effect of minimum temperature with cocoon weight was negative (-0.2146) but its indirect effect through maximum humidity was positive (0.3074). The indirect effect of maximum humidity through maximum temperature and minimum humidity was positive and the values were 0.4765 and 0.4438 respectively. The direct effect of maximum humidity with cocoon weight was negative and significant (-0.7467). The direct effect of minimum humidity on shell ratio was –0.5351 and its indirect effect on maximum humidity was positive and significant (0.6178).

4.1.22.2 Cocoon weight of cross breed

The direct and indirect effect of weather parameters on cocoon weight of cross breed race is presented in Table 12. The correlation between maximum temperature and cocoon weight was negative and significant (-0.8408). Its direct effect was also negative and strong (-0.5712). The positive indirect effect of maximum temperature via maximum humidity is negligible (-0.1836). The indirect effect via minimum humidity was negligible (0.0681) and negative. The correlation between minimum temperature and cocoon weight is negative and signifacant (-0.8931). The correlation between maximum humidity and cocoon weight was positive (0.3667) but its direct effect was negative and insignificant (-0.3146). The correlation between minimum humidity and cocoon weight was not significant and negative (-0.2603), but its direct effect was negative and weak correlation (-0.1820).

4.1.22.3 Shell ratio of bivoltine race

The direct and indirect effects of maximum and minimum temperature and humidity inside the rearing room were correlated with shell ratio of bivoltine race (Table 13). The direct effect of maximum temperature on shell ratio was negative and high (-0.9583) and it was higher than the total correlation value (-0.7147). The positive indirect effect of maximum temperature with maximum humidity was high as 0.4847. But the indirect effect through minimum humidity is low and negative (0.0902). Its effect via minimum temperature was also negative and low (-0.1519). The correlation of minimum temperature with shell ratio of bivoltine race also was negative and strong (-0.7285), but its direct effect had only a weak and negative corrlation (-0.1892). The indirect effect of minimum temperature via maximum humidity was positive and insignificant (0.3425). The correlation between maximum humidity and cocoon weight was only 0.0043. It was less than the indirect effect of maximum humidity via maximum temperature (0.5595) and via minimum humidity (0.1994). The direct effect of maximum humidity on cocoon weight was negative and less than the correlation (-0.8319). The correlation between

Table 13 Direct and indirect effects of *weather parameters* on *shell ratio* of silkworm

A. Bivoltine - NB_4D_2

Sl. No	Components	Direct effects	Indirect Effects				Total correlation
			X1	X2	X3	X4	
1	Maximum Temperature X1	-0.9583	-0.9583	-0.1519	0.4847	-0.0902	-0.7147
2	Minimum Temperature X2	-0.1892	-0.7695	-0.1892	0.3425	-0.1123	-0.7285
3	Maximum Humidity X3	-0.8319	+0.5595	0.0774	-0.8319	0.1994	0.0043
4	Minimum Humidity X4	-0.2410	+0.3585	-0.0882	0.7884	-0.2410	0.1182

Residue : 0.430

B. Crossbreed - $PMxNB_4D_2$

Sl. No	Components	Direct effects	Indirect Effects				Total correlation
			X1	X2	X3	X4	
1	Maximum Temperature X1	-0.7829	-0.7829	-0.2684	0.4706	0.0614	-0.6421
2	Minimum Temperature X2	-0.3342	-0.6287	-0.3342	0.3319	-0.0765	-0.7075
3	Maximum Humidity X3	-0.8061	+0.4571	0.1376	-0.8061	0.1365	-0.0756
4	Minimum Humidity X4	-0.1642	-0.2929	-0.1557	0.6670	-0.1642	-0.0542

Residue : 0.460

minimum humidity and shell ratio was found to be positive but not significant (0.1182). Its direct effect on shell ratio was negative (-0.2410). Its indirect effect through maximum temperature was positive (0.3585) and via maximum humidity was positive and its magnitude was high.

4.1.22.4 Shell ratio of cross breed

The path analysis of weather parameters on shell ratio of cross breed are given in Table 13. The correlation between maximum temperature and shell ratio was negative (-0.6421). Its direct effect was also negative and high (-0.7829). The marginal reduction in correlation was due to the positive indirect effect of maximum temperature via maximum humidity (0.4706). The indirect effect via minimum humidity was negative (-0.2684) and that of minimum humidity was negligible. The correlation between minimum temperature was also significant and negative (-0.7075) and its direct effect was negative (-0.3342), but the magnitude was less than the correlation. The individual effect of minimum temperature via maximum temperature was mainly responsible for the negative correlation though the indirect effect via maximum humidity was positive and that of minimum humidity was negligible. The maximum direct effect observed for maximum humidity was –0.8067, but negative while its correlation was negligible. The positive indirect effect through maximum temperature followed by minimum temperature and minimum humidity resulted in this negative correlation.

4.2 Identifying rearing technology for stress conditions of temperature and humidity

The results (Tables14-39) of the experiment conducted for identifying the suitable rearing technology for silkworms under stress conditions of temperature and humidity are presented here.

4.2.1 Total larval duration

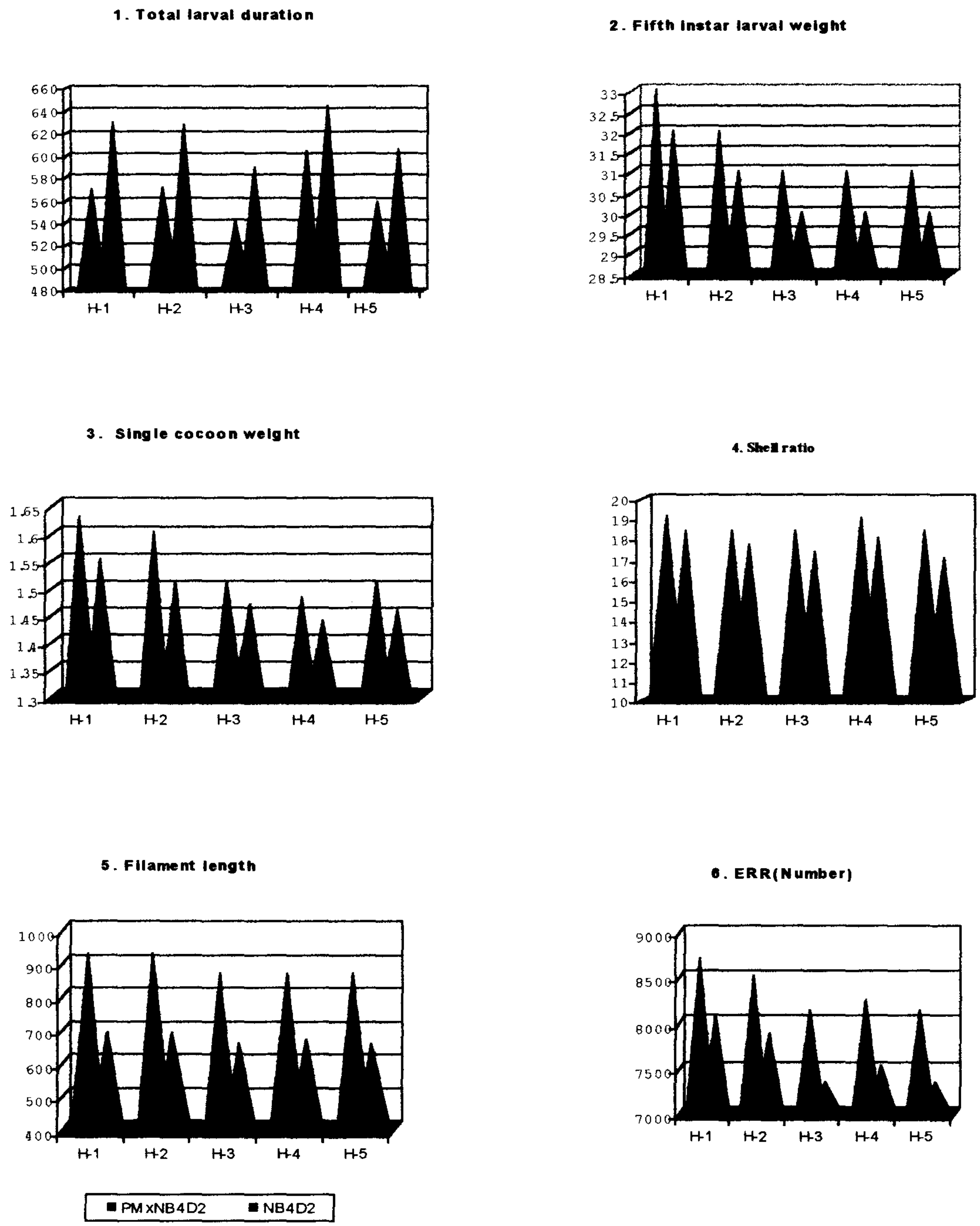
The total larval duration of silkworms in different types of rearing houses (Table 14 and Fig 2) varied from 532.00 to 661.25 hours in different seasons and the mean duration varied from 565.43 hours to 623.90 hours. The larval duration was maximum in the CSB type house with RCC roof, H4 (623.90 hours) followed by thatched house H1 (606.39 hours), thatched roof house H2 (600.08 hours), tiled roof house H5 (582.38 hours) and light roof house H3 (565.43 hours).

Under different larval densities, longest duration was recorded in the high density S1 (614.12 hours) followed by the medium recommended density S2 (587.68 hours) and low density S3 (565.11 hours). The two silkworm types in the different rearing houses had the mean total larval duration ranging from 541.43 hours to 643.72 hours. The highest duration was recorded for the bivoltine in the RCC roof house (643.72 hours) followed by bivoltine in thatched house H1 (629.72 hours). The crossbreed larvae also had the same

Table 14 Effect of rearing house and larval spacing on the **total larval duration (in hours)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	656.42	656.42	597.00	600.00	565.75	562.75	606.39
H2	615.83	629.17	607.00	607.00	550.58	590.92	600.08
H3	624.00	610.83	545.67	545.08	532.00	535.00	565.43
H4	661.25	659.08	625.75	616.83	590.92	589.58	623.90
H5	628.83	628.67	579.00	573.00	541.25	543.50	582.38
CD	**2.49**	**4.11**	**1.22**	**1.89**	**3.35**	**3.90**	**1.18**
S1	667.30	675.40	613.60	611.95	551.60	561.85	613.62
S2	635.55	638.75	588.75	585.40	535.25	542.40	587.68
S3	608.95	596.35	570.30	507.80	518.45	528.80	555.11
CD	**1.93**	**3.19**	**0.94**	**1.46**	**2.59**	**3.02**	**1.45**
H1S1	687.00	687.00	616.50	619.50	587.50	584.50	630.33
H1S2	684.00	684.00	604.00	607.00	559.25	556.25	615.75
H1S3	628.25	628.25	570.50	573.50	550.50	547.50	583.08
H2S1	652.50	676.50	630.00	630.00	566.50	600.50	626.00
H2S2	613.10	631.50	603.00	603.00	552.00	590.75	598.89
H2S3	581.50	579.50	588.00	588.00	533.25	581.50	575.29
H3S1	652.00	652.00	574.00	576.25	536.00	559.25	591.58
H3S2	622.00	608.50	540.00	537.50	532.50	535.75	562.71
H3S3	598.00	572.00	523.00	521.50	507.50	510.00	538.67
H4S1	687.00	694.00	641.50	634.00	608.50	608.50	645.58
H4S2	662.75	673.25	629.75	618.50	588.75	584.75	626.29
H4S3	634.00	610.00	606.00	598.00	575.50	575.50	599.83
H5S1	658.00	667.50	606.00	600.00	554.50	556.50	607.08
H5S2	625.50	626.50	507.00	561.00	543.75	544.50	568.04
H5S3	603.00	592.00	564.00	558.00	525.00	529.50	561.92
CD	**4.32**	**7.12**	**2.11**	**3.27**	**5.84**	**7.57**	**1.67**
H1R1	719.00	695.00	627.00	627.00	557.17	553.17	629.72
H1R2	593.83	617.83	567.00	573.00	534.33	532.33	569.72
H2R1	679.00	691.67	627.33	627.33	552.50	593.00	628.47
H2R2	552.67	566.67	586.67	586.67	548.67	588.83	571.70
H3R1	673.00	656.67	565.33	561.00	537.00	543.00	589.33
H3R2	575.00	565.00	526.00	529.17	527.00	527.00	541.53
H4R1	702.00	707.33	641.00	627.33	593.00	591.67	643.72
H4R2	620.50	610.83	610.53	606.33	588.83	587.50	604.09
H5R1	682.67	682.33	595.33	589.33	543.17	543.67	606.08
H5R2	575.00	575.00	562.67	556.67	539.33	543.33	558.67
CD	**3.52**	**4.11**	**1.72**	**2.67**	**4.74**	**5.51**	**2.05**
S1R1	724.40	732.20	640.40	636.00	557.00	556.80	641.13
S1R2	610.20	618.60	586.80	587.90	552.20	557.90	585.60
S2R1	694.60	692.20	605.40	600.20	548.00	553.50	615.65
S2R2	576.50	585.30	572.10	570.60	522.50	553.50	563.42
S3R1	654.40	635.40	687.80	583.00	528.70	539.40	604.78
S3R2	563.50	557.50	552.80	552.60	508.20	518.20	542.13
CD	**2.73**	**4.50**	**1.33**	**2.07**	**3.67**	**4.27**	**1.29**

Fig 2 Influence of types of rearing houses on yield parameters in silk worm rearing



H1-Thatched house & mud brick wall
H2-Thatched house & burnt brick wall
H3-Light roof house & mudbrick wall
H4-RCC roof & burnt brick wall
H5-Tiled roof & burnt brick wall

trend. In the rearing house H3, the least duration for both the silkworm types were recorded (R1 – 589.33 and R2 – 541.33 hours). The larval duration in the other types of rearing houses was having intermediary values.

The mean duration of bivoltine and crossbreed larvae reared under different densities varied from 542.10 hours to 641.13 hours. For both the silkworm types, the mean larval duration were highest under high density (S1R1 – 641.13 hours and S1R2 – 585.60 hours) and in low densities the duration was least (S3R1 – 604.78 and S3R2 – 542.10 hours). The medium density had intermediate duration. For the three densities in the different rearing houses, the mean larval duration was higher in the house H4 compared to other houses (H4S1 – 645.58 hours, H4S2 – 626.29 hours and H4S3 – 599.83 hours). The duration was least in the H3 house (H3S1 – 591.60 hours, H3S2 – 562.70 hours and H3S3 – 538.69 hours).

4.2.2 Total moulting duration

The mean of the total moulting duration (Table 15) of the silkworms in the different types of rearing houses varied from 98.64 hours in the tiled house to 104.11 hours in the RCC house. In the thatched houses H1 and H2 and light roof house (H3) the moulting duration was 102.59 hours, 101.61 hours and 99.09 hours respectively. The variation in the moulting duration in different seasons was 89.50 to 106.50 hours. Under high density rearing, the moulting

Table 15 Effect of rearing house and larval spacing on **total moulting duration (in hours)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	105.17	106.50	97.33	96.17	105.17	105.17	102.59
H2	104.50	102.67	97.33	96.17	104.50	104.50	101.61
H3	102.67	101.00	93.00	92.50	102.67	102.67	99.09
H4	106.50	105.33	100.33	99.50	106.50	106.50	104.11
H5	102.67	103.67	90.67	89.50	102.67	102.67	98.64
CD	**0.37**	**0.28**	**0.43**	**0.43**	**0.37**	**0.37**	**0.11**
S1	110.50	98.13	101.60	101.60	108.47	108.47	104.80
S2	103.80	101.73	94.20	93.00	100.13	100.13	98.83
S3	98.60	110.40	91.40	89.70	87.60	87.30	94.17
CD	**0.29**	**0.18**	**0.33**	**0.33**	**0.22**	**0.20**	**0.13**
H1S1	111.50	111.50	103.00	103.00	111.50	103.00	107.25
H1S2	105.00	105.00	96.00	94.50	105.00	96.00	100.25
H1S3	99.00	99.00	93.00	91.00	99.00	93.00	95.67
H2S1	111.50	111.50	103.00	103.00	111.50	103.00	107.25
H2S2	104.00	104.00	96.00	94.50	104.00	96.00	99.75
H2S3	98.00	98.00	93.00	91.00	98.00	93.00	95.17
H3S1	109.00	109.00	102.00	102.00	109.00	102.00	105.50
H3S2	102.00	102.00	91.00	90.50	102.00	91.00	96.42
H3S3	97.00	97.00	86.00	85.00	97.00	86.00	91.33
H4S1	111.50	111.50	104.00	104.00	111.50	104.00	107.75
H4S2	106.00	106.00	99.00	98.00	106.00	99.00	102.33
H4S3	102.00	102.00	98.00	96.50	102.00	98.00	99.75
H5S1	109.00	[illegible]	96.00	96.00	109.00	96.00	102.50
H5S2	102.00	102.00	89.00	87.50	102.00	89.00	95.25
H5S3	97.00	97.00	87.00	85.00	97.00	87.00	91.67
CD	**0.65**	**0.65**	**0.75**	**0.75**	**0.65**	**0.75**	**0.16**
H1R1	109.67	109.67	104.00	102.00	109.67	109.67	107.45
H1R2	100.67	100.67	90.67	90.33	100.67	100.67	97.28
H2R1	109.67	109.67	104.00	102.00	109.67	109.67	107.45
H2R2	99.33	99.33	90.67	90.33	99.33	99.33	96.39
H3R1	106.00	106.00	99.33	98.67	106.00	106.00	103.67
H3R2	99.33	99.33	86.67	86.33	99.33	99.33	95.05
H4R1	111.00	111.00	104.67	102.67	111.00	111.00	108.56
H4R2	102.00	102.00	96.00	96.33	102.00	102.00	100.06
H5R1	106.00	106.00	96.67	94.67	106.00	106.00	102.56
H5R2	99.33	99.33	84.67	84.33	99.33	99.33	94.39
CD	**0.53**	**0.53**	**0.61**	**0.61**	**0.53**	**0.53**	**0.20**
S1R1	115.00	115.00	106.00	106.00	115.00	106.00	110.50
S1R2	106.00	106.00	97.20	97.00	106.00	97.20	101.57
S2R1	110.40	110.40	101.60	100.00	110.40	101.60	105.73
S2R2	97.20	97.20	86.80	86.00	97.20	86.80	91.87
S3R1	100.00	100.00	97.60	94.00	100.00	97.60	98.20
S3R2	97.20	97.20	85.20	85.40	97.20	85.20	91.23
CD	**0.41**	**0.41**	**0.47**	**0.47**	**0.41**	**0.47**	**0.13**

duration was highest (104.80 hours) followed by the medium density (98.83 hours) and lower density (94.17 hours). Of the different types of rearing houses, the bivoltine and crossbreed silkworms registered higher mean moulting duration in the RCC roof house (R1 – 108.56 hours and R2 – 100.06 hours) and was least in the tiled house (R1 – 102.56 hours and R2 – 94.36 hours). In the other houses the duration was intermediate.

Both the silkworm types under different larval spacing had significant variations in duration from 91.23 to 110.50 hours. In higher density the duration was prolonged (R1 – 110.50 hours and R2 – 101.57 hours) followed by medium and low densities. The low density registered less duration (R1 – 98.20 hours and R2 – 91.23 hours). In general bivoltine had higher moulting duration than crossbreed. In combinations of the different rearing houses and larval densities the moulting duration was highest in the RCC roof house under high density (107.75 hours). The other spacing had correspondingly lower duration of 102.33 hours and 99.75 hours for S2 and S3 respectively. The least duration was recorded in the light roof house H3 being 105.50 hours, 96.42 hours and 91.33 hours. The mean moulting duration registered in the tiled house was 102.50 hours, 95.25 hours and 91.67 hours for S1, S2 and S3 respectively.

4.2.3 Larval weight of different instars

Results on the weight of different larval instars under the various treatments are presented in Tables 16 - 20.

4.2.3.1 First instar

The first instar larvae (Table 16) reared in the thatched houses H1 and H2 recorded highest weight (0.080 gm) and the least weight was in light roof house (0.067 gm) which was on par with the tiled house (0.068 gm). The data was not having significant variation in Oct-Nov and Feb-Mar season. The weight of the first instar larvae was more under lower larval density (0.078gm) compared to high density (0.065 gm) and medium density (0.071 gm). Both the silkworm types registered highest weight in thatched house H1 (R1 – 0.081 gm and R2 – 0.073 gm) and lowest in light roof and tiled houses (R1 – 0.070 gm and R2 – 0.064 gm). Bivoltine had higher larval weight than crossbreed in all the rearing house types. The bivoltine has registered highest weight in medium spacing and was on par with other combinations of race and spacing (0.078 gm) except the crossbreed under higher density. The crossbreed under wider spacing has recorded weight of 0.073 gm.

The larval densities had significant influence on larval weight in the different types of rearing houses. Highest larval weight was recorded under wider spacing in thatched houses (H2S3 – 0.082gm and H1S3 – 0.080gm)

Table 16 Effect of rearing house and larval spacing on **larval weight of 1st instars (gms/10worms)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	0.085	0.085	0.074	0.074	0.081	0.081	0.080
H2	0.085	0.085	0.073	0.073	0.081	0.081	0.080
H3	0.084	0.084	0.055	0.055	0.057	0.065	0.067
H4	0.085	0.085	0.058	0.058	0.071	0.072	0.072
H5	0.084	0.084	0.060	0.060	0.057	0.065	0.068
CD	**0.002**	**0.002**	**0.002**	**0.002**	**0.003**	**0.002**	**0.002**
S1	0.084	0.084	0.053	0.053	0.057	0.058	0.065
S2	0.085	0.085	0.057	0.057	0.067	0.073	0.071
S3	0.085	0.085	0.063	0.063	0.084	0.086	0.078
CD	-	**0.002**	**0.001**	**0.001**	**0.002**	**0.002**	**0.001**
H1S1	0.085	0.085	0.058	0.058	0.068	0.068	0.070
H1S2	0.085	0.085	0.061	0.061	0.080	0.080	0.075
H1S3	0.085	0.085	0.062	0.062	0.094	0.094	0.080
H2S1	0.084	0.084	0.065	0.065	0.068	0.068	0.072
H2S2	0.085	0.085	0.067	0.067	0.080	0.080	0.077
H2S3	0.086	0.086	0.065	0.065	0.094	0.094	0.082
H3S1	0.084	0.084	0.051	0.051	0.045	0.048	0.061
H3S2	0.084	0.084	0.056	0.056	0.053	0.065	0.066
H3S3	0.085	0.085	0.061	0.061	0.073	0.080	0.074
H4S1	0.084	0.084	0.061	0.061	0.058	0.058	0.068
H4S2	0.085	0.085	0.058	0.058	0.070	0.072	0.071
H4S3	0.086	0.086	0.055	0.055	0.084	0.084	0.075
H5S1	0.084	0.084	0.051	0.051	0.045	0.048	0.061
H5S2	0.084	0.084	0.056	0.056	0.053	0.065	0.066
H5S3	0.085	0.085	0.051	0.051	0.073	0.080	0.071
CD	-	-	**0.003**	**0.003**	**0.003**	**0.004**	**0.002**
H1R1	0.085	0.085	0.062	0.062	0.095	0.095	0.081
H1R2	0.085	0.085	0.069	0.069	0.066	0.066	0.073
H2R1	0.085	0.085	0.054	0.054	0.095	0.095	0.078
H2R2	0.085	0.085	0.054	0.054	0.066	0.066	0.068
H3R1	0.085	0.085	0.057	0.057	0.065	0.072	0.07
H3R2	0.084	0.084	0.054	0.054	0.049	0.057	0.064
H4R1	0.085	0.085	0.065	0.065	0.075	0.077	0.075
H4R2	0.085	0.085	0.061	0.061	0.066	0.066	0.071
H5R1	0.084	0.084	0.057	0.057	0.065	0.072	0.070
H5R2	0.084	0.084	0.054	0.054	0.049	0.057	0.064
CD	-	-	-	**0.002**	**0.004**	**0.003**	**0.001**
S1R1	0.084	0.084	0.066	0.066	0.064	0.065	0.072
S1R2	0.084	0.084	0.061	0.061	0.050	0.052	0.065
S2R1	0.085	0.085	0.069	0.069	0.076	0.083	0.078
S2R2	0.085	0.085	0.056	0.056	0.058	0.062	0.067
S3R1	0.085	0.085	0.052	0.052	0.059	0.069	0.067
S3R2	0.085	0.085	0.063	0.063	0.070	0.073	0.073
CD	-	-	**0.002**	**0.002**	**0.003**	**0.003**	**0.003**

followed by medium spacing in thatched houses (H2S2 – 0.077 gm and H1S2 – 0.075 gm) and wider spacing in RCC roof house (H4S3 – 0.075 gm). The lowest larval weight was recorded in tiled and light roof houses under high and medium density (H5S1 – 0.061, H5S2 – 0.066 and H3S1 – 0.061 and H3S2 – 0.066 gm).

4.2.3.2 Second instar

The data on the weight of second instar larvae are presented in Table 17. The larval weight recorded in different rearing houses were having no significant variation statistically. However the larvae reared in thatched houses had higher values (H1 – 0.32 gm and H2 – 0.31 gm). The different larval density also had no significant variation but the wide spacing registered 0.31 gm while the other spacings had 0.30 gm. In the different types of rearing houses, the bivoltine silkworm recorded higher larval weight in thatched houses H1 and H2 (0.32 gm) followed by light roof and RCC roof houses (0.31gm) whereas crossbreed had higher larval weight in H2 house (0.31 gm). Crossbreed had lesser weight than bivoltine race in these houses. In all the other houses the larval weight was 0.30 gm.

Regarding larval densities the variation was not significant statistically and the weight recorded under wide and medium spacings were S3R1 – 0.32 gm S3R2 – 0.31 gm S2R1 – 0.31 gm and S2R2 – 0.30 gm. The low larval

Table 17 Effect of rearing house and larval spacing on **larval weight of IInd instar (gms /10 worms)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	0.33	0.33	0.29	0.28	0.33	0.33	0.32
H2	0.33	0.31	0.29	0.29	0.33	0.33	0.31
H3	0.31	0.29	0.28	0.27	0.32	0.32	0.30
H4	0.30	0.30	0.29	0.29	0.32	0.32	0.30
H5	0.30	0.29	0.28	0.27	0.32	0.32	0.30
CD	-	-	-	-	-	-	-
S1	0.31	0.29	0.28	0.27	0.31	0.31	0.30
S2	0.31	0.30	0.28	0.28	0.32	0.32	0.30
S3	0.32	0.31	0.29	0.29	0.33	0.33	0.31
CD	-	-	-	-	-	-	-
H1S1	0.32	0.32	0.28	0.27	0.32	0.32	0.31
H1S2	0.33	0.33	0.28	0.28	0.33	0.33	0.31
H1S3	0.34	0.34	0.30	0.30	0.34	0.34	0.33
H2S1	0.30	0.32	0.28	0.28	0.32	0.32	0.30
H2S2	0.31	0.33	0.28	0.29	0.33	0.33	0.31
H2S3	0.32	0.34	0.30	0.30	0.34	0.34	0.32
H3S1	0.29	0.31	0.28	0.26	0.31	0.30	0.29
H3S2	0.30	0.31	0.28	0.28	0.32	0.31	0.30
H3S3	0.30	0.32	0.29	0.29	0.33	0.33	0.31
H4S1	0.29	0.29	0.28	0.28	0.30	0.31	0.29
H4S2	0.30	0.30	0.28	0.29	0.32	0.32	0.30
H4S3	0.31	0.30	0.30	0.30	0.33	0.33	0.31
H5S1	0.29	0.29	0.28	0.26	0.31	0.30	0.29
H5S2	0.30	0.30	0.28	0.28	0.32	0.31	0.30
H5S3	0.30	0.31	0.29	0.29	0.33	0.33	0.31
CD	**0.01**	**0.01**	-	-	**0.01**	**0.01**	**0.01**
H1R1	0.33	0.33	0.29	0.29	0.35	0.35	0.32
H1R2	0.33	0.32	0.29	0.23	0.32	0.32	0.30
H2R1	0.32	0.32	0.29	0.29	0.35	0.35	0.32
H2R2	0.30	0.33	0.28		0.32	0.32	0.31
H3R1	0.30	0.31	0.28	0.28	0.33	0.33	0.31
H3R2	0.29	0.32	0.29	0.27	0.31	0.31	0.30
H4R1	0.31	0.31	0.29	0.29	0.32	0.32	0.31
H4R2	0.29	0.29	0.29	0.29	0.31	0.31	0.30
H5R1	0.30	0.30	0.28	0.28	0.33	0.33	0.30
H5R2	0.29	0.30	0.29	0.27	0.31	0.31	0.30
CD	**0.01**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.01**
S1R1	0.30	0.31	0.28	0.27	0.32	0.32	0.30
S1R2	0.29	0.30	0.28	0.26	0.30	0.30	0.29
S2R1	0.31	0.31	0.28	0.28	0.33	0.33	0.31
S2R2	0.30	0.31	0.28	0.28	0.31	0.31	0.30
S3R1	0.32	0.32	0.29	0.29	0.34	0.34	0.32
S3R2	0.31	0.32	0.27	0.29	0.33	0.33	0.31
CD	-	-	-	-	-	-	-

density tried in thatched houses H1 and H2 registered higher weight than in other houses (H1S3 – 0.33 gm and H2S3 – 0.32 gm). The medium and high densities in thatched house (0.31 and 0.30 gm) were on par with the low density in other type of houses in which the medium and high density were found inferior.

4.2.3.3 Third instar

The mean weight of third instar larvae under different treatments are presented in Table 18. The highest larval weight was recorded in thatched houses (H1 – 1.45 gm and H2 – 1.40 gm) followed by RCC roof house (1.33 gm), tiled house (1.29 gm) and light roof house (1.28 gm). With regard to different spacing, the larvae under wide spacing had significantly more weight (1.56 gm) than medium (1.42 gm) and close spacing (1.29 gm).

The bivoltine silkworm had highest larval weight in thatched house H1 (1.63 gm) where as the crossbreed recorded highest weight in RCC house (1.46 gm) but it was interesting to note that the third instar larvae of both instars grow well in rearing houses other than the thatched house also. Of the different larval spacings, bivoltine acquired more weight in medium and wide spacings (S2R1 – 1.67 and S3R1 – 1.66 gm) where as the crossbreed gained more weight under medium spacing (S2R2 – 1.53 gm). In general bivoltine had more weight than the crossbreed under different spacings.

Table 18 Effect of rearing house and larval spacing on **larval weight of III [rd] instar (gm/10 worms)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	1.58	1.55	1.33	1.40	1.43	1.40	1.45
H2	1.45	1.57	1.28	1.28	1.43	1.40	1.40
H3	1.35	1.25	1.22	1.21	1.37	1.33	1.28
H4	1.45	1.35	1.24	1.22	1.38	1.36	1.33
H5	1.34	1.25	1.22	1.22	1.37	1.33	1.29
CD	**0.04**	**0.07**	**0.08**	**0.06**	**0.07**	**0.09**	**0.07**
S1	1.36	1.24	1.13	1.12	1.48	1.41	1.29
S2	1.47	1.45	1.28	1.28	1.55	1.47	1.42
S3	1.61	1.68	1.44	1.40	1.60	1.62	1.56
CD	**0.03**	**0.05**	**0.06**	**0.04**	**0.05**	**0.07**	**0.05**
H1S1	1.73	1.38	1.27	1.58	1.61	1.61	1.53
H1S2	1.52	1.90	1.44	1.48	1.58	1.58	1.58
H1S3	1.74	1.67	1.65	1.57	2.01	2.01	1.78
H2S1	1.34	1.33	1.13	1.43	1.61	1.61	1.41
H2S2	1.40	1.55	1.28	1.48	1.48	1.28	1.41
H2S3	1.60	1.84	1.43	1.43	2.01	2.01	1.72
H3S1	1.35	1.13	1.06	1.06	1.36	1.44	1.23
H3S2	1.51	1.25	1.25	1.24	1.38	1.88	1.42
H3S3	1.58	1.38	1.34	1.33	1.51	1.48	1.44
H4S1	1.34	1.24	1.13	1.13	1.46	1.46	1.29
H4S2	1.40	1.28	1.18	1.18	1.50	1.55	1.35
H4S3	1.60	1.54	1.43	1.38	1.56	1.55	1.51
H5S1	1.34	1.13	1.09	1.09	1.56	1.44	1.27
H5S2	1.46	1.25	1.25	1.24	1.85	1.88	1.49
H5S3	1.53	1.38	1.34	1.33	1.41	1.48	1.41
CD	**0.07**	**0.12**	-	-	**0.12**	**0.15**	**0.10**
H1R1	1.84	1.93	1.59	1.58	1.43	1.43	1.63
H1R2	1.32	1.78	1.31	1.24	1.17	1.17	1.33
H2R1	1.43	1.90	1.42	1.42	1.43	1.43	1.51
H2R2	1.47	1.24	1.13	1.13	1.17	1.17	1.22
H3R1	1.42	1.30	1.35	1.34	1.91	1.93	1.54
H3R2	1.54	1.20	1.08	1.08	1.84	1.94	1.45
H4R1	1.43	1.33	1.35	1.32	1.91	1.91	1.54
H4R2	1.47	1.38	1.13	1.13	1.83	1.83	1.46
H5R1	1.39	1.30	1.37	1.35	1.91	1.93	1.54
H5R2	1.49	1.20	1.08	1.08	1.84	1.94	1.44
CD	**0.06**	**0.10**	-	-	**0.10**	**0.12**	**0.10**
S1R1	1.38	1.38	1.24	1.21	1.54	1.56	1.39
S1R2	1.33	1.00	1.03	1.02	1.43	1.46	1.21
S2R1	1.50	1.48	1.40	1.41	2.10	2.11	1.670
S2R2	1.44	1.41	1.15	1.15	2.01	2.03	1.530
S3R1	1.62	1.79	1.60	1.50	1.72	1.70	1.66
S3R2	1.60	1.58	1.27	1.23	1.48	1.54	1.45
CD	-	**0.08**	-	**0.06**	**0.07**	-	**0.07**

The highest larval weight recorded in combinations of house types and larval density was in thatched houses with wide spacing (1.78 and 1.72 gm respectively). The thatched house H1 was more favourable than other houses for all the three larval densities. Close spacing was inferior in other types of rearing houses.

4.2.3.4 Fourth instar

The data on the mean weight of the fourth instar larvae under different treatments are presented in Table 19. The highest weight was in thatched house H1 (11.48 gm) followed by thatched house H2 (11.29 gm), light roof house (11.21 gm) and tiled house (11.14 gm). Interestingly it was least in RCC roof house (10.95 gm). Of the different larval spacings tried, wide spacing yielded significantly higher larval weight (11.91 gm) followed by medium (11.15 gm) and close (10.58 gm) spacings.

Among the different types of rearing houses, the bivoltine silkworm gained more weight in thatched houses H1 (11.74) and H2 (11.56) than others. For crossbreeds all the types except RCC roof house were on par (H1R2 – 11.21, H2R2 – 11.02, H3R2 – 10.99 and H5R2 – 10.97) as observed in the case of the third instar larvae. Bivoltine recorded significantly higher weight than crossbreed. Among the different combinations of larval spacings and silkworm

Table 19 Effect of rearing house and larval spacing on **larval weight of IV th instar (gms /10 worms)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	12.13	11.75	10.71	10.75	11.76	11.76	11.48
H2	12.09	11.83	10.33	9.97	11.76	11.76	11.29
H3	12.00	10.71	10.21	10.00	12.04	12.27	11.21
H4	11.11	11.13	10.00	9.97	11.73	11.75	10.95
H5	11.58	10.71	10.21	10.00	12.04	12.27	11.14
CD	**0.23**	**0.46**	**0.18**	**0.24**	**0.13**	**0.22**	**0.08**
S1	11.12	10.65	9.58	9.61	11.25	11.25	10.58
S2	11.69	10.95	10.35	10.15	11.82	11.95	11.15
S3	12.54	12.08	10.95	10.65	12.54	12.69	11.91
CD	**0.18**	**0.36**	**0.14**	**0.19**	**0.10**	**0.17**	**0.10**
H1S1	11.53	11.00	10.13	10.25	11.25	11.25	10.90
H1S2	11.94	11.25	10.75	10.75	11.63	11.63	11.33
H1S3	12.94	13.00	11.25	11.25	12.40	12.40	12.21
H2S1	11.38	11.25	9.50	9.40	11.25	11.25	10.67
H2S2	12.14	11.38	10.50	10.00	11.63	11.63	11.21
H2S3	12.75	12.38	11.00	10.50	12.40	12.40	11.91
H3S1	11.06	10.25	9.50	9.50	11.25	11.25	10.47
H3S2	12.06	10.63	10.25	10.00	12.13	12.43	11.25
H3S3	12.88	11.25	10.88	10.50	12.75	13.13	11.90
H4S1	10.69	10.50	9.25	9.40	11.25	11.33	10.40
H4S2	10.26	10.88	10.00	10.00	11.58	11.63	11.40
H4S3	11.88	12.00	10.75	10.50	12.38	12.38	11.65
H5S1	10.94	10.25	9.50	9.50	11.25	11.25	10.45
H5S2	11.50	10.63	10.25	10.00	12.13	12.43	11.16
H5S3	12.25	11.25	10.88	10.50	12.75	13.13	11.79
CD	-	-	-	-	**0.22**	**0.38**	**0.30**
H1R1	12.27	11.83	10.92	11.00	12.22	12.22	11.74
H1R2	12.00	11.67	10.50	10.50	11.30	11.30	11.21
H2R1	11.68	12.33	10.83	10.10	12.22	12.22	11.56
H2R2	12.50	11.33	9.83	9.83	11.30	11.30	11.02
H3R1	12.00	10.92	10.58	10.33	12.25	12.45	11.42
H3R2	12.00	10.50	9.83	9.67	11.83	12.08	10.99
H4R1	11.22	11.08	10.17	10.10	12.17	12.20	11.16
H4R2	11.00	11.17	9.83	9.83	11.30	11.30	10.74
H5R1	11.25	10.92	10.58	10.33	12.25	12.48	11.30
H5R2	11.92	10.50	9.83	9.67	11.83	12.08	10.97
CD	**0.23**	**0.12**	**0.33**	-	**0.18**	**0.31**	**0.25**
S1R1	11.09	10.90	9.95	10.02	11.50	11.50	10.83
S1R2	11.15	10.40	9.20	10.22	11.00	11.00	10.50
S2R1	11.49	10.95	10.60	10.00	12.15	12.31	11.25
S2R2	11.00	10.95	10.10	9.20	11.49	11.59	10.72
S3R1	12.48	12.40	11.30	10.10	13.02	13.12	12.07
S3R2	12.60	11.75	10.60	10.40	12.05	12.25	11.61
CD	-	-	-	**0.09**	**0.14**	**0.38**	**0.20**

breeds the bivoltine under wide spacing recorded highest weight (12.07 gm) and close spacing yielded least weight (10.50 gm). For crossbreed, the same trend was observed and values observed were 10.50, 10.72 and 11.61 gm under the spacings S1, S2 and S3 respectively.

In respect of combinations of housing and spacing, the highest weight was observed for the larvae reared under wide spacing in thatched houses H1 (12.21 gm) on par with H2 (11.91 gm). In general the other houses performed alike and the least weight was recorded under close spacing. The larvae reared in close spacing in the thatched houses had more weight than that in other types of houses.

4.2.3.5 Fifth instar

The fifth instar larvalweight recorded under different treatments are presented in Table 20 and Fig 2. The weight was significantly higher in thatched house H1 (31.64 gm) followed by thatched house H2 (30.68 gm) and RCC roof house (30.32 gm). The value was least in light roof and tiled house (29.88 gm). The combination of wide spacing and thatched houses resulted in higher larval weight (31.72 gm) compared to medium (30.58 gm) and close spacing (29.14 gm). Both the silkworm types recorded significantly higher larval weight in thatched house H1 (R1 – 31.83 and R2 – 32.75 gm) followed by thatched house H2 (R1 – 30.75 gm and R2 – 31.92 gm). The other three

Table 20 Effect of rearing house and larval spacing on **larval weight of v[th] instars(gms/10worms)**of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	32.83	32.83	29.08	29.08	33.00	33.00	31.64
H2	30.33	30.33	28.83	28.58	33.00	33.00	30.68
H3	29.38	29.38	28.00	28.17	31.92	32.50	29.88
H4	30.33	30.33	28.83	28.58	31.92	31.92	30.32
H5	29.38	29.38	28.00	28.17	31.92	32.50	29.88
CD	**0.28**	**0.28**	**0.24**	**0.36**	**0.56**	**0.54**	**0.15**
S1	29.45	29.40	27.50	27.30	30.55	30.65	29.14
S2	30.40	30.40	28.60	28.40	32.80	32.90	30.58
S3	31.50	31.50	29.55	29.85	33.70	34.20	31.72
CD	**0.26**	**0.29**	**0.29**	**0.28**	**0.43**	**0.42**	**0.16**
H1S1	32.00	32.00	28.00	28.00	31.00	31.00	30.33
H1S2	33.00	33.00	29.00	29.00	33.60	33.50	31.85
H1S3	33.50	33.50	30.25	30.25	34.50	34.50	32.75
H2S1	29.50	29.50	28.00	27.25	31.00	31.00	29.38
H2S2	30.00	30.00	29.00	28.50	33.50	33.00	30.67
H2S3	31.50	31.50	29.50	30.00	34.50	34.50	31.92
H3S1	28.13	28.00	26.75	27.00	30.00	30.25	28.36
H3S2	29.50	29.50	28.00	28.00	32.50	32.75	30.04
H3S3	30.50	30.50	29.25	29.00	33.25	34.50	31.17
H4S1	29.50	29.50	28.00	27.25	30.75	30.75	29.29
H4S2	30.50	30.50	29.00	28.50	32.00	32.00	30.42
H4S3	31.50	31.50	29.50	30.25	33.00	33.00	31.46
H5S1	28.13	28.00	26.75	27.00	30.25	30.50	28.44
H5S2	29.50	29.00	28.00	28.00	32.50	32.75	29.96
H5S3	30.50	31.00	29.25	29.50	33.25	34.50	31.33
CD	**0.13**	**0.13**	**0.42**	**0.53**	**0.84**	**0.89**	**0.21**
H1R1	33.67	33.67	29.33	29.33	34.17	34.17	31.83
H1R2	32.00	32.00	28.83	28.83	31.83	31.83	32.75
H2R1	31.33	31.33	29.00	29.00	34.17	34.17	30.75
H2R2	29.33	29.33	28.67	28.67	31.83	31.83	31.92
H3R1	29.75	29.75	28.00	28.00	32.33	33.83	30.04
H3R2	29.00	29.00	28.00	28.00	31.50	31.17	31.25
H4R1	31.33	31.33	29.00	29.00	32.00	32.00	30.25
H4R2	29.33	29.33	28.67	28.67	31.83	31.83	31.42
H5R1	29.75	29.75	28.00	28.00	32.33	33.83	30.04
H5R2	29.00	29.00	28.00	28.00	31.50	31.17	31.25
CD	**0.11**	**0.11**	**0.18**	**0.18**	**0.79**	**0.79**	**0.30**
S1R1	29.70	29.80	27.60	27.40	31.00	31.00	29.42
S1R2	29.00	29.00	27.40	27.20	33.60	30.30	29.42
S2R1	31.20	31.20	28.60	28.60	34.40	34.40	31.40
S2R2	29.60	29.60	28.60	28.20	30.10	31.50	29.60
S3R1	32.40	32.40	29.60	30.40	32.00	35.50	32.05
S3R2	30.60	30.60	29.30	29.40	33.00	33.00	30.98
CD	**0.80**	**0.80**	**0.26**	**0.39**	**0.40**	**0.60**	**0.20**

houses were on par for bivoltine and crossbreed larvae. An interesting observation here was that the crossbreed registered significantly higher weight than bivoltine in the fifth instar contrary to the earlier four instars.

The races recorded higher larval weight when reared under wide spacings (S3R1 – 32.05 and S3R2 – 30.98 gm) than others and the bivoltine showed more weight than crossbreed larvae and in medium spacing also this trend was maintained (S2R1 – 31.40 and S2R2 – 29.60 gm). But in close spacing, there was no difference between the races. The highest weight for the fifth instar larvae was recorded in thatched house H1 under wide spacing (32.75 gm) followed by thatched house H2 (31.92 gm). The medium spacing in H1 (31.85 gm) was comparable to wide spacing in other houses and the close spacing to medium spacing likewise. The thatched house H1 was found suitable to adapt even the close spacing (30.33 gm) as the weight gain was more than that in the presently recommended spacing.

4.2.4 Growth rate

The results on the growth rate of the silkworms are presented in Tables 21-24.

4.2.4.1 First instar

The growth rate of the first instar larvae was higher in thatched house H1 (6.27) followed by H2 (6.24), RCC roof (5.50), tiled roof (5.21) and light roof (5.06) houses. Of the different larval densities the growth rate was higher (6.06) under wide spacing than under medium spacing (5.43) and least in close spacing (4.90).

The bivoltine silkworm reared in thatched house H1 had highest growth rate (6.34) followed by H2 (6.04) and RCC roof house (5.85). The tiled roof (5.35) and light roof (5.38) recorded the least values. The growth rate for crossbreed was higher (5.67) in thatched house H1 compared to all other houses. The bivoltine larvae exhibited higher growth rate (6.08) in medium spacing than others and the least rate (4.56) under wide spacing was interesting one. For the crossbreed increase in growth rate was proportional to the increase in spacing. The growth rate under wide spacing (low density) in thatched houses H2 and H1 was on par (H1S3 – 6.31 and H2S3 – 6.43) and significantly superior to other combinations. The least value (4.50) was recorded in the close spacing in light roof and tiled roof houses.

4.2.4.2 Second instar

The growth rate (Table 21) was not having statistically significant variation in any of the seasons or in mean values for main factors or combinations. However, the light roof house recorded the growth rate 3.61 in contrary to the results in first instar and the least value was in thatched house H1 (2.93).

Table 21 Effect of rearing house and larval spacing on **growth rate** of **II nd instar** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	2.88	2.88	2.92	2.78	3.07	3.07	2.93
H2	2.88	2.65	2.97	2.97	3.07	3.07	2.94
H3	2.69	2.45	4.09	3.91	4.61	3.92	3.61
H4	2.53	2.53	4.00	4.00	3.51	3.44	3.34
H5	2.57	2.45	3.67	3.50	4.61	3.92	3.45
CD	-	-	-	-	-	-	-
S1	2.69	2.45	4.28	4.09	4.44	4.34	3.72
S2	2.65	2.53	3.91	3.91	3.78	3.38	3.36
S3	2.76	2.65	3.60	3.60	2.93	2.84	3.06
CD	-	-	-	-	-	-	-
H1S1	2.76	2.76	3.83	3.66	3.71	3.71	3.41
H1S2	2.88	2.88	3.59	3.59	3.13	3.13	3.20
H1S3	3.00	3.00	3.84	3.84	2.62	2.62	3.15
H2S1	2.57	2.81	3.31	3.31	3.71	3.71	3.24
H2S2	2.65	2.88	3.18	3.33	3.13	3.13	3.05
H2S3	2.72	2.95	3.62	3.62	2.62	2.62	3.03
H3S1	2.45	2.69	4.49	4.10	5.89	5.25	4.15
H3S2	2.57	2.69	4.00	4.00	5.04	3.77	3.68
H3S3	2.53	2.76	3.75	3.75	3.52	3.13	3.24
H4S1	2.45	2.45	3.59	3.59	4.17	4.34	3.43
H4S2	2.53	2.53	3.83	4.00	3.57	3.44	3.32
H4S3	2.60	2.49	4.45	4.45	2.93	2.93	3.31
H5S1	2.45	2.45	4.49	4.10	5.89	5.25	4.11
H5S2	2.57	2.57	4.00	4.00	5.04	3.77	3.66
H5S3	2.53	2.65	4.69	4.69	3.52	3.13	3.54
CD	-	-	-	-	-	-	-
H1R1	2.88	2.88	3.68	3.68	2.68	2.68	3.08
H1R2	2.88	2.76	3.20	2.33	3.85	3.85	3.15
H2R1	2.76	2.76	4.37	4.37	2.68	2.68	3.27
H2R2	2.53	2.88	4.19	4.37	3.85	3.85	3.61
H3R1	2.53	2.65	3.91	3.91	4.08	3.58	3.44
H3R2	2.45	2.81	4.37	4.00	5.33	4.44	3.90
H4R1	2.65	2.65	3.46	3.46	3.27	3.16	3.11
H4R2	2.41	2.41	3.75	3.75	3.70	3.70	3.29
H5R1	2.57	2.57	3.91	3.91	4.08	3.58	3.44
H5R2	2.45	2.57	4.37	4.00	5.33	4.44	3.86
CD	-	-	-	-	-	-	-
S1R1	2.57	2.69	3.24	3.09	4.00	3.92	3.25
S1R2	2.45	2.57	3.59	3.26	5.00	4.77	3.61
S2R1	2.65	2.65	3.06	3.06	3.34	2.98	2.96
S2R2	2.53	2.65	4.00	4.00	4.34	4.00	3.59
S3R1	2.76	2.76	4.58	4.58	2.51	-0.58	2.77
S3R2	2.65	2.76	3.29	3.60	3.71	3.52	3.26
CD	-	-	-	-	-	-	-

Regarding the effect of spacing, while close spacing recorded the growth rate of 3.72, the other spacings had growth rate of 3.36 and 3.06 respectively. The bivoltine larvae had only lower growth rate (3.08 – 3.44) than the crossbreed (3.27 – 3.90) and the light roof house had recorded higher values than other houses in both the races. Crossbreed had registered more growth rate than bivoltine under all larval densities as the values were 3.26 to 3.61 and 2.77 to 3.25 respectively. The results were not consistent in the seasons and the data was not significant statistically.

4.2.4.3 Third instar

The growth rate of the third instar (Table 22) larvae was also not statistically significant for any season or factors. The growth rate for the different type of rearing house varied only from 3.32 to 3.61 and for different spacings from 3.36 to 4.00. The values for different combinations of houses and races varied from 3.73 to 4.09 in the case of bivoltine race and 2.99 to 3.91 in crossbreed. The growth rate of bivoltines under different spacing varied from 3.61 to 4.23 and of crossbreed from 3.19 to 3.70. The spacing of the larvae in different rearing houses significantly influenced the growth rate. Wide spacing in the thatched houses H1 and H2 (4.43 and 4.30) was superior to other combinations. The medium and close spacing in thatched house H1 was superior to same spacings in other houses.

Table 22 Effect of rearing house and larval spacing on **growth rate** of **III [rd] instar** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	3.79	3.70	3.59	4.00	3.33	3.24	3.61
H2	3.39	4.06	3.41	3.41	3.33	3.24	3.47
H3	3.35	3.31	3.36	3.48	3.28	3.16	3.32
H4	3.83	3.50	3.28	3.21	3.31	3.25	3.40
H5	3.47	3.31	3.36	3.52	3.28	3.16	3.35
CD	-	-	-	-	-	-	-
S1	3.39	3.28	3.04	3.15	3.77	3.55	3.36
S2	3.74	3.83	3.57	3.57	3.84	3.59	3.69
S3	4.03	4.42	3.97	3.83	3.85	3.91	4.00
CD	-	-	-	-	-	-	-
H1S1	4.41	3.31	3.54	4.85	4.03	4.03	4.03
H1S2	3.61	4.76	4.14	4.29	3.79	3.79	4.06
H1S3	4.12	3.91	4.50	4.23	4.91	4.91	4.43
H2S1	3.47	3.16	3.04	4.11	4.03	4.03	3.64
H2S2	3.52	3.70	3.57	4.10	3.48	2.88	3.54
H2S3	4.00	4.41	3.77	3.77	4.91	4.91	4.30
H3S1	3.66	2.65	2.79	3.08	3.39	3.80	3.23
H3S2	4.03	3.03	3.46	3.43	3.31	5.06	3.72
H3S3	4.27	3.31	3.62	3.59	3.58	3.48	3.64
H4S1	3.62	3.28	3.04	3.04	3.87	3.71	3.43
H4S2	3.67	3.27	3.21	3.07	3.69	3.84	3.46
H4S3	4.16	4.13	3.77	3.60	3.73	3.70	3.85
H5S1	3.62	2.90	2.89	3.19	4.03	3.80	3.41
H5S2	3.87	3.17	3.46	3.43	4.78	5.06	3.96
H5S3	4.10	3.45	3.62	3.59	3.27	3.48	3.59
CD	**3.70**	**3.87**	**3.75**	**3.70**	**5.38**	**5.45**	**0.35**
H1R1	4.58	4.85	4.48	4.45	3.09	3.09	4.09
H1R2	3.00	4.56	3.52	4.39	2.66	2.66	3.47
H2R1	3.47	4.94	3.90	3.90	3.09	3.09	3.73
H2R2	3.90	2.76	3.04	2.90	2.66	2.66	2.99
H3R1	3.73	3.19	3.82	3.79	4.79	4.85	4.03
H3R2	4.31	2.75	2.72	3.00	4.94	5.26	3.83
H4R1	3.61	3.29	3.66	3.55	4.97	4.97	4.01
H4R2	4.07	3.76	2.90	2.90	4.90	4.90	3.91
H5R1	3.63	3.33	3.89	3.82	4.79	4.85	4.05
H5R2	4.14	3.00	2.72	3.00	4.94	5.26	3.84
CD	-	-	-	-	-	-	-
S1R1	3.60	3.45	3.43	3.48	3.81	3.88	3.61
S1R2	3.59	2.33	2.68	2.92	3.77	3.87	3.19
S2R1	3.84	3.77	4.00	4.04	5.36	2.36	3.90
S2R2	3.80	3.55	3.11	3.11	5.48	-0.90	3.03
S3R1	4.06	4.59	4.52	4.17	4.06	4.00	4.23
S3R2	4.16	3.94	3.70	3.24	3.48	3.67	3.70
CD	-	-	-	-	-	-	-

4.2.4.4 Fourth instar

The growth rate of fourth instar larvae are presented in Table 23. Higher growth rate was noticed in light roof house (7.69) and tiled house (7.63) than RCC house (7.21). The thatched roof houses H2 and H1 were on par and recorded the least value. The larval density had no significant influence on growth rate. The values for high density and low density were 7.24 and 6.64 respectively.

The influence of the houses on racial characters was also not significant. However, the crossbreed had more growth rate in thatched house H2 and H1 (8.06 and 7.58) than others. The effect of spacings on the races also was only insignificant. The crossbreed registered high values under all spacings but the effect of spacing on the races was not consistent. Regarding the influence of the combinations of type of rearing houses and spacing, close spacing in light roof house recorded high growth rate (7.54) than others followed by wide spacing in tiled roof house (7.35).

4.2.4.5 Fifth instar

The growth rate of fifth instar larvae are presented in Table 24. The growth rate was highest in RCC roof house (1.78) followed by thatched houses H1 (1.76) and H2 (1.73) which were on par. The least value was in light roof

Table 23 Effect of rearing house and larval spacing on **growth rate** of **IV[th] instar** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	6.68	6.58	7.05	6.68	7.22	7.40	6.94
H2	7.34	6.54	7.07	6.79	7.22	7.40	7.06
H3	7.89	7.57	7.37	7.26	7.79	8.23	7.69
H4	6.66	7.24	7.06	7.17	7.50	7.64	7.21
H5	7.64	7.57	7.37	7.20	7.79	8.23	7.63
CD	**0.23**	**0.32**	**0.20**	**0.22**	**0.33**	**0.33**	**0.12**
S1	7.18	7.59	7.48	7.58	6.60	6.98	7.24
S2	6.95	6.55	7.09	6.93	6.63	7.13	6.88
S3	6.79	6.19	6.60	6.61	6.84	6.83	6.64
CD	**0.11**	**0.23**	**0.32**	**0.31**	-	-	-
H1S1	5.66	6.97	6.98	5.49	5.99	5.99	6.18
H1S2	6.86	4.92	6.47	6.26	6.36	6.36	6.21
H1S3	6.44	6.78	5.82	6.17	5.17	5.17	5.93
H2S1	7.49	7.46	7.41	5.57	5.99	5.99	6.65
H2S2	7.67	6.34	7.20	5.76	6.86	8.09	6.99
H2S3	6.97	5.73	6.69	6.34	5.17	5.17	6.01
H3S1	7.19	8.07	7.96	7.96	7.27	6.81	7.54
H3S2	6.99	7.50	7.20	7.06	7.79	5.61	7.03
H3S3	7.15	7.15	7.12	6.89	7.44	7.87	7.27
H4S1	6.98	7.47	7.19	7.32	6.71	6.71	7.06
H4S2	6.33	7.50	7.47	7.47	6.72	6.50	7.00
H4S3	6.43	6.79	6.52	6.61	6.94	6.99	6.71
H5S1	7.16	8.07	7.72	7.72	6.21	6.81	7.28
H5S2	6.88	7.50	7.20	7.06	5.56	5.61	6.64
H5S3	7.01	7.15	7.12	6.89	8.04	7.87	7.35
CD	**0.32**	**0.23**	**0.43**	**0.34**	**0.22**	**0.32**	**0.11**
H1R1	5.67	5.13	5.87	5.96	7.55	7.55	6.29
H1R2	8.09	5.56	7.02	7.47	8.66	8.66	7.58
H2R1	7.17	5.49	6.63	6.11	7.55	7.55	6.75
H2R2	7.50	8.14	7.70	7.70	8.66	8.66	8.06
H3R1	7.45	7.40	6.84	6.71	5.41	5.45	6.54
H3R2	6.79	7.75	8.10	7.95	5.43	5.23	6.88
H4R1	6.85	7.33	6.53	6.65	5.37	5.39	6.35
H4R2	6.48	7.09	7.70	7.70	5.17	5.17	6.55
H5R1	7.09	7.40	6.72	6.65	5.41	5.47	6.46
H5R2	7.00	7.75	8.10	7.95	5.43	5.23	6.91
CD	-	-	-	-	**0.12**	**0.12**	-
S1R1	7.04	6.90	7.02	7.28	6.47	6.37	6.85
S1R2	7.38	9.40	7.93	9.02	6.69	6.53	7.83
S2R1	6.66	6.40	6.57	6.09	4.79	6.09	6.10
S2R2	6.64	6.77	7.78	7.00	4.72	6.33	6.54
S3R1	6.70	5.93	6.06	5.73	6.57	6.72	6.29
S3R2	6.88	6.44	7.35	7.46	7.14	6.95	7.04
CD	-	-	-	-	-	-	-

Table 24 Effect of rearing house and larval spacing on **growth rate** of V [th] **instar** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	1.71	1.79	1.72	1.71	1.81	1.81	1.76
H2	1.51	1.56	1.79	1.87	1.81	1.81	1.73
H3	1.45	1.74	1.74	1.82	1.65	1.65	1.68
H4	1.73	1.73	1.88	1.87	1.72	1.72	1.78
H5	1.54	1.74	1.74	1.82	1.65	1.65	1.69
CD	**0.11**	**0.10**	**0.11**	**0.12**	**0.13**	0.12	**0.05**
S1	1.65	1.76	1.87	1.84	1.72	1.72	1.76
S2	1.60	1.78	1.76	1.80	1.77	1.75	1.74
S3	1.51	1.61	1.70	1.80	1.69	1.70	1.67
CD	**0.09**	**0.08**	**0.11**	-	-	-	-
H1S1	1.78	1.91	1.76	1.73	1.76	1.76	1.78
H1S2	1.76	1.93	1.70	1.70	1.89	1.88	1.81
H1S3	1.59	1.58	1.69	1.69	1.78	1.78	1.68
H2S1	1.59	1.62	1.95	1.90	1.76	1.76	1.76
H2S2	1.47	1.64	1.76	1.85	1.88	1.88	1.75
H2S3	1.47	1.54	1.68	1.86	1.78	1.78	1.69
H3S1	1.54	1.73	1.82	1.84	1.67	1.69	1.72
H3S2	1.45	1.78	1.73	1.80	1.68	1.63	1.68
H3S3	1.37	1.71	1.69	1.79	1.61	1.63	1.63
H4S1	1.76	1.81	2.03	1.90	1.73	1.73	1.83
H4S2	1.97	1.80	1.90	1.85	1.76	1.75	1.84
H4S3	1.65	1.63	1.74	1.86	1.67	1.67	1.70
H5S1	1.57	1.73	1.82	1.84	1.69	1.69	1.72
H5S2	1.57	1.73	1.73	1.80	1.68	1.63	1.69
H5S3	1.49	1.76	1.69	1.81	1.61	1.61	1.66
CD	-	-	-	-	-	-	**0.11**
H1R1	1.74	1.85	1.69	1.67	1.80	1.80	1.76
H1R2	1.67	1.74	1.75	1.75	1.82	1.82	1.76
H2R1	1.68	1.54	1.68	1.87	1.80	1.80	1.73
H2R2	1.35	1.59	1.92	1.87	1.82	1.82	1.73
H3R1	1.48	1.72	1.65	1.74	1.64	1.72	1.66
H3R2	1.42	1.76	1.85	1.90	1.66	1.58	1.70
H4R1	1.79	1.83	1.85	1.87	1.63	1.62	1.77
H4R2	1.67	1.63	1.92	1.87	1.82	1.82	1.79
H5R1	1.64	1.72	1.65	1.74	1.64	1.71	1.68
H5R2	1.43	1.76	1.85	1.90	1.66	1.58	1.70
CD	-	-	-	-	-	-	-
S1R1	1.68	1.73	1.77	1.73	1.70	1.70	1.72
S1R2	1.60	1.79	1.98	1.66	2.05	1.75	1.81
S2R1	1.72	1.85	1.70	1.86	1.83	1.79	1.79
S2R2	1.69	1.70	1.83	2.07	1.62	1.71	1.77
S3R1	1.60	1.61	1.62	2.01	1.46	1.70	1.67
S3R2	1.43	1.60	1.76	1.83	1.74	1.69	1.68
CD	**0.23**	**0.20**	**0.12**	**0.12**	**0.12**	-	-

house (1.68) followed by tiled roof house (1.69). The mean data on the effect of spacing on growth rate was not of significant variation though the data for three seasons were having significant variation. Anyhow it is interesting to note that the wide spacing registered a reduction in growth rate compared to other spacings. (S1 – 1.76, S2 – 1.74 and S3 – 1.67). The influence of rearing house on silkworm types was not statistically significant as the values ranged only from 1.66 to 1.79. The combination of races and spacing also has not shown significant variation and the values ranged from 1.67 to 1.81.

The variation between the combinations of houses and spacing was statistically significant. Close spacing recorded higher growth rate than other spacings in all the house types except thatched house H1 in which medium spacing (1.81) had high rate than wide spacing (1.68). The RCC roof and thatched houses H1 and H2 recorded more growth rate.

4.2.5 Growth index

The growth index of the five larval instars are presented in Tables 25-29.

4.2.5.1 First instar

The growth index of the first instar larvae (Table 25) indicated that the thatched houses H1 and H2 (6.27 and 6.24) were favourable for the larvae. The RCC roof house ranked next (5.50) followed by tiled roof (5.21) and light roof

Table 25 Effect of rearing house and larval spacing on the **growth index of first instar larvae** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	6.73	6.73	5.73	5.73	6.36	6.36	6.27
H2	6.73	6.73	5.64	5.64	6.36	6.36	6.24
H3	6.64	6.64	4.00	4.00	4.18	4.91	5.06
H4	6.73	6.73	4.27	4.27	5.45	5.55	5.50
H5	6.64	6.64	4.45	4.45	4.18	4.91	5.21
CD	**0.02**	**0.02**	**0.03**	**0.03**	**0.03**	**0.03**	**0.01**
S1	6.64	6.64	3.82	3.82	4.18	4.27	4.90
S2	6.73	6.73	4.18	4.18	5.09	5.64	5.43
S3	6.73	6.73	4.73	4.73	6.64	6.82	6.06
CD	-	-	**0.11**	**0.11**	**0.12**	**0.12**	**0.11**
H1S1	6.73	6.73	4.27	4.27	5.18	5.18	5.39
H1S2	6.73	6.73	4.55	4.55	6.27	6.27	5.85
H1S3	6.73	6.73	4.64	4.64	7.55	7.55	6.31
H2S1	6.64	6.64	4.91	4.91	5.18	5.18	5.58
H2S2	6.73	6.73	5.09	5.09	6.27	6.27	6.03
H2S3	6.82	6.82	4.91	4.91	7.55	7.55	6.43
H3S1	6.64	6.64	3.64	3.64	3.09	3.36	4.50
H3S2	6.64	6.64	4.09	4.09	3.82	4.91	5.03
H3S3	6.73	6.73	4.55	4.55	5.64	6.27	5.75
H4S1	6.64	6.64	4.55	4.55	4.27	4.27	5.15
H4S2	6.73	6.73	4.27	4.27	5.36	5.55	5.49
H4S3	6.82	6.82	4.00	4.00	6.64	6.64	5.82
H5S1	6.64	6.64	3.64	3.64	3.09	3.36	4.50
H5S2	6.64	6.64		4.09	3.82	4.91	5.03
H5S3	6.73	6.73	3.64	3.64	5.64	6.27	5.44
CD	**0.11**	**0.11**	**0.22**	**0.22**	**0.33**	**0.33**	**0.17**
H1R1	6.73	6.73	4.64	4.64	7.64	7.64	6.34
H1R2	6.73	6.73	5.27	5.27	5.00	5.00	5.67
H2R1	6.73	6.73	3.91	3.91	7.64	7.64	6.09
H2R2	6.73	6.73	3.91	3.91	5.00	5.00	5.21
H3R1	6.73	6.73	4.18	4.18	4.91	5.55	5.38
H3R2	6.64	6.64	3.91	3.91	3.45	4.18	4.79
H4R1	6.73	6.73	4.91	4.91	5.82	6.00	5.85
H4R2	6.73	6.73	4.55	4.55	5.00	5.00	5.43
H5R1	6.64	6.64	4.18	4.18	4.91	5.55	5.35
H5R2	6.64	6.64	3.91	3.91	3.45	4.18	4.79
CD	-	-	**0.33**	**0.33**	**0.22**	**0.22**	**0.11**
S1R1	6.64	6.64	5.00	5.00	4.82	4.91	5.50
S1R2	6.64	6.64	4.55	4.55	3.55	3.73	4.94
S2R1	6.73	6.73	5.27	5.27	5.91	6.55	6.08
S2R2	6.73	6.73	4.09	4.09	4.27	4.64	5.09
S3R1	6.73	6.73	3.73	3.73	4.82	4.73	4.56
S3R2	6.73	6.73	4.73	4.73	5.36	5.64	5.65
CD	-	-	**0.20**	**0.20**	**0.40**	**0.40**	**0.22**

houses (5.06). Among the different spacings wide spacing registered higher growth index (6.06) followed by medium (5.43) and close (4.90) spacings.

The results on the combined effect of houses and silkworm types revealed higher growth index for bivoltine larvae than crossbreed in all the houses. The bivoltine in thatched house H1 (6.34) ranked first followed by H2. The crossbreed in light roof and tiled houses recorded the least value (4.79).

Of the two races reared under different spacings, crossbreed had larger growth index than bivoltine in the close and medium spacings (4.94, 5.09 against 5.50 and 6.08) respectively while under wide spacing crossbreed registered higher value (5.65) than bivoltine (4.56).

Results on the effect of combinations of houses and spacing on growth index indicated that the wide spacing had invariably high indices irrespective of the rearing house. Under all the spacings, thatched houses H1 and H2 were having higher values.

4.2.5.2 Second instar

The growth index of the second instar are presented in Table 26. The growth index was not having significant variation between different types of rearing houses. The growth index recorded in thatched houses H1 was 27.64,

Table 26 Effect of rearing house and larval spacing on the **growth index of second instar larvae** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	29.00	29.00	25.36	24.45	29.00	29.00	27.64
H2	29.00	27.18	25.36	25.36	29.00	29.00	27.48
H3	27.18	25.36	24.45	23.55	28.09	28.09	26.12
H4	26.27	26.27	25.36	25.36	28.09	28.09	26.57
H5	26.27	25.36	24.45	23.55	28.09	28.09	25.97
CD	-	-	-	-	-	-	-
S1	27.18	25.36	24.45	23.55	27.18	27.18	25.82
S2	27.18	26.27	24.45	24.45	28.09	28.09	26.42
S3	28.09	27.18	25.36	25.36	29.00	29.00	27.33
CD	-	-	-	-	-	-	-
H1S1	28.09	28.09	24.45	23.55	28.09	28.09	26.73
H1S2	29.00	29.00	24.45	24.45	29.00	29.00	27.48
H1S3	29.91	29.91	26.27	26.27	29.91	29.91	28.7
H2S1	26.27	28.09	24.45	24.45	28.09	28.09	26.57
H2S2	27.18	29.00	24.45	25.36	29.00	29.00	27.33
H2S3	28.09	29.91	26.27	26.27	29.91	29.91	28.39
H3S1	25.36	27.18	24.45	22.64	27.18	26.27	25.51
H3S2	26.27	27.18	24.45	24.45	28.09	27.18	26.27
H3S3	26.27	28.09	25.36	25.36	29.00	29.00	27.18
H4S1	25.36	25.36	24.45	24.45	26.27	27.18	25.51
H4S2	26.27	26.27	24.45	25.36	28.09	28.09	26.42
H4S3	27.18	26.27	26.27	26.27	29.00	29.00	27.33
H5S1	25.36	25.36	24.45	22.64	27.18	26.27	25.21
H5S2	26.27	26.27	24.45	24.45	28.09	27.18	26.12
H5S3	26.27	27.18	25.36	25.36	29.00	29.00	27.03
CD	-	-	-	-	-	-	-
H1R1	29.00	29.00	25.36	25.36	30.82	30.82	28.39
H1R2	29.00	28.09	25.36	19.91	28.09	28.09	26.42
H2R1	28.09	28.09	25.36	25.36	30.82	30.82	28.09
H2R2	26.27	29.00	24.45	25.36	28.09	28.09	26.88
H3R1	26.27	27.18	24.45	24.45	29.00	29.00	26.73
H3R2	25.36	28.09	25.36	23.55	27.18	27.18	26.12
H4R1	27.18	27.18	25.36	25.36	28.09	28.09	26.88
H4R2	25.36	25.36	25.36	25.36	27.18	27.18	25.97
H5R1	26.27	26.27	24.45	24.45	29.00	29.00	26.57
H5R2	25.36	26.27	25.36	23.55	27.18	27.18	25.82
CD	-	-	-	-	-	-	-
S1R1	26.27	27.18	24.45	23.55	28.09	28.09	26.27
S1R2	25.36	26.27	24.45	22.64	26.27	26.27	25.21
S2R1	27.18	27.18	24.45	24.45	29.00	29.00	26.88
S2R2	26.27	27.18	24.45	24.45	27.18	27.18	26.12
S3R1	28.09	28.09	25.36	25.36	29.91	29.91	27.79
S3R2	27.18	28.09	23.55	25.36	29.00	29.00	27.03
CD	-	-	-	-	-	-	-

H2 (27.48), RCC roof house (26.57), light roof house (26.12) and tiled roof (25.97). The mean growth index of the different larval spacings ranged from 25.82 under close spacing to 27.33 in wide spacing. The different combinations of houses and races recorded growth indices ranging from 25.82 for crossbreed in the tiled house to 28.39 for the bivoltine larvae in the thatched house H1. The two types of silkworm larvae did not vary under any of three spacings as the range was only 25.21 to 27.79.

4.2.5.3 Third instar

The growth index of the third instar larvae (Table 27) was highest in thatched house H1 (130.67) and H2 (126.42) followed by RCC roof house (120.21) and were on par. The light roof and tiled roof houses (116.12 each) had the least growth index. The wider spacings had significantly higher growth index (140.67) than the other two spacings (127.79 and 116.28) which were on par statistically.

The growth index of different silkworm types reared in different houses varied significantly. Bivoltine silkworm in thatched house H1 had higher growth index (147.49) than others followed by crossbreed in light roof and tiled roof houses. Bivoltine had higher growth index than crossbreed in all the houses and the least value was recorded in crossbreed in thatched house H2 (109.76).

Table 27 Effect of rearing house and larval spacing on **growth index of III rd instar** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	142.64	139.91	119.91	126.27	129.00	126.27	130.67
H2	130.82	141.73	115.36	115.36	129.00	126.27	126.42
H3	121.73	112.64	109.91	109.00	123.55	119.91	116.12
H4	130.82	121.73	111.73	109.91	124.45	122.64	120.21
H5	120.82	112.64	109.91	109.91	123.55	119.91	116.12
CD	-	-	-	-	-	-	**12.90**
S1	122.64	111.73	101.73	100.82	133.55	127.18	116.28
S2	132.64	130.82	115.36	115.36	139.91	132.64	127.79
S3	145.36	151.73	129.91	126.27	144.45	146.27	140.67
CD	-	-	-	-	-	-	**12.80**
H1S1	156.27	124.45	114.45	142.64	145.36	145.36	138.09
H1S2	137.18	171.73	129.91	133.55	142.64	142.64	142.94
H1S3	157.18	150.82	149.00	141.73	181.73	181.73	160.37
H2S1	120.82	119.91	101.73	129.00	145.36	145.36	127.03
H2S2	126.27	139.91	115.36	133.55	133.55	115.36	127.33
H2S3	144.45	166.27	129.00	129.00	181.73	181.73	155.36
H3S1	121.73	101.73	95.36	95.36	122.64	129.91	111.12
H3S2	136.27	112.64	112.64	111.73	124.45	169.91	127.94
H3S3	142.64	124.45	120.82	119.91	136.27	133.55	129.61
H4S1	120.82	111.73	101.73	101.73	131.73	131.73	116.58
H4S2	126.27	115.36	106.27	106.27	135.36	139.91	121.57
H4S3	144.45	139.00	129.00	124.45	140.82	139.91	136.27
H5S1	120.82	101.73	98.09	98.09	140.82	129.91	114.91
H5S2	131.73	112.64	112.64	111.73	167.18	169.91	134.31
H5S3	138.09	124.45	120.82	119.91	127.18	133.55	127.33
CD	-	-	-	-	-	-	**25.50**
H1R1	166.27	174.45	143.55	142.64	129.00	129.00	147.49
H1R2	119.00	160.82	118.09	111.73	105.36	105.36	120.06
H2R1	129.00	171.73	128.09	128.09	129.00	129.00	135.82
H2R2	132.64	111.73	101.73	101.73	105.36	105.36	109.76
H3R1	128.09	117.18	121.73	120.82	172.64	174.45	139.15
H3R2	139.00	108.09	97.18	97.18	166.27	175.36	130.51
H4R1	129.00	119.91	121.73	119.00	172.64	172.64	139.15
H4R2	132.64	124.45	101.73	101.73	165.36	165.36	131.88
H5R1	125.36	117.18	123.55	121.73	172.64	174.45	139.15
H5R2	134.45	108.09	97.18	97.18	166.27	175.36	129.76
CD	-	-	-	-	-	-	**16.80**
S1R1	124.45	124.45	111.73	109.00	139.00	140.82	124.91
S1R2	119.91	89.91	92.64	91.73	129.00	131.73	109.15
S2R1	135.36	133.55	126.27	127.18	189.91	99.91	135.36
S2R2	129.91	127.18	103.55	103.55	181.73	1.73	107.94
S3R1	146.27	161.73	144.45	135.36	155.36	153.55	149.45
S3R2	144.45	142.64	114.45	110.82	133.55	139.00	130.82
CD	-	-	-	-	-	-	**20.70**

Regarding the growth index under different larval spacings, highest value was in combination of wide spacing and bivoltine race (149.45) which was on par with its own medium spacing (135.36) and crossbreed under wide spacing (130.82). Crossbreed under medium and close spacing registered low growth index (107.94 and 109.15). In the combination of rearing house and larval spacing, wide spacing had higher index in all the houses than other spacings. Wide spacing in thatched houses H1 (160.37) and H2 (155.36) were superior to all other combinations.

4.2.5.4 Fourth instar

The growth index of the fourth instar (Table 28) was statistically not significant in any of the six seasons but for the mean growth index. Growth index was low in RCC roof house (994.30) and the thatched houses H1 and H2 ranked first (H1 – 1042.33 and H2 – 1025.36) followed by tiled roof house (1017.64) which were on par with thatched house. Regarding larval density, the mean of the seasons indicated that the wide larval spacings resulted in higher growth index (1081.58) than the medium and closer spacings (1012.79 and 960.52). With regard to the influence of houses on silkworm races, in all the house types bivoltine was superior to crossbreed. Bivoltine in the thatched houses H1 (1066.58) ranked top and was on par with H2 (1050.21) and were superior to other houses. Growth index of the crossbreed was least in RCC roof

Table 28 Effect of rearing house and larval spacing on **growth index of fourth instar larvae** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	1101.73	1067.18	972.64	976.27	1068.09	1068.09	1042.33
H2	1098.09	1074.45	938.09	905.36	1068.09	1068.09	1025.36
H3	1089.91	972.64	927.18	908.09	1093.55	1114.45	1017.64
H4	1009.00	1010.82	908.09	905.36	1065.36	1067.18	994.3
H5	1051.73	972.64	927.18	908.09	1093.55	1114.45	1011.27
CD	-	-	-	-	-	-	**34.89**
S1	1009.91	967.18	869.91	872.64	1021.73	1021.73	960.52
S2	1061.73	994.45	939.91	921.73	1073.55	1085.36	1012.79
S3	1139.00	1097.18	994.45	967.18	1139.00	1152.64	1081.58
CD	-	-	-	-	-	-	**5.67**
H1S1	1047.18	999.00	919.91	930.82	1021.73	1021.73	990.06
H1S2	1084.45	1021.73	976.27	976.27	1056.27	1056.27	1028.54
H1S3	1175.36	1180.82	1021.73	1021.73	1126.27	1126.27	1108.7
H2S1	1033.55	1021.73	862.64	853.55	1021.73	1021.73	969.15
H2S2	1102.64	1033.55	953.55	908.09	1056.27	1056.27	1018.4
H2S3	1158.09	1124.45	999.00	953.55	1126.27	1126.27	1081.27
H3S1	1004.45	930.82	862.64	862.64	1021.73	1021.73	950.67
H3S2	1095.36	965.36	930.82	908.09	1101.73	1129.00	1021.73
H3S3	1169.91	1021.73	988.09	953.55	1158.09	1192.64	1080.67
H4S1	970.82	953.55	839.91	853.55	1021.73	1021.73	943.55
H4S2	931.73	988.09	908.09	908.09	1051.73	1056.27	974
H4S3	1079.00	1089.91	976.27	953.55	1124.45	1124.45	1057.94
H5S1	993.55	930.82	862.64	862.64	1021.73	1021.73	948.85
H5S2	1044.45	965.36	930.82	908.09	1101.73	1129.00	1013.24
H5S3	1112.64	1021.73	988.09	953.55	1158.09	1192.64	1071.12
CD	-	-	-	-	-	-	**10.56**
H1R1	1114.45	1074.45	991.73	999.00	1109.91	1109.91	1066.58
H1R2	1089.91	1059.91	953.55	953.55	1026.27	1026.27	1018.24
H2R1	1060.82	1119.91	983.55	917.18	1109.91	1109.91	1050.21
H2R2	1135.36	1029.00	892.64	892.64	1026.27	1026.27	1000.36
H3R1	1089.91	991.73	960.82	938.09	1112.64	1130.82	1037.34
H3R2	1089.91	953.55	892.64	878.09	1074.45	1097.18	997.64
H4R1	1019.00	1006.27	923.55	917.18	1105.36	1108.09	1013.24
H4R2	999.00	1014.45	892.64	892.64	1026.27	1026.27	975.21
H5R1	1021.73	991.73	960.82	938.09	1112.64	1133.55	1026.43
H5R2	1082.64	953.55	892.64	878.09	1074.45	1097.18	996.43
CD	-	-	-	-	-	-	**23.89**
S1R1	1007.18	989.91	903.55	909.91	1044.45	1044.45	983.24
S1R2	1012.64	944.45	835.36	928.09	999.00	999.00	953.09
S2R1	1043.55	994.45	962.64	908.09	1103.55	1118.09	1021.73
S2R2	999.00	994.45	917.18	835.36	1043.55	1052.64	973.7
S3R1	1133.55	1126.27	1026.27	917.18	1182.64	1191.73	1096.27
S3R2	1144.45	1067.18	962.64	944.45	1094.45	1112.64	1054.3
CD	-	-	-	-	-	-	**23.56**

house (975.21) and the others were on par, the values being 996.43, 997.64, 1000.36 and 1018.24 for H5, H3, H2 and H1 houses respectively.

The wide larval spacing in bivoltine race resulted in higher growth index (1096.27) followed by crossbreed with the same spacing (1054.30). Close spacing had least value for both the races. Bivoltine was found superior to crossbreed under all the larval spacings. Regarding the combinations of houses and larval spacings, the wide spacing has recorded higher growth index than medium and closer spacings in all the houses and the medium spacing higher values than closer spacing. Thatched house H1 was superior to others under all the spacings.

4.2.5.5 Fifth instar

The results the growth index of the fifth instar larvae are presented in Table 29. The growth index in the thatched house H1 (2875.06) was highest and significantly superior to other rearing houses. The least values were in light roof house and tiled roof house (2716.43) and were on par with RCC roof house (2755.21). The wide spacing (2882.34) was significantly superior to other spacings and medium spacing was superior to close spacing.

Of the different combinations of house types and races, the bivoltine had higher growth index in all the houses than the crossbreed. The thatched house

Table 29 Effect of rearing house and larval spacing on **growth index of fifth instar larvae** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	2983.55	2983.55	2642.64	2642.64	2999.00	2999.00	2875.06
H2	2756.27	2756.27	2619.91	2597.18	2999.00	2999.00	2787.94
H3	2669.91	2669.91	2544.45	2559.91	2900.82	2953.55	2716.43
H4	2756.27	2756.27	2619.91	2597.18	2900.82	2900.82	2755.21
H5	2669.91	2669.91	2544.45	2559.91	2900.82	2953.55	2716.43
CD	**123.45**	**125.75**	**NS**	**NS**	**NS**	**NS**	**55.60**
S1	2676.27	2671.73	2499.00	2480.82	2776.27	2785.36	2648.24
S2	2762.64	2762.64	2599.00	2580.82	2980.82	2989.91	2779.31
S3	2862.64	2862.64	2685.36	2712.64	3062.64	3108.09	2882.34
CD	**120.98**	**126.87**	**135.56**	**138.96**	**145.50**	**157.85**	**67.09**
H1S1	2908.09	2908.09	2544.45	2544.45	2817.18	2817.18	2756.57
H1S2	2999.00	2999.00	2635.36	2635.36	3053.55	3044.45	2894.45
H1S3	3044.45	3044.45	2749.00	2749.00	3135.36	3135.36	2976.27
H2S1	2680.82	2680.82	2544.45	2476.27	2817.18	2817.18	2669.45
H2S2	2726.27	2726.27	2635.36	2589.91	3044.45	3044.45	2794.45
H2S3	2862.64	2862.64	2680.82	2726.27	3135.36	3135.36	2900.52
H3S1	2556.27	2544.45	2430.82	2453.55	2726.27	2749.00	2576.73
H3S2	2680.82	2680.82	2544.45	2544.45	2953.55	2976.27	2730.06
H3S3	2771.73	2771.73	2658.09	2658.09	3021.73	3135.36	2836.12
H4S1	2680.82	2680.82	2544.45	2476.27	2794.45	2794.45	2661.88
H4S2	2771.73	2771.73	2635.36	2589.91	2908.09	2908.09	2764.15
H4S3	2862.64	2862.64	2680.82	2726.27	2999.00	2999.00	2855.06
H5S1	2556.27	2544.45	2430.82	2453.55	2749.00	2749.00	2580.52
H5S2	2680.82	2635.36	2544.45	2544.45	2953.55	2976.27	2722.48
H5S3	2771.73	2817.18	2658.09	2680.82	3021.73	3112.64	2843.70
CD	**124.45**	**120.00**	**135.67**	**123.90**	**188.09**	**155.78**	**162.56**
H1R1	3059.91	3059.91	2665.36	2665.36	3105.36	3105.36	2943.54
H1R2	2908.09	2908.09	2619.91	2619.91	2892.64	2892.64	2806.88
H2R1	2847.18	2847.18	2635.36	2635.36	3105.36	3105.36	2862.63
H2R2	2665.36	2665.36	2605.36	2559.91	2892.64	2892.64	2713.55
H3R1	2703.55	2696.27	2544.45	2574.45	2938.09	3074.45	2755.21
H3R2	2635.36	2635.36	2544.45	2544.45	2862.64	2832.64	2675.82
H4R1	2847.18	2847.18	2635.36	2635.36	2908.09	2908.09	2796.88
H4R2	2665.36	2665.36	2605.36	2559.91	2892.64	2892.64	2713.55
H5R1	2703.55	2696.27	2544.45	2574.45	2938.09	3074.45	2755.21
H5R2	2635.36	2635.36	2544.45	2544.45	2862.64	2832.64	2675.82
CD	**120.87**	**125.56**	**129.56**	**134.45**	**134.45**	**137.89**	**67.89**
S1R1	2699.00	2708.09	2508.09	2489.91	2817.18	2817.18	2673.24
S1R2	2635.36	2635.36	2489.91	2471.73	3053.55	2753.55	2673.24
S2R1	2835.36	2835.36	2599.00	2599.00	3126.27	3126.27	2853.54
S2R2	2689.91	2689.91	2599.00	2562.64	2735.36	2853.55	2688.4
S3R1	2944.45	2944.45	2689.91	2762.64	2908.09	3217.18	2911.12
S3R2	2780.82	2780.82	2662.64	2671.73	2999.00	2999.00	2815.67
CD	**135.50**	**125.70**	**135.00**	**125.90**	**130.50**	**123.20**	**88.90**

H1 was significantly more favourable than other houses to bivoltine and crossbreed larvae. Thatched house ranked next on the same pattern. The other three houses were on par in respect of the different races.

The influence of larval spacing on races was more evident under the wide spacing for both the races. The bivoltine had the highest growth index under wide spacing (2911.12) followed by medium spacing (2853.54). The crossbreed under the medium and wider spacing ranked next (2688.47 and 2815.67). The close spacing (2673.24) was inferior for both the races.

The wide and medium spacings were on par in all the house types and the closer spacing had only lower index. There was no statistically significant difference between the house types in respect of the individual spacings except the close spacing in thatched house H1 (2756.57) which was superior to the tiled roof house (2580.52) and light roof house (2576.73).

4.2.6 Leaf consumption

The mean weight of mulberry leaves consumed by 100 larvae during the larval period are presented in Table 30. The larvae reared in thatched house consumed 1.62 kg followed by that in the RCC roof house (1.60 kg), thatched house H2 and light roof (1.59 kg) houses and were on par. The tiled house

Table 30 Effect of rearing house and larval spacing on the **leaf consumption (kg/100 worms)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	1.69	1.65	1.51	1.52	1.68	1.68	1.62
H2	1.61	1.66	1.42	1.48	1.69	1.68	1.59
H3	1.90	1.75	1.31	1.32	1.65	1.64	1.59
H4	1.62	1.63	1.47	1.50	1.69	1.68	1.60
H5	1.67	1.75	1.31	1.32	1.65	1.64	1.56
CD	**0.05**	**0.02**	**0.03**	**0.02**	**0.02**	**0.01**	**0.02**
S1	1.59	1.66	1.35	1.39	1.63	1.63	1.54
S2	1.70	1.70	1.40	1.42	1.68	1.65	1.59
S3	1.80	1.71	1.47	1.47	1.71	1.71	1.64
CD	**0.04**	**0.01**	**0.02**	**0.02**	**0.01**	**0.01**	**0.04**
H1S1	1.61	1.58	1.45	1.45	1.63	1.63	1.56
H1S2	1.68	1.68	1.48	1.50	1.66	1.65	1.61
H1S3	1.76	1.70	1.60	1.61	1.76	1.75	1.70
H2S1	1.49	1.68	1.35	1.48	1.64	1.63	1.55
H2S2	1.65	1.69	1.42	1.48	1.69	1.65	1.60
H2S3	1.70	1.63	1.47	1.48	1.75	1.75	1.63
H3S1	1.78	1.73	1.26	1.25	1.61	1.63	1.54
H3S2	1.91	1.74	1.31	1.32	1.68	1.65	1.66
H3S3	2.00	1.78	1.38	1.38	1.65	1.65	1.64
H4S1	1.58	1.60	1.45	1.50	1.64	1.63	1.57
H4S2	1.63	1.64	1.47	1.50	1.69	1.65	1.60
H4S3	1.65	1.66	1.50	1.51	1.75	1.76	1.64
H5S1	1.53	1.73	1.26	1.35	1.61	1.63	1.52
H5S2	1.64	1.74	1.31	1.32	1.68	1.65	1.56
H5S3	1.85	1.78	1.38	1.38	1.65	1.65	1.62
CD	**0.09**	**0.03**		**0.04**	**0.03**	**0.02**	**0.06**
H1R1	1.73	1.73	1.51	1.51	1.73	1.73	1.66
H1R2	1.64	1.57	1.52	1.53	1.63	1.63	1.59
H2R1	1.68	1.75	1.49	1.49	1.70	1.70	1.64
H2R2	1.54	1.58	1.35	1.47	1.68	1.65	1.55
H3R1	1.88	1.82	1.30	1.31	1.62	1.64	1.60
H3R2	1.91	1.68	1.33	1.33	1.67	1.65	1.60
H4R1	1.67	1.68	1.52	1.52	1.70	1.70	1.63
H4R2	1.57	1.59	1.43	1.48	1.68	1.65	1.57
H5R1	1.65	1.82	1.30	1.31	1.62	1.64	1.56
H5R2	1.69	1.68	1.33	1.33	1.67	1.65	1.56
CD	**0.07**	**0.02**	**0.04**	-	**0.03**	**0.02**	**0.08**
S1R1	1.63	1.67	1.36	1.37	1.60	1.61	1.54
S1R2	1.56	1.65	1.35	1.40	1.65	1.65	1.54
S2R1	1.71	1.77	1.42	1.41	1.69	1.72	1.62
S2R2	1.70	1.62	1.37	1.44	1.66	1.58	1.56
S3R1	1.83	1.84	1.49	1.50	1.72	1.72	1.68
S3R2	1.76	1.58	1.45	1.44	1.70	1.70	1.61
CD	-	**0.02**	-	**0.03**	**0.02**	**0.01**	**0.05**

recorded the least (1.56kg). The wide spacings registered higher leaf consumption (1.64 kg) than close (1.54 kg) and medium (1.59 kg) spacings.

The bivoltine silkworms reared in thatched house H1 recorded higher rate of leaf consumption (H1R1 – 1.66 kg and H2R1 – 1.64 kg) followed by other houses. Crossbreed larvae was on par with bivoltine as the consumption ranged from 1.55 to 1.60 kg. The leaf consumption by bivoltine silkworms was higher under wide and medium spacings (1.68 kg and 1.62 kg) than the close spacing (1.54kg). In case of crossbreed the wide spacing (1.61kg) was superior to close spacing(1.55 kg) as the leaf consumption was more.

Worms under wide spacing in the thatched house had recorded the highest leaf consumption (1.70 kg) followed by the medium spacing in light roof house (1.66 kg) and wide spacing in RCC roof house (1.64 kg). Close spacing in all the houses was inferior to wide spacing. The tiled house recorded least leaf consumption in all the three corresponding larval spacings (H5S1 – 1.52 H5S2 – 1.56 and H5S3 – 1.62 kg).

4.2.7 Missing larvae

The mean missing larval percentage of the silkworms reared in the different types of rearing houses are presented in Table 31. It was highest in the light roof house (5.72) followed by tiled (5.61), RCC (4.83) and thatched

Table 31 Effect of rearing house and larval spacing on the **missing larval** percentage of bivoltine and cross breed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	6.00	6.00	5.00	5.00	3.00	3.00	4.67
H2	6.00	6.00	5.00	5.00	3.00	3.00	4.67
H3	7.00	7.00	6.33	6.33	3.83	3.83	5.72
H4	6.00	6.00	5.50	5.50	3.00	3.00	4.83
H5	7.00	7.00	6.33	6.33	3.50	3.50	5.61
CD	**0.59**	**0.59**	**0.59**	**0.59**	**0.61**	**0.61**	**0.24**
S1	6.40	6.40	7.40	7.40	4.20	4.20	6.00
S2	6.40	6.40	4.75	4.75	3.25	3.25	4.80
S3	6.40	6.40	4.75	4.75	2.35	2.35	4.50
CD	-	-	**0.46**	**0.46**	**0.47**	**0.47**	**0.26**
H1S1	6.00	6.00	7.00	7.00	4.00	4.00	5.67
H1S2	6.00	6.00	4.00	4.00	3.00	3.00	4.33
H1S3	6.00	6.00	4.00	4.00	2.00	2.00	4.00
H2S1	6.00	6.00	7.00	7.00	4.00	4.00	5.67
H2S2	6.00	6.00	4.00	4.00	3.00	3.00	4.33
H2S3	6.00	6.00	4.00	4.00	2.00	2.00	4.00
H3S1	7.00	7.00	8.00	8.00	4.50	4.50	6.50
H3S2	7.00	7.00	5.50	5.50	4.00	4.00	5.50
H3S3	7.00	7.00	5.50	5.50	3.00	3.00	5.17
H4S1	6.00	6.00	7.00	7.00	4.00	4.00	5.67
H4S2	6.00	6.00	4.75	4.75	3.00	3.00	4.58
H4S3	6.00	6.00	4.75	4.75	2.00	2.00	4.25
H5S1	7.00	7.00	8.00	8.00	4.50	4.50	6.50
H5S2	7.00	7.00	5.50	5.50	3.25	3.25	5.25
H5S3	7.00	7.00	5.50	5.50	2.75	2.75	5.08
CD	-	-	-	-	-	**0.47**	**0.41**
H1R1	6.50	6.50	5.67	5.67	3.50	3.50	5.22
H1R2	5.50	5.50	4.33	4.33	2.50	2.50	4.11
H2R1	6.50	6.50	5.67	5.67	3.50	3.50	5.22
H2R2	5.50	5.50	4.33	4.33	2.50	2.50	4.11
H3R1	7.50	7.50	7.50	7.50	4.33	4.33	6.44
H3R2	6.50	6.50	5.17	5.17	3.33	3.33	5.00
H4R1	6.50	6.50	6.00	6.00	3.50	3.50	5.33
H4R2	5.50	5.50	5.00	5.00	2.50	2.50	4.33
H5R1	7.50	7.50	7.50	7.50	3.83	3.83	6.28
H5R2	6.50	6.50	5.17	5.17	3.17	3.17	4.95
CD	-	-	-	-	**0.47**	-	**0.33**
S1R1	6.90	6.90	8.60	8.60	4.70	4.70	6.73
S1R2	5.90	5.90	6.20	6.20	3.70	3.70	5.27
S2R1	6.90	6.90	5.40	5.40	3.70	3.70	5.33
S2R2	5.90	5.90	4.10	4.10	2.80	2.80	4.27
S3R1	6.90	6.90	5.40	5.40	2.80	2.80	5.03
S3R2	5.90	5.90	4.10	4.10	1.90	1.90	3.97
CD	-	-	**0.65**	**0.65**	-	-	**0.65**

houses (4.67). Among the different larval densities the wider spacing had least loss (4.50) and the closer ones had a higher loss (6.00). Both the silkworm breeds recorded higher values in the light roof house (R1 – 6.44 and R2 – 5.00) than others and least in thatched roof houses (R1 – 5.22 and R2 – 4.11). Both the silkworm types in the higher density had higher missing larval percentage (S1R1 – 6.73 and S1R2 – 5.27) and in the low density, the missing larval percentage was least (S3R1 – 5.03 and S3R2 – 3.97). Of the two silkworm types bivoltine registered higher percentage of missing larvae than crossbred.

Of the combinations of rearing houses and larval density, the mean percentage of missing larvae was higher in the combinations of light roof and higher density and tiled roof and higher density (H3S1 – 6.50 and H5S1 – 6.50). The least value was in the thatched houses H1 and H2 under the low density (4.00) and medium density (4.33) which were on par with low density reared in RCC roof house (4.25). The others were intermediate in effect. Only the mean values and observations during May-June seasons in 1996 were having statistically significant variation.

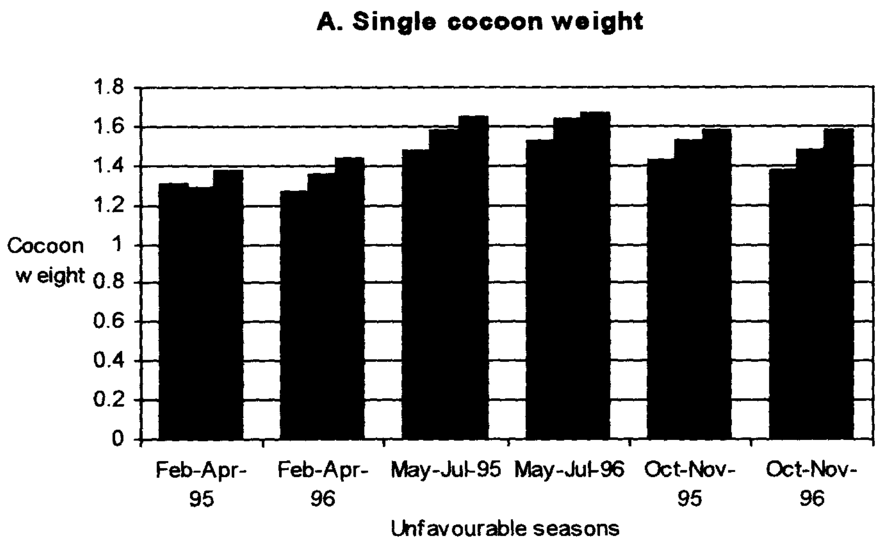
4.2.8 Single cocoon weight

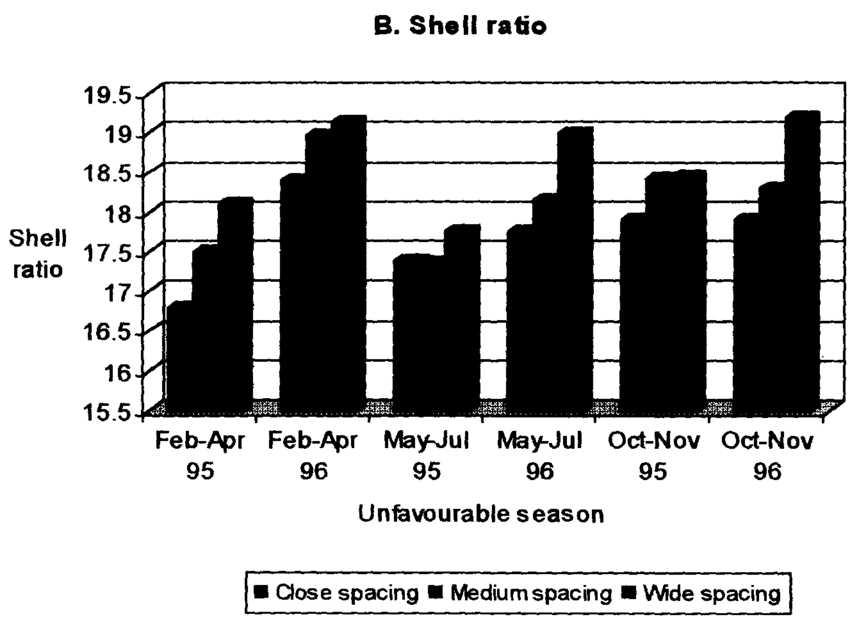
The results on single cocoon weight are presented in Table 32, Fig 2 and Fig 3. The single cocoon weight recorded inside thatched house H1 was the highest (1.55 gm) followed by H2 (1.51 gm), light roof house (1.45 gm),

Table 32 Effect of rearing house and larval spacing on **singlecocoon weight (gm/cocoon)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	1.57	1.60	1.40	1.35	1.72	1.66	1.55
H2	1.52	1.47	1.41	1.34	1.70	1.65	1.51
H3	1.46	1.47	1.34	1.33	1.55	1.55	1.45
H4	1.48	1.46	1.32	1.34	1.50	1.48	1.43
H5	1.42	1.47	1.34	1.33	1.55	1.55	1.44
CD	**0.03**	**0.03**	**0.02**	**0.01**	**0.02**	**0.03**	**0.01**
S1	1.40	1.40	1.31	1.27	1.53	1.48	1.40
S2	1.50	1.51	1.30	1.33	1.62	1.60	1.49
S3	1.57	1.58	1.41	1.40	1.66	1.60	1.55
CD	**0.02**	**0.02**	**0.01**	**0.01**	**0.02**	**0.02**	**0.01**
H1S1	1.48	1.50	1.32	1.26	1.63	1.57	1.46
H1S2	1.57	1.60	1.40	1.35	1.72	1.67	1.52
H1S3	1.67	1.69	1.47	1.44	1.79	1.74	1.57
H2S1	1.40	1.36	1.35	1.27	1.62	1.55	1.43
H2S2	1.52	1.46	1.41	1.33	1.71	1.66	1.45
H2S3	1.65	1.59	1.47	1.41	1.75	1.73	1.53
H3S1	1.38	1.39	1.30	1.28	1.46	1.43	1.37
H3S2	1.48	1.49	1.35	1.33	1.58	1.57	1.42
H3S3	1.51	1.54	1.38	1.38	1.61	1.65	1.44
H4S1	1.40	1.38	1.30	1.27	1.45	1.40	1.37
H4S2	1.50	1.49	1.31	1.33	1.52	1.51	1.47
H4S3	1.53	1.52	1.37	1.41	1.53	1.54	1.52
H5S1	1.34	1.39	1.30	1.28	1.46	1.43	1.37
H5S2	1.43	1.49	1.35	1.33	1.58	1.57	1.52
H5S3	1.50	1.54	1.38	1.38	1.61	1.65	1.57
CD	**0.04**	-	**0.03**	**0.02**	-	-	**0.01**
H1R1	1.54	1.58	1.39	1.35	1.66	1.62	1.55
H1R2	1.61	1.61	1.41	1.34	1.77	1.70	1.63
H2R1	1.51	1.52	1.41	1.36	1.63	1.60	1.51
H2R2	1.54	1.43	1.40	1.31	1.76	1.69	1.60
H3R1	1.48	1.52	1.32	1.30	1.58	1.54	1.47
H3R2	1.44	1.43	1.37	1.35	1.53	1.56	1.51
H4R1	1.47	1.46	1.32	1.36	1.47	1.48	1.44
H4R2	1.49	1.47	1.33	1.31	1.53	1.49	1.48
H5R1	1.48	1.52	1.32	1.30	1.58	1.54	1.46
H5R2	1.36	1.43	1.37	1.35	1.53	1.56	1.51
CD	**0.04**	**0.04**	**0.02**	**0.01**	**0.03**	**0.04**	**0.02**
S1R1	1.42	1.44	1.33	1.29	1.50	1.46	1.40
S1R2	1.38	1.37	1.30	1.25	1.55	1.50	1.48
S2R1	1.51	1.54	1.35	1.23	1.60	1.57	1.46
S2R2	1.48	1.47	1.38	1.33	1.65	1.63	1.48
S3R1	1.56	1.58	1.38	1.38	1.64	1.65	1.49
S3R2	1.59	1.57	1.45	1.42	1.67	1.67	1.56
CD	**0.03**	**0.03**	**0.02**	**0.01**	-	-	**0.01**

Fig 3 Influence of different spacings on different yield and quality parameters of silkworm rearing in unfavourable seasons of the year





tiled roof house (1.44 gm) and RCC roof house (1.43 gm). The wide spacing registered significantly higher cocoon weight (1.55 gm) compared to medium spacing (1.49 gm) which was inferior to close spacing (1.40 gm).

The crossbreed silkworms had highest cocoon weight in thatched house H1 (1.63 gm) and was superior to all other combinations. This was in agreement with higher larval weight recorded in fifth instar in this house. The thatched house H2 was next in order to thatched house H1. RCC house and tiled house had the least value for bivoltine and were on par. In all the houses the crossbreed had recorded higher cocoon weight than bivoltine. With regard to the influence of spacing, both the breeds have registered higher weight in wide spacing (S3R2-1.56 gm and S3R1-1.49).

The wide spacing has recorded higher cocoon weight in all the rearing houses than other spacing and the highest value (1.57 gm) was observed in thatched house H1 and tiled house. The close spacing in light roof, RCC and tiled roof houses had the least cocoon weight (1.37 gm).

4.2.9 Shell weight

The results on shell weight are presented in Table 33. The highest shell weight (0.28 gm) recorded in thatched house H1 was significantly superior to RCC house (0.25 gm). The other three houses were on par (0.27 gm). With

Table 33 Effect of rearing house and larval spacing on the **shell weight (gm/shell)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	0.29	0.31	0.25	0.24	0.30	0.30	0.28
H2	0.26	0.29	0.24	0.24	0.29	0.29	0.27
H3	0.27	0.28	0.25	0.24	0.30	0.30	0.27
H4	0.24	0.24	0.25	0.25	0.27	0.27	0.25
H5	0.24	0.28	0.25	0.24	0.30	0.30	0.27
CD	**0.01**	**0.01**	-	-	**0.01**	**0.01**	**0.02**
S1	0.23	0.26	0.23	0.23	0.26	0.26	0.25
S2	0.26	0.28	0.25	0.24	0.30	0.30	0.27
S3	0.28	0.30	0.26	0.26	0.31	0.31	0.29
CD	**0.02**	**0.02**	**0.02**	**0.01**	**0.03**	**0.03**	**0.01**
H1S1	0.26	0.29	0.24	0.24	0.27	0.27	0.26
H1S2	0.29	0.30	0.24	0.24	0.30	0.30	0.28
H1S3	0.31	0.33	0.26	0.25	0.32	0.32	0.30
H2S1	0.24	0.26	0.23	0.23	0.27	0.27	0.25
H2S2	0.26	0.29	0.24	0.24	0.30	0.30	0.27
H2S3	0.27	0.32	0.26	0.26	0.31	0.31	0.29
H3S1	0.23	0.26	0.23	0.23	0.27	0.27	0.25
H3S2	0.26	0.29	0.25	0.25	0.31	0.31	0.28
H3S3	0.30	0.31	0.26	0.26	0.31	0.31	0.29
H4S1	0.23	0.23	0.23	0.23	0.25	0.25	0.24
H4S2	0.24	0.24	0.25	0.25	0.27	0.27	0.25
H4S3	0.25	0.26	0.26	0.26	0.28	0.29	0.27
H5S1	0.21	0.26	0.23	0.23	0.27	0.27	0.25
H5S2	0.23	0.29	0.25	0.25	0.31	0.31	0.27
H5S3	0.28	0.31	0.26	0.26	0.31	0.31	0.29
CD	**0.02**	**0.02**	**0.01**	**0.01**	**0.02**	**0.02**	**0.01**
H1R1	0.28	0.31	0.25	0.25	0.30	0.30	0.28
H1R2	0.29	0.30	0.25	0.24	0.30	0.30	0.28
H2R1	0.24	0.29	0.23	0.23	0.29	0.29	0.26
H2R2	0.28	0.29	0.26	0.26	0.29	0.29	0.28
H3R1	0.27	0.28	0.24	0.23	0.29	0.30	0.27
H3R2	0.26	0.29	0.26	0.26	0.31	0.29	0.28
H4R1	0.22	0.23	0.24	0.24	0.26	0.27	0.24
H4R2	0.26	0.26	0.26	0.26	0.27	0.27	0.26
H5R1	0.24	0.28	0.24	0.23	0.29	0.30	0.26
H5R2	0.24	0.29	0.26	0.26	0.31	0.29	0.28
CD	**0.01**	**0.01**	**0.01**	**0.01**	**0.02**	**0.02**	**0.01**
S1R1	0.23	0.25	0.23	0.22	0.26	0.26	0.24
S1R2	0.24	0.26	0.23	0.23	0.27	0.27	0.25
S2R1	0.25	0.29	0.24	0.23	0.30	0.30	0.27
S2R2	0.26	0.28	0.26	0.26	0.30	0.29	0.28
S3R1	0.27	0.29	0.25	0.24	0.30	0.31	0.28
S3R2	0.30	0.31	0.27	0.27	0.31	0.31	0.30
CD	**0.02**	**0.02**	**0.02**	**0.01**	**0.02**	**0.02**	**0.02**

regard to spacing, wide spacing (0.29 gm) was significantly superior to medium spacing (0.27 gm) which was superior to close spacing (0.25 gm).

The thatched house H1 was most efficient in registering a higher shell weight (0.28 gm) for both the races, while the crossbreed had the same weight in all the houses except the RCC roof house (0.26 gm) where the bivoltine shell also had a lower weight (0.24 gm). This was most evident in bivoltine in October-November season (0.22 and 0.23 gm) than in other seasons.

Under close spacing the bivoltine and crossbreed had the least shell weight (0.25 and 0.27 respectively) and was significantly inferior to other two spacings. The crossbreed cocoons registered a higher shell weight than bivoltine. In all the five houses, invariably the wide spacing recorded higher shell weight (0.27 gm to 0.30 gm) and the H1 house was superior to others in respect of all the spacing. The least shell weight was in RCC roof house (S1 – 0.24, S2 – 0.25 and S3 – 0.27 gm) in contrast to the higher shell weight recorded in thatched house H1 (S1 – 0.26, S2 – 0.28 and S3 – 0.30 gm).

4.2.10 Shell ratio

The shell ratio (Table 34, Fig 2 and Fig 3) was highest in thatched house H1 (18.71) followed by RCC roof house (18.50) and thatched house H2 (18.08). Shell weight was least in tiled house (17.70) and was on par with light

Table 34 Effect of rearing house and larval spacing on **shell ratio** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	18.21	19.33	18.30	18.32	19.15	18.96	18.71
H2	18.13	19.14	17.72	18.08	17.42	17.99	18.08
H3	17.06	19.51	17.27	18.18	17.23	17.67	17.82
H4	16.89	19.33	18.30	18.27	19.15	19.07	18.50
H5	16.29	16.54	18.76	18.68	17.84	18.10	17.70
CD	**0.36**	**0.47**	**0.22**	**0.25**	**0.32**	**0.48**	**0.14**
S1	16.75	18.31	17.70	18.07	17.40	17.95	17.70
S2	17.11	18.78	18.10	18.42	18.47	18.60	18.25
S3	18.08	19.23	18.41	18.43	18.61	18.53	18.55
CD	**0.10**	**0.36**	**0.17**	**0.19**	**0.25**	**0.37**	**0.11**
H1S1	16.62	18.45	17.90	17.64	16.31	18.69	17.60
H1S2	17.93	19.51	18.32	18.48	19.76	19.47	18.91
H1S3	20.07	20.04	18.78	18.85	19.39	18.70	19.31
H2S1	17.49	19.33	18.24	18.80	16.77	17.38	18.00
H2S2	18.21	18.75	17.19	17.76	17.67	18.30	17.98
H2S3	18.69	19.34	17.73	17.67	17.83	18.31	18.26
H3S1	17.47	18.78	16.94	17.86	16.52	17.20	17.46
H3S2	17.17	19.83	17.32	18.33	17.33	17.89	17.98
H3S3	16.53	19.91	17.56	18.36	17.85	17.91	18.02
H4S1	15.88	18.45	17.80	17.64	18.31	18.70	17.80
H4S2	16.29	17.51	18.32	18.48	19.46	19.47	18.26
H4S3	18.51	20.04	18.78	18.70	19.39	19.03	19.08
H5S1	16.28	16.55	17.73	18.39	17.10	17.76	17.30
H5S2	15.97	16.28	19.37	19.07	17.87	17.85	17.74
H5S3	16.62	16.80	19.19	18.57	18.60	18.70	18.08
CD	**0.62**	**0.81**	**0.38**	**0.44**	-	-	**0.20**
H1R1	18.54	18.66	18.05	17.68	18.24	19.03	18.37
H1R2	17.81	20.00	18.56	18.96	20.07	18.89	19.05
H2R1	18.40	19.74	17.71	18.12	18.18	18.20	18.39
H2R2	17.86	18.55	17.73	18.04	16.67	17.32	17.71
H3R1	15.85	19.01	16.09	16.63	17.81	18.33	17.29
H3R2	18.27	20.01	18.45	19.74	16.66	17.00	18.36
H4R1	16.09	18.66	18.05	17.68	18.24	19.24	17.99
H4R2	17.70	20.00	18.56	18.86	20.07	18.89	19.01
H5R1	15.07	15.47	18.16	17.68	17.93	17.92	17.04
H5R2	17.50	17.62	19.37	19.71	17.76	18.29	18.38
CD	**0.18**	**0.66**	**0.38**	**0.36**	**0.45**	**0.68**	**0.25**
S1R1	16.27	17.62	17.39	17.38	17.36	18.08	17.35
S1R2	17.23	19.00	18.02	18.76	17.51	17.81	18.06
S2R1	16.60	18.69	17.60	17.59	18.55	19.37	18.07
S2R2	17.63	18.86	18.61	19.26	18.39	17.83	18.43
S3R1	17.50	18.62	17.84	17.69	18.38	18.47	18.08
S3R2	18.66	19.84	18.98	19.18	18.84	18.60	19.02
CD	-	**0.51**	**0.35**	-	-	**0.52**	**0.16**

roof house (17.83). The three spacings varied significantly in shell ratio and wide spacing recorded highest shell ratio (18.55) and the least in close spacing (17.20).

Of the two races, the crossbreed registered a higher shell ratio (19.05 and 19.01) in thatched house H1 and RCC roof house. The crossbreed was superior to bivoltine in all the houses and the least shell ratio was in tiled roof house (17.04 and 18.38).

The crossbreed cocoons spun under wide larval spacing had the highest shell ratio (19.02) and was significantly superior to other combinations. The bivoltine under close spacing recorded the least shell ratio (17.35). All other combinations were intermediate in effect. Of the combinations of houses and spacing wide spacing in thatched house H1 had higher shell ratio (19.31) than others followed by the same spacing in RCC roof house. The least shell ratio was in the tiled roof house under close spacing (17.30) and the same spacing was significantly inferior to other houses except light roof house (17.46)

4.2.11 Reelability

The reelability (Table 35) of the cocoons reared in thatched house H1 (70.03) was more followed by thatched house H2 and RCC roof houses (68.96). The light roof and tiled roof houses had the least value (65.83). The

Table 35 Effect of rearing house and larval spacing on **reelability** percentage of silk of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	66.67	65.00	70.83	71.00	73.33	73.33	70.03
H2	66.67	63.33	69.58	70.00	71.67	72.50	68.96
H3	65.00	62.50	64.17	63.33	70.00	70.00	65.83
H4	66.67	63.33	69.58	70.00	71.67	72.50	68.96
H5	65.00	62.50	64.17	63.33	70.00	70.00	65.83
CD	**0.76**	-	**1.86**	**2.02**	-	-	**0.50**
S1	64.25	61.50	66.25	64.35	69.00	69.00	65.73
S2	66.25	63.00	67.50	68.25	71.50	71.50	68.00
S3	67.50	65.50	69.25	70.00	73.50	74.50	70.04
CD	**0.59**	-	**1.44**	**1.57**	-	-	**0.40**
H1S1	66.25	62.50	68.75	66.75	70.00	70.00	67.38
H1S2	66.25	65.00	70.00	71.25	72.50	72.50	69.58
H1S3	67.50	67.50	73.75	75.00	77.50	77.50	73.13
H2S1	65.00	62.50	68.75	66.25	70.00	70.00	67.08
H2S2	67.50	62.50	70.00	71.25	72.50	72.50	69.38
H2S3	67.50	65.00	70.00	72.50	72.50	75.00	70.42
H3S1	62.50	60.00	62.50	61.25	67.50	67.50	63.54
H3S2	65.00	62.50	63.75	63.75	70.00	70.00	65.83
H3S3	67.50	65.00	66.25	65.00	72.50	72.50	68.13
H4S1	65.00	62.50	68.75	66.25	70.00	70.00	67.08
H4S2	67.50	62.50	70.00	71.25	70.00	70.00	68.54
H4S3	67.50	65.00	70.00	72.50	70.00	72.50	69.58
H5S1	62.50	60.00	62.50	61.25	72.50	70.00	64.79
H5S2	65.00	62.50	63.75	63.75	70.00	70.00	65.83
H5S3	67.50	65.00	66.25	65.00	72.50	72.50	68.13
CD	**1.32**	-	-	-	-	-	**0.65**
H1R1	63.33	61.67	70.00	70.33	71.67	70.00	67.83
H1R2	70.00	68.33	71.67	70.33	75.00	72.50	71.31
H2R1	63.33	61.67	69.17	68.33	70.00	77.50	68.33
H2R2	70.00	65.00	70.00	71.67	73.33	70.00	70.00
H3R1	61.67	61.67	62.50	62.50	66.67	72.50	64.59
H3R2	68.33	63.33	65.83	64.17	73.33	75.00	68.33
H4R1	63.33	61.67	69.17	68.33	70.00	67.50	66.67
H4R2	70.00	65.00	70.00	71.67	73.33	70.00	70.00
H5R1	61.67	61.67	62.50	62.50	66.67	72.50	64.59
H5R2	68.33	63.33	65.83	64.17	73.33	70.00	67.50
CD	-	-	-	-	-	-	**0.80**
S1R1	60.50	60.00	65.50	64.20	68.00	68.00	64.37
S1R2	68.00	63.00	67.00	64.50	70.00	70.00	67.08
S2R1	62.50	60.00	67.00	67.00	68.00	68.00	65.42
S2R2	70.00	66.00	68.00	69.50	75.00	75.00	70.58
S3R1	65.00	65.00	67.50	68.00	71.00	73.00	68.25
S3R2	70.00	66.00	71.00	72.00	76.00	76.00	71.83
CD	**0.83**	-	-	-	-	-	**0.50**

wide spacing could obtain higher reelability percentage (70.04) followed by middle (68.00) and close (65.73) spacings. The variations were not significant in May-July seasons in both the years.

The crossbreed cocoons recorded more reelability than bivoltine in all the types of houses. The thatched house H1 was more efficient for crossbreed and bivoltine (R1 – 69.83 and R2 – 71.31) followed by thatched house H2 (R1 – 68.33 and R2 - 70.00) and RCC roof house (R1 - 66.77 and R2 – 70.00). The least value (64.59) was recorded for bivoltine reared in light roof and tiled roof houses. The data in the different seasons were not having significant variations but for the mean values. Wide spacings in thatched house H1 recorded highest reelability (73.13) followed by thatched house H2 (70.42). For medium spacings also these two houses were superior to others. The least reelablity was recorded in light roof house under closer spacing. Except for October-November 1995 other seasons had no significant variations in reelability.

4.2.12 Filament length

The silk filament reeled out from samples of cocoons are presented in Table 36 and Fig 2. The length of silk filament reared in thatched houses H1 and H2 (808.82 meters) was higher than in RCC roof house (765.44 m). Light roof and tiled houses recorded the least value (761.32 meters).

Table 36 Effect of rearing house and larval spacing on **filament length of silk (meters)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	764.58	770.42	779.17	779.17	878.75	880.83	808.82
H2	764.58	770.42	779.17	779.17	878.75	880.83	808.82
H3	740.00	740.00	719.58	719.58	822.92	825.83	761.32
H4	743.33	743.33	724.17	722.92	825.58	833.33	765.44
H5	740.00	740.00	719.58	719.58	822.92	825.83	761.32
CD	**2.20**	**4.18**	**7.51**	**7.98**	**6.82**	**6.35**	**2.42**
S1	743.50	746.00	720.25	719.25	820.00	824.50	762.25
S2	749.00	751.50	733.50	734.00	827.50	832.00	771.25
S3	759.00	761.00	779.25	779.00	889.85	891.50	809.93
CD	**1.79**	**5.92**	**5.08**	**6.18**	**5.28**	**4.92**	**1.88**
H1S1	758.75	765.00	743.75	743.75	850.00	850.00	785.21
H1S2	762.50	768.75	760.00	760.00	855.00	860.00	794.38
H1S3	772.50	777.50	833.75	833.75	931.25	932.50	846.88
H2S1	758.75	765.00	743.75	743.75	850.00	850.00	785.21
H2S2	762.50	768.75	760.00	760.00	855.00	860.00	794.38
H2S3	772.50	777.50	833.75	833.75	931.25	932.50	846.88
H3S1	730.00	730.00	701.25	701.25	800.00	805.00	744.58
H3S2	740.00	740.00	715.00	715.00	807.50	810.00	754.58
H3S3	750.00	750.00	742.50	742.50	861.25	861.50	784.63
H4S1	740.00	740.00	711.25	706.25	800.00	812.50	751.67
H4S2	740.00	740.00	717.50	720.00	812.50	820.00	758.33
H4S3	750.00	750.00	743.75	742.50	864.25	867.50	786.33
H5S1	730.00	730.00	701.25	701.25	800.00	805.00	744.58
H5S2	740.00	740.00	715.00	715.00	807.00	810.00	754.50
H5S3	750.00	750.00	742.50	742.50	861.25	862.50	784.79
CD	**1.32**	**1.11**	**13.01**	**13.82**	**11.80**	**11.00**	**3.43**
H1R1	649.17	650.83	664.17	664.17	757.50	760.00	690.97
H1R2	880.00	890.00	894.17	894.17	1000.00	1001.67	926.67
H2R1	649.17	650.83	664.17	664.17	757.50	760.00	690.97
H2R2	880.00	890.00	894.17	894.17	1000.00	1001.67	926.67
H3R1	636.67	636.67	613.33	613.33	712.50	716.67	654.86
H3R2	843.33	843.33	825.83	825.83	933.33	935.00	867.78
H4R1	640.00	640.00	624.17	620.00	726.17	740.00	665.06
H4R2	846.67	846.67	824.17	825.83	925.00	926.67	865.84
H5R1	636.67	636.67	613.00	613.00	712.50	716.67	654.75
H5R2	843.33	843.33	825.83	825.83	933.33	935.00	867.78
CD	**2.20**	**5.92**	**10.62**	**11.28**	**9.64**	**8.98**	**4.19**
S1R1	636.00	638.00	620.50	618.50	720.00	729.00	660.33
S1R2	851.00	854.00	820.00	820.00	920.00	920.00	864.17
S2R1	647.00	641.00	631.00	631.00	735.00	739.00	670.67
S2R2	857.00	862.00	836.00	837.00	920.00	925.00	872.83
S3R1	650.00	650.00	656.00	655.50	744.70	748.00	684.03
S3R2	868.00	872.00	902.50	902.50	1035.00	1035.00	935.83
CD	**8.00**	**8.50**	**8.23**	**8.74**	**7.46**	**6.95**	**2.65**

The cocoons produced under wide spacing had more filament length (809.93 m) than in medium (771.25 m) and close spacings (762.75 m). The crossbreed silkworms registered highest filament length in thatched houses H1 and H2 (926.67 m) and were superior to other houses in which the filament length was on par with each other. The bivoltine had significantly low filament length in all the houses compared to crossbreed and the thatched houses recorded higher filament length among bivoltine.

The crossbreed worms reared under wide spacing had the highest filament length (935.83m). Middle spacing (872.83m) was inferior to wide spacing and superior to close spacing. The filament length in bivoltine cocoons was much less (684.03m) than in the crossbreed even under wide spacing and the least value was recorded under close spacing. The cocoons produced from larvae under wide spacing in the thatched houses H1 and H2 (846.88 m) had significantly higher filament length than others. The variations from spacing were not so pronounced in any other houses though in general the wider spacing had more filament length in all the houses.

4.2.13 ERR (By number)

The effective rearing rate by number computed for 10000 larvae are presented in Table 37 and Fig 2. The ERR was maximum in thatched house H1 (8397.22) followed by thatched house H2 (8196.11). The RCC roof house

Table 37 Effect of rearing house and larval spacing on **effective rearing rate (number)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	8333.33	8333.33	7950.00	7950.00	8908.33	8908.33	8397.22
H2	8133.33	8133.33	7750.00	7750.00	8709.17	8700.83	8196.11
H3	7766.67	7783.33	7066.67	7066.67	8350.00	8441.67	7745.83
H4	7941.67	7958.33	7275.00	7283.33	8433.33	8441.67	7880.89
H5	7766.67	7783.33	7066.67	7066.67	8350.00	8441.67	7745.83
CD	**24.35**	**11.16**	**92.09**	**116.99**	**60.93**	**58.95**	**27.76**
S1	7840.00	7810.00	7175.00	7215.00	8385.00	8435.00	7810.00
S2	7960.00	7965.00	7330.00	7330.00	8515.50	8560.50	7943.50
S3	8165.00	8220.00	7760.00	7725.00	8750.00	8765.00	8230.83
CD	**18.86**	**8.64**	**71.33**	**90.62**	**47.20**	**45.66**	**17.60**
H1S1	8200.00	8200.00	7700.00	7700.00	8750.00	8750.00	8216.67
H1S2	8300.00	8300.00	7800.00	7800.00	8850.00	8825.00	8312.50
H1S3	8500.00	8500.00	8350.00	8350.00	9125.00	9150.00	8662.50
H2S1	8000.00	8000.00	7500.00	7500.00	8550.00	8525.00	8012.50
H2S2	8100.00	8100.00	7600.00	7600.00	8652.50	8627.50	8113.33
H2S3	8300.00	8300.00	8150.00	8150.00	8925.00	8950.00	8462.50
H3S1	7600.00	7550.00	6800.00	6900.00	8175.00	8300.00	7554.17
H3S2	7750.00	7750.00	7000.00	7000.00	8325.00	8450.00	7712.50
H3S3	7950.00	8050.00	7400.00	7300.00	8550.00	8575.00	7970.83
H4S1	7800.00	7750.00	7075.00	7075.00	8275.00	8300.00	7712.50
H4S2	7900.00	7925.00	7250.00	7250.00	8425.00	8450.00	7866.67
H4S3	8125.00	8200.00	7500.00	7525.00	8600.00	8575.00	8087.50
H5S1	7600.00	7550.00	6800.00	6900.00	8175.00	8300.00	7554.17
H5S2	7750.00	77[illegible].00	7000.00	7000.00	8325.00	8450.00	7712.50
H5S3	7950.00	8050.00	7400.00	7300.00	8550.00	8575.00	7970.83
CD	**58.75**	**19.33**	**14.70**	**12.90**	**35.00**	**102.30**	**39.26**
H1R1	8100.00	8100.00	7500.00	7500.00	8633.33	8633.33	8077.78
H1R2	8566.67	8566.67	8400.00	8400.00	9183.33	9183.33	8716.67
H2R1	7900.00	7900.00	7300.00	7300.00	8433.33	8416.67	7875.00
H2R2	8366.67	8366.67	8200.00	8200.00	8985.00	8985.00	8517.22
H3R1	7433.33	7466.67	6500.00	6550.00	8050.00	8116.67	7352.78
H3R2	8100.00	8100.00	7633.00	7583.33	8650.00	8766.67	8138.83
H4R1	7633.33	7650.00	6766.67	6766.67	8216.67	8116.67	7525.00
H4R2	8250.00	8266.67	7783.37	7800.00	8650.00	8766.67	8252.79
H5R1	7433.33	7466.67	6500.00	6550.00	8050.00	8116.67	7352.78
H5R2	8100.00	8100.00	7633.33	7583.33	8650.00	8766.67	8138.89
CD	**34.44**	**15.78**	**130.23**	**40.50**	**35.60**	**105.50**	**48.08**
S1R1	7580.00	7580.00	6680.00	6740.00	8170.00	8210.00	7493.33
S1R2	8100.00	8040.00	7670.00	7690.00	8600.00	8660.00	8126.67
S2R1	7640.00	7630.00	6880.00	6880.00	8240.00	8260.00	7588.33
S2R2	8280.00	8300.00	7780.00	7780.00	8791.00	8861.00	8298.67
S3R1	7880.00	7940.00	7180.00	7180.00	8420.00	8370.00	7828.33
S3R2	8450.00	8500.00	8340.00	8270.00	9080.00	9160.00	8633.33
CD	**26.68**	**12.22**	**100.83**	**34.93**	**66.74**	**64.58**	**30.41**

(7880.89) was next in order. Light roof and tiled houses recorded the least ERR. Larvae under wide spacing had higher ERR (8230.83) than in medium (7943.50) and close (7810.00) spacings.

The crossbreed larvae invariably had higher ERR in all the five types of houses and the highest value was in the thatched house H1 (8716.78) followed by H2 (8517.22), RCC roof (8252.79) and light roof and tiled roof (8138.89) houses. Bivoltine had low ERR compared to crossbreed. For bivoltine also the most favourable house was thatched house H1 (8077.78) followed by H2 (7875.00). For crossbreed and bivoltine wide spacing caused a higher ERR than other spacings (S3R1 – 7828.33 and S3R2 – 8633.33). Crossbreed had higher ERR than bivoltine and more the spacing ERR was higher significantly. Regarding the spacing of larvae in different houses, wide spacing in thatched house H1 had higher ERR (H1S3-8662.50) followed by H2 (H2S3 – 8462.50). The least ERR was in close spacings in light roof and tiled houses (H3S1 – 7554.17 and H5S5 – 7554.10) which were on par.

4.2.14 ERR (by weight)

Effective rearing rate (by weight) computed is presented in Table 38. Of the five types of houses ERR by weight was highest in tiled house H1 (13059.00 gm) followed by H2 (12476.00) and RCC house (11567.00). Light roof and tiled houses were having least value (11240.00). Larvae recorded

Table 38 Effect of rearing house and larval spacing on **effective rearing rate (weight in gm)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	12947.67	12947.67	11450.17	10825.83	15091.67	15091.67	13059.00
H2	12515.00	12515.00	10733.50	10825.33	14183.33	14086.75	12476.00
H3	11259.17	11289.83	9478.67	9421.75	12967.25	13028.00	11240.00
H4	11459.17	11489.83	10120.33	10104.92	13159.00	13072.33	11567.00
H5	11259.17	11289.83	9478.67	9421.75	12967.25	13028.00	11240.00
CD	**9.74**	**13.34**	**122.68**	**124.32**	**90.60**	**209.71**	**46.08**
S1	11113.10	11072.60	9497.50	10016.50	12666.85	12647.85	11059.00
S2	11847.00	11844.00	10247.20	10162.50	13643.10	13653.20	11899.00
S3	12704.00	12802.70	11012.10	10837.70	14711.15	14683.00	12791.00
CD	**7.55**	**10.33**	**95.03**	**96.29**	**70.18**	**162.44**	**35.67**
H1S1	11888.00	11888.00	10660.00	10010.00	14125.00	14125.00	12116.00
H1S2	12920.00	12920.00	11620.50	10910.00	14900.00	14900.00	13028.42
H1S3	14035.00	14035.00	12070.00	11556.00	16250.00	16250.00	14032.67
H2S1	11850.00	11850.00	10010.00	10010.00	13400.00	13342.00	11743.67
H2S2	12555.00	12555.00	10620.50	10910.00	13400.00	13691.00	12288.58
H2S3	13140.00	13140.00	11570.00	11556.00	15250.00	15226.75	13313.79
H3S1	10442.00	10375.00	8747.50	8733.75	11769.50	11915.75	10330.58
H3S2	11220.00	11215.00	9415.00	9400.00	13113.50	13191.50	11259.17
H3S3	12115.00	12279.50	10273.50	10131.50	14018.50	13976.75	12132.46
H4S1	10942.50	10875.00	9322.50	9308.75	12269.75	11940.75	10776.54
H4S2	11320.00	11315.00	10165.00	10192.50	13188.50	13291.50	11578.75
H4S3	12115.00	12279.50	10873.50	10813.50	14018.75	13984.75	12347.50
H5S1	10442.50	10375.00	8747.50	8733.75	11769.75	11915.75	10330.71
H5S2	11220.00	11215.00	9415.00	9400.00	13113.50	13191.50	11259.17
H5S3	12115.00	12279.50	10273.50	10131.50	14018.50	13976.75	12132.46
CD	**16.87**	**23.10**	**19.60**	**72.00**	**156.92**	**363.23**	**65.16**
H1R1	12178.67	12178.67	11129.00	10170.67	14133.33	14133.33	13028.00
H1R2	13716.67	13716.67	11771.33	11480.00	16050.00	16050.00	14032.00
H2R1	11793.33	11793.33	10129.00	10170.67	13316.67	12965.67	12372.00
H2R2	13236.67	13236.67	11338.00	11480.00	15050.00	15207.83	13313.00
H3R1	11033.33	11093.00	8466.67	8519.17	12539.17	12681.50	11259.00
H3R2	11485.00	11486.67	10490.67	10324.33	13395.33	13374.50	12132.00
H4R1	11433.33	11493.00	9366.67	9369.17	12872.50	12681.50	11578.00
H4R2	11485.00	11486.67	10874.00	10840.67	13445.50	13463.17	12347.00
H5R1	11033.33	11093.00	8466.67	8519.17	12539.17	12681.50	11259.00
H5R2	11485.00	11486.67	10490.67	10324.33	13395.33	13374.50	12132.00
CD	**13.78**	**18.86**	**173.50**	**175.81**	**128.12**	**296.58**	**79.81**
S1R1	10787.20	10787.20	8885.00	8741.50	12186.50	12220.50	10601.00
S1R2	11516.00	11358.00	10110.00	9977.00	13147.20	13075.20	11517.00
S2R1	12180.00	11516.00	9568.00	9414.00	12976.00	12993.60	11330.00
S2R2	11439.00	12172.00	10926.00	10911.00	14310.20	14312.80	12468.00
S3R1	12178.00	12287.40	10081.40	9893.80	14078.00	13872.00	12065.00
S3R2	13228.00	13318.00	11942.80	11781.60	15344.30	15494.00	13518.00
CD	**10.67**	**14.61**	**134.39**	**136.18**	**99.24**	**22973.00**	**50.48**

under wide spacings had the higher ERR by weight (12791.00) followed by medium spacing (11899.00) and closer spacing (11059.00 gm)

The crossbreed larvae reared in thatched house had highest ERR by weight (14032.00 gm) followed by H2 (13313.00 gm). In all the house types CB had higher ERR. But the bivoltine larvae reared in thatched house H1 has registered higher ERR by weight than crossbreed reared in H3, H4 and H5 type of houses. The thatched house H1 was superior to other houses for crossbreed and bivoltine alike.

Regarding the combinations of house and spacing, crossbreed reared under wide spacing had higher ERR (13518.00 gm) followed by medium spacing (12468.00 gm) which was still superior to bivoltine under wide spacing (12065.00). Bivoltine under close spacing had the least ERR by weight. The larvae reared with the combination of wide spacing and thatched house H1 had the highest ERR (14032.67) followed by combinations of wide spacing and thatched house H2 (13313.79). The medium spacing in house H1 (13028.42) was superior to all other house types. The closer spacing in light roof and tiled roof houses had least value (H3S1 – 10330.58 and H5S1 – 10330.71).

4.2.15 Disease incidence

The percentage incidence of flacherie and grasserie observed in different treatments are presented in Table 39.

4.2.15.1 Flacherie

There was no significant variation between the different houses in the incidence of flacherie in any of the seasons and mean value of percentage incidence was 2.58 in all the types of houses. Regarding spacing also there was no significant variation though the incidence was 2.42 under wider spacing and 2.67 under other spacings. The data did not show any significant variation in the different treatment combinations.

4.2.15 .2 Grasserie

The incidence was significantly less in thatched houses H1 and and H2 (2.28) compared to the other three types of rearing houses (3.56). The percentage of grasserie gradually declined from close spacing to wide spacing in the order of 3.18 to 2.87 and each spacing differed significantly from the other. The crossbreed reared in thatched house H1 and H2 had the lowest incidence (2.00) compared to other rearing houses (2.78).

Table 39 Effect of rearing house and larval spacing on percentage incidence of diseases of bivoltine and crossbreed silkworms during stress seasons

Flacherie

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	2.50	2.50	3.33	3.50	1.83	1.83	2.58
H2	2.50	2.50	3.33	3.50	1.83	1.83	2.58
H3	2.50	2.50	3.33	3.50	1.83	1.83	2.58
H4	2.50	2.50	3.33	3.50	1.83	1.83	2.58
H5	2.50	2.50	3.33	3.50	1.83	1.83	2.58
CD	-	-	-	-	-	-	-

Grasserie

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
H1	2.00	2.00	3.33	3.33	1.50	1.50	2.28
H2	2.00	2.00	3.33	3.33	1.50	1.50	2.28
H3	3.33	3.33	5.00	5.00	2.33	2.33	3.56
H4	3.33	3.33	5.00	5.00	2.33	2.33	3.56
H5	3.33	3.33	5.00	5.00	2.33	2.33	3.56
CD	0.13	0.13	0.26	0.26	0.20	0.20	0.04
S1	2.90	2.90	4.55	4.55	4.55	2.10	3.18
S2	2.90	2.90	4.40	4.40	4.40	1.95	3.08
S3	2.60	2.60	4.05	4.05	4.05	1.95	2.87
CD	0.01	0.01	0.20	0.20	0.10	0.10	0.05
H1S1	2.00	2.00	3.50	3.50	1.50	2.00	2.42
H1S2	2.00	2.00	3.50	3.50	1.50	2.00	2.42
H1S3	2.00	2.00	3.00	3.00	1.50	1.50	2.17
H2S1	2.00	2.00	3.50	3.50	1.50	2.00	2.42
H2S2	2.00	2.00	3.50	3.50	1.50	2.00	2.42
H2S3	2.00	2.00	3.00	3.00	1.50	1.50	2.17
H3S1	3.50	3.50	5.25	5.25	2.50	2.00	3.67
H3S2	3.50	3.50	5.00	5.00	2.25	2.00	3.54
H3S3	3.00	3.00	4.75	4.75	2.25	1.50	3.21
H4S1	3.50	3.50	5.25	5.25	2.50	2.00	3.67
H4S2	3.50	3.50	5.00	5.00	2.25	2.00	3.54
H4S3	3.00	3.00	4.75	4.75	2.25	2.00	3.29
H5S1	3.50	3.50	5.25	5.25	2.50	2.00	3.67
H5S2	3.50	3.50	5.00	5.00	2.25	2.00	3.54
H5S3	3.00	3.00	4.75	4.75	2.25	1.00	3.13
CD	-	-	0.25	0.25	0.25	-	0.12
H1R1	2.00	2.00	4.00	4.00	2.00	2.00	2.67
H1R2	2.00	2.00	2.67	2.67	1.00	1.67	2.00
H2R1	2.00	2.00	4.00	4.00	2.00	2.00	2.67
H2R2	2.00	2.00	2.67	2.67	1.00	1.67	2.00
H3R1	4.00	4.00	6.00	6.00	3.00	2.00	4.17
H3R2	2.67	2.67	4.00	4.00	1.67	1.67	2.78
H4R1	4.00	4.00	6.00	6.00	3.00	2.00	4.17
H4R2	2.67	2.67	4.00	4.00	1.67	1.67	2.78
H5R1	4.00	4.00	6.00	6.00	3.00	2.00	4.17
H5R2	2.67	2.67	4.00	4.00	1.67	1.67	2.78
CD	-	-	0.37	0.37	-	-	0.15
S1R1	3.20	3.20	5.20	5.20	2.60	2.00	3.57
S1R2	2.60	2.60	3.90	3.90	1.60	2.00	2.77
S2R1	3.20	3.20	5.20	5.20	2.60	2.00	3.57
S2R2	2.60	2.60	3.60	3.60	1.30	2.00	2.62
S3R1	3.20	3.20	5.20	5.20	2.60	2.00	3.57
S3R2	2.00	2.00	2.90	2.90	1.30	1.00	2.02
CD	-	-	0.29	0.29	-	-	0.02

The bivoltine recorded a higher rate of incidence (2.67) than crossbreed in thatched houses and in other houses (4.17). The crossbreed under wide spacing registered lower incidence (2.02) compared to other spacings. Bivoltine in all the three spacings registered the same percentage of 3.57. The larvae reared under wide spacing in thatched houses H1 and H2 recorded an incidence (2.17) lower to other spacings and houses. The medium and closer spacings had the same effect (2.42) in these two houses. The other treatment combinations recorded significantly high percentage of incidence ranging from 3.13 and 3.67

4.3 Manipulation of feeding schedule with reference to seasons and types of rearing houses

The results of this experiment conducted for six seasons are presented in the Tables 40-66.

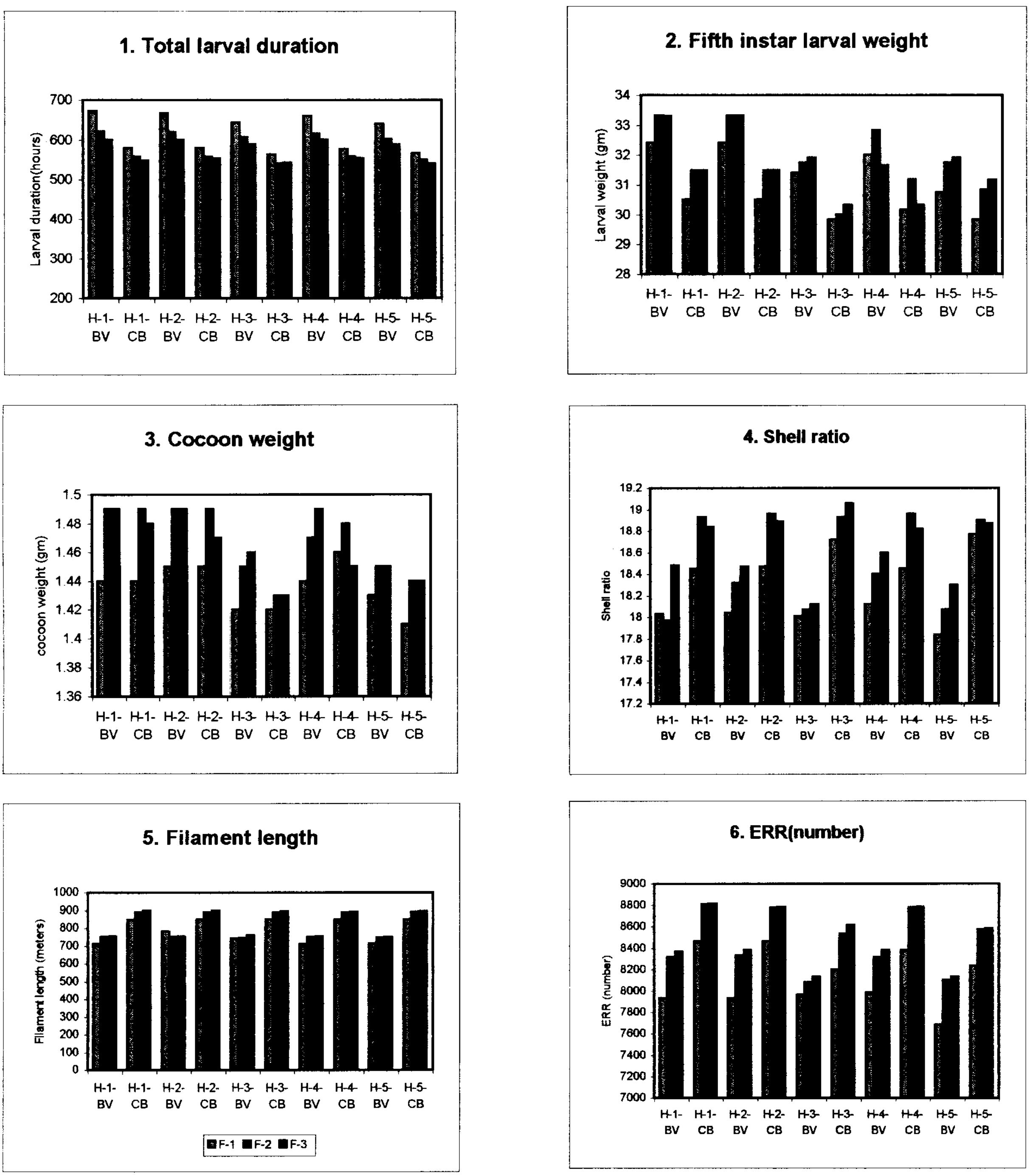
4.3.1 Total larval duration

The total larval duration of the bivoltine (NB_4D_2) and crossbreed ($PMxNB_4D_2$) reared under different feeding frequencies are given in Table 40 and Fig 4 (Appendix VI). Two feedings a day had resulted in the prolongation of the duration to 616.98 hours compared to 584.07 hours under three feedings and 571.72 hours in four feedings. But in February-April season the three feedings and four feedings were on par. Of the combinations of frequencies and races, bivoltine recorded significantly higher larval duration of 640.47 hours

Table 40 Influence of feeding frequency on the **total larval duration (hours)** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	650.95	666.55	595.90	610.00	589.50	589.00	616.98
F2	612.70	623.50	562.70	568.80	568.35	568.35	584.07
F3	589.40	599.20	563.65	568.45	554.80	554.80	571.72
CD	**10.13**	**4.36**	**3.96**	**5.27**	**4.83**	**4.83**	**1.89**
F1R1	697.50	708.40	644.80	649.90	571.10	571.10	640.47
F1R2	604.40	612.70	547.00	552.10	501.90	501.90	553.33
F2R1	650.40	667.00	589.00	596.00	529.60	539.67	595.28
F2R2	575.00	580.00	534.40	541.60	507.10	507.10	540.87
F3R1	614.90	627.20	589.20	595.80	547.80	547.00	586.98
F3R2	563.90	591.20	568.10	561.10	534.80	534.80	558.98
CD	**14.33**	**6.16**	**5.60**	**7.45**	**6.84**	**6.54**	**2.32**
H1F1	657.50	670.00	608.50	613.25	596.50	596.50	623.71
H1F2	619.75	630.50	568.00	575.00	537.25	537.25	577.96
H1F3	589.25	602.25	569.75	575.00	550.00	556.00	573.71
H2F1	659.00	669.75	607.25	613.20	546.00	546.50	606.95
H2F2	618.75	628.50	568.00	573.25	527.75	527.00	573.88
H2F3	588.75	604.25	569.75	574.25	547.25	547.00	571.88
H3F1	643.00	645.50	583.25	586.75	550.00	580.00	598.08
H3F2	610.50	614.00	654.50	563.75	526.50	533.20	583.74
H3F3	585.50	590.50	556.50	561.25	542.25	542.25	563.04
H4F1	659.00	669.75	595.50	602.00	571.00	571.75	611.5
H4F2	612.50	630.75	568.25	572.25	569.75	569.75	587.21
H4F3	605.25	605.75	566.75	570.75	558.25	558.00	577.46
H5F1	636.25	647.75	583.00	589.50	572.75	572.00	600.21
H5F2	602.00	613.75	554.75	559.75	534.50	543.50	568.04
H5F3	578.25	593.20	555.50	560.00	540.00	539.00	560.99
CD	**4.70**	**9.00**	**12.60**	**8.40**	**4.30**	**4.30**	**5.18**

Fig 4 Influence of feeding frequency on yield and quality parameters of silkworm rearing in different types of rearing houses



H1-Thatched house & mudbrick wall H2-Thatched house & burntbrick wall
H3-Light roof house & mudbrick wall H4-RCC roof house & burntbrick wall
H5-Tiled roof & burnt brick wall CB-PMxNB4D2 BV-NB4D2
F1-2 feeds/ day ; F2-3 feeds/ day ; F3- 4 feeds/ day

under two feedings, 595.28 under three feedings and 586.98 under four feedings. For the crossbreed, values were 553.33, 540.87 and 558.98 hours for the three frequencies respectively.

It may be noted that the four feedings had a low duration than others. With regard to the combinations of the different housing and feeding frequencies in all the types of rearing houses, two feedings has resulted in longer duration. The longest duration was in the thatched roof house H1 with 623.71 hours followed by RCC roof house (611.50 hours) and thatched roof house H2 which were on par. In the thatched roof houses H1 and H2, two feedings and three feedings were on par and in others three feedings registered longer duration than the four feedings.

4.3.2 Total moulting duration

The total duration taken for the four moultings are presented in Table 41. The moulting duration was longer in the treatment with two feedings irrespective of the seasons and was least under four feedings. The mean moulting duration ranged from 97.32 to 90.35 hours. The different combinations of frequency and races were not having significant difference in any of the seasons but the mean values registered significant variation. The bivoltine with two feedings a day had the longest duration of 100.47 followed by three feedings and four feedings a day.

Table 41 Influence of feeding frequency on the **total moulting duration (hours)** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	106.90	106.90	98.25	98.25	86.80	86.80	97.32
F2	104.45	104.45	90.00	90.00	82.75	82.75	92.40
F3	99.10	99.10	89.55	89.55	82.40	82.40	90.35
CD	**1.83**	**1.83**	**0.50**	**0.50**	**1.80**	**1.80**	**0.85**
F1R1	111.90	111.90	100.80	100.80	88.70	88.70	100.47
F1R2	101.90	101.90	95.70	95.70	84.90	84.90	94.17
F2R1	109.50	109.50	92.40	92.40	84.30	84.30	95.40
F2R2	99.40	99.40	87.60	87.60	81.20	81.20	89.40
F3R1	103.90	103.90	91.50	91.50	82.90	82.90	92.77
F3R2	94.30	94.30	87.60	87.60	81.90	81.90	87.93
CD	-	-	-	-	-	-	**0.94**
H1F1	109.00	109.00	98.75	98.75	87.25	87.25	98.33
H1F2	107.00	107.00	90.75	90.75	82.75	82.75	93.50
H1F3	100.75	100.75	89.75	89.75	81.75	81.75	90.75
H2F1	109.00	109.00	98.50	98.50	87.25	87.25	98.25
H2F2	105.75	105.75	90.00	90.00	82.75	82.75	92.83
H2F3	100.25	100.25	89.75	89.75	82.50	82.50	90.83
H3F1	104.25	104.25	97.75	97.75	86.50	86.50	96.17
H3F2	101.75	101.75	89.00	89.00	82.75	82.75	91.17
H3F3	97.00	97.00	89.00	89.00	82.50	82.50	89.50
H4F1	107.25	107.25	98.50	98.50	86.50	86.50	97.42
H4F2	105.25	105.25	90.75	90.75	82.75	82.75	92.92
H4F3	100.00	100.00	89.75	89.75	82.75	82.75	90.83
H5F1	105.00	105.00	97.75	97.75	86.50	86.50	96.42
H5F2	102.50	102.50	89.50	89.50	82.75	82.75	91.58
H5F3	97.50	97.50	89.50	89.50	82.50	82.50	89.83
CD	-	-	-	-	-	-	**1.49**

The crossbreed recorded 94.17, 89.40 and 87.93 for the corresponding frequencies respectively. The combinations of house type and feeding frequencies, the two feedings in thatched houses H1 (98.33) and H2 (98.25) and RCC roof house (97.42) the durations were longer and on par. The three feedings and four feedings had longer duration of 93.50, 92.83 and 92.92 compared to the shorter durations obtained under four feedings a day. The light roof house and tiled house had a comparatively shorter duration under all the frequencies than the above houses. However the variation was not significant in any of the seasons but for the mean values.

4.3.3 Larval weight of different instars

Results on the weight of different larval instars under the various treatments are presented in Tables 42 - 46.

4.3.3.1 First instar

The larval weight in February-April season alone were having statistical significance and the four feeding schedule registered higher larval weight (0.068 gm/10 larvae) than the other two schedules. Regarding the combinations of feeding schedules in races except the crossbreed fed two times a day, the others were on par and the larval weight ranged from 0.067 to 0.078. Of the combinations of housing types and feeding schedules, the thatched houses H2 and H1 with four feedings a day registered the highest weights of 0.080 and 0.082 gm respectively. The least value (0.061) was recorded in the tiled roof

Table 42 Influence of feeding frequency on the **larval weight of 1st instar (gms/10worms)** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	0.084	0.084	0.065	0.066	0.077	0.078	0.076
F2	0.085	0.085	0.066	0.066	0.077	0.078	0.076
F3	0.085	0.085	0.068	0.068	0.078	0.078	0.077
CD	**0.001**	**0.001**	**0.001**	**0.001**	**0.002**	**0.002**	**0.001**
F1R1	0.084	0.084	0.066	0.066	0.064	0.065	0.072
F1R2	0.084	0.084	0.061	0.061	0.050	0.052	0.065
F2R1	0.085	0.085	0.069	0.069	0.076	0.083	0.078
F2R2	0.085	0.085	0.056	0.056	0.058	0.062	0.067
F3R1	0.085	0.085	0.052	0.052	0.059	0.069	0.067
F3R2	0.085	0.085	0.063	0.063	0.070	0.073	0.073
CD	-	-	**0.002**	**0.002**	**0.003**	**0.003**	**0.003**
H1F1	0.085	0.085	0.058	0.058	0.068	0.068	0.070
H1F2	0.085	0.085	0.061	0.061	0.080	0.080	0.075
H1F3	0.085	0.085	0.062	0.062	0.094	0.094	0.080
H2F1	0.084	0.084	0.065	0.065	0.068	0.068	0.072
H2F2	0.085	0.085	0.067	0.067	0.080	0.080	0.077
H2F3	0.086	0.086	0.065	0.065	0.094	0.094	0.082
H3F1	0.084	0.084	0.051	0.051	0.045	0.048	0.061
H3F2	0.084	0.084	0.056	0.056	0.053	0.065	0.066
H3F3	0.085	0.085	0.061	0.061	0.073	0.080	0.074
H4F1	0.084	0.084	0.061	0.061	0.058	0.058	0.068
H4F2	0.085	0.085	0.058	0.058	0.070	0.072	0.071
H4F3	0.086	0.086	0.055	0.055	0.084	0.084	0.075
H5F1	0.084	0.084	0.051	0.051	0.045	0.048	0.061
H5F2	0.084	0.084	0.056	0.056	0.053	0.065	0.066
H5F3	0.085	0.085	0.051	0.051	0.073	0.080	0.071
	-	-	**0.003**	**0.003**	**0.003**	**0.004**	**0.002**

and light roof houses under two feeding schedule. The others were having intermediate values ranging from 0.066 to 0.075.

4.3.3.2 Second instar

The influence of different feeding schedule on the weight of the second instar larvae was negligible as the data were not statistically significant. Regarding the effect of feeding schedule on races, only the mean data were having significant variation in any of the seasons or mean values as the larval weight ranged from 0.29 to 0.32 gm. Of the combinations of housing types and feeding schedules, the thatched houses H2 and H1 with four feedings a day registered the highest weight of 0.33 and 0.32 gm respectively.

4.3.3.3 Third instar

Regarding the combinations bivoltine with four feedings registered significantly the highest larval weight (1.66 gm) followed by bivoltine with three feedings (1.50 gm) and crossbreed with four feedings (1.45 gm) which were on par. It is interesting to note that the bivoltine with two feeding schedule (1.39) was on par with crossbreed with four feeding schedule (1.45 gm). The other combinations were having the least value. Of the combination of houses and feeding schedule, the four feedings in thatched houses H1 and H2 resulted in a higher larval weight of 1.78 and 1.72 gm respectively. The three and two feeding schedules in thatched house H1 were superior to the

Table 43 Effect of rearing house and larval spacing on **larval weight of II^nd instar (gms/10 worms)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	0.31	0.29	0.28	0.27	0.32	0.32	0.30
F2	0.31	0.30	0.28	0.28	0.32	0.32	0.30
F3	0.32	0.31	0.29	0.29	0.33	0.33	0.31
CD	-	-	-	-	-	-	-
F1R1	0.30	0.31	0.28	0.27	0.32	0.32	0.30
F1R2	0.29	0.30	0.28	0.26	0.30	0.30	0.29
F2R1	0.31	0.31	0.28	0.28	0.33	0.33	0.31
F2R2	0.30	0.31	0.28	0.28	0.31	0.31	0.30
F3R1	0.32	0.32	0.29	0.29	0.34	0.34	0.32
F3R2	0.31	0.32	0.27	0.29	0.33	0.33	0.31
CD	-	-	-	-	-	-	**0.18**
H1F1	0.32	0.32	0.28	0.27	0.32	0.32	0.31
H1F2	0.33	0.33	0.28	0.28	0.33	0.33	0.31
H1F3	0.34	0.34	0.30	0.30	0.34	0.34	0.33
H2F1	0.30	0.32	0.28	0.28	0.32	0.32	0.30
H2F2	0.31	0.33	0.28	0.29	0.33	0.33	0.31
H2F3	0.32	0.34	0.30	0.30	0.34	0.34	0.32
H3F1	0.29	0.31	0.28	0.26	0.31	0.30	0.29
H3F2	0.30	0.31	0.28	0.28	0.32	0.31	0.30
H3F3	0.30	0.32	0.29	0.29	0.33	0.33	0.31
H4F1	0.29	0.29	0.28	0.28	0.30	0.31	0.29
H4F2	0.30	0.30	0.28	0.29	0.32	0.32	0.30
H4F3	0.31	0.30	0.30	0.30	0.33	0.33	0.31
H5F1	0.29	0.29	0.28	0.26	0.31	0.30	0.29
H5F2	0.30	0.30	0.28	0.28	0.32	0.31	0.30
H5F3	0.30	0.31	0.29	0.29	0.33	0.33	0.31
CD	-	-	-	-	-	-	-

Table 44 Effect of rearing house and larval spacing on **larval weight of III rd instar (gm/10 worms)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	1.58	1.58	1.33	1.42	1.55	1.47	1.47
F2	1.59	1.59	1.38	1.38	1.55	1.47	1.49
F3	1.61	1.60	1.44	1.40	1.60	1.52	1.53
CD	**0.03**	**0.02**	**0.06**	**0.04**	**0.05**	**0.05**	**0.07**
F1R1	1.38	1.38	1.24	1.21	1.54	1.56	1.39
F1R2	1.33	1.00	1.03	1.02	1.43	1.46	1.21
F2R1	1.50	1.48	1.40	1.41	2.10	1.11	1.50
F2R2	1.44	1.41	1.15	1.15	2.01	.03	1.20
F3R1	1.62	1.79	1.60	1.50	1.72	1.70	1.66
F3R2	1.60	1.58	1.27	1.23	1.48	1.54	1.45
CD	**-**	**0.08**	**-**	**0.06**	**0.07**	**-**	**0.07**
H1F1	1.73	1.38	1.27	1.58	1.61	1.61	1.53
H1F2	1.52	1.90	1.44	1.48	1.58	1.58	1.58
H1F3	1.74	1.67	1.65	1.57	2.01	2.01	1.78
H2F1	1.34	1.33	1.13	1.43	1.61	1.61	1.41
H2F2	1.40	1.55	1.28	1.48	1.48	1.28	1.41
H2F3	1.60	1.84	1.43	1.43	2.01	2.01	1.72
H3F1	1.35	1.13	1.06	1.06	1.36	1.44	1.23
H3F2	1.51	1.25	1.25	1.24	1.38	1.88	1.42
H3F3	1.58	1.38	1.34	1.33	1.51	1.48	1.44
H4F1	1.34	1.24	1.13	1.13	1.46	1.46	1.29
H4F2	1.40	1.28	1.18	1.18	1.50	1.55	1.35
H4F3	1.60	1.54	1.43	1.38	1.56	1.55	1.51
H5F1	1.34	1.13	1.09	1.09	1.56	1.44	1.27
H5F2	1.46	1.25	1.25	1.24	1.85	1.88	1.49
H5S3	1.53	1.38	1.34	1.33	1.41	1.48	1.41
CD	**0.07**	**0.12**	**-**	**-**	**0.12**	**0.15**	**0.10**

same schedules in other house types. The least value was recorded in the light roof and tiled roof houses under the two feeding schedule (1.23 and 1.27 respectively).

4.3.3.4 Fourth instar

The larval weight of fourth instar are given in Table 45. The feeding schedules of four and three feeding registered higher larval weight (11.34 and 11.03) compared to two feeding schedule (10.81). Regarding the combinations of feeding schedule and races bivoltine fed four times a day had 12.07 gm and was superior to all other combinations followed by crossbreed under the same schedule of feeding (11.61). Three feedings a day registered higher weights than two feeding schedule. Regarding the influence of house types and feeding schedules, the thatched house H1 and H2 with the four feeding schedule resulted in significantly higher larval weight (12.21 and 11.91 respectively) than the other combinations. The least weight was recorded in the RCC roof, light roof and tiled roof houses under the two feeding schedule.

4.3.3.5 Fifth instar

The results presented in Table 46 and Fig 4 regarding the combinations of races and feeding schedule, the data were not significant in most seasons but mean values varied significantly. The highest larval weight was recorded in bivoltine (32.60) fed four times or three times a day. The crossbreed had a significantly less weight compared to bivoltine irrespective of feeding

Table 45 Effect of rearing house and larval spacing on **larval weight of IVth instar (gm/10 worms)** of bivoltine and crossbreed silkworms during stress seasons

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	11.52	10.65	10.50	9.41	11.55	11.25	10.81
F2	11.69	10.75	10.55	10.00	11.62	11.55	11.03
F3	12.10	10.88	10.95	10.65	11.74	11.69	11.34
CD	**0.58**	**0.36**	**0.14**	**0.19**	**0.20**	**0.47**	**0.32**
F1R1	11.09	10.90	9.95	10.02	11.50	11.50	10.83
F1R2	11.15	10.40	9.20	10.22	11.00	11.00	10.50
F2R1	11.49	10.95	10.60	10.00	12.15	12.31	11.25
F2R2	11.00	10.95	10.10	9.20	11.49	11.59	10.72
F3R1	12.48	12.40	11.30	10.10	13.02	13.12	12.07
F3R2	12.60	11.75	10.60	10.40	12.05	12.25	11.61
CD	-	-	-	**0.09**	**0.14**	**0.38**	**0.20**
H1F1	11.53	11.00	10.13	10.25	11.25	11.25	10.90
H1F2	11.94	11.25	10.75	10.75	11.63	11.63	11.33
H1F3	12.94	13.00	11.25	11.25	12.40	12.40	12.21
H2F1	11.38	11.25	9.50	9.40	11.25	11.25	10.67
H2F2	12.14	11.38	10.50	10.00	11.63	11.63	11.21
H2f3	12.75	12.38	11.00	10.50	12.40	12.40	11.91
H3F1	11.06	10.25	9.50	9.50	11.25	11.25	10.47
H3F2	12.06	10.63	10.25	10.00	12.13	12.43	11.25
H3F3	12.88	11.25	10.88	10.50	12.75	13.13	11.90
H4F1	10.69	10.50	9.25	9.40	11.25	11.33	10.40
H4F2	10.26	10.88	10.00	10.00	11.58	11.63	10.73
H4F3	11.88	12.00	10.75	10.50	12.38	12.38	11.65
H5F1	10.94	10.25	9.50	9.50	11.25	11.25	10.45
H5F2	11.50	10.63	10.25	10.00	12.13	12.43	11.16
H5F3	12.25	11.25	10.88	10.50	12.75	13.13	11.79
CD	-	-	-	-	**0.22**	**0.38**	**0.30**

Table 46 Influence of feeding frequency on the **larval weight of v[th] instar (gms/10worms)** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	32.65	32.70	27.80	27.80	33.00	33.00	31.62
F2	32.70	32.70	29.20	29.20	33.25	33.25	31.72
F3	32.70	32.70	29.45	29.45	33.45	33.45	31.87
CD	-	-	**0.95**	**0.95**	**0.53**	**0.53**	**0.25**
F1R1	33.40	33.50	28.30	28.30	34.10	34.10	31.95
F1R2	31.90	31.90	27.30	27.30	31.30	31.30	30.17
F2R1	33.50	33.50	29.90	29.90	34.40	34.40	32.60
F2R2	31.90	31.90	28.50	28.50	32.10	32.10	30.83
F3R1	33.50	33.50	29.90	29.90	34.40	34.40	32.60
F3R2	31.90	31.90	29.00	29.00	32.50	32.50	31.13
CD	-	-	-	-	-	-	**0.43**
H1F1	33.38	33.50	28.00	28.00	33.00	33.00	31.48
H1F2	33.50	33.50	30.00	30.00	33.75	33.75	32.42
H1F3	33.50	33.50	30.00	30.00	33.75	33.75	32.42
H2F1	33.38	33.50	28.00	28.00	33.00	33.00	31.48
H2F2	33.50	33.50	30.00	30.00	33.75	33.75	32.42
H2F3	33.50	33.50	30.00	30.00	33.75	33.75	32.42
H3F1	33.50	32.13	27.50	27.50	32.25	32.25	30.86
H3F2	32.13	32.13	28.00	28.00	32.50	32.50	30.88
H3F3	32.13	32.13	28.00	28.00	33.25	33.25	31.13
H4F1	32.25	32.25	28.00	28.00	33.00	33.00	31.08
H4F2	32.25	32.25	30.00	30.00	33.75	33.75	32.00
H4F3	32.25	32.25	30.00	30.00	33.25	33.25	31.83
H5F1	32.13	32.13	27.50	27.50	32.25	32.25	30.63
H5F2	32.13	32.13	28.00	28.00	32.50	32.50	30.88
H5F3	32.13	32.13	29.25	29.25	33.25	33.25	31.54
CD	-	-	-	-	-	-	**0.67**

schedules. Of the combinations of different house types and three and four feedings in the thatched houses Hl and H2 registered the highest value of 32.42 and were on par with the four feeding schedule in the RCC house. The combinations next in order were four feedings in RCC house, two feedings in thatched houses Hl and H2 and three feedings in the light roof house and two feedings in RCC house. The other combinations were least.

4.3.4 Growth rate

Of the different larval instars are presented in Tables 47-50.

4.3.4.1 Second instar

Growth rate in second instar was (Table 47) highest in four feeding schedule (3.07), followed by three and two feeding schedule (2.99 and 2.97) which were on par. The variation was significant only in two seasons and in mean values.

The bivoltine race recorded higher growth rate only in four feeding schedule (3.90) than the crossbreed. The crossbreed had registered higher growth rate in three and two feeding schedules (3.59 and 3.61). In the combination of different houses and feeding schedule higher growth rate was recorded in the two feeding schedule in light roof and tiled roof (H3F1-4.15 & H5F1-4.11) followed by the three feeding schedule in the same houses (3.68 &

Table 47 Influence of feeding frequency on the **growth rate of second instar larvae** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	2.69	2.45	3.31	3.09	3.16	3.10	2.97
F2	2.65	2.53	3.24	3.24	3.16	3.10	2.99
F3	2.76	2.65	3.26	3.26	3.23	3.23	3.07
CD	**0.20**	**0.12**	**0.03**	**0.20**	**0.07**	**0.13**	**0.07**
F1R1	2.57	2.69	3.24	3.09	4.00	3.92	3.25
F1R2	2.45	2.57	3.59	3.26	5.00	4.77	3.61
F2R1	2.65	2.65	3.06	3.06	3.34	2.98	2.96
F2R2	2.53	2.65	4.00	4.00	4.34	4.00	3.59
F3R1	2.76	2.76	4.58	4.58	4.76	3.93	3.90
F3R2	2.65	2.76	3.29	3.60	3.71	3.52	3.26
CD	-	-	-	-	-	-	**0.11**
H1F1	2.76	2.76	3.83	3.66	3.71	3.71	3.41
H1F2	2.88	2.88	3.59	3.59	3.13	3.13	3.20
H1F3	3.00	3.00	3.84	3.84	2.62	2.62	3.15
H2F1	2.57	2.81	3.31	3.31	3.71	3.71	3.24
H2F2	2.65	2.88	3.18	3.33	3.13	3.13	3.05
H2F3	2.72	2.95	3.62	3.62	2.62	2.62	3.03
H3F1	2.45	2.69	4.49	4.10	5.89	5.25	4.15
H3F2	2.57	2.69	4.00	4.00	5.04	3.77	3.68
H3F3	2.53	2.76	3.75	3.75	3.52	3.13	3.24
H4F1	2.45	2.45	3.59	3.59	4.17	4.34	3.43
H4F2	2.53	2.53	3.83	4.00	3.57	3.44	3.32
H4F3	2.60	2.49	4.45	4.45	2.93	2.93	3.31
H5F1	2.45	2.45	4.49	4.10	5.89	5.25	4.11
H5F2	2.57	2.57	4.00	4.00	5.04	3.77	3.66
H5F3	2.53	2.65	4.69	4.69	3.52	3.13	3.54
CD	**0.50**	**0.50**	**0.67**	**0.55**	**1.00**	**1.13**	**0.12**

3.66) and four feeding schedules in these houses (3.43 & 3.54). The least values were recorded under three and four feeding schedules in thatched house H2 (3.05 & 3.03).

4.3.4.2 Third instar

The growth rate of the third instar (Table 48) was higher in two feeding schedule (4.00) than in three (3.95) and four feeding schedules (3.91). The bivoltine race registered higher values than crossbreed in all the feeding schedules and higher values than four feeding schedule (4.23) followed by three feeding schedule (3.90). Regarding the combination of house types and feeding schedules all feeding schedules in thatched houses H1, four feedings in H2 and three feedings in tiled roof house registered higher indices (4.43 to 3.96) and were on par. Two feedings in light roof had the least index (3.23) and the other combinations had intermediate values and were on par among themselves.

4.3.4.3 Fourth instar

The growth rate of the fourth instar larave (Table 49) was higher in four and three feeding schedule (6.43 & 6.39) which were on par and followed by the two feeding (6.28) schedule. The crossbreed larvae recorded higher growth rate in all feeding schedules than bivoltine and highest growth rate was under crossbreed with two feeding schedule (7.83) followed by four feedings (7.04)

Table 48 Influence of feeding frequency on the **growth rate of third instar larvae** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	4.10	4.45	3.75	4.26	3.84	3.59	4.00
F2	4.13	4.30	3.93	3.93	3.84	3.59	3.95
F3	4.03	4.16	3.97	3.83	3.85	3.61	3.91
CD	**0.01**	**0.20**	**0.11**	**0.23**	**0.01**	**0.02**	**0.01**
F1R1	3.60	3.45	3.43	3.48	3.81	3.88	3.61
F1R2	3.59	2.33	2.68	2.92	3.77	3.87	3.19
F2R1	3.84	3.77	4.00	4.04	5.36	2.36	3.90
F2R2	3.80	3.55	3.11	3.11	5.48	0.90	3.32
F3R1	4.06	4.59	4.52	4.17	4.06	4.00	4.23
F3R2	4.16	3.94	3.70	3.24	3.48	3.67	3.70
CD	**0.12**	**0.22**	**0.33**	**0.22**	**0.22**	**0.23**	**0.20**
H1F1	4.41	3.31	3.54	4.85	4.03	4.03	4.03
H1F2	3.61	4.76	4.14	4.29	3.79	3.79	4.06
H1F3	4.12	3.91	4.50	4.23	4.91	4.91	4.43
H2F1	3.47	3.16	3.04	4.11	4.03	4.03	3.64
H2F2	3.52	3.70	3.57	4.10	3.48	2.88	3.54
H2F3	4.00	4.41	3.77	3.77	4.91	4.91	4.30
H3F1	3.66	2.65	2.79	3.08	3.39	3.80	3.23
H3F2	4.03	3.03	3.46	3.43	3.31	5.06	3.72
H3F3	4.27	3.31	3.62	3.59	3.58	3.48	3.64
H4F1	3.62	3.28	3.04	3.04	3.87	3.71	3.43
H4F2	3.67	3.27	3.21	3.07	3.69	3.84	3.46
H4F3	4.16	4.13	3.77	3.60	3.73	3.70	3.85
H5F1	3.62	2.90	2.89	3.19	4.03	3.80	3.41
H5F2	3.87	3.17	3.46	3.43	4.78	5.06	3.96
H5F3	4.10	3.45	3.62	3.59	3.27	3.48	3.59
CD	**0.50**	**0.75**	**0.50**	**0.50**	**1.10**	**1.20**	**0.50**

Table 49 Influence of feeding frequency on the **growth rate of fourth instar larvae** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	6.29	5.74	6.89	5.63	6.45	6.65	6.28
F2	6.35	5.76	6.64	6.25	6.50	6.86	6.39
F3	6.52	5.80	6.60	6.61	6.34	6.69	6.43
CD	**0.13**	**0.17**	**0.13**	**0.15**	**0.10**	**0.09**	**0.13**
F1R1	7.04	6.90	7.02	7.28	6.47	6.37	6.85
F1R2	7.38	9.40	7.93	9.02	6.69	6.53	7.83
F2R1	6.66	6.40	6.57	6.09	4.79	7.09	6.27
F2R2	6.64	6.77	7.78	7.00	4.72	8.33	6.87
F3R1	6.70	5.93	6.06	5.73	6.57	6.72	6.29
F3R2	6.88	6.44	7.35	7.46	7.14	6.95	7.04
CD	**0.55**	**1.09**	**1.25**	**0.50**	**1.00**	**1.20**	**0.93**
H1F1	5.66	6.97	6.98	5.49	5.99	5.99	6.18
H1F2	6.86	4.92	6.47	6.26	6.36	6.36	6.21
H1F3	6.44	6.78	5.82	6.17	5.17	5.17	5.93
H2F1	7.49	7.46	7.41	5.57	5.99	5.99	6.65
H2F2	7.67	6.34	7.20	5.76	6.86	8.09	6.99
H2F3	6.97	5.73	6.69	6.34	5.17	5.17	6.01
H3F1	7.19	8.07	7.96	7.96	7.27	6.81	7.54
H3F2	6.99	7.50	7.20	7.06	7.79	5.61	7.03
H3F3	7.15	7.15	7.12	6.89	7.44	7.87	7.27
H4F1	6.98	7.47	7.19	7.32	6.71	6.76	7.07
H4F2	6.33	7.50	7.47	7.47	6.72	6.50	7.00
H4F3	6.43	6.79	6.52	6.61	6.94	6.99	6.71
H5F1	7.16	8.07	7.72	7.72	6.21	6.81	7.28
H5F2	6.88	7.50	7.20	7.06	5.56	5.61	6.64
H5F3	7.01	7.15	7.12	6.89	8.04	7.87	7.35
CD	**0.55**	**1.09**	**1.25**	**0.50**	**0.83**	**1.13**	**0.89**

which were on par. In the combination of different rearing houses and feeding schedules, the highest index was registered under two feedings in light roof house H3 (7.54) followed by four feedings (7.35) and two feedings (7.28) in tiled roof house. Significantly lower indices were recorded under four feeding schedule (5.93) in the thatched house H1 followed by four feedings in H2 (6.01) and three feedings (6.64) in tiled roof. In all other combinations higher indices were on par with the lowest values.

4.3.4.4Fifth instar

The growth rate of the fifth instar was high in two and three feeding schedules (1.88) followed by four feeding (1.81) except in Feb-Apr 1995 season. The bivoltine and crossbreed larvae under different feeding schedules registered growth rate ranging from 1.69 to 1.95 but the variation was statistically not significant in any of the seasons and mean value. Growth rate under the combination of different house types and feeding schedules was highest in two and three feeding schedules in H4 (1.99) followed by two feedings in thatched roof house H2, light roof house (1.95) and tiled (1.93) roof houses. The least values were under four feeding schedule in light roof house H3, thatched house H1 and tiled roof house H5 (1.62, 1.66 & 1.68). Other combinations were insignificant in effect.

Table 50 Influence of feeding frequency on the **growth rate of fifth instar larvae** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	1.83	2.07	1.65	1.95	1.86	1.93	1.88
F2	1.80	2.04	1.77	1.92	1.86	1.88	1.88
F3	1.70	2.01	1.69	1.77	1.85	1.86	1.81
CD	**0.05**	**0.02**	**0.03**	**0.04**	-	**0.02**	**0.02**
F1R1	2.01	2.07	1.84	1.82	1.97	1.97	1.95
F1R2	1.86	2.07	1.97	1.67	1.85	1.85	1.88
F2R1	1.92	2.06	1.82	1.99	1.83	1.79	1.90
F2R2	1.90	1.91	1.82	2.10	1.79	1.77	1.88
F3R1	1.68	1.70	1.65	1.96	1.64	1.62	1.71
F3R2	1.53	1.71	1.74	1.79	1.70	1.65	1.69
CD	-	-	-	-	-	-	-
H1F1	1.90	2.05	1.76	1.73	1.93	1.93	1.88
H1F2	1.81	1.98	1.79	1.79	1.90	1.90	1.86
H1F3	1.59	1.58	1.67	1.67	1.72	1.72	1.66
H2F1	1.93	1.98	1.95	1.98	1.93	1.93	1.95
H2F2	1.76	1.94	1.86	2.00	1.90	1.90	1.89
H2F3	1.63	1.71	1.73	1.86	1.72	1.72	1.73
H3F1	2.03	2.13	1.89	1.89	1.87	1.87	1.95
H3F2	1.66	2.02	1.73	1.80	1.68	1.61	1.75
H3F3	1.49	1.86	1.57	1.67	1.61	1.53	1.62
H4F1	2.02	2.07	2.03	1.98	1.93	1.91	1.99
H4F2	2.14	1.96	2.00	2.00	1.91	1.90	1.99
H4F3	1.71	1.69	1.79	1.86	1.69	1.69	1.74
H5F1	1.94	2.13	1.89	1.89	1.87	1.87	1.93
H5F2	1.79	2.02	1.73	1.80	1.68	1.61	1.77
H5F3	1.62	1.86	1.69	1.79	1.61	1.53	1.68
CD	**0.03**	**0.03**	**0.02**	**0.03**	**0.04**	**0.03**	**0.02**

4.3.5 Growth index

Growth index of the different larval instars are presented in Tables 51-55.

4.3.5.1 First instar

The growth index of the first instar (Table 51) larvae was higher in four and three feeding schedule (6.00 and 5.93) than in two feeding schedule (5.88). Bivoltine race registered higher index in two and three feeding schedules (5.50 and 6.08) than crossbreed. The highest value was in three feeding schedule for the bivoltine followed by crossbreed under four feeding schedule. Other combinations registered a lower index ranging from 4.94 to 5.50.

In the combinations of different rearing houses and feeding schedules the highest value registered was in the thatched houses H2 (H2F3-6.43) and H1 (H1F3-6.31) followed by four feedings in RCC roof house, light roof house and three feedings in thatched house H1 and H2 which were on par. Two feedings in light roof house and tiled roof house had the least indices and others were intermediate in effect.

4.3.5.2 Second instar

Results are presented in Table 52. The three feeding schedule recorded the highest index (27.33) followed by three feedings (26.42) and two feeding

Table 51 Influence of feeding frequency on the **growth index of first instar larvae** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	6.64	6.64	4.91	5.00	6.00	6.09	5.88
F2	6.73	6.73	5.00	5.00	6.00	6.09	5.93
F3	6.73	6.73	5.18	5.18	6.09	6.09	6.00
CD	-	-	-	-	-	-	**0.11**
F1R1	6.64	6.64	5.00	5.00	4.82	4.91	5.50
F1R2	6.64	6.64	4.55	4.55	3.55	3.73	4.94
F2R1	6.73	6.73	5.27	5.27	5.91	6.55	6.08
F2R2	6.73	6.73	4.09	4.09	4.27	4.64	5.09
F3R1	6.73	6.73	3.73	3.73	4.36	5.27	5.09
F3R2	6.73	6.73	4.73	4.73	5.36	5.64	5.65
CD	-	-	**0.82**	**0.82**	**0.73**	**0.73**	**0.55**
H1F1	6.73	6.73	4.27	4.27	5.18	5.18	5.39
H1F2	6.73	6.73	4.55	4.55	6.27	6.27	5.85
H1F3	6.73	6.73	4.64	4.64	7.55	7.55	6.31
H2F1	6.64	6.64	4.91	4.91	5.18	5.18	5.58
H2F2	6.73	6.73	5.09	5.09	6.27	6.27	6.03
H2F3	6.82	6.82	4.91	4.91	7.55	7.55	6.43
H3F1	6.64	6.64	3.64	3.64	3.09	3.36	4.50
H3F2	6.64	6.64	4.09	4.09	3.82	4.91	5.03
H3F3	6.73	6.73	4.55	4.55	5.64	6.27	5.75
H4F1	6.64	6.64	4.55	4.55	4.27	4.27	5.15
H4F2	6.73	6.73	4.27	4.27	5.36	5.55	5.49
H4F3	6.82	6.82	4.00	4.00	6.64	6.64	5.82
H5F1	6.64	6.64	3.64	3.64	3.09	3.36	4.50
H5F2	6.64	6.64	4.09	4.09	3.82	4.91	5.03
H5F3	6.73	6.73	3.64	3.64	5.64	6.27	5.44
CD	-	-	**0.73**	**0.73**	**0.73**	**0.64**	**0.71**

Table 52 Influence of feeding frequency on the **growth index of second instar larvae** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	27.18	25.36	24.45	23.55	28.09	28.09	26.12
F2	27.18	26.27	24.45	24.45	28.09	28.09	26.42
F3	28.09	27.18	25.36	25.36	29.00	29.00	27.33
CD	**0.75**	**0.85**	**0.77**	**0.77**	**0.50**	**0.50**	**0.22**
F1R1	26.27	27.18	24.45	23.55	28.09	28.09	26.27
F1R2	25.36	26.27	24.45	22.64	26.27	26.27	25.21
F2R1	27.18	27.18	24.45	24.45	29.00	29.00	26.88
F2R2	26.27	27.18	24.45	24.45	27.18	27.18	26.12
F3R1	28.09	28.09	25.36	25.36	29.91	29.91	27.79
F3R2	27.18	28.09	23.55	25.36	29.00	29.00	27.03
CD	**1.28**	**0.75**	**1.30**	**1.25**	**1.10**	**0.95**	**0.75**
H1F1	28.09	28.09	24.45	23.55	28.09	28.09	26.73
H1F2	29.00	29.00	24.45	24.45	29.00	29.00	27.48
H1F3	29.91	29.91	26.27	26.27	29.91	29.91	28.70
H2F1	26.27	28.09	24.45	24.45	28.09	28.09	26.57
H2F2	27.18	29.00	24.45	25.36	29.00	29.00	27.33
H2F3	28.09	29.91	26.27	26.27	29.91	29.91	28.39
H3F1	25.36	27.18	24.45	22.64	27.18	26.27	25.51
H3F2	26.27	27.18	24.45	24.45	28.09	27.18	26.27
H3F3	26.27	28.09	25.36	25.36	29.00	29.00	27.18
H4F1	25.36	25.36	24.45	24.45	26.27	27.18	25.51
H4F2	26.27	26.27	24.45	25.36	28.09	28.09	26.42
H4F3	27.18	26.27	26.27	26.27	29.00	29.00	27.33
H5F1	25.36	25.36	24.45	22.64	27.18	26.27	25.21
H5F2	26.27	26.27	24.45	24.45	28.09	27.18	26.12
H5F3	26.27	27.18	25.36	25.36	29.00	29.00	27.03
CD	**2.25**	**2.46**	**1.20**	**1.59**	**1.56**	**1.80**	**1.07**

schedule (26.12). The bivoltine had higher growth indices than crossbreed in all the feeding schedules and the highest value was in four feeding schedule (27.79). Crossbreed fed four times (27.03) was on par with bivoltine fed three times (26.88) and ranked next. The least value was in crossbreed larvae fed two times and other combination had significantly higher values from the least.

The four feeding schedule in thatched house H1 and H2 registered highest growth indices of 28.70 and 28.39 respectively and were on par with each other. The combinations ranked next were four feeding schedule in the other types of houses and three feedings in houses H1 and H2. The other combinations registered only lower values ranging from 26.73 to 25.21.

4.3.5.3 Third instar

The growth index of third instar larvae are presented in Table 53. The four feeding schedule recorded significantly higher growth index (137.94) than three and two feeding schedule (134.76 & 134.31) which were on par. Bivoltine larvae had higher growth indices than crossbreed and the combinations of bivoltine and four feeding schedule (149.45) was superior to others. The bivoltine fed three times and crossbreed fed four times a day (135.36 & 130.82) were on par and was ranked next followed by the bivoltine larvae fed twice a day (124.91). The crossbreed fed twice and thrice (109.15& 107.94) were inferior to this combination. Regarding the combination of house

Table 53 Influence of feeding frequency on the **growth index of third instar larvae** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	142.64	142.64	119.91	128.09	139.91	132.64	134.31
F2	143.55	143.55	124.45	124.45	139.91	132.64	134.76
F3	145.36	144.45	129.91	126.27	144.45	137.18	137.94
CD	**1.73**	**0.82**	**4.45**	**2.64**	**3.55**	**3.55**	**2.79**
F1R1	124.45	124.45	111.73	109.00	139.00	140.82	124.91
F1R2	119.91	89.91	92.64	91.73	129.00	131.73	109.15
F2R1	135.36	133.55	126.27	127.18	189.91	99.91	135.36
F2R2	129.91	127.18	103.55	103.55	181.73	1.73	107.94
F3R1	146.27	161.73	144.45	135.36	155.36	153.55	149.45
F3R2	144.45	142.64	114.45	110.82	133.55	139.00	130.82
CD	**7.75**	**6.27**	**7.75**	**4.45**	**5.36**	**6.87**	**6.41**
H1F1	156.27	124.45	114.45	142.64	145.36	145.36	138.09
H1F2	137.18	171.73	129.91	133.55	142.64	142.64	142.94
H1F3	157.18	150.82	149.00	141.73	181.73	181.73	160.37
H2F1	120.82	119.91	101.73	129.00	145.36	145.36	127.03
H2F2	126.27	139.91	115.36	133.55	133.55	115.36	127.33
H2F3	144.45	166.27	129.00	129.00	181.73	181.73	155.36
H3F1	121.73	101.73	95.36	95.36	122.64	129.91	111.12
H3F2	136.27	112.64	112.64	111.73	124.45	169.91	127.94
H3F3	142.64	124.45	120.82	119.91	136.27	133.55	129.61
H4F1	120.82	111.73	101.73	101.73	131.73	131.73	116.58
H4F2	126.27	115.36	106.27	106.27	135.36	139.91	121.57
H4F3	144.45	139.00	129.00	124.45	140.82	139.91	136.27
H5F1	120.82	101.73	98.09	98.09	140.82	129.91	114.91
H5F2	131.73	112.64	112.64	111.73	167.18	169.91	134.31
H5F3	138.09	124.45	120.82	119.91	127.18	133.55	127.33
CD	**5.36**	**9.91**	**7.75**	**7.89**	**9.91**	**12.64**	**4.67**

types and feeding schedules the highest feeding schedule was registered in thatched house H1 with four feeding schedule (H1F3-160.37) followed by H2 (155.36) and three feeding in H1 (142.94). The least values were in two feeding schedules in light roof house (111.12), tiled roof house (114.91) and RCC roof house (116.58). The others were intermediate in effect.

4.3.5.4 Fourth instar

The growth index of the fourth instar larvae are presented in Table 54. The four feeding schedule (1029.45) had a higher growth index higher than other feeding schedules but was on par with three feeding schedules (1001.42). The bivoltine larvae fed four times a day reported a higher growth index of 1096.27 significantly than others in combination followed by crossbreed under the same schedule. Bivoltine was superior to crossbreed under all feeding schedules. The least value was for the crossbreed fed two times a day (953.09). The four feeding schedule in thatched house H1 had the highest growth index of 1108.70. The four feeding schedules under the thatched roof H2 (1081.27) and light roof H3 (1080.67) houses ranked next which were on par.

4.3.5.5 Fifth instar

The growth index of the fifth instar larvae are given in Table 55. The three and four feeding schedules registered growth indices of 2882.34 and

Table 54 Influence of feeding frequency on the **growth index of fourth instar** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	1046.27	967.18	953.55	854.45	1049.00	1021.73	982.03
F2	1061.73	976.27	958.09	908.09	1055.36	1049.00	1001.42
F3	1099.00	988.09	994.45	967.18	1066.27	1061.73	1029.45
CD	**51.73**	**31.73**	**11.73**	**16.27**	**17.18**	**41.73**	**28.4**
F1R1	1007.18	989.91	903.55	909.91	1044.45	1044.45	983.24
F1R2	1012.64	944.45	835.36	928.09	999.00	999.00	953.09
F2R1	1043.55	994.45	962.64	908.09	1103.55	1118.09	1021.73
F2R2	999.00	994.45	917.18	835.36	1043.55	1052.64	973.7
F3R1	1133.55	1126.27	1026.27	917.18	1182.64	1191.73	1096.27
F3R2	1144.45	1067.18	962.64	944.45	1094.45	1112.64	1054.3
CD	**25.59**	**25.56**	**17.60**	**17.18**	**21.73**	**43.55**	**25.2**
H1F1	1047.18	999.00	919.91	930.82	1021.73	1021.73	990.06
H1F2	1084.45	1021.73	976.27	976.27	1056.27	1056.27	1028.54
H1F3	1175.36	1180.82	1021.73	1021.73	1126.27	1126.27	1108.7
H2F1	1033.55	1021.73	862.64	853.55	1021.73	1021.73	969.15
H2F2	1102.64	1033.55	953.55	908.09	1056.27	1056.27	1018.4
H2F3	1158.09	1124.45	999.00	953.55	1126.27	1126.27	1081.27
H3F1	1004.45	930.82	862.64	862.64	1021.73	1021.73	950.67
H3F2	1095.36	965.36	930.82	908.09	1101.73	1129.00	1021.73
H3F3	1169.91	1021.73	988.09	953.55	1158.09	1192.64	1080.67
H4F1	970.82	953.55	839.91	853.55	1021.73	1029.00	944.76
H4F2	931.73	988.09	908.09	908.09	1051.73	1056.27	974
H4F3	1079.00	1089.91	976.27	953.55	1124.45	1124.45	1057.94
H5F1	993.55	930.82	862.64	862.64	1021.73	1021.73	948.85
H5F2	1044.45	965.36	930.82	908.09	1101.73	1129.00	1013.24
H5F3	1112.64	1021.73	988.09	953.55	1158.09	1192.64	1071.12
CD	**85.56**	**80.86**	**66.74**	**55.56**	**19.00**	**33.55**	**34.80**

Table 55 Influence of feeding frequency on the **growth index of fifth instar larvae** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	2967.18	2971.73	2526.27	2526.27	2999.00	2999.00	2831.58
F2	2971.73	2971.73	2653.55	2653.55	3021.73	3021.73	2882.34
F3	2971.73	2971.73	2676.27	2676.27	3039.91	3039.91	2895.97
CD	-	-	**55.36**	**45.50**	**50.10**	**37.80**	**35.50**
F1R1	3035.36	3044.45	2571.73	2571.73	3099.00	3099.00	2903.55
F1R2	2899.00	2899.00	2480.82	2480.82	2844.45	2844.45	2741.42
F2R1	3044.45	3044.45	2717.18	2717.18	3126.27	3126.27	2962.63
F2R2	2899.00	2899.00	2589.91	2589.91	2917.18	2917.18	2802.03
F3R1	3044.45	3044.45	2717.18	2717.18	3126.27	3126.27	2962.63
F3R2	2899.00	2899.00	2635.36	2635.36	2953.55	2953.55	2829.30
CD	**55.65**	**45.67**	**120.70**	**100.65**	**105.50**	**120.78**	**36.75**
H1F1	3033.55	3044.45	2544.45	2544.45	2999.00	2999.00	2860.82
H1F2	3044.45	3044.45	2726.27	2726.27	3067.18	3067.18	2945.97
H1F3	3044.45	3044.45	2726.27	2726.27	3067.18	3067.18	2945.97
H2F1	3033.55	3044.45	2544.45	2544.45	2999.00	2999.00	2860.82
H2F2	3044.45	3044.45	2726.27	2726.27	3067.18	3067.18	2945.97
H2F3	3044.45	3044.45	2726.27	2726.27	3067.18	3067.18	2945.97
H3F1	3044.45	2919.91	2499.00	2499.00	2930.82	2930.82	2804
H3F2	2919.91	2919.91	2544.45	2544.45	2953.55	2953.55	2805.97
H3F3	2919.91	2919.91	2544.45	2544.45	3021.73	3021.73	2828.70
H4F1	2930.82	2930.82	2544.45	2544.45	2999.00	2999.00	2824.76
H4F2	2930.82	2930.82	2726.27	2726.27	3067.18	3067.18	2908.09
H4F3	2930.82	2930.82	2726.27	2726.27	3021.73	3021.73	2892.94
H5F1	2919.91	2919.91	2499.00	2499.00	2930.82	2930.82	2783.24
H5F2	2919.91	2919.91	2544.45	2544.45	2953.55	2953.55	2805.97
H5F3	2919.91	2919.91	2658.09	2658.09	3021.73	3021.73	2866.58
CD	**56.86**	**56.86**	**79.00**	**44.98**	**68.87**	**55.86**	**25.65**

2895.97 respectively and were significantly higher than two feeding schedule (2831.58). The bivoltine had higher index compared to crossbreed under all the three schedules of feeding and the bivoltine larvae fed two times a day (2903.55) recorded higher index than crossbreed fed four times a day. The bivoltine under four and three feeding schedules registered the highest index (2962.63). With regard to the combinations of types of houses and feeding schedules the three and four feeding schedules in thatched houses H1 and H2 (2945.97) than other types of houses but followed by the RCC roof house (2908.09 and 2892.94). The least value was in the tiled roof house under two feeding schedule (2783.24) and three feeding schedule (2805.97) which were on par with the same feeding schedules in light roof house.

4.3.6 Leaf consumption

The quantity of mulberry leaf consumed by 100 worms of the two races under different treatments are presented in Table 56. The data on the feeding frequency was of no significant variation in the different seasons and mean values. Of the combinations of the races and feeding schedules, the data was of significant variation during February-April 1995 and 1996 and the mean values. The highest consumption was recorded in the combination of bivoltine and four feedings (1.64) followed by bivoltine with three and two feedings (1.62). The least consumption was recorded by the crossbreed under the two feeding schedule. Regarding the combinations of different houses and feeding

Table 56 Influence of feeding frequency on the **leaf consumption (kg/100 worms)** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	1.65	1.65	1.50	1.50	1.58	1.58	1.58
F2	1.66	1.66	1.50	1.50	1.62	1.62	1.59
F3	1.66	1.66	1.50	1.50	1.59	1.59	1.58
CD	-	-	-	-	**0.04**	**0.04**	**0.01**
F1R1	1.70	1.70	1.53	1.53	1.63	1.63	1.62
F1R2	1.60	1.60	1.48	1.48	1.53	1.53	1.54
F2R1	1.70	1.70	1.51	1.51	1.66	1.66	1.62
F2R2	1.61	1.61	1.49	1.49	1.57	1.57	1.56
F3R1	1.70	1.70	1.51	1.51	1.72	1.72	1.64
F3R2	1.61	1.61	1.49	1.49	1.66	1.66	1.59
CD	-	-	**0.02**	**0.02**	-	-	**0.01**
H1F1	1.68	1.68	1.51	1.51	1.59	1.59	1.59
H1F2	1.68	1.68	1.51	1.51	1.64	1.64	1.61
H1F3	1.68	1.68	1.51	1.51	1.70	1.70	1.63
H2F1	1.68	1.68	1.51	1.51	1.59	1.59	1.59
H2F2	1.68	1.68	1.51	1.51	1.64	1.64	1.61
H2F3	1.62	1.62	1.51	1.51	1.70	1.70	1.61
H3F1	1.63	1.63	1.50	1.50	1.56	1.56	1.56
H3F2	1.63	1.63	1.50	1.50	1.59	1.59	1.57
H3F3	1.68	1.68	1.50	1.50	1.66	1.66	1.61
H4F1	1.68	1.68	1.51	1.51	1.59	1.59	1.59
H4F2	1.68	1.68	1.51	1.51	1.64	1.64	1.61
H4F3	1.68	1.68	1.51	1.51	1.70	1.70	1.63
H5F1	1.61	1.61	1.50	1.50	1.57	1.57	1.56
H5F2	1.65	1.65	1.50	1.50	1.59	1.59	1.58
H5F3	1.65	1.65	1.50	1.50	1.67	1.67	1.61
CD	-	-	-	-	-	-	**0.03**

schedules, only the mean values have shown significant variation. The four feeding schedule in thatched house H1 and RCC roof house registered the highest value 1.63 followed by three and four feedings in thatched house H2, three feedings in H1, four feedings in H5 and three feedings in RCC house which were on par. The least values were recorded in light roof house and tiled house under two feeding schedule (1.56).

4.3.7 Missing larvae

The percentage of missing larvae (Table 57) was significantly higher under two feedings a day (5.97) while the three feedings and four feedings were on par (4.97 and 4.93). The data were not significant for October-November seasons. The bivoltine race registered higher missing larval percentage (6.73) under the two feedings a day followed by three and four feedings which were on par. The crossbreed had no significant variation among the different feeding frequencies. October-November and May-July seasons, the variation was not significant. Regarding the combination of house types and feeding frequencies, the light roof house and tiled house recorded the highest percentage of missing larvae (6.50) under two feeding treatments. The thatched houses H1 and H2 recorded the lowest missing larvae percentage (4.33) with the exception of two feedings in the H2 house. The other combinations were intermediate in effect and were on par themselves.

Table 57 Influence of feeding frequency on the **missing larval percentage** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	6.40	6.40	7.40	7.40	4.10	4.10	5.97
F2	6.40	6.40	4.75	4.75	3.75	3.75	4.97
F3	6.40	6.40	4.75	4.75	3.65	3.65	4.93
CD	-	-	**0.60**	**0.60**	**0.57**	**0.57**	**0.59**
F1R1	6.90	6.90	8.60	8.60	4.70	4.70	6.73
F1R2	5.90	5.90	6.20	6.20	3.70	3.70	5.27
F2R1	6.90	6.90	5.40	5.40	3.70	3.70	5.33
F2R2	5.90	5.90	4.10	4.10	3.80	3.80	4.60
F3R1	6.90	6.90	5.40	5.40	3.80	3.80	5.37
F3R2	5.90	5.90	4.10	4.10	3.90	3.90	4.63
CD	-	-	**0.75**	**0.75**	-	-	**0.75**
H1F1	6.00	6.00	7.00	7.00	4.00	4.00	4.23
H1F2	6.00	6.00	4.00	4.00	3.00	3.00	4.33
H1F3	6.00	6.00	4.00	4.00	3.00	3.00	4.33
H2F1	6.00	6.00	7.00	7.00	4.00	4.00	5.67
H2F2	6.00	6.00	4.00	4.00	3.00	3.00	4.33
H2F3	6.00	6.00	4.00	4.00	3.00	3.00	4.33
H3F1	7.00	7.00	8.00	8.00	4.50	4.50	6.50
H3F2	7.00	7.00	5.50	5.50	4.00	4.00	5.50
H3F3	7.00	7.00	5.50	5.50	3.00	3.00	5.17
H4F1	6.00	6.00	7.00	7.00	4.00	4.00	5.67
H4F2	6.00	6.00	4.75	4.75	3.00	3.00	4.58
H4F3	6.00	6.00	4.75	4.75	3.00	3.00	4.58
H5F1	7.00	7.00	8.00	8.00	4.50	4.50	6.5
H5F2	7.00	7.00	5.50	5.50	4.25	4.25	5.58
H5F3	7.00	7.00	5.50	5.50	3.75	3.75	5.42
CD	-	-	-	-	-	**0.66**	**0.66**

Variations in the data were significant only for the May-July season in 1996 and the mean values.

4.3.8 Single cocoon weight

The single cocoon weight under the different treatments are presented in Table 58 and Fig 4. The feeding schedules had no significant variation except in February-April 1995 and 1996 in which the two feedings a day was (1.32 and 1.30) inferior to three and four feeding schedules (1.38 and 1.37). Regarding the combinations of feeding schedule and races both the races had the same cocoon weight under the four and three feedings. The two feedings in both types of silkworms were inferior. Of the combinations of different houses and feeding schedules, the highest single cocoon weight was recorded in thatched house H1 and H2 under the four and three feeding schedules which were on par with four and three feedings in RCC roof house. The least weight was recorded in light roof house and tiled roof house under the two feeding schedules (1.41). The others were intermediate in effect.

4.3.9 Shell weight

The shell weight of the cocoons under different treatments are given in Table 59. The feeding schedules had no significant influence on shell weight in

Table 58 Influence of feeding frequency on the **single cocoon weight (gms)** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	1.43	1.45	1.32	1.30	1.62	1.60	1.47
F2	1.43	1.44	1.38	1.37	1.62	1.61	1.47
F3	1.44	1.45	1.38	1.37	1.63	1.61	1.48
CD	-	-	**0.02**	**0.01**	**0.01**	**0.01**	**0.01**
F1R1	1.46	1.48	1.31	1.30	1.51	1.50	1.43
F1R2	1.40	1.41	1.33	1.31	1.57	1.56	1.43
F2R1	1.46	1.47	1.38	1.37	1.60	1.59	1.48
F2R2	1.40	1.41	1.38	1.37	1.63	1.62	1.47
F3R1	1.46	1.48	1.38	1.37	1.60	1.61	1.48
F3R2	1.41	1.43	1.38	1.37	1.64	1.63	1.48
CD	-	-	-	-	**0.02**	**0.02**	**0.01**
H1F1	1.45	1.46	1.33	1.31	1.55	1.54	1.44
H1F2	1.45	1.46	1.40	1.38	1.64	1.63	1.50
H1F3	1.45	1.47	1.40	1.38	1.66	1.65	1.50
H2F1	1.45	1.46	1.33	1.31	1.55	1.54	1.44
H2F2	1.45	1.46	1.39	1.38	1.64	1.63	1.49
H2F3	1.45	1.47	1.39	1.38	1.66	1.65	1.50
H3F1	1.41	1.43	1.30	1.29	1.52	1.51	1.41
H3F2	1.41	1.41	1.36	1.35	1.58	1.57	1.45
H3F3	1.41	1.43	1.36	1.35	1.58	1.57	1.45
H4F1	1.44	1.45	1.32	1.31	1.55	1.54	1.44
H4F2	1.44	1.45	1.40	1.38	1.64	1.63	1.49
H4F3	1.44	1.45	1.40	1.38	1.66	1.65	1.49
H5F1	1.41	1.44	1.31	1.29	1.52	1.51	1.41
H5F2	1.41	1.43	1.36	1.35	1.58	1.57	1.45
H5F3	1.44	1.45	1.36	1.35	1.58	1.57	1.46
CD	**0.08**	**0.10**	**0.08**	**0.13**	**0.03**	**0.03**	**0.02**

Table 59 Influence of feeding frequency on the **shell weight** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	0.28	0.28	0.23	0.23	0.29	0.29	0.27
F2	0.28	0.28	0.24	0.24	0.29	0.29	0.27
F3	0.28	0.28	0.24	0.24	0.30	0.30	0.28
CD	-	-	-	-	**0.01**	**0.01**	-
F1R1	0.27	0.27	0.23	0.23	0.29	0.29	0.26
F1R2	0.28	0.28	0.25	0.25	0.28	0.28	0.27
F2R1	0.27	0.27	0.23	0.23	0.30	0.30	0.27
F2R2	0.28	0.28	0.25	0.25	0.28	0.28	0.28
F3R1	0.27	0.27	0.23	0.23	0.31	0.31	0.27
F3R2	0.28	0.28	0.25	0.25	0.30	0.30	0.27
CD	-	-	-	-	-	-	-
H1F1	0.28	0.28	0.24	0.24	0.29	0.29	0.27
H1F2	0.28	0.28	0.24	0.24	0.29	0.29	0.27
H1F3	0.28	0.28	0.24	0.24	0.31	0.31	0.28
H2F1	0.28	0.28	0.24	0.24	0.29	0.29	0.27
H2F2	0.28	0.28	0.24	0.24	0.29	0.29	0.27
H2F3	0.28	0.28	0.24	0.24	0.31	0.31	0.28
H3F1	0.27	0.27	0.24	0.24	0.28	0.28	0.26
H3F2	0.27	0.27	0.24	0.24	0.29	0.29	0.26
H3F3	0.27	0.27	0.24	0.24	0.30	0.30	0.27
H4F1	0.28	0.28	0.24	0.24	0.29	0.29	0.27
H4F2	0.28	0.28	0.24	0.24	0.29	0.29	0.27
H4F3	0.28	0.28	0.24	0.24	0.31	0.31	0.28
H5F1	0.27	0.27	0.24	0.24	0.28	0.28	0.26
H5F2	0.27	0.27	0.24	0.24	0.29	0.29	0.27
H5F3	0.27	0.27	0.24	0.24	0.30	0.30	0.27
CD	-	-	-	-	-	-	**0.01**

any of the seasons or mean values and the shell weight ranged from 0.27 to 0.28 gm /cocoon.

The combinations of the feeding schedule and races also had no significant effect on shell weight as the recorded mean values varied only from 0.26 to 0.28. With regard to the combinations of different types of housing and feeding the data was not significant in any of the seasons but the mean values differed significantly. The schedule of four feedings a day in thatched houses H1 and H2 and RCC roof house had a shell weight of 0.28 gm/cocoon and was superior to the schedule of two feeding in tiled roof and have two and three feedings in light roof house (0.26 gm). The other treatments were on par with the above values (0.27 gm).

4.3.10 Shell ratio

The shell ratio of the different treatments are presented in Table 60 and Fig 4. The values were not showing significant variations in different seasons. In May-July seasons the schedule of four feedings registered higher shell ratio of 19.06 and 19.18 than three feedings, but two feedings was on par with four feedings. The values computed on the combinations of feeding schedule and races were also not of significant values in any seasons but the mean values were having significantly highest shell ratio (18.93) in the crossbreed fed four times and two times. It was interesting to observe that though insignificant in the October-November and February-April seasons the crossbreed had a higher

Table 60 Influence of feeding frequency on the **shell ratio** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	19.39	19.16	18.14	18.35	18.47	18.53	18.67
F2	19.37	19.21	17.35	17.52	18.07	18.23	18.29
F3	19.30	19.09	17.35	17.51	19.06	19.18	18.58
CD	**0.10**	**0.12**	**0.62**	**0.66**	**0.65**	**0.68**	**0.18**
F1R1	18.49	18.24	17.50	17.71	19.16	19.29	18.4
F1R2	20.29	20.08	18.78	19.00	17.65	17.77	18.93
F2R1	18.44	18.35	16.65	16.81	18.79	19.01	18.01
F2R2	20.29	20.08	18.05	18.23	17.35	17.45	18.58
F3R1	18.45	18.26	16.66	16.82	19.55	19.68	18.24
F3R2	20.15	19.91	18.05	18.20	18.57	18.69	18.93
CD	-	-	-	-	-	-	**0.22**
H1F1	19.46	19.26	18.12	18.40	18.44	18.56	18.71
H1F2	19.43	19.23	17.26	17.50	17.94	18.06	18.24
H1F3	19.46	19.26	17.26	17.50	18.99	19.11	18.60
H2F1	19.43	19.26	18.12	18.40	18.43	18.56	18.70
H2F2	19.43	19.23	17.38	17.50	17.94	18.06	18.26
H2F3	19.24	19.23	17.38	17.50	18.99	19.11	18.58
H3F1	19.21	18.90	18.14	18.29	18.34	18.46	18.56
H3F2	19.23	19.23	17.40	17.56	18.22	18.68	18.39
H3F3	19.58	19.03	17.42	17.55	19.16	19.29	18.67
H4F1	19.58	19.37	18.25	18.40	18.43	18.56	18.77
H4F2	19.56	19.36	17.31	17.50	17.94	18.06	18.29
H4F3	19.56	19.35	17.32	17.51	18.99	19.11	18.64
H5F1	19.21	19.00	18.07	18.29	18.40	18.52	18.58
H5F2	19.20	19.00	17.40	17.55	18.30	18.41	18.31
H5F3	18.86	18.67	17.39	17.48	19.17	19.29	18.48
CD	-	-	-	-	-	-	**0.50**

shell ratio than the bivoltine whereas in May-July this trend was reversed. With regard to the house type and feeding schedules, the values computed for all the seasons and the mean were not having significant variation as the values ranged from 18.24 to 18.77.

4.3.11 Reelability

The reelability of the cocoons reared under different treatments are given in Table 61. The mean values for the two feeding schedules indicated a poor reelability of 69.54 against 71.05 and 71.15 for the three and four feeding schedules respectively. The data recorded in different seasons were not statistically significant. In the combinations of the feeding schedule and races the data was significant for February-April and March-July seasons along with the mean values. The crossbreed with four feeding schedule was having higher reelability of 73.63 compared to all other combinations. The next in order was crossbreed with three feeding schedule (72.03). The least value was for bivoltine (68.73) fed two times a day. Regarding the combinations of house types and feeding schedule only the mean values recorded sufficient variation. The cocoon reared with four feedings a day in thatched house H1 and H2 and RCC roof house had the highest reelability percentage. (72.25) which was on par with the tiled house (72.17) and light roof house (71.83). Three feeding schedule was ranked next in all the house types.

Table 61 Influence of feeding frequency on the **reelability** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	65.75	65.75	71.25	71.65	71.75	71.75	71.75
F2	65.75	65.75	73.65	73.65	73.75	73.75	71.05
F3	65.75	65.75	73.50	73.50	74.20	74.20	71.15
CD	-	-	-	-	**3.00**	**3.00**	**1.38**
F1R1	64.50	64.50	71.00	71.00	70.70	70.70	68.73
F1R2	67.00	67.00	71.50	71.50	72.80	72.80	70.43
F2R1	64.50	64.50	72.50	72.50	73.20	73.20	70.07
F2R2	67.00	67.00	74.80	74.80	74.30	74.30	72.03
F3R1	64.50	64.50	72.50	72.50	75.00	75.00	70.67
F3R2	67.00	67.00	74.50	74.50	79.40	79.40	73.63
CD	-	-	**1.04**	**1.04**	**1.34**	**1.34**	**0.31**
H1F1	65.75	65.75	71.25	71.25	72.00	72.00	69.67
H1F2	65.75	65.75	73.75	73.75	74.00	74.00	71.17
H1F3	65.75	65.75	73.50	73.50	77.50	77.50	72.25
H2F1	65.75	65.75	71.25	71.25	72.00	72.00	69.67
H2F2	65.75	65.75	73.75	73.75	74.00	74.00	71.17
H2F3	65.75	65.75	73.50	73.50	77.50	77.50	72.25
H3F1	65.75	65.75	71.75	71.75	71.25	71.25	69.58
H3F2	65.75	65.75	73.50	73.50	73.25	73.25	70.83
H3F3	65.75	65.75	73.50	73.50	76.25	76.25	71.83
H4F1	65.75	65.75	71.25	71.25	72.00	72.00	69.67
H4F2	65.75	65.75	73.75	73.75	74.00	74.00	71.17
H4F3	65.75	65.75	73.50	73.50	77.50	77.50	72.25
H5F1	65.75	65.75	70.75	70.75	71.50	71.50	69.33
H5F2	65.75	65.75	73.50	73.50	73.50	73.50	70.92
H5F3	65.75	65.75	73.50	73.50	77.25	77.25	72.17
CD	-	-	-	-	-	-	**0.85**

4.3.12 Filament length

The filament length obtained by reeling out sample cocoons are given in Table 62 and Fig 4. The variations in the filament length was significant in February-April season and the four and three feeding schedule recorded filament length of 835.75 and 832.59 respectively than the two feeding schedule (792.25 m). The mean values of four and three feedings were on par and superior to two feeding. The combinations of feeding schedule and races also varied significantly only with the mean values. The highest length was observed in crossbreed fed with four times a day (897.60) followed by that fed three times (891.00) and two times a day (841.33). The bivoltine registered a lower filament length in the range 713.60 and 753.13. With regard to the combinations of house types and feeding schedules the mean values were having significant variation and the highest values were observed (827.33) in light roof house under the four feeding schedule which was on par with four and three feedings in all types of rearing house. The two feeding schedule had the least filament length ranging from 780.33 to 782.42 meters.

4.3.13 ERR (no)

The results on the ERR (number) are presented in Table 63 and Fig 4. In the February-April seasons the mean values had significant variations in the four feeding schedules having the highest ERR (8460.00) and were on par with

Table 62 Influence of feeding frequency on the **filament length (meters)** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	742.00	742.00	792.25	792.25	880.25	880.25	804.830
F2	742.00	742.00	832.50	832.50	883.75	883.75	819.42
F3	742.00	742.00	835.75	835.75	899.75	899.75	825.83
CD	-	-	**15.32**	**15.32**	**19.59**	**19.59**	**14.67**
F1R1	653.30	653.30	738.00	738.00	749.50	749.50	713.60
F1R2	830.50	830.50	846.50	846.50	871.00	871.00	849.33
F2R1	653.30	653.30	771.00	771.00	819.00	819.00	747.77
F2R2	830.50	830.50	894.00	894.00	948.50	948.50	891.00
F3R1	653.30	653.30	775.00	775.00	833.50	833.50	753.93
F3R2	830.50	830.50	896.50	896.50	966.00	966.00	897.60
CD	-	-	-	-	-	-	**5.71**
H1F1	742.00	742.00	782.75	782.75	816.25	816.25	780.33
H1F2	742.00	742.00	829.00	829.00	888.75	888.75	819.92
H1F3	742.00	742.00	831.25	831.25	906.25	906.25	826.50
H2F1	742.00	742.00	789.00	789.00	816.25	816.25	782.42
H2F2	742.00	742.00	829.00	829.00	888.75	888.75	819.92
H2F3	742.00	742.00	828.75	828.75	906.25	906.25	825.67
H3F1	742.00	742.00	804.00	804.00	801.25	801.25	782.42
H3F2	742.00	742.00	834.00	834.00	876.25	876.25	817.42
H3F3	742.00	742.00	848.75	848.75	891.25	891.25	827.33
H4F1	742.00	742.00	782.75	782.75	816.25	816.25	780.33
H4F2	742.00	742.00	829.00	829.00	888.75	888.75	819.92
H4F3	742.00	742.00	831.25	831.25	906.25	906.25	826.50
H5F1	742.00	742.00	802.75	802.75	801.25	801.25	782.00
H5F2	742.00	742.00	841.50	841.50	876.25	876.25	819.92
H5F3	742.00	742.00	838.75	838.75	888.75	888.75	823.17
CD	-	-	-	-	-	-	**12.76**

Table 63 Influence of feeding frequency on the **effective rearing rate-weight (weigt in gms)** of bivoltine and crossbreed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	11780.40	11921.15	9704.95	9593.65	14389.80	14302.65	11948.77
F2	11777.15	11881.85	11104.95	10992.10	14442.00	14451.95	12441.67
F3	11837.80	11965.45	11114.95	11014.00	14538.60	14500.60	12495.23
CD	**100.55**	**100.11**	**242.14**	**239.79**	**205.95**	**210.57**	**86.18**
F1R1	11714.80	11869.00	9183.00	9077.00	12855.00	12769.50	11244.72
F1R2	11846.00	11972.00	10226.40	10110.30	13924.00	13835.80	11985.75
F2R1	11697.50	11763.10	10808.10	10699.00	14226.00	14137.20	12221.82
F2R2	11856.00	12000.60	11401.80	11285.20	15058.00	14966.70	12761.38
F3R1	11717.80	11829.00	10808.10	10699.00	14505.00	14414.80	12328.95
F3R2	11957.00	12101.70	11421.80	11329.00	15372.10	15278.40	12910.00
CD	-	-	-	**262.68**	-	-	**121.87**
H1F1	12096.50	12229.50	10032.75	9880.25	13508.50	13421.25	11861.46
H1F2	12099.25	12224.25	11478.00	11315.00	14908.75	14818.75	12807.33
H1F3	12098.25	12266.50	11478.00	11315.00	15272.00	15179.75	12934.92
H2F1	12096.50	12222.00	10032.75	9880.25	13508.75	13421.25	11860.25
H2F2	12101.00	12226.00	11396.50	11315.00	14908.75	14818.75	12794.33
H2F3	12065.25	12181.75	11396.50	11315.00	15272.00	15179.75	12901.71
H3F1	11344.00	11544.00	9218.25	9148.25	13211.25	13124.50	11265.04
H3F2	11372.25	11357.75	10710.50	10611.00	14182.00	14092.25	12054.29
H3F3	11404.25	11525.00	10725.00	10645.00	14418.25	14326.75	12174.04
H4F1	11983.50	12108.75	9921.25	9846.25	13508.75	13421.25	11798.29
H4F2	11941.00	12108.50	11331.50	11210.00	14901.75	14818.75	12718.58
H4F3	12004.50	12108.50	11333.50	11212.00	15272.25	15179.75	12851.75
H5F1	11381.00	11501.75	9319.75	9213.25	13211.75	13125.00	11292.08
H5F2	11372.25	11492.50	10608.25	10509.50	14301.75	14211.25	12082.58
H5F3	11616.75	11737.50	10641.75	10583.00	14458.50	14367.00	12234.08
CD	-	-	-	-	-	-	**192.69**

three feeding schedule (8444.67). The two feeding schedule was inferior as the ERR was 8178.33. The crossbreed reared with four and three feeding schedules was the best combination and recorded ERR of 8706.67 and 8653.33 respectively. The crossbreed with two feeding schedule was next in order (8350.00). The least value was registered in the combination of bivoltine with two feeding schedule (7840.00) and was inferior to all. Regarding the combination of house type and feeding, the thatched house recorded the highest value of 8591.67 followed by H2 house 8583.33. Similar mean ERR (no) was observed in three feedings in H1 and H2 houses (8541.67). The next effective combinations were four feeding in light roof house (8375.00), tiled roof house (8358.33) and three feedings in light roof and tiled houses (8308.33). The least values were recorded in light roof house (7933.33) and tiled roof house (7958.33) in the two feeding schedule. The remaining combinations were significantly superior to these combinations.

4.3.14 ERR (wt)

The results of effective rearing rate (by weight) of the different treatments are given in Table 64. The February-April season in 1995-96 along with the mean values were having significant variations in respect of the feeding schedule. The four and three feedings were on par and they have recorded the ERR as 12495.23 and 12441.67 gm respectively. The two feeding schedule resulted in the least value of 11948.77. The combinations of feeding schedule

Table 64 Influence of feeding frequency on the **effective rearing rate (number)** of bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	8230.00	8230.00	7350.00	7350.00	8955.00	8955.00	8178.33.00
F2	8235.00	8235.00	8040.00	8040.00	9050.00	9050.00	8441.67
F3	8240.00	8240.00	8050.00	8050.00	9090.00	9090.00	8460
CD	-	-	**103.18**	**103.18**	**168.10**	**168.10**	**55.13**
F1R1	8000.00	8000.00	6990.00	6990.00	8530.00	8530.00	7840.00
F1R2	8460.00	8460.00	7710.00	7710.00	8880.00	8880.00	8350.00
F2R1	7990.00	7990.00	7820.00	7820.00	8888.00	8888.00	8232.67
F2R2	8480.00	8480.00	8260.00	8260.00	9220.00	9220.00	8653.33
F3R1	8000.00	8000.00	7820.00	7820.00	9020.00	9020.00	8280.00
F3R2	8480.00	8480.00	8280.00	8280.00	9360.00	9360.00	8706.67
CD	-	-	-	-	-	-	**60.85**
H1F1	8350.00	8350.00	7525.00	7525.00	8725.00	8725.00	8200.00
H1F2	8350.00	8350.00	8200.00	8200.00	9075.00	9075.00	8541.67
H1F3	8350.00	8350.00	8200.00	8200.00	9225.00	9225.00	8591.67
H2F1	8350.00	8350.00	7525.00	7525.00	8725.00	8725.00	8200.00
H2F2	8350.00	8350.00	8200.00	8200.00	9075.00	9075.00	8541.67
H2F3	8325.00	8325.00	8200.00	8200.00	9225.00	9225.00	8583.33
H3F1	8050.00	8050.00	7075.00	7075.00	8675.00	8675.00	7933.33
H3F2	8075.00	8075.00	7875.00	7875.00	8975.00	8975.00	8308.33
H3F3	8100.00	8100.00	7900.00	7900.00	9125.00	9125.00	8375.00
H4F1	8325.00	8325.00	7500.00	7500.00	8725.00	8725.00	8183.33
H4F2	8325.00	8325.00	8125.00	8125.00	9075.00	9075.00	8508.33
H4F3	8325.00	8325.00	7125.00	7125.00	9225.00	9225.00	8225.00
H5F1	8075.00	8075.00	7125.00	7125.00	8675.00	8675.00	7958.33
H5F2	8075.00	8075.00	7800.00	7800.00	9050.00	9050.00	8308.33
H5F3	8100.00	8100.00	7825.00	7825.00	9150.00	9150.00	8358.33
CD	-	-	-	-	-	-	**96.21**

and races, four and three feedings of the crossbreed were ranked first (12910.00 and 12761.38). The bivoltine under the same feeding schedule was ranked next. The two feedings had the least values for both the races. But the crossbreed was significantly superior to the bivoltine in all the feeding schedules. Of the combinations of different housing and feeding schedule, the four feedings in the thatched house H1 recorded the highest ERR (12934.92) followed by four feedings in thatched house H2 (12901.71), three feedings in RCC roof house (12851.75) and H4 (12807.33) were significantly superior to other combinations. Three feeding in RCC roof house was next in order and this was superior to the remaining combinations (12718.58). The schedule of four and three feeding in the light roof house and tiled roof house were ranked next. The least values were registered in two feeding schedules of the five types of houses. Only the mean values were statistically significant.

4.3.15 Disease incidence

The results on the incidence of diseases in the experiment are given in Tables 65-66.

4.3.15.1 Flacherie

The results on the incidence of flacherie in the experiment are given in Table 65. The data pertaining to the February-April season and mean values are only significant. The two feeding schedule had the highest incidence in

Table 65 Influence of feeding frequency on the incidence of **flacherie** in bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	2.50	2.50	4.15	4.15	1.75	1.75	2.80
F2	2.50	2.50	3.00	3.00	1.25	1.25	2.25
F3	2.50	2.50	3.00	3.00	1.25	1.25	2.25
CD	-	-	**0.43**	**0.43**	**0.72**	**0.72**	**0.19**
F1R1	3.00	3.00	4.76	4.76	2.00	2.00	3.25
F1R2	2.00	2.00	3.60	3.60	1.50	1.50	2.37
F2R1	3.00	3.00	3.50	3.50	1.50	1.50	2.67
F2R2	2.00	2.00	2.50	2.50	1.00	1.00	1.83
F3R1	3.00	3.00	3.50	3.50	1.50	1.50	2.67
F3R2	2.00	2.00	2.50	2.50	1.00	1.00	1.83
CD	-	-	-	-	-	-	**0.14**
H1F1	2.50	2.50	4.00	4.00	1.75	1.75	2.75
H1F2	2.50	2.50	3.00	3.00	1.25	1.25	2.25
H1F3	2.50	2.50	3.00	3.00	1.25	1.25	2.25
H2F1	2.50	2.50	4.00	4.00	1.75	1.75	2.75
H2F2	2.50	2.50	3.00	3.00	1.25	1.25	2.25
H2F3	2.50	2.50	3.00	3.00	1.25	1.25	2.25
H3F1	2.50	2.50	4.50	4.50	1.75	1.75	2.92
H3F2	2.50	2.50	3.00	3.00	1.25	1.25	2.25
H3F3	2.50	2.50	3.00	3.00	1.25	1.25	2.25
H4F1	2.50	2.50	4.00	4.00	1.75	1.75	2.75
H4F2	2.50	2.50	3.00	3.00	1.25	1.25	2.25
H4F3	2.50	2.50	3.00	3.00	1.25	1.25	2.25
H5F1	2.50	2.50	4.25	4.25	1.75	1.75	2.83
H5F2	2.50	2.50	3.00	3.00	1.25	1.25	2.25
H5F3	2.50	2.50	3.00	3.00	1.25	1.25	2.25
CD	-	-	-	-	-	-	**0.30**

February-April season (4.15) and the mean values. The highest incidence was 2.80. The other two feeding schedules did not vary in the mean value (2.25) or in February-April season (3.00). The incidence of flacherie in the combination was significantly more in bivoltine with two feedings (3.25) followed by the three and four feedings (2.67). The crossbreed fed with three and four feedings had the least incidence (1.83) and were significantly superior to the crossbreed fed twice a day. Of the combinations of house types and feeding schedule, the two feedings in all the five types of houses registered significantly higher incidence and were on par. The highest incidence was in the light roof house (3.92). The three and four feedings in all the house types had the least incidence (2.25). The data was not of significant variation in any of the seasons, unlike the mean values.

4.3.15.2 Grasserie

The results on the influence of feeding schedule on the incidence of grasserie are given in Table 66. The incidence was much less in general but varied significantly in different schedules in February-April and May-July seasons in both the years along with the mean values. The incidence was significantly more in the two feeding schedule (2.60) than the other schedules (2.12) which were on par. The bivoltine race fed twice a day recorded the highest incidence (2.97) followed by three and four feedings (2.43). The

Table 66 Influence of feeding frequency on the incidence of **grasserie** in bivoltine and cross breed silkworms in different types of rearing houses.

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96	Mean
F1	1.65	1.65	4.40	4.40	1.75	1.75	2.60
F2	1.60	1.60	3.50	3.50	1.25	1.25	2.12
F3	1.60	1.60	3.50	3.50	1.25	1.25	2.12
CD	-	-	**0.46**	**0.46**	**0.32**	**0.32**	**0.17**
F1R1	2.00	2.00	4.90	4.90	2.00	2.00	2.97
F1R2	1.30	1.30	3.90	3.90	1.50	1.50	2.23
F2R1	2.00	2.00	3.80	3.80	1.50	1.50	2.43
F2R2	1.20	1.20	3.20	3.20	1.00	1.00	1.80
F3R1	2.00	2.00	3.80	3.80	1.50	1.50	2.43
F3R2	1.20	1.20	3.20	3.20	1.00	1.00	1.80
CD	-	-	-	-	-	-	**0.17**
H1F1	1.50	1.50	4.00	4.00	1.75	1.75	2.42
H1F2	1.50	1.50	3.25	3.25	1.25	1.25	2.00
H1F3	1.50	1.50	3.25	3.25	1.25	1.25	2.00
H2F1	1.50	1.50	4.00	4.00	1.75	1.75	2.42
H2F2	1.50	1.50	3.25	3.25	1.25	1.25	2.00
H2F3	1.50	1.50	3.25	3.25	1.25	1.25	2.00
H3F1	1.75	1.75	5.00	5.00	1.75	1.75	2.83
H3F2	1.75	1.75	3.75	3.75	1.25	1.25	2.25
H3F3	1.75	1.75	3.75	3.75	1.25	1.25	2.25
H4F1	1.75	1.75	4.00	4.00	1.75	1.75	2.50
H4F2	1.50	1.50	3.25	3:25	1.25	1.25	2.00
H4F3	1.50	1.50	3.25	3.25	1.25	1.25	2.00
H5F1	1.75	1.75	5.00	5.00	1.75	1.75	2.83
H5F2	1.75	1.75	4.10	4.10	1.25	1.25	2.37
H5F3	1.75	1.75	4.00	4.00	1.25	1.25	2.33
CD	-	-	-	-	-	-	**0.27**

crossbreed with two feedings (2.23) ranked next and the least incidence was seen in three and four feedings (1.80). Only the mean values were having significant variation. Regarding the combination of house types and feeding schedule, the highest incidence was recorded with the combination of two feedings in light roof house and tiled house. The incidence was least with the three and four feeding schedules in thatched house H1 and H2 and RCC roof house. The others were intermediate in effect.

DISCUSSION

5. DISCUSSION

5.1 Effect of climatic factors on the mulberry silkworm crop

The results of the data presented under experiment-1 are discussed below. The feeding and moulting durations of the larvae of the two races under different seasons and brushing intervals varied significantly. Duration in October-November season was longer for the first instar larvae but the second and the third instars were having the longest in December-January seasons while the fourth and fifth instars had the longest duration in August-September seasons. The total feeding duration was longest in August-September season followed by December-January. Regarding the brushing intervals, the feeding duration was lowest in the first brushing in December-January season, the second brushing was seen having the optimum conditions for the larval growth. The temperature recorded in the month of December has been lower than the optimum (maximum 27.71 and minimum 23.03). The rise in temperature at the brushing in the third fortnight of December-January might have helped the normal growth and development of the worm. During August-September, the third brushing had better results than the other two brushings as the temperature was declining gradually.

The bivoltine race had longer feeding duration than crossbreed in all the seasons except February-April. The moulting duration was not having significant variation in any of the instars, in the data.

Development of economic characters in the silkworm larvae is mostly in its fourth and fifth instars. Venugopala Pillai et al. (1983) established that the feedings in the later stages improved the economic characters of the worm.

The total larval duration, combining the moulting and feeding durations, was longest in December-January season (622.30 hours) followed by August-September (612.13 hours). This was due to the longer moulting duration observed in December-January probably because of low temperature prevailing in that season. Regarding the influence of seasons on the races the bivoltine had larger larval duration than crossbreed in all the seasons. It is largely due to the influence of the racial character. The combination of third brushing and bivoltine race had the highest total feeding duration of 582 hours, the same treatment combinations had the highest total larval durations also in December-January (696 hours) and in August-September seasons (647.75 hours).

The missing larval percentage was not having any significant variation in the different brushing intervals but in seasons varied significantly and the lowest percentage was recorded in August-September followed by December-January confirming the conducive nature of these seasons. The different combinations of brushing intervals and races also have showed the suitability of December-January and August-September seasons in which the percentages of missing larvae were low.

The first instar larval weight was highest in May-July followed by August-September and December-January seasons even though the longest first instar duration was recorded in October-November season. Latter is the rainy season and as such the higher moisture content in tender leaves might have influenced the larval weight and duration. The second, third and fourth instars were having highest larval weight in October-November followed by August-September and May-July seasons whereas the fifth instar was having highest weight in December-January and August-September followed by May-July season. As the late instar worms were fed with mature and coarse leaves of which the water content is relatively low and the grown up larvae were able to maintain a stable water level in the tissues. The good quality of leaves in the rainy season has helped in the optimum conversion of food into body weight in the late instar larvae.

The highest fifth instar weight recorded in August-September and December-January has corroborated with total larval duration and the suitability of these seasons for efficient larval rearing is indicated. The maximum and minimum temperature and humidity in these seasons were almost similar and were favourable for normal larval growth and development.

Upadhyay and Misra (1991) has reported that the efficiency of digestion and gain in body weight was higher in the fifth instar larvae at 30-34 ^{0}C but Giridhar and Reddy (1991) has contradicted this view while they observed that the weight of the larvae was more in rainy seasons. The bivoltine race had more larval weight than crossbreed in all the seasons and it is more by its genetic factor than climatic influence. Also it was not in proportion to the difference in larval duration as the gain in larval weight was only 5-10 gm against a prolonged larval duration of 30-100 hours.

The growth rate and growth index values computed on the basis of larval weight of different races of silkworms in the different instars had varying results. The growth rate and growth index values were consistent only in August-September season. The values were higher in bivoltine race than in crossbreed as the bivoltine had higher larval weight. The third brushing had showed higher growth rate and growth indices in the first, second and fourth instars whereas the first brushing showed higher values in third and fifth instars than others.

The leaf consumption was found least in December-January followed by August-September and February-April seasons. Though the leaf consumption was less, the larval weight had been higher in August-September followed by December-January. During February-April season, the leaf consumption and fifth instar larval weight were less. The minimum and maximum temperatures were higher in these seasons than others while the minimum relative humidity had been low during these seasons. Gangavar et al (1993) has reported that higher temperature and lower humidity prevailing during the hot hours of day accelerated leaf withering leading to lower rate of ingestion by silkworms during hot periods of the day. In the December-January and August-September seasons the leaves consumed would have been utilized well under the optimum conditions of temperature and relative humidity, would have built up the larval weight efficiently.

The weight of silk gland was more in August-September than in other seasons followed by May-July and December-January. Here also the third brushing was found to have the highest weight in the particular season even though the larval weight did not vary significantly with brushing. Dinakar et al (1991) suggested that the higher size of silk gland in winter larvae might be responsible for higher cocoon weight and thereby silk yielding capacity. In the present study the silk gland had higher weight in August-September (0.72 gm) than December-January (0.66 gm) which represents the winter season in the state. The availability of fresh leaves in August-September after the bottom pruning in June-July might have contributed to the optimum development of silk gland under the favourable temperature and relative humidity prevailing during the season. The dry weight of the silk gland was found low when the larvae was fed with leaves of high water content during winter season in comparison with the summer season (Dinakar et al 1991). The present finding that the weight of silk gland had been least in summer season is in agreement with this observation.

The spinning percentage was highest in August-September followed by December-January and the other seasons were much inferior. In this season the maximum temperature and maximum humidity were close to the optimum requirements during rearing periods. The larvae were not under any stress and it could complete its normal growth and development and could spin successfully. The third brushing was found more efficient than the other two brushings. The higher percentage of spinning in crossbreed larvae indicated its adaptation to the particular climatic condition.

The single cocoon weight was also high in August-September followed by May-June and December-January seasons. It was proportional to the silk gland weight and the fifth instar weight observed in these seasons. Singh Deo et al (1992) supported the finding as he observed that the single cocoon weight was significantly higher in December-January, July- August, September-October and November-December. But in the present study, October-November has recorded only least cocoon weight presumably due to the high relative humidity in combination with the minimum temperature. The shell weight and pupal weight were also higher in August-September, May-July and December-January seasons, while the shell ratio was better in August-September and December-January. The high pupal weight recorded in May-July resulted in lower shell ratio than in December-January season. The high water content of the cocoon during this monsoon season might be responsible for the higher pupal weight. The higher shell ratio in bivoltine race might be due to its hereditary character also. The good cocoon number also had the same trend as in shell ratio as resulted from the high efficiency in spinning during the favorable season.

The cocoon yield per 100 worms followed the trends of spinning percentage and single cocoon weight. August-September was the most favorable season and was significantly superior to December-January season which was ranked second. In these seasons, the third brushing had yielded the higher weight than others. Singh Deo et al (1992) also reported that September-October was the most favorable season for cocoon yield in Korapt, Orissa. The bivoltine race, though less acclamatized than crossbreed, produced significantly higher yield indicating its suitability for rearing in these seasons.

The fecundity observed was more in August-September and December-January and thus corresponding to the pupal weight in the favorable season. The fecundity recorded in May-July was low compared to the high pupal weight observed in the season. This finding is in confirmation with Singh Deo et al (1992) reporting a low fecundity in July-August. In December-January, the incidence of flacherie was nil whereas in August-September, the incidence of grasserie was nil. During all the seasons, the disease incidence had been very low even in the bivoltine race.

Sivaprakasam (1994) reported that the incidence of grasserie was maximum in February-April, but was not in agreement with the present finding of least incidence in August-September. However the high incidence of grasserie in October-November was in agreement with Savanurmath et al (1995) who reported that the combined effect of temperature and relative humidity had significant correlation with incidence of the disease. October-November had the highest maximum relative humidity (93.89 per cent) in combination with higher temperature of 30.06^{0}C. The first brushing had reduced the incidence of flacherie whereas the graseerie was least in first brushing. Of the two silkworm types, bivoltine race was more prone to infection.

The reelability and filament length of cocoons were also highest in August-September followed by December-January. It was interesting to note that though May-July season was comparable to December-January season, in cocoon characters, the reelability and filament length in May-July was in general much inferior, even to the February-April season. Raj(1988) has stated that the cocoons reared in high temperature seasons had shorter filament length than other seasons, but in the present study the cocoons reared under high humidity prevailing in October-November and May-July seasons were found to have poor reelability and shorter filament length.

Raju and Krishnamoorthy (1995) have reported high renditta and filament length for $PMxNB_4D_2$ during monsoon and pre monsoon seasons than post monsoon seasons. The present finding is in agreement with the earlier report as the rate of relative humidity in monsoon seasons in the state may be very high to the range of 90-95 percent under which the normal spinning and evenness of the filament can be affected.

Effective rearing rates (by number and weight) were high in August-September followed by December-January and was least in February-April and October-November seasons. The high temperature prevailing in February-April and high humidity in October-November might have acted as stress factors in the normal growth and development of the larvae which resulted in low ERR values. According to Singh Deo et al (1992) the most effective rearing season for bivoltine race is September-October and the ERR (by no) was high in March-April and September-October. The present study was not in agreement with this report probably due to difference in climatic factors in Orissa and Kerala in the two seasons. The third brushing had been beneficial for ERR values.

The correlation of the different weather parameters with larval weight of fifth instar, leaf consumption, silkgland weight, total larval duration, shell ratio, cocoon yield, single cocoon weight and filament length showed that maximum temperature and minimum temperature inside the rearing house produced consistent correlations with the characters tested. Among these characters, path analysis was done to study direct and indirect effects of temperature and humidity on the shell ratio and single cocoon weight.

Results of the path analysis showed that the maximum temperature and maximum humidity are the main factors determining the shell ratio. Higher the values of these parameters, lower the shell ratio. 54 per cent of the variation in shell ratio in crossbreed race can be explained by the climatic parameters especially maximum temperature and maximum humidity as evidenced by the residue value of 0.46. In the case of bivoltine race, 57 per cent of the variation can be explained by the climatic parameters as evidenced by the residue value of 0.43.

Similarly, the maximum temperature and maximum humidity are the main factors determining cocoon weight in both the races. Higher the values of these parameters lower the cocoon weight. 62 per cent of the variation in cocoon weight in crossbreed race and 63 per cent of the variation in bivoltine race can be explained by the climatic parameters especially maximum temperature and

Table 67 Suitability of different seasons to the silkworm types NB_4D_2 and PMx NB_4D_2 in terms of important biological and economical characters

Character	BV I[st] rank	CB I[st] rank	BV II[nd] rank	CB II[nd] rank	BV III[rd] rank	CB III[rd] rank	BV IV[th] rank	CB IV[th] rank	BV V[th] rank	CB V[th] rank
Total larval duration	1	4	3	1	4	2	5	5	2	3
Fifth instar larval weight	4	4	1	1	3	3	2	2	5	5
Single cocoon weight	4	4	3	3	1	1	2	2	5	5
Shell ratio	4	4	1	1	3	3	2	2	5	5
Good Cocoon Number	4	4	1	1	3	3	2	5	5	2
Effective rearing rate (No)	4	4	1	1	3	3	5	2	5	2
Reelability	4	4	1	1	2	2	5	3	3	5
Filament length	1	4	4	1	2	2	3	5	3	5
Cocoon yield	4	4	1	1	3	3	5	2	2	3

1 – December-January 2 - February-April 3 - May-July 4 - August -september 5 – October-November

BV - NB_4D_2 CB - PM x NB_4D_2

maximum humidity as evidenced by the residue values of 0.38 in the case of crossbreed race and 0.37 in the case of bivoltine race.

The influence of different seasons on the important larval, cocoon and economic characters of the two silkworm types are shown in Table 67. It may be observed that for bivoltine August-September and December-January seasons were ranked as first and second, while for crossbreed, the season August-September was the most favourable consistently for all the characters. For bivoltine, December-January season was optimum for total larval duration and filament length. Based on these findings, the August-September and December-January seasons were identified as favourable ones for the growth and development of silkworm and for commercial rearing. The other three seasons thus identified as unfavourable seasons for normal silkworm rearing for which suitable rearing techniques have to be evolved for maximizing production.

5.2 Identifying rearing technology for stress conditions of temperature and humidity

The different types of rearing houses and larval spacings were tried to improve rearing in the unfavourable seasons in the experiment-II. The total larval duration was highest in RCC roof house followed by the thatched houses and the duration in the RCC roof house recorded in the unfavourable seasons (623.90 hours) was almost similar to that recorded in the favourable season viz December-January (622.33 hours). The higher larval duration under closer spacings were due to the lack of suffficient space and food and the duration was prolonged very much in October-November season, especially in the case of bivoltine race.

Even though the mean larval duration was 623.90 hours in RCC house, depending on the temperature prevailing in different seasons, the duration varied from 545.08 hours in February-April season to 661.25 hours in October-November. The longer larval duration in H4 rearing house may be due to the low temperature and high humidity in the rearing house with RCC roof and false ceilings. The thatched houses also have been efficient in reducing the temperature inside the rearing house as evidenced in the Appendix IV. Gangawar and Somasundaram (1991) found that the mud house with thatched roof had cooler climatic conditions than tiled house and RCC building and enhanced larval duration. In this study the added efficiency of RCC house may probably be due to the additional false ceilings provided. Similar observations were also made by Shivakumar et. al. (1995).

The moulting duration was highest in RCC roof rearing house followed by thatched houses. The reduced duration in other houses had been due to the high temperature prevailing in those houses. The higher larval spacing induced earlier moulting. The higher moulting duration observed for the bivoltine race in all the houses than in the previous experiment is in confirmation with its racial character. The crossbreed was not having significant variation due to spacing.

The missing larval percentage was found least in thatched houses and RCC house. This indicated the fulfillment of the optimum requirements for the early instar rearings viz the temperature and humidity in thatched houses. The wide spacing could reduce the missing larval percentage to 25 per cent compared to close spacing. The missing larval percentage in summer season was 6.47 in the case of bivoltine race in contrast to 25.33 recorded in the previous experiment. The difference between the favourable and unfavourable seasons was reduced very much and the value was to the level of the favourable seasons. The larval weight of the first and second instar did not differ significantly in between the houses except for the May-July seasons. The larval weight of the first and second instar did not differ significantly between the houses except for the May-July season. The weight of these two instars was highest in the room with thatched house with mud walls. The larval density also had no impact during these instars.

The weight of third, fourth and fifth larval instars was highest in the rearing house made of mud wall and thatched house. The weight gain due to wide spacing in comparison to the normal spacing was not pronounced when compared to the area utilized. But the different rearing houses could not enhance the fifth instar larval weight in February-April season from those recorded in the first experiment as the mean temperature prevailed within the rearing house was higher than the outside temperature though the temperature in the house H1 was the least. The weight gain was more in October-November season than in May-July seasons.

The thatched house H1 and wide spacing recorded the highest leaf consumption. The availability of food without competition may be attributed to high leaf consumption in wide spacing. But high leaf consumption under all spacings might be due to optimum climatic conditions in the thatched house H1. The higher leaf consumption by bivoltine race was in agreement with the previous experiment. The data recorded in the combination of houses and spacing are also in agreement with the independent values recorded.

Of the growth rate computed for the five larval instars, rearing house H1 was found more efficient as the first, third and fifth larval instars obtained highest growth rate in this rearing house. While the second instar did not have any significant difference, the fourth instar had a different pattern. The wide spacing also had higher growth rate than others for the first and third instars. The impact of the spacing was negligible in the case of the late instars. Upto third instar, the bivoltine race had better growth rate than crossbreed and in the late instar the difference was not significant.

Regarding the growth index, the thatched house H1 was found to be the most suitable rearing house for growth index followed by thatched house H2 except in the second instar larvae in which the difference was not significant. Invariably the wide spacing independently and in combination with other factors had higher growth rate than the medium and close spacings. The high growth index recorded in the bivoltine race is in conformity with the other experiments.

Sengupta and Yousuf (1974) noted that in bivoltine silkworms larger spacing helped to improve growth and vigour of larva. In the present study the bivoltine race also improved the growth under wide spacing. Rangaswamy et al (1976), Jolly et al (1987) and Krishanswamy (1988) noted that the larval growth is related with larval spacing by ensuring ideal microclimatic conditions of the bed. But Sehnal (1985) has opined that no insect growth and development was optimum under certain environmental conditions. The caterpillars are adjusted for a wide range of population densities. This must be applicable to the crossbreed as it has gained almost similar growth rates in close spacing compared to other spacings.

Single cocoon weight also was highest in the thatched house H1 under wide spacing. Wide spacing in tiled roof house could also improve the single cocoon weight. The single cocoon weight increased in the thatched house H1 by 21 per cent in comparison with the single cocoon weight obtained in the unfavourable seasons. Though the bivoltine had higher growth rate, growth index, and larval weight, single cocoon weight had been highest in the thatched house H1, the crossbreed was not having much impact on spacing in terms of the single cocoon weight as the close spacing could produce cocoons of higher weight than in the medium spacing. Anyhow the combination of wide spacing and houses Hl and H5 were superior when the racial character was not considered.

Haque et al (1992) has reported that spacing of silkworms have direct effect on cocoon production. He observed that 3 sq.ft /laying for local races and 4 sq.ft /laying for improved and bivoltine races was optimum. Though the wide spacing could produce cocoons of higher weight the difference between optimum spacing was limited and hence it may not be advisable to adopt a higher spacing.

The shell weight has been highest in thatched house Hl as in the case of single cocoon weight but the RCC house was inferior to all other houses though it was ranked as fourth in the case of single cocoon weight under different spacings. The thatched house Hl is found to have fulfilled the optimum requirement for both the races to spin cocoons of high shell weight. The crossbreed could produce cocoons of higher shell weight than bivoltine in other types of rearing houses also as it has acclamatized better than the bivoltine race. Under wide spacing the highest shell weight was recorded in the case of crossbreed and the combination of the crossbreed and thatched house H1.

In the case of shell ratio the pattern was slightly different. Though thatched house H1 was the most efficient, the RCC roof house was ranked next even though it had only low shell weight. This was due to small size of the cocoon which contained comparatively higher silk content.

For filament length and reelability of cocoons, the thatched houses were more promising. The higher percentage of shell ratio in small sized cocoons obtained in RCC roof house can not be attributed as a good commercial character. The filament length and reelability were highest in thatched houses especially in the combination of crossbreed and wide spacing. The cocoon characters of the crossbreed reared in thatched house H1 under wide spacing has been better than other houses in the case of single cocoon weight, shell weight, shell ratio, reelability and filament length.

The disease incidence in the present study was meagre. Flacherie was not having any significant variation between the houses. The incidence of grasserie varied significantly in between the houses. The highest incidence was recorded in light roof and tiled roof houses with the bivoltine race. The close spacing though recorded significant values, the intensity was not enough to bring an economic loss as the values ranged between 2.32 and 3.57 per cent.

The ERR (no) and ERR (wt) were higher in the crossbreed reared in thatched house H1 under wide spacing. The ERR (no) for crossbreed in the previous experiment in February-April, May-July and October-November were 6891.31, 8430.00 and 6833.33 respectively compared to 8400.00, 9183.33 and 8566.67 obtained in the present study in the thatched house H1. The ERR (wt) also was highest in thatched house H1 and the crossbreed was better than bivoltine. ERR (wt) could be improved by 26 per cent, 16 per cent and 18 per cent in the seasons of October-November, February-April and May-July respectively by rearing in the thatched house H1.There had been much improvement in these characters when compared to rearings undertaken in unfavourable seasons in the previous experiment except for the filament length recorded for the bivoltine race. The filament length of the cocoons produced from different rearing houses were not proportional to the reelability of cocoons. Hence the crossbreed emerged as the suitable race to be reared during unfavourable seasons.

The filament length in the crossbreed cocoon was much higher than in bivoltine cocoons in this study and it can be substantiated with reference to the higher single cocoon weight, shell ratio and reelability recorded in the crossbreed cocoons. In the favourable rearing house the commercial characters of the crossbreed were higher during these normally unfavourable seasons.

Therefore the crossbreed may have to be preferred for rearing in the unfavorable seasons.

Of the three spacings studied independently and in combinations with different types of rearing houses, wide spacing had been more efficient than the medium and close spacing in promoting optimum larval characters and commercial characters of cocoons. The mean percentage of increase or decrease of the important characters in the thatched house H1 during the three unfavorable seasons over the mean of unfavorable seasons in the first experiment is presented in Table 68.

It may be noted that the percentage increase in ERR (no), single cocoon weight, reelability and filament length were 4.2 per cent, 3.2 per cent, 5.1 per cent and 6.6 per cent respectively in the wide spacing compared to presently recommended medium spacing. For this gain, the additional space requirement have been 25 per cent of the previously recommended space along with the additional expenditure required for rearing equipment and labour charges. As the increase in productivity is not proportional with the profit generated after the additional investment required for wide spacing, the existing recommendation of spacing was found adaptable even for the unfavorable season rearing in the favorable house.

Table 68 Percentage variation in larval and cocoon characters observed when reared in different types of rearing houses and spacings in comparison with the criteria in experiment I

Characters	Unfavor able season (Expt .I)	H1S1	% Differ-ence(H1 S1-Expt.1)	H1S2	% Differ-ence(H1 S2-Expt.1)	H1S3	% Differ ence(H1 S3-Expt.1)	%Differ-ence(H1 S3-H1S2)
Total larval duration	594.45	630.33	+6.00	615.75	+3.60	583.08	-2.00	-5.31
Larval wt. of fifth instar	29.48	30.33	+2.9	31.85	+8.04	32.75	+11.09	+2.83
Single cocoon weight	1.41	1.46	+3.55	1.52	+7.80	1.57	+11.35	+3.29
Shell ratio	15.93	17.60	+10.48	18.91	+2.98	19.31	+19.90	+2.12
Effective rearing rate (No)	7218.55	8216.67	+13.83	8312.50	+15.15	8662.50	+20.00	+4.21
Filament length	787.67	785.21	--0.31	794.38	-0.85	846.88	+7.52	+6.60
Reelability	66.27	67.38	+1.67	69.58	+4.96	73.13	+10.35	+5.10

H1S1 –Thatched house & Close spacing. H1S2- Thatched house & Medium spacing.
H1S3- Thatched house & Wide spacing.

5.3 Manipulation of feeding schedule with reference to seasons and types of rearing houses

In order to evolve a more profitable rearing technique for unfavorable seasons by reducing the cost of rearing, the third experiment was conducted with medium spacing and three feeding frequencies and the results obtained are discussed below.

The total larval and moulting durations were prolonged when the larvae were fed twice daily which resulted in insufficient food intake. The difference in duration between three and four feedings had been less than between two and three feedings. The bivoltine race had longer larval and moulting durations than the crossbreed in accordance with its genetical makeup. The variation between different seasons in moulting duration was negligible. In the thatched house H1, the larval and moulting duration was optimum as found in the previous experiment.

The missing larval percentage was also highest under two feeding schedules especially in the bivoltine race. Crossbreed had only significantly less percentage of missing larvae. Anyhow the difference in missing larval percentage between four feeding and two feeding was about 1 per cent which may not have any impact on the returns considering the time and money required for feeding four times a day. The weight gain in the early larval instars was more under the four feeding schedule particularly in the case of bivoltine race reared under the thatched houses H1 and H2. The fourth instar larva also maintained the same pattern. In fifth instar, the larval weight exhibited a different pattern. The weight gains in three and four feedings were on par in the case of bivoltine in the thatched houses H1 and H2. This indicates that a shift from four feeding to three feeding does not interfere with larval weight in its final instar though there may be some weight reduction in the earlier instars. With regard to total leaf consumption, the variation between the three seasons was not significant and there was no significant reduction in consumption when the larvae were fed 2, 3 or 4 times a day. The significant difference between the bivoltine and crossbreed in leaf consumption is purely a racial character. As the bivoltine race consumed more leaves under four feeding schedule only, in case of crossbreed the difference was not significant among the feeding schedules. The three and four feedings in thatched houses H1 and H2 resulted in the same rate of leaf consumption. But the higher rate of leaf consumption in the RCC roof house was not reflected in the larval weight recorded in this house.

Legay (1951, 55 and 1958) has also obtained similar results. He stated that the continuous feeding did not favour the growth and development as compared to fixed intervals of feeding. He also revealed that less number of feeding frequencies per day did not affect the development of silk worms upto third moult. The worms fed six times per day ate less quantity than the worms fed with two or four feeding. He also pointed out that if the nutritional qualities of mulberry leaves were maintained properly, the larvae could be fed at leisure. In the present studies also three feeding schedule was found as effective as four feeding schedule in the thatched house with mud walls.

The requirement of higher feeding frequencies for the first instar larva observed in this experiment was supported by Hakkim Ali (1992). He reported that the required number of feeding times for the first age was more than second, third and fourth age larvae but he has suggested 5-7 feedings for the fifth instar larvae, in contrary to the report of Legay (1958).

The weight gains in thatched houses H1 and H2 under three and four feeding frequencies are in agreement with the leaf consumption in these treatments. The results recorded as the single cocoon weight under this experiment revealed that the single cocoon weight is influenced by total leaf consumption but not by the number of feedings. The slight weight gain for cocoons obtained under four feeding schedule was not significantly different from that of three feeding schedule in all the seasons. Bivoltine and crossbreed were similar in their response to three and four feeding schedule and cocoon weight did not differ significantly between these combinations. Other interesting observation was that of similar cocoon weights (1.50gm) obtained for three and four feeding schedules in the thatched house H1. This house has been efficient in providing the highest cocoon weight among the rearing houses under this experiment and is on par with thatched house H2 and RCC roof house for the three feeding schedules. Even the four feeding schedule in other houses was not able to provide cocoons of similar weight as obtained in thatched house H1.

Gabriel and Rapuses (1983), Kuruda et al (1983) and Venugopala Pillai (1986) observed that restricted feeding at fifth instar has affected the larval duration. This is in confirmation with the present finding that the higher duration of 623.41 hours observed under the two feeding schedules in the thatched house was actually a prolonged larval duration as it was able to produce only a cocoon of 1.44 gm compared to three and four feeding schedules in the same house which produced 1.50 gm of cocoon. Though Krishnaswamy et al (1976) found that four feedings are advantageous over three feedings in terms of cocoon weight, here three feedings are found on par with four feedings and significantly superior to two feedings per day. It requires special mention that the cocoon weight in the summer seasons of February-April was less than that of other two seasons which are rainy in nature.

The growth rate and growth index of different larval instars under different feeding schedules were not consistent. The first instar larvae followed a pattern where the four feeding and three feeding schedules recorded higher values. The bivoltine and crossbreed were on par for the three and four feeding schedules and in thatched houses, the larvae recorded the highest growth rate and growth index. In the second instar, the growth rate and growth indices were highest in the four feeding schedule for the bivoltine reared in thatched houses H2 and H1. In the third instar, the two feeding schedule recorded the highest growth rate while in combination with the rearing houses all the three feeding schedules could register higher values. But the growth index was consistent and highest with four feeding schedules in the combination of the bivoltine and thatched house H1.

In fourth instar, the growth rate and growth index were higher in three and four feeding schedules than the two feeding schedule. While the growth rate was more for the crossbreed, the growth index was found higher for the bivoltine. Most of the houses recorded similar growth rate while thatched houses H1 and H2 and light roof house had higher growth indices under the four feeding schedule. In the case of the fifth instar larvae, the growth rate was observed higher in two and three feeding schedule. It may be recalled that the fifth instar weight and rate of leaf consumption was not significant between three and four feeding schedules. The higher growth rate obtained in RCC roof house under two and three feeding schedules is in agreement with the larval weight and rate of leaf consumption in that house during the particular stage. The continuous influence of the feeding frequencies on the different larval instars has been reflected in the growth index of the fifth instar larvae. The three and four feeding schedules have recorded the highest indices independently. The bivoltine was having higher growth index than the crossbreed under the four and three feeding schedules.

In the thatched houses H1 and H2 the three and four feeding schedules were on par for the final instar. This combination gave the highest single cocoon weight. Higher growth indices of bivoltine race was not reflected in higher single cocoon weight in the crossbreed.

The shell weight and shell ratio were not having significant differences among the feeding frequencies while the combinations of feeding frequencies and races were not having significant variation in the case of shell weight, the shell ratio was found best in the combination of crossbreed fed with two and four feeding schedules. The significance in the case of two feeding schedule resulted from the low weight of cocoons (1.43 gm) obtained under this schedule against 1.48 gm under the other two feeding schedules. The combination of houses and feeding frequencies was not having any significant influence on the shell weight and shell ratio in different seasons. But the higher shell weight recorded in thatched houses H1, H2 and RCC roof house under the three feeding schedules had not reflected in the shell ratio under the same treatments. Therefore single cocoon weight may be considered as the main factor in deciding the effective combinations.

In the case of filament length and reelability three and four feeding schedules were found significantly superior to the two feeding schedule. The crossbreed reared under four feeding schedule emerged as the best combination in the case of filament length and reelability. Though the bivoltine were having high single cocoon weight, the filament length and reelability were inferior to crossbreed. Though the bivoltine is known to have a higher filament length than the crossbreed, the poor reelability in unfavorable season especially in October-November could be responsible for low filament length. Geethadevi et al (1986) also pointed out that the effect of two, three and four feeding frequencies were not significantly different in terms of single cocoon weight, shell weight, shell ratio and absolute silk content.

While the reelability of the cocoons reared in different houses under three and four feeding schedules were on par, the filament length in all the houses under the four feeding schedules had been slightly higher in the present study. Though the single cocoon weight was significantly less under the two feeding schedule, the shell weight, shell ratio and filament length did not vary significantly in different seasons and the mean values were useful in drawing conclusions. These findings are in agreement with Narayanan and Chawla (1965) where they observed significant difference in between two, three or four feedings as judged by single cocoon weight, filament length and reelability.

Disease incidence was significantly higher in the two feeding schedule compared to other feeding schedules which were on par. The bivoltine larvae reared with two feedings per day were infected more with flacherie and grasserie. The three and four feeding schedules were on par in the case of disease incidence. Findings of Aruga and Tanada (1991) and Samson (1981) corroborated the finding and they observed that two feedings causes starvation and thereby leading to higher incidence of diseases resulting in poor cocoon characters. The houses with light roof and tiled roof enhanced the rate of disease incidence especially under the two feeding schedule.

The ERR (no) and ERR (wt) also had a similar pattern and two feeding schedule was inferior to three and four feeding schedules. The crossbreed reared under three and four feeding schedules had better ERR (no) and ERR (wt). The better adaptation of the crossbreed to the unfavorable climatic conditions than bivoltine is well known and it was reflected under the different feeding schedules also. The suitability of the thatched houses for the silkworm rearing in unfavorable seasons was confirmed here also as the highest ERR (no) and ERR (wt) were obtained in the treatment. Four feeding schedule was on par with three feeding schedule in the thatched houses.

A consolidated ranking of the different types of rearing houses, larval density and feeding frequencies against the larval and cocoon characters is given in Table 69. It may be observed that thatched houses H1 with mud wall

Table 69 Ranking of the efficiency of rearing tools tested in the unfavorable seasons in experiment II and III in terms of important larval and cocoon characters

Character	BV I[st] rank	CB I[st] rank	BV II[nd] rank	CB II[nd] rank	BV III[rd] rank	CB III[rd] rank
Total larval duration	S1 H4 F1	S1 H4 F1	S2 H1,H2 F2	S2 H1,H2 F2	S3 H5 F3	S3 H5 F3
Fifth instar larval weight	S3 H1 F3 F2	S3 H1 F3	S2 H2 F1	S2 H2 F2	S1 H4	S1 H1 F1
Single cocoon weight	S3 H1 F3 F2	S3 H1 F3 F2	S2 H2 F1	S1,S2 H2 F1	S1 H3	H3 H5
Shell ratio	S3 H1,H2 F1	S3 H1 F3 F1	S2 H4 F3	S2 H4 F2	S1 H5 F2	S1 H5
Effective Rearing Rate(no.)	S3 H1 F3	S3 H1 F3	S2 H2 F2	S2 H2 F2	S1 H4 F1	S1 H4 F1
Reelability	S3 H1 F3	S3 H1 F3	S2 H2 F2	S2 H2 F2	S1 H4 F1	S1 H4 F1
Filament length	S3 H1,H2 F3	S3 H1,H2 F3	S2 H3,H5 F2	S2 H3,H4,H5 F2	S1 H4 F1	S1 F1
Effective Rearing rate(wt.)	S3 H1 F3	S3 H1 F3	S2 H2 F2	S2 H2 F2	S1 H4 F1	S1 H4 F1

H1-Thatched roof house with sun dried brick wall. H2-Thatched roof house with burnt brickwall.
H3-Light roof house with sun dried brick wall. H4-RCC roof house with burnt brick wall.
H5-Tiled roof house with burnt brickwall.

S3-Wide spacing S2-Medium spacing S1-Close spacing

F3-Four feeding /day F2-Three feeding /day F1-Two feeding /day.

ranked first for rearing crossbreed larvae during the unfavorable seasons. For the bivoltine larvae, the only variation from this pattern was in total larval duration. But as all other parameters *viz* single cocoon weight, shell ratio, reelability, filament length and ERR are best in thatched house H1.Hence this type of rearing house is identified as the best for rearing silkworms under unfavorable conditions. Based on ranking, thatched house with mud wall, thatched house with brick wall, and RCC roof house with false ceiling and brick wall came in descending order. It may be due to low fluctuations of major weather components inside these rearing houses. Regarding the larval density, the existing recommendation of larval spacing may be followed though wider spacing ranked first. The returns from wider spacing is not proportional to investments. In the case of feeding frequencies, four feedings and three feedings were on par for most of the characters. The crossbreed showed more production potential than bivoltine race in unfavorable seasons. So it would be more cost effective if crossbreed silkworm types were reared during unfavorable season. The cocoon characters like single cocoon weight, shell ratio, filament length and reelability were better for the crossbreed reared during the unfavorable seasons compared to the bivoltine race. Therefore considering the growth and development of the silkworm larvae during these seasons and cocoon characters like single cocoon weight, shell ratio and ERR (no), the crossbreed was found more suitable than bivoltine for rearing in unfavorable seasons even for adopting new techniques. It may be noted that even with the new techniques the total larval duration of the bivoltine was much higher than the crossbreed and without any reflection on the cocoon weight. This will cause waste of mulberry leaves, labour and time, and hence on this ground also it is advisable to rear crossbreed during the unfavorable seasons in preference to bivoltine.

The labour saving by reducing one feeding a day was estimated as two hours per day per 100 layings. An important advantage of this feeding schedule is that the farmers will be able to feed larvae in the morning, noon interval and night without interference to other routine work.

The impact of silkworm rearing adopting the new rearing techniques are presented in Table 70 and Fig 5.

It is interesting to note that the larval and cocoon characters in the unfavorable seasons have been improved by rearing the larvae in the thatched house (H1), the existing larval spacing and three feeding a day. The yield and quality components are comparable even with those of the favorable seasons. Thus silkworm rearing can be made equally remunerative in the favorable or unfavorable seasons of the year. The economics computed for rearing 50 dfls each in five seasons in an year following the improved techniques are presented in the Table 71.

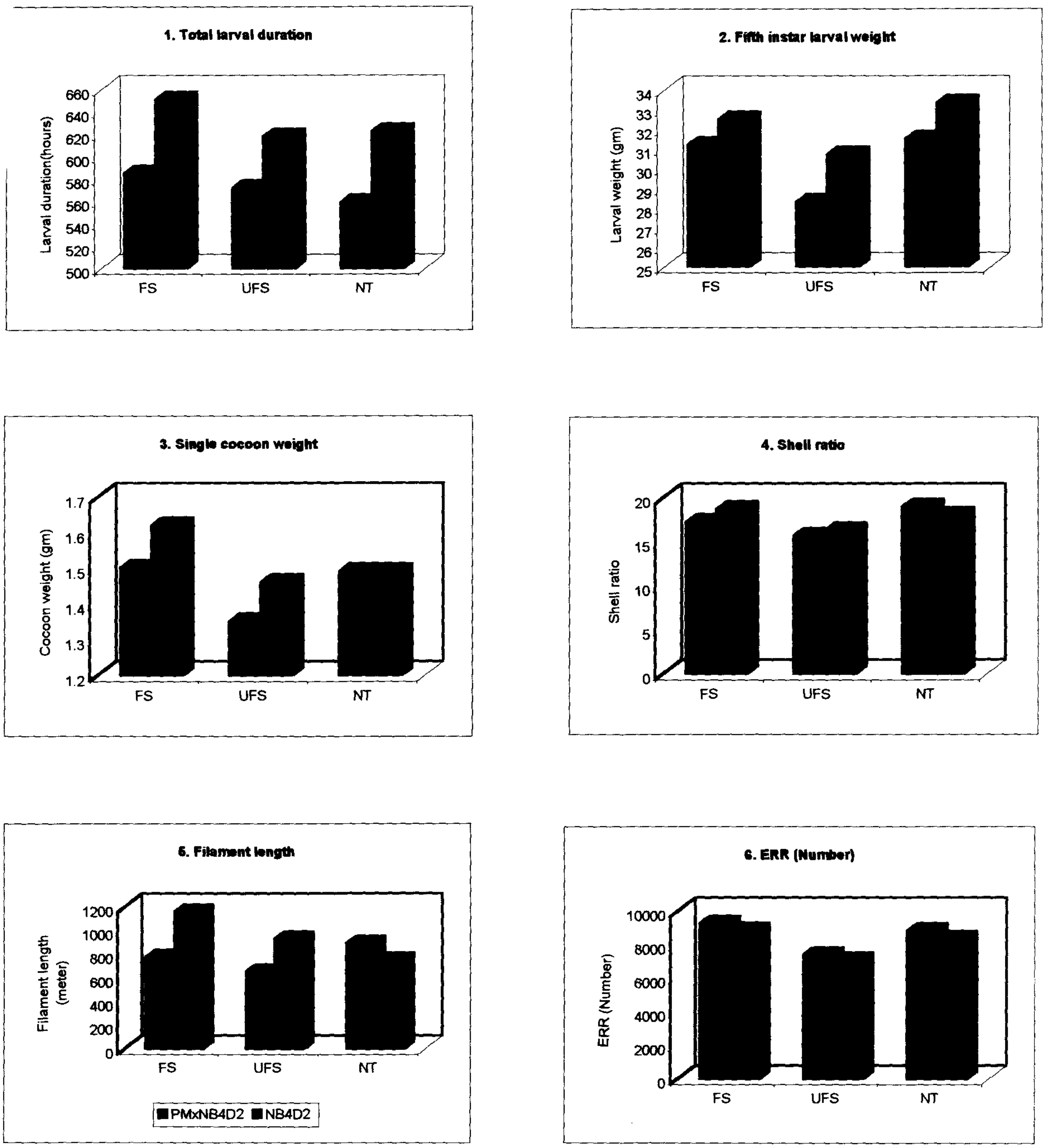
Table 70 Comparison of new rearing techniques and traditional method of silkworm rearing under favourable and unfavourable seasons of the year

Characters	Means of favorable seasons (Expt. I)	Means of Unfavorable seasons (Expt. I)	Means of data in unfavorable seasons in thatched house H1 in Experiment II* & III*			
			Larval spacing		Feeding frequency	
			S3	S2	F3	F2
Total larval duration						
CB	584.34	571.36	542.10	563.42	549.10	558.40
BV	650.13	617.53	604.28	615.65	600.90	621.55
Fifth instar larval wt.						
CB	31.18	28.26	30.98	29.60	31.50	31.50
BV	32.48	30.70	32.05	31.40	33.30	33.33
Single cocoon wt						
CB	1.55	1.35	1.56	1.48	1.48	1.49
BV	1.62	1.46	1.49	1.44	1.48	1.49
Shell ratio						
CB	17.19	15.62	19.02	18.73	18.84	18.93
BV	18.67	16.24	18.08	18.07	18.48	17.97
E.R.R (number)						
CB	9233.34	7375.00	8633.33	8498.67	8816.66	8810.56
BV	8816.67	7061.11	7828.33	7588.33	8366.66	8316.66
Filament length						
CB	770.96	648.78	953.83	872.83	899.33	890.33
BV	1155.83	926.56	684.03	669.67	753.66	750.00
Reelability						
CB	77.88	64.42	71.83	70.58	73.63	73.50
BV	82.17	68.33	68.25	65.42	70.67	70.17

CB-PM X NB_4D_2 ; BV- NB_4D_2 : S3- Wide spacing ; S2- Medium spacing : F3-4 feeding ; F2-3feeding; H1-Thatched house with mud brick wall.

*(Appendix-VI)

Fig 5 Performance of silkworms reared under conventional rearing techniques in comparison with the new technology evolved during unfavourable seasons of the year



FS - Favourable seasons in experiment 1
UFS - Unfavourable seasons in experiment 1
NT - New technology (Three feeding ; Medium spacing ; Thatched house with mudbrick walls and PMxNB4D2

Table 71 Yield and income from 50 dfls of silkworm in five seasons of the year

A. Under existing practices

Parameters	Race	Seasons				
	BV/CB	Dec-Jan	Feb-Apr	May-Jul	Aug-Sep	Oct-Nov
Cocoon yield (Kg)	BV	23.10	14.21	21.62	25.06	13.98
	CB	22.32	14.64	22.23	26.20	15.11
Good cocoons (Nos)	BV	85.08	63.83	80.67	91.25	67.33
	CB	90.92	68.92	84.00	93.75	68.33
Shell ratio	BV	18.27	16.47	17.57	19.06	14.68
	CB	16.96	15.91	16.62	17.42	14.33
Recovery silk ratio	BV	65	60	60	65	55
	CB	60	55	55	60	55
Renditta	BV	9.94	15.90	11.78	8.81	18.52
	CB	10.83	16.87	13.25	10.25	18.71
Price per kg	BV	143.80	89.94	121.19	162.31	77.24
	CB	120.96	77.65	98.86	127.80	70.00
Receipt from different seasons	BV	3323	1278	2620	4068	1080
	CB	2700	1137	2197	3348	1058
Receipt from five seasons	BV	For five seasons-Rs 12370/-				
	CB	For five seasons-Rs 10440/-				
Incentive	BV	Rs 15/kg	98 x 15 = 1470/-			
	CB	Rs 5/kg	101 x 5 = 505/-			
Total receipt	BV	12370 + 1470 =13840/ year / 50 layings				
	CB	10440 + 505 =10945/ year / 50 layings				

(Average cost-CB silk- Rs1310/- & BV Silk-1430/- ; Labour cost/ manday- Rs130/-)

Table 71 *(Contd.)*

B. Under new practices

Parameters	Race	Seasons				
	BV/CB	Dec-Jan	Feb-Apr	May-Jul	Aug-Sep	Oct-Nov
Cocoon yield (Kg)	BV	23.10	18.35	23.72	25.06	19.75
	CB	22.32	19.32	25.34	26.20	20.41
Good cocoons (Nos)	BV	85.08	75.50	86.00	91.25	79.85
	CB	90.92	80.20	92.00	93.75	86.00
Shell ratio	BV	18.27	16.76	18.89	19.06	18.49
	CB	16.96	18.09	17.16	17.42	19.18
Recovery silk ratio	BV	65	60	65	65	65
	CB	60	65	60	60	65
Renditta	BV	9.94	13.16	9.45	8.81	10.41
	CB	10.83	10.64	10.61	10.25	9.31
Price per kg	BV	143.80	108.66	151.32	162.31	138.70
	CB	120.96	123.12	123.47	127.80	140.70
Receipt from different seasons	BV	3323	-	-	4068	-
	CB	-	2378	3127	-	2862
Receipt from five seasons	2 BV& 3 CB	For five seasons under new technology - Rs 15768/- For five seasons under old technology – Rs 11783/-				
Incentive	BV	Rs 15/kg	Rs 725/-			
	CB	Rs 5/kg	Rs 320/-			
Total receipt	For five seasons under new technology – Rs 15768 + 725 + 320 = Rs 16813 /- For five seasons under old technology – Rs 11783 + 725 + 259 = Rs 12767/- Receipt gain due to new technology – Rs 4046/-					

(Average cost-CB silk- Rs1310/- & BV Silk-1430/- ; Labour cost/ manday- Rs130/-)

As per Central Silk Board norms (Jolly, 1987) for feeding 50 layings , 2 hours are required for feeding the young stage larvae/ day and 6 hours for feeding late age worms/day. So for one time feeding, half an hour is required when the worms are in the young stage and one and half hours are required in the later stages. If one feeding is reduced, 24 hours (6 hours in young larval stage and 18 hours in late larval stage) or 3 man days can be saved / season. So in a year 15 man days and an amount of Rs 1950/- will be saved.

For the marginal farmers and agricultural labourers engaged in silkworm rearing in the state, an additional income generated by the new technology during unfavourable seasons will be an incentive to continue the sericulture activities. As the major crops in Kerala like coconut and rubber are facing crisis due to low price and thereby reduction in profit, the small and marginal farmers can be attracted to sericulture as an ideal source of supplementary income.

SUMMARY

SUMMARY

The objectives of the study were to (1) Study the effect of climatic factors on the mulberry silkworm crop in Kerala (2) To identify suitable rearing house and spacing for unfavourable seasons for rearing and (3) To manipulate feeding schedule with reference to stress seasons and types of rearing houses

The first experiment was conducted based on the weather factors prevailing during 1977-1991 and one year was demarcated into five seasons viz December-January, February-April, May-July, August-September and October-November. The impact of weather factors on silkworm rearing and the favourable and unfavourable seasons of the year were studied. The rearings were undertaken during 1993-1994 using two silkworm types, bivoltine NB_4D_2 and crossbreed PM x NB_4D_2. In each season, three brushings were done at fortnightly intervals commencing at the beginning of the season and the data on the biological characters of the silkworm and economic traits of cocoons on these types of silkworms were recorded. The observations recorded are instar wise feeding and moulting durations, instarwise larval weights, missing larval percentage, single cocoon weight, shell weight, leaf consumption, disease incidence, silkgland weight, fecundity, reelability and filament length. The computed observations like growth rate, growth index, shell ratio, ERR by weight and ERR by number were also worked out along with the recording of daily meteorological observations like temperature and relative humidity inside and outside the rearing house.

Results of Experiment-I revealed that feeding duration was longer in December-January, August-September and May-July seasons and moulting durations was more in February-April. The total larval duration was more in December-January, August-September and May-July seasons and in the silkworm types bivoltine has shown prolonged duration than crossbreed. The missing larval percentage was high during February-April, October-November and May-July seasons. The larval weights recorded were high during August-September and December-January seasons. The bivoltine registered higher larval weights than crossbreed. The growth rate and growth index values of different larval instars showed varying trends in the different seasons and in the different races. The leaf consumption was more in October-November and May-July seasons than others. The bivoltine consumed more leaves than crossbreed during different larval instars. The silkgland weight was more in August-September and December-January than in other seasons. The economic traits like spinning percentage, single cocoon weight, cocoon yield, shell weight and shell ratio were maximum during August-September followed by December-January season.

Among the races, bivoltine registered higher silkgland weight, cocoon weight, shell weight, shell ratio, cocoon yield, reelability and filament length than crossbreed. The crossbreed recorded more spinning percentage and ERR. Among the different brushing frequencies, the third brushing had desirable biological characters and economic traits. The correlation studies between the climatic factors and important biological and economical traits showed that the weather factors inside the rearing house was more correlated with the above traits. The path analysis showed that in cocoon weight and the shell ratio the identified negative correlation was due to direct effect of maximum temperature and predominantly through indirect effect of minimum temperature and maximum humidity to some extent. The August-September and December-January seasons were identified as favourable seasons based on biological characters of larvae and economic traits of cocoons. February-April, May-July and October-November were identified as unfavourable seasons.

In order to evolve suitable rearing technology for these unfavourable seasons, second experiment was conducted with five different types of rearing houses (i) with sun dried brick wall and thatched roof (H1) (ii) with burnt brick wall and thatched roof (H2) (iii) with sun dried brick wall and light roof (H3) (iv) with burnt brick wall and RCC roof (H4) and (v) with burnt brick wall and tiled roof (H5) were designed, constructed and the worms were reared during 1995-1996 in three different larval densities. The larval duration was longer in H1, H2 and H4 compared to H3 and H5. The larval weight and other biological characters were high in H1. The economical traits like cocoon weight, shell ratio, ERR (weight and number), filament length and reelability were higher in H1 and H2 than in other houses. The incidence of diseases and missing larvae also were low in these houses. Among the different spacings tried in this experiment, wide and medium spacing recorded significant increase in the larval weight, single cocoon weight, ERR by number, ERR by weight, shell weight, shell ratio, filament length and reelability compared to close spacing. The crossbreed cocoons recorded higher ERR (number), shell ratio, filament length and reelability than bivoltine. The present recommendation of medium spacing was found to be advantageous over wide spacing due to better cost effectiveness in terms of less space and labour requirement.

There was significant increase in the cocoon characters, ERR, growth rate and growth index for the crossbreed silkworm than the bivoltine in these rearings. The rearing house H1, medium spacing and crossbreed silkworms were found beneficial for silkworm rearing during unfavourable seasons.

In the third experiment, three feeding schedules *viz.* two, three and four feedings per day were tested in the five types of rearing houses by using a bivoltine and a crossbreed silkworm type. The three feeding schedule was found to be on par with four feeding schedule in the case of larval parameters and economical traits. Of the silkworm types the crossbreed showed more desirable traits than the bivoltine race. The thatched houses registered better growth and development of the larvae and cocoon characters than the other types of rearing houses. The performance of the crossbreed larvae was better than bivoltine in the unfavourable seasons. The two feeding schedule was found to be less productive and less efficient than three and four feeding schedules. The feasibility and efficiency in the adoption of new practices for rearing silkworms in the unfavourable seasons are discussed in comparison with the data of the unfavourable seasons. The new technology could increase important desirable characters of the silkworms and significantly increase in the annual net returns from sericulture, when a continuous rearing covering all the five seasons was practiced.

Salient findings emerging from the studies

- August-September and December-January were identified as favourable seasons and February-April, May-July and October-November were identified as suitable but less favourable seasons for silkworm rearing in Kerala.

- Bivolitne NB_4D_2 proved to be better than PMx NB_4D_2 for rearing for favourable seasons of the year.

- The total feeding duration was prolonged more in the normal than in the unfavourable seasons.

- The total larval duration was not directly associate with the larval weight of the final instar.

- The missing larval percentage and disease incidence were more in unfavourable seasons.

- In rainy seasons leaf consumption was more which is not associated with the larval weight of the final instar.

- The silk gland weight, spinning percentage, shell weight, pupal weight, fecundity and shell ratio were significantly higher in favourable seasons than in unfavourable seasons.

- The spinning percentage, good cocoon number and ERR number were more in crossbreed PM x NB_4D_2.

- The cocoon yield, filament length and reelability were higher in favourable seasons and in the bivoltine race.

- The weather parameters (temperature and humidity) recorded inside the rearing house showed significant negative correlation with important biological and economical traits of silkworms like larval weight, silkgland weight, shell ratio, single cocoon weight and yield.

- The maximum and minimum temperature inside the rearing house was negatively and directly correlated with important economical traits of silkworms like shell ratio and single cocoon weight while maximum humidity had significant negative correlation with shell ratio and single cocoon weight and exerted an indirect effect through temperature.

- Thatched house with mud brick wall was found to be the ideal cost effective rearing house for rearing silkworms in the unfavourable seasons.

- Medium spacing was found advantageous in terms of convenience, space requirement and labour utilization.

- Crossbreed silkworms showed better desirable characters than bivoltine race during unfavourable seasons.

- Three feeding per day was more desirable, profitable and convenient than other feeding schedules.

- The rearing of crossbreed worms during unfavourable seasons with medium spacing in thatched houses by feeding thrice a day, combined with the rearing of bivoltine race in favourable seasons can be practised as a profitable new technology for silkworm rearing in Kerala.

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* Originals not seen

APPENDICES

APPENDIX – I

Identification of silkworm rearing seasons based on weather parameters (1977-1991)

Seasons	Mean Max.Temp. °C	Mean Min. Temp. °C	Mean Max. Hum. %	Mean Min. Hum. %	Mean Rainfall cm
Dec-Jan	30-31	23-24	90-92	77-78	2-3
Feb-Apr	31-33	24-27	85-87	70-72	1-2
May-Jul	29-30	22-24	90-92	80-82	7-9
Aug-Sep	27.5-29	23.4-24.2	87-89.5	75-74	1-2
Oct-Nov	29-29.8	22-25	91-93	79-81	12-14

APPENDIX – II

BRUSHING INTERVALS IN DIFFERENT SEASONS (1993 – 1994)

Seasons (1993 & 1994)	First brushing	Second brushing	Third brushing
Oct-Nov (1993)	02-10-1993	16-10-1993	30-10-1993
Dec-Jan (1993 – 1994)	01-12-1993	15-12-1993	29-12-1993
Feb-Apr (1994)	10-02-1994	24-02-1994	10-03-1994
May-July (1994)	15-05-1994	29-05-1994	13-06-1994
Aug-Sept (1994)	03-09-1994	17-09-1994	31-09-1994

APPENDIX – III

WEATHER PARAMETERS (1993-94)

Seasons	OUTSIDE REARING HOUSE					INSIDE REARING HOUSE			
	Mean Max. Temp. °C	Mean Min. Temp. °C	Mean Max. Hum. %	Mean Min. Hum. %	Mean Rainfall Cm	Mean Max. Temp °C	Mean Max. Temp °C	Mean Max. Hum. %	Mean Min. Hum. %
Dec-Jan	27.71	23.03	92.33	77.00	8.96	28.50	23.50	92.33	86.00
Feb-Apr	33.37	24.25	87.85	72.00	1.92	31.78	26.06	88.00	87.00
May-Jul	30.00	23.16	91.83	80.00	1.30	29.29	22.18	92.85	83.15
Aug-Sep	30.10	23.16	90.18	81.96	2.16	27.90	22.88	90.81	83.63
Oct-Nov	29.86	23.32	91.10	79.60	11.40	30.40	26.04	93.89	83.86

APPENDIX -IV

LARVAL SPACING (Sq.ft/100 Dfl)

(Based on Masui's constants)

SPACINGS	I-INSTAR	II-INSTAR	III-INSTAR	IV-INSTAR	V-INSTAR
High Density (Close spacing)	12	40	70	130	270
Present Reco-mmendation (Medium spacing)	20	60	130	190	360
Low Density (Wide spacing)	25	65	140	220	450

APPENDIX V

WEATHER PARAMETERS (1995&1996)

Seasons	Outside rearing house				H-1(Thatched house)				H-2 (Thatched house)				H-3 (Light roof house)				H-4 (CSB-type-RCC roof)				H-5 (Tiled roof house)			
	Max. Tem	Min Tem	Max Hum	Min Hum	Max. Tem	Min Tem	Max Hum	Min Hum	Max. Tem	Min Tem	Max Hum	Min Hum	Max. Tem	Min Tem	Max Hum	Min Hum	Max. Tem	Min Tem	Max Hum	Min Hum	Max. Tem	Min Tem	Max Hum	Min Hum
Feb-Apr 95	33.1	27.2	83	74	30	24	88	83	30.5	25	88	83.5	32	26	86	80	30.5	25.3	88	83	32	26	86	80
May-Jul 95	31	24.5	90	80	28	22.5	92.6	86	28.3	23.1	92	86.3	29.5	25	89.5	81	28.5	23.5	91	86.5	29.5	25.5	88.5	83
Oct-Nov 95	30.8	25	91	81	29.3	23.5	93.5	86.5	29.5	24.3	93	86.4	30.5	24	91	82	29.5	24.5	92	86.5	30.5	25	90	81
Feb-Apr 96	32.8	25.5	83	77	30.5	24	88	82	30.5	25	88	83.7	31.8	26	86	80	31	25	88	84	32	25	85	80
May-Jul 96	30.5	24.8	90	80.7	28.2	23	90	85.7	28.5	23.4	92	85.3	29.8	25	90	81	29	24	91	85	30	25	88	80
Oct-Nov 96	31	25.3	91.5	81.5	29	25.3	91.5	86.5	29.2	24.5	93.4	86.5	30.5	25	91	83	30	25	93	86	31	25	90	83

Appendix-VI

Basic data relating to different tables

Table - 14

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	753.00	729.00	642.00	642.00	518.00	514.00
H1R1S2	621.00	645.00	591.00	597.00	457.00	455.00
H1R1S3	726.00	702.00	642.00	642.00	495.10	491.50
H1R2S1	582.00	606.00	566.00	572.00	423.00	421.00
H1R2S2	678.00	654.00	597.00	597.00	478.00	474.00
H1R2S3	578.80	602.50	544.00	550.00	423.00	421.00
H2R1S1	722.00	746.00	658.00	658.00	556.00	600.00
H2R1S2	583.00	607.00	602.00	602.00	571.00	601.00
H2R1S3	684.00	698.00	624.00	627.00	563.00	592.00
H2R2S1	543.00	565.00	582.00	582.00	541.00	589.50
H2R2S2	631.00	631.00	600.00	600.00	538.50	587.00
H2R2S3	532.00	528.00	576.00	576.00	528.00	576.00
H3R1S1	702.00	702.00	610.00	604.00	561.00	565.00
H3R1S2	602.00	602.00	538.00	548.50	551.00	553.50
H3R1S3	677.00	652.00	548.00	543.00	537.00	546.00
H3R2S1	567.00	565.00	532.00	532.00	528.00	525.50
H3R2S2	640.00	616.00	538.00	536.00	513.00	518.00
H3R2S3	556.00	528.00	508.00	507.00	502.00	502.00
H4R1S1	731.00	751.00	658.00	648.00	608.00	608.00
H4R1S2	643.00	637.00	625.00	620.00	609.00	609.00
H4R1S3	702.00	721.00	637.00	622.00	590.00	586.00
H4R2S1	623.00	625.50	622.50	615.00	587.50	583.50
H4R2S2	673.00	650.00	628.00	612.00	581.00	581.00
H4R2S3	595.00	570.00	584.00	584.00	570.00	570.00
H5R1S1	714.00	733.00	634.00	628.00	542.00	542.00
H5R1S2	602.00	602.00	578.00	570.00	567.00	571.00
H5R1S3	684.00	688.00	576.00	570.00	554.50	552.00
H5R2S1	564.00	565.00	558.00	532.00	533.00	537.00
H5R2S2	650.00	626.00	576.00	570.00	533.00	537.00
H5R2S3	556.00	558.00	552.00	546.00	518.00	522.00

Table – 15

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	115.00	115.00	102.50	102.50	89.00	89.00
H1R1S2	103.00	103.00	95.00	95.00	85.50	85.50
H1R1S3	113.00	113.00	93.50	93.50	84.00	84.00
H1R2S1	101.00	101.00	88.00	88.00	81.50	81.50
H1R2S2	105.50	105.50	91.50	91.50	82.50	82.50
H1R2S3	96.00	96.00	88.00	88.00	81.00	81.00
H2R1S1	115.00	115.00	100.50	100.50	89.00	89.00
H2R1S2	103.00	103.00	96.50	96.50	85.50	85.50
H2R1S3	110.00	110.00	92.00	92.00	84.50	84.50
H2R2S1	101.50	101.50	88.00	88.00	81.00	81.00
H2R2S2	105.50	105.50	91.50	91.50	83.00	83.00
H2R2S3	95.00	95.00	88.00	88.00	82.00	82.00
H3R1S1	107.50	107.50	99.50	99.50	88.50	88.50
H3R1S2	101.00	101.00	96.00	96.00	84.50	84.50
H3R1S3	107.00	107.00	91.50	91.50	84.50	84.50
H3R2S1	96.50	96.50	86.50	86.50	81.00	81.00
H3R2S2	101.00	101.00	91.00	91.00	83.00	83.00
H3R2S3	93.00	93.00	87.00	87.00	82.00	82.00
H4R1S1	113.00	113.00	100.50	100.50	88.50	88.50
H4R1S2	101.50	101.50	96.50	96.50	84.50	84.50
H4R1S3	110.50	110.50	92.00	92.00	84.50	84.50
H4R2S1	100.00	100.00	89.50	89.50	81.00	81.00
H4R2S2	105.50	105.50	90.50	90.50	83.50	83.50
H4R2S3	94.50	94.50	89.00	89.00	82.00	82.00
H5R1S1	109.00	109.00	101.00	101.00	88.50	88.50
H5R1S2	101.00	101.00	94.50	94.50	84.50	84.50
H5R1S3	107.00	107.00	93.00	93.00	84.00	84.00
H5R2S1	98.00	98.00	86.00	86.00	81.50	81.50
H5R2S2	102.00	102.00	93.00	93.00	82.50	82.50
H5R2S3	93.00	93.00	86.00	86.00	82.50	82.50

Table - 16

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	0.76	0.74	0.71	0.68	0.91	0.91
H1R1S2	0.76	0.74	0.71	0.70	0.98	0.98
H1R1S3	0.78	0.75	0.72	0.71	1.18	1.18
H1R2S1	0.74	0.74	0.67	0.64	0.90	0.90
H1R2S2	0.74	0.75	0.68	0.68	1.00	1.00
H1R2S3	0.75	0.78	0.70	0.70	1.10	1.10
H2R1S1	0.73	0.70	0.70	0.70	0.91	0.91
H2R1S2	0.74	0.72	0.71	0.70	0.98	0.98
H2R1S3	0.76	0.74	0.72	0.71	1.18	1.18
H2R2S1	0.74	0.73	0.68	0.68	0.90	0.90
H2R2S2	0.75	0.74	0.68	0.68	1.00	1.00
H2R2S3	0.75	0.75	0.70	0.70	1.10	1.10
H3R1S1	0.72	0.70	0.68	0.68	0.83	0.82
H3R1S2	0.72	0.71	0.70	0.70	0.88	0.87
H3R1S3	0.73	0.73	0.70	0.71	1.08	1.05
H3R2S1	0.73	0.72	0.68	0.65	0.80	0.88
H3R2S2	0.73	0.73	0.68	0.65	1.00	1.00
H3R2S3	0.74	0.74	0.69	0.68	1.00	1.05
H4R1S1	0.75	0.65	0.71	0.72	0.81	0.81
H4R1S2	0.71	0.70	0.71	0.72	0.88	0.88
H4R1S3	0.74	0.72	0.70	0.73	1.00	1.00
H4R2S1	0.76	0.72	0.70	0.72	0.80	0.80
H4R2S2	0.73	0.73	0.70	0.72	0.90	0.90
H4R2S3	0.71	0.74	0.70	0.72	0.90	0.90
H5R1S1	0.74	0.65	0.65	0.65	0.73	0.73
H5R1S2	0.71	0.72	0.68	0.70	0.78	0.82
H5R1S3	0.73	0.72	0.70	0.71	0.92	0.90
H5R2S1	0.63	0.73	0.64	0.65	0.70	0.83
H5R2S2	0.70	0.74	0.65	0.65	0.85	0.85
H5R2S3	0.72	0.65	0.69	0.68	0.80	0.90

Table - 17

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	1.48	1..33	1.42	1.31	1.07	1.07
H1R1S2	1.46	1.38	1.55	1.60	1.25	1.25
H1R1S3	1.41	1.50	1.60	1.68	1.46	1.45
H1R2S1	1.02	1.32	1.32	1.30	1.24	1.24
H1R2S2	1.16	2.02	1.36	1.33	1.53	1.53
H1R2S3	1.32	1.81	1.36	1.38	1.72	1.70
H2R1S1	1.24	1.43	1.32	1.32	1.06	1.06
H2R1S2	1.27	1.44	1.39	1.39	1.25	1.25
H2R1S3	1.25	1.37	1.40	1.49	1.46	1.46
H2R2S1	1.31	1.11	1.42	1.42	1.24	1.24
H2R2S2	1.13	1.56	1.40	1.40	1.53	1.53
H2R2S3	1.12	1.27	1.32	1.32	1.72	1.72
H3R1S1	1.28	1.17	1.34	1.34	1.27	1.31
H3R1S2	1.30	1.10	1.47	1.45	1.44	1.25
H3R1S3	1.18	1.13	1.52	1.50	1.39	1.31
H3R2S1	1.43	1.22	1.31	1.33	1.37	1.35
H3R2S2	1.46	1.32	1.33	1.33	1.00	1.47
H3R2S3	1.47	1.35	1.25	1.23	1.74	1.70
H4R1S1	1.24	1.19	1.50	1.43	1.13	1.13
H4R1S2	1.27	1.00	1.41	1.52	1.30	1.32
H4R1S3	1.25	1.00	1.57	1.57	1.25	1.01
H4R2S1	1.31	1.25	1.31	1.42	1.25	1.41
H4R2S2	1.13	1.68	1.23	1.23	1.41	1.41
H4R2S3	1.12	1.31	1.17	1.17	1.29	1.29
H5R1S1	1.34	1.17	1.37	1.37	1.27	1.31
H5R1S2	1.35	1.10	1.47	1.45	1.44	1.25
H5R1S3	1.34	1.13	1.52	1.50	1.39	1.31
H5R2S1	1.46	1.22	1.31	1.33	1.37	1.33
H5R2S2	1.46	1.32	1.32	1.33	1.61	1.47
H5R2S3	1.45	1.35	1.35	1.23	1.73	1.70

Table - 18

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	1.52	1.50	1.41	1.41	1.81	1.81
H1R1S2	1.56	1.60	1.42	1.43	1.94	1.94
H1R1S3	1.62	1.80	1.44	1.42	2.12	2.12
H1R2S1	1.52	1.40	1.35	1.36	1.56	1.56
H1R2S2	1.53	1.33	1.38	1.39	1.66	1.66
H1R2S3	1.54	1.45	1.40	1.41	1.76	1.76
H2R1S1	1.46	1.50	1.40	1.40	1.81	1.81
H2R1S2	1.50	1.60	1.43	1.43	1.94	1.94
H2R1S3	1.60	1.75	1.50	1.50	2.12	2.12
H2R2S1	1.48	1.43	1.30	1.30	1.56	1.56
H2R2S2	1.60	1.25	1.32	1.32	1.66	1.66
H2R2S3	1.70	1.55	1.40	1.40	1.76	1.76
H3R1S1	1.45	1.50	1.34	1.34	1.50	1.51
H3R1S2	1.50	1.55	1.37	1.38	1.60	1.74
H3R1S3	1.61	1.60	1.40	1.40	1.85	1.92
H3R2S1	1.40	1.35	1.30	1.29	1.40	1.46
H3R2S2	1.45	1.40	1.33	1.33	1.46	1.56
H3R2S3	1.50	1.43	1.40	1.41	1.61	1.69
H4R1S1	1.46	1.50	1.30	1.31	1.74	1.79
H4R1S2	1.50	1.60	1.33	1.35	1.92	1.92
H4R1S3	1.60	1.75	1.40	1.40	1.56	1.56
H4R2S1	1.48	1.43	1.30	1.30	1.66	1.66
H4R2S2	1.60	1.25	1.41	1.41	1.76	1.76
H4R2S3	1.70	1.55	1.50	1.50	1.50	1.74
H5R1S1	1.40	1.50	1.34	1.37	1.60	1.92
H5R1S2	1.45	1.55	1.37	1.38	1.85	1.46
H5R1S3	1.51	1.60	1.40	1.40	1.40	1.56
H5R2S1	1.40	1.35	1.30	1.29	1.46	1.69
H5R2S2	1.45	1.40	1.33	1.33	1.61	1.56
H5R2S3	1.50	1.43	1.40	1.41	1.61	1.69

Table - 19

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	11.55	11.00	10.25	10.50	11.50	11.50
H1R1S2	11.88	11.00	11.00	11.00	12.11	12.11
H1R1S3	13.38	13.50	11.50	11.50	13.05	13.05
H1R2S1	11.50	11.00	10.00	10.00	11.00	11.00
H1R2S2	12.00	11.50	10.10	10.50	11.15	11.15
H1R2S3	12.50	11.50	11.00	11.00	11.75	11.75
H2R1S1	11.25	12.50	10.00	9.80	11.50	11.50
H2R1S2	11.18	12.00	11.00	10.00	12.11	12.11
H2R1S3	12.00	11.50	11.50	10.50	13.05	13.05
H2R2S1	11.50	13.50	9.00	9.00	11.00	11.00
H2R2S2	12.50	10.50	10.00	10.00	11.15	11.15
H2R2S3	13.50	11.25	10.50	10.00	11.75	11.75
H3R1S1	11.00	12.25	10.00	10.00	11.50	11.50
H3R1S2	12.00	10.50	10.50	10.50	12.25	12.61
H3R1S3	13.00	10.75	11.25	11.00	13.00	13.25
H3R2S1	11.13	11.50	9.00	9.00	11.00	11.00
H3R2S2	12.13	10.00	10.00	10.00	12.00	12.25
H3R2S3	12.75	10.50	10.50	10.00	12.50	13.00
H4R1S1	10.88	11.00	9.50	9.50	11.50	11.50
H4R1S2	10.78	10.50	10.00	10.00	12.00	12.11
H4R1S3	12.00	12.00	11.00	10.50	13.00	13.00
H4R2S1	10.50	10.50	9.00	9.00	11.00	11.00
H4R2S2	10.75	11.00	10.00	10.00	11.15	11.15
H4R2S3	11.75	12.00	10.50	10.50	11.75	11.75
H5R1S1	10.75	10.50	10.00	10.00	11.50	11.50
H5R1S2	11.00	10.75	10.50	10.00	12.25	12.61
H5R1S3	12.00	11.50	11.25	11.00	13.00	13.25
H5R2S1	11.13	10.00	9.00	9.00	11.00	11.00
H5R2S2	12.13	10.50	10.00	10.00	12.00	12.25
H5R2S3	12.50	11.00	10.50	10.00	12.50	13.00

Table - 20

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	32.00	33.08	28.00	28.00	34.00	34.00
H1R1S2	33.00	33.25	29.00	29.00	35.11	35.11
H1R1S3	35.50	35.00	30.00	30.00	36.13	36.12
H1R2S1	32.50	31.50	28.00	26.00	30.64	30.64
H1R2S2	33.00	33.00	28.75	28.50	32.37	32.37
H1R2S3	34.00	33.75	30.50	30.50	33.00	33.00
H2R1S1	31.50	32.00	29.00	28.00	34.00	34.00
H2R1S2	31.00	32.50	29.00	29.00	35.11	35.11
H2R1S3	33.50	34.00	30.00	30.00	3613	3613
H2R2S1	29.00	33.00	28.00	28.00	30.64	30.64
H2R2S2	31.00	34.00	28.00	29.00	32.37	32.37
H2R2S3	31.50	34.00	30.00	30.00	33.00	33.00
H3R1S1	30.00	31.00	28.50	27.00	32.00	32.00
H3R1S2	31.00	31.00	28.00	28.00	33.11	33.11
H3R1S3	31.00	32.00	29.00	29.00	34.13	29.64
H3R2S1	28.00	31.50	29.00	26.00	30.14	30.37
H3R2S2	29.00	32.50	29.00	28.00	31.02	31.02
H3R2S3	30.00	33.00	29.00	29.00	33.00	33.00
H4R1S1	30.50	31.17	29.00	26.00	32.00	32.00
H4R1S2	31.00	31.00	29.00	28.00	32.61	33.11
H4R1S3	32.00	31.75	30.00	30.00	33.13	33.13
H4R2S1	28.00	28.50	28.00	28.00	29.14	30.14
H4R2S2	30.00	29.00	28.00	28.00	33.37	32..37
H4R2S3	31.00	30.00	30.00	30.00	33.00	33.00
H5R1S1	30.00	30.00	28.50	27.00	32.00	32.00
H5R1S2	31.00	31.00	28.00	28.00	33.11	33.11
H5R1S3	31.00	31.75	29.00	29.00	34.13	34.13
H5R2S1	28.00	29.00	29.00	26.00	30.14	29.64
H5R2S2	29.00	30.00	29.00	28.00	31.02	30.37
H5R2S3	30.00	32.00	29.00	29.00	33.00	33.00

Table - 21

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	2.06	2.14	2.02	2.27	2.09	2.09
H1R1S2	2.10	1.89	2.03	1.97	1.81	1.81
H1R1S3	2.43	2.00	2.07	2.03	1.50	1.51
H1R2S1	2.74	2.39	2.20	2.22	2.14	2.14
H1R2S2	2.64	1.88	2.22	2.23	1.65	1.85
H1R2S3	2.50	2.07	2.24	2.18	1.45	1.55
H2R1S1	2.44	2.30	2.08	2.02	2.09	2.09
H2R1S2	2.46	1.95	2.24	1.94	1.78	1.78
H2R1S3	2.33	2.26	2.19	1.92	1.51	1.51
H2R2S1	2.38	2.50	1.86	1.86	2.14	2.14
H2R2S2	2.68	2.52	2.18	2.18	1.64	1.64
H2R2S3	2.75	2.41	2.23	2.23	1.50	1.50
H3R1S1	2.33	2.23	2.20	2.20	2.38	2.31
H3R1S2	2.48	2.31	2.10	1.92	2.14	2.23
H3R1S3	2.71	2.38	2.19	1.86	1.94	2.00
H3R2S1	2.27	2.33	2.00	2.18	2.32	2.24
H3R2S2	2.39	2.23	2.23	2.23	2.15	2.18
H3R2S3	2.49	2.28	2.33	2.15	1.84	1.86
H4R1S1	2.32	2.20	1.92	1.96	2.36	2.36
H4R1S2	2.17	2.37	2.14	2.14	2.00	1.95
H4R1S3	2.53	2.43	2.06	1.92	2.01	2.40
H4R2S1	2.09	2.28	2.00	1.86	2.14	1.95
H4R2S2	2.16	2.28	2.18	2.18	1.76	1.79
H4R2S3	2.19	2.36	2.23	2.23	2.00	2.00
H5R1S1	2.28	2.23	2.15	2.15	2.38	2.31
H5R1S2	2.24	2.31	2.10	1.96	2.14	2.23
H5R1S3	2.40	2.38	2.19	2.14	1.94	2.00
H5R2S1	2.22	2.33	2.00	2.00	2.31	2.24
H5R2S2	2.42	2.23	2.23	2.23	2.15	2.18
H5R2S3	2.45	2.28	2.33	2.17	1.84	1.86

Table - 22

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	3.78	3.50	3.40	3.25	3.73	3.73
H1R1S2	3.83	3.80	3.63	3.70	4.36	4.36
H1R1S3	3.90	4.50	3.75	3.80	5.22	5.22
H1R2S1	3.08	3.25	3.13	3.11	3.50	3.50
H1R2S2	3.30	4.00	3.26	3.25	4.21	4.21
H1R2S3	3.58	4.07	3.55	3.35	4.80	4.80
H2R1S1	3.28	3.65	3.25	3.25	3.73	3.73
H2R1S2	3.40	3.90	3.40	3.40	4.36	4.36
H2R1S3	3.60	4.15	3.60	3.60	5.22	5.22
H2R2S1	3.40	3.00	3.00	3.00	3.50	3.50
H2R2S2	3.40	3.20	3.15	3.15	4.21	4.21
H2R2S3	3.60	3.53	3.25	3.25	4.80	4.80
H3R1S1	3.30	3.25	3.13	3.13	3.40	3.48
H3R1S2	3.45	3.40	3.39	3.38	3.90	3.91
H3R1S3	3.50	3.00	3.53	3.50	4.42	4.42
H3R2S1	3.40	3.25	3.00	3.00	3.31	3.40
H3R2S2	3.57	3.35	3.10	3.10	3.81	3.86
H3R2S3	3.66	3.28	3.15	3.15	4.40	4.55
H4R1S1	3.28	3.20	3.25	3.25	3.43	3.43
H4R1S2	3.40	3.50	3.20	3.20	4.00	4.00
H4R1S3	3.60	3.20	3.60	3.50	4.32	4.22
H4R2S1	3.40	3.20	3.00	3.00	3.50	3.50
H4R2S2	3.40	3.35	3.15	3.15	4.00	4.00
H4R2S3	3.60	3.57	3.25	3.25	4.00	4.00
H5R1S1	3.28	3.25	3.18	3.18	3.40	3.48
H5R1S2	3.40	3.25	3.39	3.38	3.90	3.91
H5R1S3	3.50	3.40	3.53	3.50	4.42	4.42
H5R2S1	3.40	3.00	3.00	3.00	3.31	3.40
H5R2S2	3.53	3.25	3.10	3.10	3.81	3.86
H5R2S3	3.55	3.35	3.15	3.15	4.40	4.55

Table - 23

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	3.99	4.16	3.68	4.00	3.63	3.63
H1R1S2	4.11	4.15	4.00	4.19	3.98	3.98
H1R1S3	4.86	3.79	4.00	4.09	3.98	3.97
H1R2S1	4.04	3.77	3.85	4.00	3.98	3.97
H1R2S2	3.85	3.85	4.05	3.82	3.94	3.95
H1R2S3	3.89	3.85	4.00	4.00	4.00	4.00
H2R1S1	3.69	3.76	3.83	4.17	3.63	3.63
H2R1S2	3.77	4.00	4.00	3.91	3.98	3.98
H2R1S3	3.85	3.93	4.00	3.83	3.98	3.98
H2R2S1	3.39	4.01	4.00	3.87	3.98	3.98
H2R2S2	3.27	3.68	4.18	4.00	3.94	3.97
H2R2S3	3.41	3.77	3.83	4.00	4.00	3.95
H3R1S1	3.56	3.67	3.65	4.17	3.77	3.77
H3R1S2	3.84	3.84	4.00	4.19	3.98	4.27
H3R1S3	3.84	4.00	4.09	4.00	3.91	4.36
H3R2S1	3.45	4.00	3.66	4.00	3.91	4.06
H3R2S2	3.46	4.00	3.83	3.82	4.20	4.04
H3R2S3	3.55	4.00	4.00	4.00	4.00	4.00
H4R1S1	3.89	3.92	4.00	3.82	3.84	3.84
H4R1S2	4.00	4.00	4.00	4.00	3.91	3.83
H4R1S3	4.20	4.16	4.00	4.17	3.98	3.96
H4R2S1	4.09	4.18	3.83	3.91	4.23	4.12
H4R2S2	4.00	3.83	3.91	3.83	4.02	4.02
H4R2S3	4.00	3.92	4.26	3.81	4.00	3.95
H5R1S1	4.00	4.00	3.91	3.82	3.77	3.77
H5R1S2	4.00	4.00	4.09	4.00	4.06	4.28
H5R1S3	4.20	4.32	4.26	4.17	4.06	4.41
H5R2S1	4.00	4.18	3.83	3.91	4.06	3.96
H5R2S2	3.83	4.00	4.00	3.83	4.02	3.72

Table - 24

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	1.77	1.73	1.56	1.56	2.28	2.28
H1R1S2	1.83	1.91	1.58	1.58	2.52	2.52
H1R1S3	1.95	2.27	1.62	1.62	2.85	2.85
H1R2S1	2.38	2.11	2.00	2.00	2.69	2.48
H1R2S2	2.40	1.94	2.07	2.01	2.92	2.69
H1R2S3	2.42	2.22	2.11	2.10	2.01	2.92
H2R1S1	1.44	1.50	1.33	1.33	2.23	2.01
H2R1S2	1.50	1.67	1.38	1.38	2.53	2.23
H2R1S3	1.67	1.92	1.50	1.50	2.13	2.53
H2R2S1	1.95	1.85	1.60	1.61	2.32	2.13
H2R2S2	2.20	1.50	1.63	1.63	2.53	2.32
H2R2S3	2.40	2.10	1.80	1.80	2.13	2.53
H3R1S1	1.42	1.50	1.33	1.33	2.32	2.01
H3R1S2	1.50	1.67	1.38	1.38	2.53	2.23
H3R1S3	1.68	1.92	1.50	1.50	2.01	2.53
H3R2S1	1.80	1.85	1.60	1.60	2.23	2.13
H3R2S2	1.90	1.50	1.63	1.63	2.53	2.32
H3R2S3	2.00	2.10	1.80	1.80	2.13	2.53
H4R1S1	1.43	1.50	1.17	1.19	2.32	1.68
H4R1S2	1.50	1.67	1.21	1.25	2.53	1.96
H4R1S3	1.67	1.92	1.33	1.33	2.19	2.19
H4R2S1	1.95	1.85	1.60	1.60	2.12	2.13
H4R2S2	2.20	1.50	1.83	1.83	2.32	2.32
H4R2S3	2.40	2.10	2.00	2.00	2.50	2.50
H5R1S1	1.33	1.50	1.23	1.23	1.50	1.51
H5R1S2	1.42	1.58	1.28	1.30	1.67	1.89
H5R1S3	1.51	1.67	1..33	1.33	2.08	2.19
H5R2S1	1.80	1.70	1.60	1.58	1.80	1.93
H5R2S2	1.90	1.80	1.66	1.66	1.93	2.13
H5R2S3	2.00	1.85	1.80	1.82	2.23	2.37

Table - 25

Treatments	Oct-Nov-95	Oct-No5v-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	5.86	5.36	5.18	5.18	5.77	5.77
H1R1S2	5.96	5.91	5.59	5.59	6.92	5..92
H1R1S3	6.09	7.18	5.82	5.82	8.48	8.48
H1R2S1	5.83	6.22	5.96	5.96	6.78	6.78
H1R2S2	6.33	7.89	6.24	6.23	8.35	8.35
H1R2S3	6.94	8.06	6.46	6.46	9.67	9.67
H2R1S1	4.46	5.08	4.42	4.42	5.21	5.21
H2R1S2	4.67	5.50	4.67	4.67	6.26	6.26
H2R1S3	5.00	5.92	5.00	5.00	7.68	7.68
H2R2S1	5.80	5.00	5.30	5.30	6.00	6.00
H2R2S2	5.80	5.40	5.30	5.30	7.42	7.42
H2R2S3	6.20	6.05	5.50	5.50	8.60	8.60
H3R1S1	17.33	19.00	15.67	15.33	18.17	18.17
H3R1S2	19.00	18.17	17.33	15.67	19.19	19.19
H3R1S3	20.67	21.50	18.17	16.50	20.75	20.75
H3R2S1	21.25	20.00	17.00	17.00	21.00	21.00
H3R2S2	23.25	21.50	19.00	19.00	21.20	21.20
H3R2S3	24.50	23.00	20.00	20.00	23.00	23.00
H4R1S1	4.67	4.46	4.42	4.42	4.71	4.71
H4R1S2	4.46	4.33	4.33	4.67	5.67	5.85
H4R1S3	5.00	4.83	5.00	5.00	6.19	5.42
H4R2S1	5.80	5.40	5.00	5.30	6.00	6.50
H4R2S2	5.80	5.70	5.30	5.30	7.00	7.10
H4R2S3	6.20	6.15	5.50	5.50	7.00	7.00
H5R1S1	4.46	4.42	4.29	4.29	4.67	4.79
H5R1S2	4.67	4.42	4.65	4.65	5.50	5.51
H5R1S3	4.88	4.67	4.88	4.83	6.37	6.36
H5R2S1	5.90	5.00	5.00	5.00	5.64	5.80
H5R2S2	6.10	5.50	5.20	5.20	6.62	6.72
H5R2S3	6.11	5.71	5.30	5.30	7.80	8.10

Table - 26

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	33.00	33.00	29.00	29.00	31.50	31.50
H1R1S2	34.00	34.00	29.00	29.00	35.00	35.00
H1R1S3	34.00	34.00	30.00	30.00	36.00	36.00
H1R2S1	31.00	31.00	27.00	27.00	30.50	30.50
H1R2S2	32.00	32.00	29.00	29.00	32.00	32.00
H1R2S3	33.00	33.00	30.50	30.50	33.00	33.00
H2R1S1	30.00	30.00	28.00	27.00	31.50	31.50
H2R1S2	31.00	31.00	29.00	29.00	35.00	35.00
H2R1S3	33.00	33.00	30.00	31.00	36.00	36.00
H2R2S1	29.00	29.00	28.00	27.50	30.50	30.50
H2R2S2	29.00	29.00	29.00	28.00	32.00	32.00
H2R2S3	30.00	30.00	29.00	29.00	33.00	33.00
H3R1S1	25.00	25.00	26.50	27.00	30.50	30.50
H3R1S2	30.00	30.00	28.00	28.00	33.00	35.00
H3R1S3	31.00	31.00	29.50	30.00	33.50	36.00
H3R2S1	28.00	28.00	27.00	27.00	29.50	30.00
H3R2S2	29.00	29.00	28.00	28.00	32.00	30.50
H3R2S3	30.00	30.00	29.00	29.00	33.00	33.00
H4R1S1	30.00	30.00	28.00	27.00	31.00	31.00
H4R1S2	31.00	31.00	29.00	29.00	32.00	32.00
H4R1S3	33.00	33.00	30.00	31.00	33.00	33.00
H4R2S1	29.00	29.00	28.00	27.50	30.50	30.50
H4R2S2	29.00	29.00	29.00	28.00	32.00	32.00
H4R2S3	30.00	30.00	29.00	29.00	33.00	33.00
H5R1S1	28.25	28.00	26.50	27.00	30.50	30.50
H5R1S2	30.00	30.00	28.00	28.00	33.00	35.00
H5R1S3	31.00	31.00	29.50	30.00	33.50	36.00
H5R2S1	28.00	28.00	27.00	27.00	29.50	30.00
H5R2S2	29.00	29.00	28.00	28.00	32.00	30.50
H5R2S3	30.00	30.00	29.00	29.50	33.00	33.00

Table – 27

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	119.27	115.36	100.82	100.82	122.64	122.64
H1R1S2	119.91	119.00	104.46	104.46	126.68	126.68
H1R1S3	126.67	128.09	108.09	108.09	130.36	130.36
H1R2S1	135.67	143.44	114.56	114.56	135.17	135.17
H1R2S2	145.67	145.67	125.67	125.67	142.88	142.88
H1R2S3	149.00	150.11	134.56	134.56	145.67	145.67
H2R1S1	105.67	104.00	95.67	92..33	112..33	112..33
H2R1S2	107..33	102.33	95.67	95.67	116.04	116.04
H2R1S3	112..33	110.67	99.00	99.00	119.42	119.40
H2R2S1	131.00	115.00	111.00	111.00	121.55	121.50
H2R2S2	135.00	123.00	111.00	115.00	128.49	128.49
H2R2S3	135.00	127.00	119.00	118.00	130.50	130.50
H3R1S1	102.33	104.00	95.67	92.33	112.33	112.33
H3R1S2	102.33	102.33	95.67	95.67	116.04	116.00
H3R1S3	105.67	110.67	99.00	99.00	119.42	119.42
H3R2S1	125.00	115.00	111.00	111.00	121.55	121.55
H3R2S2	129.00	123.00	111.00	115.00	128.49	128.49
H3R2S3	131.00	127.00	119.00	119.00	131.00	130.50
H4R1S1	101..22	100.67	95.67	92.33	105.67	112.33
H4R1S2	102..33	102.33	95.67	95.67	107.75	116.07
H4R1S3	104..83	105.67	99.00	99.00	109.38	109.83
H4R2S1	113.00	111.00	111.00	111.00	115.55	120.00
H4R2S2	115.00	119.00	115.00	115.00	126.50	127.50
H4R2S3	119.00	123.00	119.00	118.00	131.00	130.00
H5R1S1	99.00	99.00	94.00	92.33	105.67	105.67
H5R1S2	102.33	102.33	94.00	95.67	107.75	109.42
H5R1S3	104.83	102.33	94.00	99.00	109.38	109.33
H5R2S1	115.00	111.00	115.00	111.00	115.55	120.00
H5R2S2	119.00	115.00	115.00	115.00	126.50	128.25
H5R2S3	127.00	119.00	115.00	118.00	131.00	131.00

Table - 29

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	599.00	599.00	526.27	526.27	571.73	571.73
H1R1S2	617.18	617.18	526.27	526.27	635.36	635.36
H1R1S3	617.18	617.18	544.46	544.46	653.55	653.55
H1R2S1	687.89	687.89	599.00	599.00	676.78	676.78
H1R2S2	710.11	710.11	643.44	643.44	710.11	710.11
H1R2S3	732.33	732.33	676.78	676.78	732..33	732..33
H2R1S1	499.00	499.00	465.67	499.00	524.00	524.00
H2R1S2	515.67	515.67	482..33	482..33	582..33	582..33
H2R1S3	549.00	549.00	499...00	515.67	599.00	599.00
H2R2S1	579.00	579.00	559.00	549.00	609.00	609.00
H2R2S2	579.00	579.00	579.00	559.00	639.00	639.00
H2R2S3	599.00	609.00	579.00	579.00	659.00	659.00
H3R1S1	499.00	499.00	465.67	449.00	524.00	524.00
H3R1S2	515.67	515.67	482..33	482..33	582.33	582.33
H3R1S3	549.00	549.00	499...00	515.67	599.00	599.00
H3R2S1	579.00	579.00	559.00	549.00	609.00	609.00
H3R2S2	579.00	579.00	579.00	559.00	639.00	639.00
H3R2S3	599.00	599.00	579.00	579.00	659.00	659.00
H4R1S1	499.00	499.00	465.67	449.00	515.67	515.67
H4R1S2	515.67	515.67	482..33	482..33	552.33	552.33
H4R1S3	549.00	549.00	499.00	515.67	549.00	549.00
H4R2S1	579.00	579.00	559.00	549.00	609.00	619.00
H4R2S2	579.00	579.00	579.00	559.00	639.00	639.00
H4R2S3	599.00	609.00	579.00	579.00	659.00	649.00
H5R1S1	499.00	499.00	465.67	449.00	507.33	507..33
H5R1S2	515.67	515.67	482.33	482.33	549.00	582..33
H5R1S3	549.00	549.00	499.00	515.67	557.33	599.00
H5R2S1	579.00	579.00	559.00	589.00	549.00	599.00
H5R2S2	579.00	579.00	579.00	639.00	559.00	609.00
H5R2S3	599.00	609.00	579.00	659.00	579.00	659.00

Table - 30

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	1.67	1.65	1.40	1.40	1.64	1.64
H1R1S2	1.72	1.75	1.50	1.50	1.72	1.72
H1R1S3	1.80	1.80	1.63	1.60	1.82	1.82
H1R2S1	1.55	1.50	1.50	1.50	1.61	1.61
H1R2S2	1.65	1.60	1.46	1.50	1.58	1.58
H1R2S3	1.73	1.60	1.59	1.60	1.70	1.70
H2R1S1	1.55	1.70	1.40	1.45	1.60	1.60
H2R1S2	1.70	1.80	1.51	1.45	1.70	1.70
H2R1S3	1.80	1.75	1.55	1.56	1.80	1.80
H2R2S1	1.43	1.65	1.30	1.50	1.67	1.66
H2R2S2	1.60	1.58	1.34	1.50	1.68	1.58
H2R2S3	1.61	1.50	1.40	1.40	1.70	1.70
H3R1S1	1.80	1.70	1.26	1.26	1.58	1.60
H3R1S2	1.90	1.80	1.30	1.29	1.68	1.72
H3R1S3	1.95	1.95	1.35	1.38	1.60	1.80
H3R2S1	1.75	1.75	1.27	1.25	1.65	1.66
H3R2S2	1.93	1.68	1.32	1.35	1.68	1.58
H3R2S3	2.06	1.60	1.40	1.38	1.70	1.70
H4R1S1	1.63	1.60	1.50	1.50	1.60	1.60
H4R1S2	1.68	1.70	1.51	1.56	1.70	1.72
H4R1S3	1.70	1.73	1.55	1.50	1.80	1.60
H4R2S1	1.53	1.60	1.40	1.50	1.67	1.66
H4R2S2	1.58	1.58	1.44	1.45	1.68	1.58
H4R2S3	1.61	1.60	1.45	1.45	1.70	1.70
H5R1S1	1.50	1.70	1.26	1.26	1.58	1.60
H5R1S2	1.55	1.80	1.30	1.29	1.68	1.72
H5R1S3	1.90	1.95	1.35	1.38	1.60	1.80
H5R2S1	1.55	1.75	1.27	1.25	1.65	1.66
H5R2S2	1.73	1.68	1.32	1.35	1.68	1.58
H5R2S3	1.81	1.60	1.40	1.38	1.70	1.70

Table – 31

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	4.73	4.82	4.47	4.33	4.91	4.91
H1R1S2	4.60	5.00	4.27	4.27	4.73	4.73
H1R1S3	4.23	4.26	4.23	4.23	4.52	4.54
H1R2S1	4.35	4.91	4.60	4.20	4.57	4.57
H1R2S2	4.50	4.75	4.48	4.43	4.40	4.81
H1R2S3	4.40	4.44	4.55	4.55	4.39	4.62
H2R1S1	4.69	4.28	4.80	4.71	4.91	4.91
H2R1S2	4.52	4.40	4.27	4.80	4.80	4.80
H2R1S3	4.67	3.97	4.22	4.73	4.54	4.54
H2R2S1	4.74	4.53	5.22	5.22	4.57	4.57
H2R2S2	4.45	4.51	4.60	4.80	4.83	4.83
H2R2S3	4.04	4.33	4.71	4.67	4.50	4.50
H3R1S1	4.64	4.73	4.70	4.40	4.57	4.57
H3R1S2	4.17	4.75	4.33	4.60	4.26	4.41
H3R1S3	3.92	4.40	4.16	4.27	4.08	4.25
H3R2S1	4.66	4.10	5.44	4.78	4.39	4.47
H3R2S2	4.36	4.54	4.80	4.60	3.96	4.13
H3R2S3	4.18	4.46	4.52	4.81	4.08	4.28
H4R1S1	4.64	4.82	5.12	4.71	4.57	4.57
H4R1S2	4.75	4.77	4.80	4.80	4.47	4.44
H4R1S3	4.29	4.33	4.46	4.73	4.11	4.09
H4R2S1	4.43	4.35	5.22	5.22	4.50	4.30
H4R2S2	4.40	4.46	4.80	4.80	4.80	4.77
H4R2S3	4.22	4.17	4.71	4.67	4.50	4.50
H5R1S1	4.58	4.73	4.70	4.60	4.57	4.57
H5R1S2	4.64	4.77	4.43	4.80	4.25	4.33
H5R1S3	4.29	4.00	4.07	4.46	4.02	4.09
H5R2S1	4.21	4.60	5.44	5.22	4.50	4.30
H5R2S2	3.95	4.54	4.80	4.80	4.28	4.31
H5R2S3	4.23	4.46	4.52	4.90	4.08	4.28

Table - 32

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	1.45	1.50	1.33	1.30	1.55	1.51
H1R1S2	1.54	1.60	1.41	1.35	1.67	1.63
H1R1S3	1.63	1.65	1.42	1.41	1.76	1.73
H1R2S1	1.51	1.50	1.30	1.22	1.72	1.64
H1R2S2	1.60	1.60	1.40	1.34	1.78	1.71
H1R2S3	1.72	1.73	1.52	1.46	1.81	1.76
H2R1S1	1.41	1.40	1.40	1.33	1.54	1.51
H2R1S2	1.53	1.50	1.41	1.35	1.66	1.60
H2R1S3	1.60	1.65	1.43	1.40	1.70	1.70
H2R2S1	1.40	1.33	1.30	1.22	1.71	1.60
H2R2S2	1.51	1.43	1.40	1.30	1.77	1.73
H2R2S3	1.71	1.53	1.50	1.41	1.80	1.75
H3R1S1	1.40	1.45	1.30	1.25	1.50	1.43
H3R1S2	1.50	1.55	1.30	1.30	1.60	1.55
H3R1S3	1.53	1.55	1.35	1.35	1.63	1.65
H3R2S1	1.35	1.33	1.30	1.30	1.43	1.43
H3R2S2	1.45	1.43	1.40	1.35	1.57	1.60
H3R2S3	1.50	1.53	1.41	1.40	1.60	1.65
H4R1S1	1.40	1.38	1.31	1.33	1.44	1.41
H4R1S2	1.50	1.50	1.32	1.35	1.48	1.50
H4R1S3	1.50	1.50	1.33	1.40	1.50	1.53
H4R2S1	1.40	1.38	1.30	1.22	1.46	1.40
H4R2S2	1.51	1.48	1.30	1.30	1.57	1.53
H4R2S3	1.55	1.55	1.40	1.41	1.55	1.55
H5R1S1	1.43	1.45	1.30	1.25	1.50	1.43
H5R1S2	1.50	1.55	1.30	1.30	1.60	1.55
H5R1S3	1.53	1.55	1.35	1.35	1.63	1.65
H5R2S1	1.25	1.33	1.30	1.30	1.43	1.43
H5R2S2	1.36	1.43	1.40	1.35	1.57	1.60
H5R2S3	1.48	1.53	1.41	1.40	1.60	1.65

Table – 33

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	0.26	0.30	0.24	0.24	0.27	0.27
H1R1S2	0.29	0.31	0.24	0.24	0.32	0.32
H1R1S3	0.31	0.33	0.26	0.25	0.32	0.32
H1R2S1	0.26	0.28	0.24	0.23	0.28	0.28
H1R2S2	0.29	0.29	0.24	0.24	0.29	0.29
H1R2S3	0.32	0.33	0.26	0.26	0.32	0.32
H2R1S1	0.23	0.25	0.22	0.21	0.26	0.27
H2R1S2	0.24	0.30	0.23	0.23	0.30	0.30
H2R1S3	0.25	0.32	0.24	0.24	0.31	0.31
H2R2S1	0.26	0.26	0.24	0.24	0.27	0.27
H2R2S2	0.28	0.28	0.26	0.26	0.29	0.29
H2R2S3	0.30	0.32	0.28	0.28	0.31	0.31
H3R1S1	0.24	0.25	0.24	0.22	0.26	0.27
H3R1S2	0.28	0.30	0.24	0.23	0.30	0.31
H3R1S3	0.30	0.30	0.24	0.24	0.30	0.30
H3R2S1	0.22	0.26	0.23	0.23	0.27	0.27
H3R2S2	0.25	0.28	0.26	0.26	0.33	0.30
H3R2S3	0.31	0.32	0.28	0.28	0.33	0.32
H4R1S1	0.22	0.22	0.22	0.22	0.24	0.24
H4R1S2	0.22	0.23	0.25	0.25	0.27	0.27
H4R1S3	0.23	0.23	0.25	0.25	0.28	0.28
H4R2S1	0.24	0.24	0.24	0.24	0.25	0.26
H4R2S2	0.26	0.25	0.26	0.26	0.27	0.27
H4R2S3	0.28	0.28	0.28	0.28	0.29	0.29
H5R1S1	0.21	0.25	0.24	0.22	0.26	0.27
H5R1S2	0.23	0.30	0.24	0.23	0.30	0.31
H5R1S3	0.28	0.30	0.24	0.24	0.30	0.31
H5R2S1	0.22	0.26	0.23	0.23	0.27	0.27
H5R2S2	0.23	0.28	0.26	0.26	0.33	0.30
H5R2S3	0.28	0.32	0.28	0.28	0.33	0.32

Table - 34

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	17.73	20.00	17.95	18.69	17.50	17.95
H1R1S2	18.60	19.38	17.05	17.76	18.89	19.51
H1R1S3	18.87	19.84	18.13	17.91	18.15	18.56
H1R2S1	17.24	18.67	18.54	18.92	16.04	16.81
H1R2S2	17.81	18.13	17.32	17.76	16.46	17.08
H1R2S3	18.51	18.84	17.33	17.44	17.52	18.07
H2R1S1	16.34	17.93	15.43	16.08	17.12	17.78
H2R1S2	15.74	20.00	16.06	16.66	18.10	18.97
H2R1S3	15.47	19.09	16.79	17.14	18.22	18.24
H2R2S1	18.60	19.63	18.46	19.65	15.94	16.63
H2R2S2	18.61	19.65	18.07	20.00	16.57	16.81
H2R2S3	17.60	20.73	18.33	19.58	17.47	17.58
H3R1S1	17.32	17.28	18.28	17.59	17.50	18.71
H3R1S2	18.67	19.38	18.08	17.69	18.75	20.18
H3R1S3	19.65	19.36	17.78	17.76	18.47	18.20
H3R2S1	15.93	19.63	17.31	17.69	19.13	18.67
H3R2S2	17.20	19.65	18.57	19.26	20.77	18.77
H3R2S3	20.50	20.73	19.79	19.93	16.90	19.24
H4R1S1	15.39	15.64	17.00	16.94	16.90	17.23
H4R1S2	14.67	15.33	18.74	18.14	18.27	18.00
H4R1S3	15.17	15.43	18.73	17.86	18.62	18.53
H4R2S1	17.17	17.46	18.46	19.84	17.30	18.29
H4R2S2	17.28	17.23	20.00	20.00	17.41	17.71
H4R2S3	18.07	18.16	19.64	19.29	18.57	18.81
H5R1S1	14.56	17.26	18.29	17.59	17.50	18.73
H5R1S2	15.33	19.38	18.08	17.69	18.75	20.18
H5R1S3	18.37	19.36	17.78	17.76	18.47	18.82
H5R2S1	17.20	19.63	17.31	17.69	19.13	18.67
H5R2S2	17.24	19.65	18.57	19.26	20.77	18.77
H5R2S3	18.65	20.73	19.79	19.64	20.31	19.24

Table - 35

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	62.50	60.00	67.50	66.00	70.00	70.00
H1R1S2	62.50	60.00	70.00	77.00	70.00	70.00
H1R1S3	65.00	65.00	72.50	75.00	75.00	75.00
H1R2S1	70.00	65.00	70.00	67.50	70.00	70.00
H1R2S2	70.00	70.00	70.00	72.50	75.00	75.00
H1R2S3	70.00	70.00	75.00	75.00	80.00	80.00
H2R1S1	60.00	60.00	62.50	65.00	70.00	70.00
H2R1S2	65.00	60.00	70.00	70.00	70.00	75.00
H2R1S3	65.00	65.00	70.00	70.00	70.00	70.00
H2R2S1	70.00	65.00	70.00	67.50	70.00	70.00
H2R2S2	70.00	65.00	70.00	72.50	75.00	75.00
H2R2S3	70.00	65.00	70.00	75.00	65.00	65.00
H3R1S1	60.00	60.00	62.50	62.50	70.00	70.00
H3R1S2	60.00	60.00	62.50	62.50	70.00	70.00
H3R1S3	65.00	65.00	62.50	62.50	75.00	65.00
H3R2S1	65.00	60.00	62.50	60.00	75.00	65.00
H3R2S2	70.00	65.00	65.00	65.00	70.00	70.00
H3R2S3	70.00	65.00	70.00	67.50	70.00	70.00
H4R1S1	60.00	60.00	67.50	65.00	70.00	70.00
H4R1S2	65.00	60.00	70.00	70.00	70.00	75.00
H4R1S3	65.00	65.00	70.00	70.00	75.00	75.00
H4R2S1	70.00	65.00	70.00	67.50	70.00	70.00
H4R2S2	70.00	65.00	70.00	72.50	70.00	70.00
H4R2S3	70.00	65.00	62.50	62.50	70.00	75.00
H5R1S1	60.00	60.00	62.50	62.50	75.00	70.00
H5R1S2	60.00	60.00	62.50	62.50	70.00	75.00
H5R1S3	65.00	65.00	62.50	60.00	70.00	70.00
H5R2S1	65.00	60.00	62.50	65.00	70.00	70.00
H5R2S2	70.00	65.00	65.00	65.00	75.00	75.00
H5R2S3	70.00	65.00	70.00	67.50	75.00	75.00

Table - 36

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	647.50	652.50	637.50	637.50	750.00	750.00
H1R1S2	650.00	650.00	650.00	650.00	760.00	765.00
H1R1S3	650.00	650.00	705.00	705.00	762.50	765.00
H1R2S1	870.00	877.50	850.00	850.00	950.00	950.00
H1R2S2	875.00	887.50	870.00	870.00	950.00	955.00
H1R2S3	895.00	905.00	962.50	962.50	1100.00	1100.00
H2R1S1	647.50	652.50	637.50	637.50	750.00	750.00
H2R1S2	650.00	650.00	650.00	650.00	760.00	765.00
H2R1S3	650.00	650.00	705.00	705.00	762.50	765.00
H2R2S1	870.00	877.50	850.00	850.00	950.00	950.00
H2R2S2	875.00	887.50	870.00	870.00	950.00	955.00
H2R2S3	895.00	905.00	962.50	962.50	1100.00	1100.00
H3R1S1	625.00	625.00	602.50	602.50	700.00	710.00
H3R1S2	635.00	635.00	615.00	615.00	715.00	715.00
H3R1S3	650.00	650.00	622.50	622.50	722.50	725.00
H3R2S1	835.00	835.00	800.00	800.00	900.00	900.00
H3R2S2	845.00	845.00	815.00	815.00	900.00	905.00
H3R2S3	850.00	850.00	862.50	862.50	1000.00	1000.00
H4R1S1	635.00	635.00	622.50	622.50	700.00	725.00
H4R1S2	635.00	635.00	625.00	625.00	725.00	735.00
H4R1S3	650.00	650.00	625.00	625.00	753.50	760.00
H4R2S1	845.00	845.00	800.00	800.00	900.00	900.00
H4R2S2	845.00	845.00	810.00	810.00	900.00	905.00
H4R2S3	850.00	850.00	862.50	862.50	975.00	975.00
H5R1S1	625.00	625.00	602.50	602.50	700.00	710.00
H5R1S2	635.00	635.00	615.00	615.00	715.00	715.00
H5R1S3	650.00	650.00	622.50	622.50	722.50	725.00
H5R2S1	835.00	835.00	800.00	800.00	900.00	900.00
H5R2S2	845.00	845.00	815.00	815.00	900.00	905.00
H5R2S3	850.00	850.00	862.50	862.50	1000.00	1000.00

Table -37

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	8000.00	8000.00	7200.00	7200.00	8500.00	8500.00
H1R1S2	8000.00	8000.00	7400.00	7400.00	8600.00	8600.00
H1R1S3	8300.00	8300.00	7900.00	7900.00	8800.00	8800.00
H1R2S1	8400.00	8400.00	8200.00	8200.00	9000.00	9000.00
H1R2S2	8600.00	8600.00	8200.00	8200.00	9100.00	9050.00
H1R2S3	8700.00	8700.00	8800.00	8800.00	9450.00	9500.00
H2R1S1	7800.00	7800.00	7000.00	7000.00	8300.00	8250.00
H2R1S2	7800.00	7800.00	7200.00	7200.00	8400.00	8400.00
H2R1S3	8100.00	8100.00	7700.00	7700.00	8600.00	8600.00
H2R2S1	8200.00	8200.00	8000.00	8000.00	8800.00	8800.00
H2R2S2	8400.00	8400.00	8000.00	8000.00	8905.00	8855.00
H2R2S3	8500.00	8500.00	8600.00	8600.00	9250.00	9300.00
H3R1S1	7300.00	7300.00	6300.00	6450.00	7950.00	8100.00
H3R1S2	7400.00	7400.00	6500.00	6500.00	8000.00	8100.00
H3R1S3	7600.00	7700.00	6700.00	6700.00	8200.00	8150.00
H3R2S1	7900.00	7800.00	7300.00	7350.00	8400.00	8500.00
H3R2S2	8100.00	8100.00	7500.00	7500.00	8650.00	8800.00
H3R2S3	8300.00	8400.00	8100.00	7900.00	8900.00	9000.00
H4R1S1	7500.00	7500.00	6300.00	6600.00	8150.00	8100.00
H4R1S2	7600.00	7550.00	6500.00	6800.00	8200.00	8100.00
H4R1S3	7800.00	7900.00	6700.00	6900.00	8300.00	8150.00
H4R2S1	8100.00	8000.00	7300.00	7550.00	8400.00	8500.00
H4R2S2	8200.00	8300.00	7500.00	7700.00	8650.00	8800.00
H4R2S3	8450.00	8500.00	6500.00	8150.00	8900.00	9000.00
H5R1S1	7300.00	7300.00	6600.00	6450.00	7950.00	8100.00
H5R1S2	7400.00	7400.00	6800.00	6500.00	8000.00	8100.00
H5R1S3	7600.00	7700.00	6900.00	6700.00	8200.00	8150.00
H5R2S1	7900.00	7800.00	7550.00	7350.00	8400.00	8500.00
H5R2S2	8100.00	8100.00	7700.00	7500.00	8650.00	8800.00
H5R2S3	8300.00	8400.00	8100.00	7900.00	8900.00	9000.00

Table - 38

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	11176.00	11176.00	10400.00	9360.00	12900.00	12900.00
H1R1S2	12080.00	12080.00	11207.00	10360.00	14100.00	14100.00
H1R1S3	13280.00	13280.00	11186.00	10792.00	15400.00	15400.00
H1R2S1	12600.00	12600.00	10420.00	10660.00	15350.00	15350.00
H1R2S2	13760.00	13760.00	12040.00	11460.00	15700.00	15700.00
H1R2S3	14790.00	14790.00	12354.00	12320.00	17100.00	17100.00
H2R1S1	11100.00	11100.00	9400.00	9360.00	12315.00	12315.00
H2R1S2	12000.00	12000.00	10201.00	10360.00	12717.00	12717.00
H2R1S3	12280.00	12280.00	10786.00	10792.00	13865.00	13865.00
H2R2S1	12600.00	12600.00	10620.00	10660.00	14369.00	14369.00
H2R2S2	13110.00	13110.00	11040.00	11460.00	14666.00	14666.00
H2R2S3	14000.00	14000.00	12354.00	12320.00	16588.00	16588.50
H3R1S1	10220.00	10220.00	7875.00	8062.50	11962.00	11962.50
H3R1S2	11100.00	11100.00	8480.00	8450.00	12717.00	12717.00
H3R1S3	11780.00	11959.00	9745.00	9795.00	13530.00	13365.00
H3R2S1	10665.00	10530.00	9620.00	9405.00	12012.00	11869.00
H3R2S2	11345.00	11330.00	10350.00	10350.00	13667.00	13666.00
H3R2S3	12450.00	12600.00	11502.00	11218.00	14507.00	14588.50
H4R1S1	10220.00	10220.00	8875.00	8862.50	12527.50	11962.50
H4R1S2	11100.00	11100.00	9480.00	11300.00	11300.00	12717.00
H4R1S3	11780.00	11959.00	9745.00	9795.00	13530.00	13365.00
H4R2S1	10665.00	10530.00	9770.00	9755.00	12012.00	11919.00
H4R2S2	11345.00	11330.00	10850.00	10935.00	13817.00	13866.00
H4R2S3	12450.00	12600.00	12002.00	11832.00	14507.50	14604.50
H5R1S1	10220.00	10220.00	7875.00	8062.00	11527.50	11962.50
H5R1S2	11100.00	11100.00	8480.00	12560.00	12717.00	12717.00
H5R1S3	11780.00	11959.00	9045.00	9045.00	13530.00	13365.00
H5R2S1	10665.00	10530.00	9620.00	9405.00	12012.00	11869.00
H5R2S2	11340.00	11330.00	10350.00	10350.00	13667.00	13666.00
H5R2S3	12450.00	12600.00	11502.00	11218.00	14507.00	14588.00

Table- 39

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	3.00	3.00	4.00	4.00	2.00	2.00
H1R1S2	3.00	3.00	4.00	4.00	2.00	2.00
H1R1S3	3.00	3.00	4.00	4.00	2.00	2.00
H1R2S1	2.00	2.00	3.00	3.00	2.00	2.00
H1R2S2	2.00	2.00	3.00	3.00	2.00	2.00
H1R2S3	2.00	2.00	2.00	3.00	1.00	1.00
H2R1S1	3.00	3.00	4.00	4.00	2.00	2.00
H2R1S2	3.00	3.00	4.00	4.00	2.00	2.00
H2R1S3	3.00	3.00	4.00	4.00	2.00	2.00
H2R2S1	2.00	2.00	3.00	3.00	2.00	2.00
H2R2S2	2.00	2.00	3.00	3.00	2.00	2.00
H2R2S3	2.00	2.00	2.00	3.00	1.00	1.00
H3R1S1	3.00	3.00	4.00	4.00	2.00	2.00
H3R1S2	3.00	3.00	4.00	4.00	2.00	2.00
H3R1S3	3.00	3.00	4.00	4.00	2.00	2.00
H3R2S1	2.00	2.00	3.00	3.00	2.00	2.00
H3R2S2	2.00	2.00	3.00	3.00	2.00	2.00
H3R2S3	2.00	2.00	2.00	3.00	1.00	1.00
H4R1S1	3.00	3.00	4.00	4.00	2.00	2.00
H4R1S2	3.00	3.00	4.00	4.00	2.00	2.00
H4R1S3	3.00	3.00	4.00	4.00	2.00	2.00
H4R2S1	2.00	2.00	3.00	3.00	2.00	2.00
H4R2S2	2.00	2.00	3.00	3.00	2.00	2.00
H4R2S3	2.00	2.00	2.00	3.00	1.00	1.00
H5R1S1	3.00	3.00	4.00	4.00	2.00	2.00
H5R1S2	3.00	3.00	4.00	4.00	2.00	2.00
H5R1S3	3.00	3.00	4.00	4.00	2.00	2.00
H5R2S1	2.00	2.00	3.00	3.00	2.00	2.00
H5R2S2	2.00	2.00	3.00	3.00	2.00	2.00
H5R2S3	2.00	2.00	2.00	3.00	1.00	1.00

Table- 39

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1R1S1	2.00	2.00	4.00	4.00	2.00	2.00
H1R1S2	2.00	2.00	4.00	4.00	2.00	2.00
H1R1S3	2.00	2.00	4.00	4.00	2.00	2.00
H1R2S1	2.00	2.00	3.00	3.00	1.00	2.00
H1R2S2	2.00	2.00	3.00	3.00	1.00	2.00
H1R2S3	2.00	2.00	2.00	2.00	1.00	1.00
H2R1S1	2.00	2.00	4.00	4.00	2.00	2.00
H2R1S2	2.00	2.00	4.00	4.00	2.00	2.00
H2R1S3	2.00	2.00	4.00	4.00	2.00	2.00
H2R2S1	2.00	2.00	3.00	3.00	1.00	2.00
H2R2S2	2.00	2.00	3.00	3.00	1.00	2.00
H2R2S3	2.00	2.00	2.00	2.00	1.00	1.00
H3R1S1	4.00	4.00	6.00	6.00	3.00	2.00
H3R1S2	4.00	4.00	6.00	6.00	3.00	2.00
H3R1S3	4.00	4.00	6.00	6.00	3.00	2.00
H3R2S1	3.00	3.00	4.50	4.50	2.50	2.00
H3R2S2	3.00	3.00	4.00	4.00	1.50	2.00
H3R2S3	2.00	2.00	3.50	3.50	1.50	1.00
H4R1S1	4.00	4.00	6.00	6.00	3.00	2.00
H4R1S2	4.00	4.00	6.00	6.00	3.00	2.00
H4R1S3	4.00	4.00	6.00	6.00	3.00	2.00
H4R2S1	3.00	3.00	4.50	4.50	2.00	2.00
H4R2S2	3.00	3.00	4.00	4.00	1.50	2.00
H4R2S3	2.00	2.00	3.50	3.50	1.50	1.00
H5R1S1	4.00	4.00	6.00	6.00	3.00	2.00
H5R1S2	4.00	4.00	6.00	6.00	3.00	2.00
H5R1S3	4.00	4.00	6.00	6.00	3.00	2.00
H5R2S1	3.00	3.00	4.50	4.50	2.00	2.00
H5R2S2	3.00	3.00	4.00	4.00	1.50	2.00
H5R2S3	2.00	2.00	3.50	3.50	1.50	1.00

Table - 40

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	709.00	716.00	660.00	665.00	662.00	626.00
H1F1R2	606.00	623.50	557.00	561.50	567.00	567.00
H1F2R1	667.00	674.50	595.00	606.50	593.00	593.00
H1F2R2	572.50	586.50	541.00	543.50	553.50	553.50
H1F3R1	621.00	630.00	595.00	606.50	576.50	576.50
H1F3R2	557.50	574.50	544.50	544.50	537.00	537.00
H2F1R1	710.00	719.00	658.00	665.00	626.00	626.00
H2F1R2	608.00	620.50	556.50	562.00	567.00	567.00
H2F2R1	666.00	672.50	595.00	598.00	593.00	593.00
H2F2R2	571.50	584.50	541.00	548.50	552.50	552.50
H2F3R1	620.00	634.50	595.00	602.50	577.50	577.50
H2F3R2	578.50	574.00	544.50	547.00	537.00	537.00
H3F1R1	690.50	691.50	631.50	633.50	606.00	606.00
H3F1R2	595.50	599.50	535.00	540.00	555.00	555.00
H3F2R1	654.00	655.50	579.50	591.00	585.00	585.00
H3F2R2	567.00	572.50	529.50	536.50	540.00	540.00
H3F3R1	613.50	613.50	581.00	586.00	571.50	571.50
H3F3R2	557.50	567.50	532.00	536.50	533.00	533.00
H4F1R1	710.00	719.00	646.00	651.00	618.50	618.50
H4F1R2	608.00	620.50	549.00	553.00	564.00	564.00
H4F2R1	641.50	676.00	595.50	599.50	592.00	592.00
H4F2R2	583.50	585.50	541.00	545.00	547.50	547.50
H4F3R1	621.00	639.00	591.00	595.00	578.50	578.50
H4F3R2	589.50	572.50	542.50	546.50	538.00	538.00
H5F1R1	668.00	696.00	628.00	635.00	609.00	609.00
H5F1R2	604.05	599.50	537.50	544.00	556.50	556.00
H5F2R1	623.50	656.50	580.00	585.00	585.00	585.00
H5F2R2	580.50	571.00	529.50	534.50	542.00	542.00
H5F3R1	599.00	619.00	584.00	589.00	570.00	570.00
H5F3R2	557.50	567.50	527.00	531.00	529.00	529.00

Table – 41

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	115.00	115.00	102.50	102.50	89.00	89.00
H1F1R2	103.00	103.00	95.00	95.00	85.50	85.50
H1F2R1	113.00	113.00	93.50	93.50	84.00	84.00
H1F2R2	101.00	101.00	88.00	88.00	81.50	81.50
H1F3R1	105.50	105.50	91.50	91.50	82.50	82.50
H1F3R2	96.00	96.00	88.00	88.00	81.00	81.00
H2F1R1	115.00	115.00	100.50	100.50	89.00	89.00
H2F1R2	103.00	103.00	96.50	96.50	85.50	85.50
H2F2R1	110.00	110.00	92.00	92.00	84.50	84.50
H2F2R2	101.50	101.50	88.00	88.00	81.00	81.00
H2F3R1	105.50	105.50	91.50	91.50	83.00	83.00
H2F3R2	95.00	95.00	88.00	88.00	82.00	82.00
H3F1R1	107.50	107.50	99.50	99.50	88.50	88.50
H3F1R2	101.00	101.00	96.00	96.00	84.50	84.50
H3F2R1	107.00	107.00	91.50	91.50	84.50	84.50
H3F2R2	96.50	96.50	86.50	86.50	81.00	81.00
H3F3R1	101.00	101.00	91.00	91.00	83.00	83.00
H3F3R2	93.00	93.00	87.00	87.00	82.00	82.00
H4F1R1	113.00	113.00	100.50	100.50	88.50	88.50
H4F1R2	101.50	101.50	96.50	96.50	84.50	84.50
H4F2R1	110.50	110.50	92.00	92.00	84.50	84.50
H4F2R2	100.00	100.00	89.50	89.50	81.00	81.00
H4F3R1	105.50	105.50	90.50	90.50	83.50	83.50
H4F3R2	94.50	94.50	89.00	89.00	82.00	82.00
H5F1R1	109.00	109.00	101.00	101.00	88.50	88.50
H5F1R2	101.00	101.00	94.50	94.50	84.50	84.50
H5F2R1	107.00	107.00	93.00	93.00	84.00	84.00
H5F2R2	98.00	98.00	86.00	86.00	81.50	81.50
H5F3R1	102.00	102.00	93.00	93.00	82.50	82.50
H5F3R2	93.00	93.00	86.00	86.00	82.50	82.50

Table - 46

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	34.25	34.50	28.50	28.50	34.50	34.50
H1F1R2	32.50	32.50	27.50	27.50	31.50	31.50
H1F2R1	34.50	34.50	30.50	30.50	35.00	35.00
H1F2R2	32.50	32.50	29.50	29.50	32.50	32.50
H1F3R1	34.50	34.50	30.50	30.50	35.00	35.00
H1F3R2	32.50	32.50	29.50	29.50	32.50	32.50
H2F1R1	34.25	34.50	28.50	28.50	34.50	34.50
H2F1R2	32.50	32.50	27.50	27.50	31.50	31.50
H2F2R1	34.50	34.50	30.50	30.50	35.00	35.00
H2F2R2	32.50	32.50	29.50	29.50	32.50	32.50
H2F3R1	34.50	34.50	30.50	30.50	34.50	34.50
H2F3R2	32.50	32.50	29.50	29.50	31.50	31.50
H3F1R1	32.75	34.50	28.00	28.00	35.00	35.00
H3F1R2	31.50	32.50	27.00	27.00	32.50	32.50
H3F2R1	32.75	32.50	29.00	29.00	35.00	35.00
H3F2R2	31.50	32.75	27.00	27.00	32.50	32.50
H3F3R1	32.75	31.50	29.00	29.00	33.50	33.50
H3F3R2	31.50	32.75	27.00	27.00	31.00	31.00
H4F1R1	33.00	31.50	28.50	28.50	33.50	33.50
H4F1R2	31.50	33.00	27.50	27.50	31.50	31.50
H4F2R1	33.00	31.50	30.50	30.50	35.00	35.00
H4F2R2	31.50	33.00	29.50	29.50	32.00	32.00
H4F3R1	33.00	33.00	30.50	30.50	34.00	34.00
H4F3R2	31.50	31.50	29.50	29.50	32.50	32.50
H5F1R1	32.75	32.75	28.00	28.00	33.50	33.50
H5F1R2	31.50	31.50	27.00	27.00	31.00	31.00
H5F2R1	32.75	32.75	29.00	29.00	33.50	33.50
H5F2R2	31.50	31.50	27.00	27.00	31.50	31.50
H5F3R1	32.75	32.75	29.00	29.00	34.00	34.00
H5F3R2	31.50	31.50	29.50	29.50	32.50	32.50

Table – 56

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	1.73	1.73	1.54	1.54	1.65	1.65
H1F1R2	1.63	1.63	1.48	1.48	1.53	1.53
H1F2R1	1.72	1.72	1.52	1.52	1.69	1.69
H1F2R2	1.63	1.63	1.50	1.50	1.59	1.59
H1F3R1	1.73	1.73	1.52	1.52	1.72	1.72
H1F3R2	1.63	1.63	1.50	1.50	1.68	1.68
H2F1R1	1.73	1.73	1.54	1.54	1.65	1.65
H2F1R2	1.63	1.63	1.52	1.52	1.53	1.53
H2F2R1	1.72	1.72	1.50	1.50	1.69	1.69
H2F2R2	1.63	1.63	1.52	1.52	1.59	1.59
H2F3R1	1.73	1.73	1.50	1.50	1.72	1.72
H2F3R2	1.63	1.63	1.51	1.51	1.68	1.68
H3F1R1	1.66	1.66	1.48	1.48	1.60	1.60
H3F1R2	1.58	1.58	1.51	1.51	1.53	1.53
H3F2R1	1.68	1.68	1.51	1.51	1.64	1.64
H3F2R2	1.58	1.58	1.50	1.50	1.54	1.54
H3F3R1	1.68	1.68	1.54	1.54	1.70	1.70
H3F3R2	1.58	1.58	1.48	1.48	1.63	1.63
H4F1R1	1.73	1.73	1.52	1.52	1.65	1.65
H4F1R2	1.63	1.63	1.50	1.50	1.53	1.53
H4F2R1	1.72	1.72	1.52	1.52	1.69	1.69
H4F2R2	1.63	1.63	1.52	1.52	1.59	1.59
H4F3R1	1.73	1.73	1.49	1.49	1.72	1.72
H4F3R2	1.63	1.63	1.52	1.52	1.68	1.68
H5F1R1	1.68	1.68	1.52	1.52	1.61	1.61
H5F1R2	1.55	1.55	1.49	1.49	1.53	1.53
H5F2R1	1.68	1.68	1.51	1.51	1.64	1.64
H5F2R2	1.63	1.63	1.49	1.49	1.54	1.54
H5F3R1	1.68	1.68	1.51	1.51	1.71	1.71
H5F3R2	1.63	1.63	1.49	1.49	1.63	1.63

Table – 57

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	6.50	6.50	8.00	8.00	4.50	4.50
H1F1R2	5.50	5.50	6.00	6.00	3.50	3.50
H1F2R1	6.50	6.50	4.50	4.50	3.50	3.50
H1F2R2	5.50	5.50	3.50	3.50	2.50	2.50
H1F3R1	6.50	6.50	4.50	4.50	2.50	2.50
H1F3R2	5.50	5.50	3.50	3.50	1.50	1.50
H2F1R1	6.50	6.50	8.00	8.00	4.50	4.50
H2F1R2	5.50	5.50	6.00	6.00	3.50	3.50
H2F2R1	6.50	6.50	4.50	4.50	3.50	3.50
H2F2R2	5.50	5.50	3.50	3.50	2.50	2.50
H2F3R1	6.50	6.50	4.50	4.50	2.50	2.50
H2F3R2	5.50	5.50	3.50	3.50	1.50	1.50
H3F1R1	7.50	7.50	9.50	9.50	5.00	5.00
H3F1R2	6.50	6.50	6.50	6.50	4.00	4.00
H3F2R1	7.50	7.50	6.50	6.50	4.50	4.50
H3F2R2	6.50	6.50	4.50	4.50	3.50	3.50
H3F3R1	7.50	7.50	6.50	6.50	3.50	3.50
H3F3R2	6.50	6.50	4.50	4.50	2.50	2.50
H4F1R1	6.50	6.50	8.00	8.00	4.50	4.50
H4F1R2	5.50	5.50	6.00	6.00	3.50	3.50
H4F2R1	6.50	6.50	5.00	5.00	3.50	3.50
H4F2R2	5.50	5.50	4.50	4.50	2.50	2.50
H4F3R1	6.50	6.50	5.00	5.00	2.50	2.50
H4F3R2	5.50	5.50	4.50	4.50	1.50	1.50
H5F1R1	7.50	7.50	9.50	9.50	5.00	5.00
H5F1R2	6.50	6.50	6.50	6.50	4.00	4.00
H5F2R1	7.50	7.50	6.50	6.50	3.50	3.50
H5F2R2	6.50	6.50	4.50	4.50	3.00	3.00
H5F3R1	7.50	7.50	6.50	6.50	3.00	3.00
H5F3R2	6.50	6.50	4.50	4.50	2.50	2.50

Table - 58

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	1.48	1.50	1.33	1.31	1.52	1.51
H1F1R2	1.42	1.44	1.34	1.32	1.58	1.57
H1F2R1	1.48	1.50	1.40	1.38	1.62	1.61
H1F2R2	1.42	1.44	1.40	1.38	1.66	1.66
H1F3R1	1.48	1.50	1.40	1.38	1.63	1.62
H1F3R2	1.42	1.45	1.40	1.38	1.68	1.67
H2F1R1	1.48	1.50	1.33	1.38	1.50	1.51
H2F1R2	1.42	1.44	1.34	1.31	1.55	1.57
H2F2R1	1.48	1.50	1.39	1.32	1.58	1.61
H2F2R2	1.42	1.44	1.39	1.38	1.59	1.66
H2F3R1	1.48	1.50	1.39	1.38	1.58	1.62
H2F3R2	1.42	1.44	1.39	1.38	1.59	1.67
H3F1R1	1.48	1.46	1.29	1.38	1.52	1.51
H3F1R2	1.42	1.39	1.32	1.28	1.58	1.57
H3F2R1	1.48	1.43	1.36	1.31	1.62	1.61
H3F2R2	1.42	1.39	1.36	1.35	1.55	1.66
H3F3R1	1.48	1.46	1.36	1.35	1.58	1.62
H3F3R2	1.42	1.39	1.36	1.35	1.59	1.67
H4F1R1	1.48	1.48	1.32	1.35	1.58	1.49
H4F1R2	1.42	1.44	1.33	1.31	1.59	1.54
H4F2R1	1.48	1.48	1.40	1.32	1.52	1.57
H4F2R2	1.42	1.44	1.40	1.38	1.58	1.58
H4F3R1	1.48	1.44	1.40	1.28	1.62	1.57
H4F3R2	1.42	1.46	1.40	1.38	1.68	1.67
H5F1R1	1.48	1.39	1.30	1.38	1.50	1.49
H5F1R2	1.42	1.47	1.32	1.28	1.55	1.54
H5F2R1	1.48	1.39	1.37	1.31	1.58	1.59
H5F2R2	1.42	1.46	1.36	1.35	1.59	1.58
H5F3R1	1.48	1.44	1.37	1.35	1.58	1.57
H5F3R2	1.42	1.44	1.36	1.35	1.59	1.58

Table – 59

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	0.27	0.27	0.23	0.23	0.29	0.29
H1F1R2	0.29	0.29	0.25	0.25	0.28	0.28
H1F2R1	0.27	0.27	0.23	0.23	0.31	0.31
H1F2R2	0.29	0.29	0.25	0.25	0.28	0.28
H1F3R1	0.27	0.27	0.23	0.23	0.32	0.32
H1F3R2	0.29	0.29	0.25	0.25	0.31	0.31
H2F1R1	0.27	0.27	0.23	0.23	0.29	0.29
H2F1R2	0.29	0.29	0.25	0.25	0.28	0.28
H2F2R1	0.27	0.27	0.23	0.23	0.31	0.31
H2F2R2	0.29	0.29	0.25	0.25	0.28	0.28
H2F3R1	0.27	0.27	0.23	0.23	0.32	0.32
H2F3R2	0.29	0.29	0.25	0.25	0.31	0.31
H3F1R1	0.26	0.26	0.23	0.23	0.28	0.28
H3F1R2	0.28	0.28	0.25	0.25	0.28	0.28
H3F2R1	0.26	0.26	0.23	0.23	0.30	0.30
H3F2R2	0.28	0.28	0.25	0.25	0.28	0.28
H3F3R1	0.26	0.26	0.23	0.23	0.31	0.31
H3F3R2	0.28	0.28	0.25	0.25	0.30	0.30
H4F1R1	0.27	0.27	0.23	0.23	0.29	0.29
H4F1R2	0.29	0.29	0.25	0.25	0.28	0.28
H4F2R1	0.27	0.27	0.23	0.23	0.31	0.31
H4F2R2	0.29	0.29	0.25	0.25	0.28	0.28
H4F3R1	0.27	0.27	0.23	0.23	0.32	0.32
H4F3R2	0.29	0.29	0.25	0.25	0.31	0.31
H5F1R1	0.26	0.26	0.23	0.23	0.29	0.29
H5F1R2	0.28	0.28	0.25	0.25	0.28	0.28
H5F2R1	0.26	0.26	0.23	0.23	0.30	0.30
H5F2R2	0.28	0.28	0.25	0.25	0.28	0.28
H5F3R1	0.26	0.26	0.23	0.23	0.31	0.31
H5F3R2	0.28	0.28	0.25	0.25	0.30	0.30

Table - 60

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	18.64	18.44	17.42	17.70	19.28	19.40
H1F1R2	19.29	19.07	18.82	19.10	17.60	17.71
H1F2R1	18.58	18.40	16.58	16.81	18.83	18.95
H1F2R2	19.29	19.07	17.94	18.19	17.06	17.16
H1F3R1	18.58	18.39	16.59	16.83	19.66	17.79
H1F3R2	19.28	19.07	17.92	18.18	18.33	18.44
H2F1R1	18.64	19.07	17.42	17.70	19.27	19.40
H2F1R2	19.29	18.40	18.81	19.10	17.00	17.71
H2F2R1	18.58	19.07	16.70	16.81	18.83	18.95
H2F2R2	19.28	19.93	18.07	18.20	17.06	17.16
H2F3R1	18.58	18.39	16.71	16.83	19.66	19.79
H2F3R2	19.28	19.07	18.05	18.18	18.33	18.44
H3F1R1	18.17	17.70	17.58	17.72	18.93	19.06
H3F1R2	19.32	19.11	18.71	18.85	17.74	17.86
H3F2R1	18.11	18.36	16.70	16.81	18.73	19.35
H3F2R2	19.32	19.11	18.10	18.30	17.70	17.81
H3F3R1	18.12	17.94	16.68	16.81	19.38	19.52
H3F3R2	19.33	19.12	18.15	18.29	18.94	19.06
H4F1R1	18.87	18.67	17.56	17.70	19.27	19.40
H4F1R2	19.29	19.07	18.94	19.10	17.60	17.71
H4F2R1	18.84	18.66	16.64	16.81	18.83	18.95
H4F2R2	19.28	19.07	17.99	18.20	17.03	17.16
H4F3R1	18.83	18.64	16.65	16.83	19.66	19.79
H4F3R2	19.28	19.06	17.99	18.19	18.33	18.44
H5F1R1	18.13	17.94	17.51	17.72	19.06	19.19
H5F1R2	19.29	19.07	18.63	18.85	17.70	17.86
H5F2R1	18.11	17.92	16.63	16.81	18.73	18.84
H5F2R2	19.29	19.07	18.16	18.29	17.86	17.98
H5F3R1	18.15	17.97	16.64	16.81	19.39	19.51
H5F3R2	19.58	19.38	18.15	18.15	18.94	19.06

Table - 61

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	64.50	64.50	71.00	71.00	71.00	71.00
H1F1R2	67.00	67.00	71.50	71.50	73.00	73.00
H1F2R1	64.50	64.50	72.50	72.50	73.50	73.50
H1F2R2	67.00	67.00	75.00	75.00	74.50	74.50
H1F3R1	64.50	64.50	72.50	72.50	75.50	75.50
H1F3R2	67.00	67.00	74.50	74.50	79.50	79.50
H2F1R1	64.50	64.50	71.00	71.00	71.00	71.00
H2F1R2	67.00	67.00	71.50	71.50	73.00	73.00
H2F2R1	64.50	64.50	72.50	72.50	73.50	73.50
H2F2R2	67.00	67.00	75.00	75.00	74.50	74.50
H2F3R1	64.50	64.50	72.50	72.50	75.50	75.50
H2F3R2	67.00	67.00	74.50	74.50	79.50	79.50
H3F1R1	64.50	64.50	71.50	71.50	69.50	69.50
H3F1R2	67.00	67.00	72.00	72.00	73.00	73.00
H3F2R1	64.50	64.50	72.50	72.50	72.00	72.00
H3F2R2	67.00	67.00	74.50	74.50	74.50	74.50
H3F3R1	64.50	64.50	72.50	72.50	73.00	73.00
H3F3R2	67.00	67.00	74.50	74.50	79.50	79.50
H4F1R1	64.50	64.50	71.00	71.00	71.00	71.00
H4F1R2	67.00	67.00	71.50	71.50	73.00	73.00
H4F2R1	64.50	64.50	72.50	72.50	73.50	73.50
H4F2R2	67.00	67.00	75.00	75.00	74.50	74.50
H4F3R1	64.50	64.50	72.50	72.50	75.50	75.50
H4F3R2	67.00	67.00	74.50	74.50	79.50	79.50
H5F1R1	64.50	64.50	70.50	70.50	71.00	71.00
H5F1R2	67.00	67.00	71.00	71.00	72.00	72.00
H5F2R1	64.50	64.50	72.50	72.50	73.50	73.50
H5F2R2	67.00	67.00	74.50	74.50	73.50	73.50
H5F3R1	64.50	64.50	72.50	72.50	75.50	75.50
H5F3R2	67.00	67.00	74.50	74.50	79.00	79.00

Table - 62

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	653.50	653.50	725.00	725.00	757.50	757.50
H1F1R2	830.50	830.50	840.50	840.50	875.00	875.00
H1F2R1	653.50	653.50	770.00	770.00	825.00	825.00
H1F2R2	830.50	830.50	888.00	888.00	952.50	952.50
H1F3R1	653.50	653.50	770.00	770.00	837.50	837.50
H1F3R2	830.50	830.50	892.50	892.50	975.00	975.00
H2F1R1	653.50	653.50	737.50	737.50	757.50	757.50
H2F1R2	830.50	830.50	840.50	840.50	875.00	875.00
H2F2R1	653.50	653.50	770.00	770.00	825.00	825.00
H2F2R2	830.50	830.50	888.00	888.00	952.50	952.50
H2F3R1	653.50	653.50	770.00	770.00	837.50	837.50
H2F3R2	830.50	830.50	887.50	887.50	975.00	975.00
H3F1R1	653.50	653.50	752.50	752.50	737.50	737.50
H3F1R2	830.50	830.50	855.50	855.50	865.00	865.00
H3F2R1	653.50	653.50	770.00	770.00	810.00	810.00
H3F2R2	830.50	830.50	898.00	898.00	942.50	942.50
H3F3R1	653.50	653.50	795.00	795.00	827.50	827.50
H3F3R2	830.50	830.50	902.50	902.50	955.00	955.00
H4F1R1	653.50	653.50	725.00	725.00	757.50	757.50
H4F1R2	830.50	830.50	840.50	840.50	825.00	825.00
H4F2R1	653.50	653.50	770.00	770.00	825.00	825.00
H4F2R2	830.50	830.50	888.00	888.00	952.50	952.50
H4F3R1	653.50	653.50	770.00	770.00	837.50	837.50
H4F3R2	830.50	830.50	892.50	892.50	975.00	975.00
H5F1R1	653.50	653.50	750.00	750.00	737.50	737.50
H5F1R2	830.50	830.50	855.50	855.50	565.00	565.00
H5F2R1	653.50	653.50	775.00	775.00	810.00	810.00
H5F2R2	830.50	830.50	908.00	908.00	942.50	942.50
H5F3R1	653.50	653.50	770.00	770.00	827.50	827.50
H5F3R2	830.50	830.50	907.50	907.50	950.00	950.00

Table - 63

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	11911	12047	9582	9434	12953	12868
H1F1R2	12252	12412	10483	10327	14063	13975
H1F2R1	11914	12035	11196	11038	14474	14328
H1F2R2	12284	12413	11170	11592	15400	15310
H1F3R1	11913	12033	11196	11038	14751	14660
H1F3R2	12283	12499	11760	11592	15793	15699
H2F1R1	11911	12032	9582	9434	12953	12868
H2F1R2	12282	12412	10483	10326	14064	13975
H2F2R1	11988	12910	11117	11038	14417	14328
H2F2R2	12214	12343	11676	11592	15400	15309
H2F3R1	11988	12110	11116	11038	14751	14656
H2F3R2	12142	12270	11676	11592	15793	15699
H3F1R1	11390	11667	8574	8509	12707	12632
H3F1R2	11298	11422	98625	9787	13715	13626
H3F2R1	11379	11227	10336	10260	13860	13772
H3F2R2	11365	11489	11085	10962	14585	14412
H3F3R1	11375	11492	10336	10260	14096	14006
H3F3R2	11433	11558	11114	11039	14741	14667
H4F1R1	11897	12019	9573	9499	12954	12867
H4F1R2	12070	12198	10269	10194	14064	13976
H4F2R1	11826	11948	11085	10968	14417	14328
H4F2R2	12056	12270	11578	11452	15400	15310
H4F3R1	11938	12019	11085	10968	14751	14661
H4F3R2	12071	12198	11582	11456	15793	15699
H5F1R1	11465	11583	8607	8509	12708	12623
H5F1R2	11298	11421	10033	9918	13716	13627
H5F2R1	11379	11497	10306	10191	14019	13930
H5F2R2	11365	11489	10910	10828	14584	14493
H5F3R1	11365	11492	10306	10191	14177	14086
H5F3R2	11375	11983	10977	10975	14741	14648

Table - 64

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	8050.00	8050.00	7200.00	7200.00	8550.00	8550.00
H1F1R2	8650.00	8650.00	7850.00	7850.00	8900.00	8900.00
H1F2R1	8050.00	8050.00	8000.00	8000.00	8900.00	8900.00
H1F2R2	8650.00	8650.00	8400.00	8400.00	9250.00	9250.00
H1F3R1	8050.00	8050.00	7800.00	7800.00	9050.00	9050.00
H1F3R2	8650.00	8650.00	8400.00	8400.00	9400.00	9400.00
H2F1R1	8050.00	8050.00	7200.00	7200.00	8550.00	8550.00
H2F1R2	8650.00	8650.00	7850.00	7850.00	8900.00	8900.00
H2F2R1	8100.00	8100.00	8000.00	8000.00	8900.00	8900.00
H2F2R2	8600.00	8600.00	8400.00	8400.00	9250.00	9250.00
H2F3R1	8100.00	8100.00	8000.00	8000.00	9050.00	9050.00
H2F3R2	8550.00	8550.00	8400.00	8400.00	9400.00	9400.00
H3F1R1	7850.00	7850.00	6650.00	6650.00	8500.00	8500.00
H3F1R2	8250.00	8250.00	7500.00	7500.00	8850.00	8850.00
H3F2R1	7850.00	7850.00	7600.00	7600.00	8800.00	8800.00
H3F2R2	8300.00	8300.00	8150.00	8150.00	9150.00	9150.00
H3F3R1	7850.00	7850.00	7600.00	7600.00	8950.00	8950.00
H3F3R2	8350.00	8350.00	8200.00	8200.00	9300.00	9300.00
H4F1R1	8150.00	8150.00	7250.00	7250.00	8550.00	8550.00
H4F1R2	8500.00	8500.00	7750.00	7750.00	8900.00	8900.00
H4F2R1	8100.00	8100.00	7950.00	7950.00	8900.00	8900.00
H4F2R2	8580.00	8580.00	8300.00	8300.00	9250.00	9250.00
H4F3R1	8150.00	8150.00	7950.00	7950.00	9050.00	9050.00
H4F3R2	8500.00	8500.00	8300.00	8300.00	9400.00	9400.00
H5F1R1	7900.00	7900.00	6650.00	6650.00	8500.00	8500.00
H5F1R2	8250.00	8250.00	7600.00	7600.00	8850.00	8850.00
H5F2R1	7850.00	7850.00	7550.00	7550.00	8900.00	8900.00
H5F2R2	8300.00	8300.00	8050.00	8050.00	9200.00	9200.00
H5F3R1	7850.00	7850.00	7550.00	7550.00	9000.00	9000.00
H5F3R2	8350.00	8350.00	8100.00	8100.00	9300.00	9300.00

Table - 65

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	2.00	2.00	4.50	4.50	2.00	2.00
H1F1R2	1.00	1.00	3.50	3.50	1.50	1.50
H1F2R1	2.00	2.00	3.50	3.50	1.50	1.50
H1F2R2	1.00	1.00	3.00	3.00	1.00	1.00
H1F3R1	2.00	2.00	3.50	3.50	2.50	2.50
H1F3R2	1.00	1.00	3.00	3.00	1.00	1.00
H2F1R1	2.00	2.00	4.50	4.50	1.00	1.00
H2F1R2	1.00	1.00	3.50	3.50	2.00	2.00
H2F2R1	2.00	2.00	3.50	3.50	1.50	1.50
H2F2R2	1.00	1.00	3.00	3.00	1.50	1.50
H2F3R1	2.00	2.00	3.50	3.50	1.00	1.00
H2F3R2	1.00	1.00	3.00	3.00	1.50	1.50
H3F1R1	2.00	2.00	5.10	5.10	1.00	1.00
H3F1R2	1.50	1.50	4.50	4.50	2.00	2.00
H3F2R1	2.00	2.00	4.00	4.00	1.50	1.50
H3F2R2	1.50	1.50	3.50	3.50	1.50	1.50
H3F3R1	2.00	2.00	4.00	4.00	1.00	1.00
H3F3R2	1.50	1.50	3.50	3.50	1.50	1.50
H4F1R1	2.00	2.00	4.50	4.50	1.00	1.00
H4F1R2	1.50	1.50	3.50	3.50	2.00	2.00
H4F2R1	2.00	2.00	3.50	3.50	1.50	1.50
H4F2R2	1.50	1.50	3.00	3.00	1.50	1.50
H4F3R1	2.00	2.00	3.50	3.50	1.50	1.50
H4F3R2	1.00	1.00	3.00	3.00	1.00	1.00
H5F1R1	2.00	2.00	5.50	5.50	1.50	1.50
H5F1R2	1.00	1.00	4.50	4.50	1.00	1.00
H5F2R1	2.00	2.00	4.50	4.50	2.00	2.00
H5F2R2	1.50	1.50	3.50	3.50	1.50	1.50
H5F3R1	2.00	2.00	4.50	4.50	1.50	1.50
H5F3R2	1.50	1.50	3.50	3.50	1.00	1.00

Table - 66

Treatments	Oct-Nov-95	Oct-Nov-96	Feb-Apr-95	Feb-Apr-96	May-Jul-95	May-Jul-96
H1F1R1	3.00	3.00	4.50	4.50	2.00	2.00
H1F1R2	2.00	2.00	3.50	3.50	1.50	1.50
H1F2R1	3.00	3.00	3.50	3.50	1.50	1.50
H1F2R2	2.00	2.00	2.50	2.50	1.00	1.00
H1F3R1	3.00	3.00	3.50	3.50	1.50	1.50
H1F3R2	2.00	2.00	2.50	2.50	1.00	1.00
H2F1R1	3.00	3.00	4.50	4.50	2.00	2.00
H2F1R2	2.00	2.00	3.50	3.50	1.50	1.50
H2F2R1	3.00	3.00	3.50	3.50	1.50	1.50
H2F2R2	2.00	2.00	2.50	2.50	1.00	1.00
H2F3R1	3.00	3.00	3.50	3.50	1.50	1.50
H2F3R2	2.00	2.00	2.50	2.50	1.50	1.50
H3F1R1	3.00	3.00	5.00	5.00	1.00	1.00
H3F1R2	2.00	2.00	4.00	4.00	1.50	1.50
H3F2R1	3.00	3.00	3.50	3.50	1.00	1.00
H3F2R2	2.00	2.00	2.50	2.50	2.00	2.00
H3F3R1	3.00	3.00	3.50	3.50	1.50	1.50
H3F3R2	2.00	2.00	2.50	2.50	1.50	1.50
H4F1R1	3.00	3.00	4.50	4.50	1.00	1.00
H4F1R2	2.00	2.00	3.50	3.50	1.50	1.50
H4F2R1	3.00	3.00	3.50	3.50	1.00	1.00
H4F2R2	2.00	2.00	2.50	2.50	2.00	2.00
H4F3R1	3.00	3.00	3.50	3.50	1.50	1.50
H4F3R2	2.00	2.00	2.50	2.50	1.00	1.00
H5F1R1	3.00	3.00	5.00	5.00	2.00	2.00
H5F1R2	2.00	2.00	3.50	3.50	2.00	1.50
H5F2R1	3.00	3.00	3.50	3.50	1.50	1.50
H5F2R2	2.00	2.00	2.50	2.50	1.00	1.00
H5F3R1	3.00	3.00	3.50	3.50	1.50	1.50
H5F3R2	2.00	2.00	2.50	2.50	1.00	1.00

INFLUENCE OF WEATHER AND REARING TECHNIQUES ON MULBERRY SILK WORM CROPS IN KERALA

BY

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ABSTRACT OF A THESIS
Submitted in partial fulfilment of the requirement
for the degree
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ABSTRACT

Investigations were conducted on the effect of weather parameters on the mulberry silkworm crops reared in different seasons and to evolve suitable rearing technology for stress seasons in order to improve the rearing during these seasons and for developing suitable package of practices recommendations for silkworm rearing in Kerala. The study was conducted during 1992-1996 at College of Agriculture, Vellayani. The experiments conducted were

- Effect of climatic factors on mulberry silkworm crops in different seasons.
- Identifying rearing technology for stress seasons of high temperature and humidity.
- Manipulation of feeding schedule with reference to stress seasons and types of silkworm rearing houses.

To study the effect of climatic conditions on the mulberry silkworm crop, the silkworms were reared during different identified seasons *viz* December-January, February-April, May-July, August-September and October-November in 1993-94. The mulberry silkworms used for the study were bivoltine NB_4D_2 and crossbreed PM x NB_4D_2. Three brushing were done in each season at fortnightly intervals and fifteen continuous rearings were conducted. The important weather

parameters recorded were maximum temperature, minimum temperature, maximum humidity and minimum humidity inside and outside the rearing house. The rearing characters like instarwise larval duration, moulting duration, larval weight, leaf consumption, silk gland weight, disease incidences, missing larval percentage and economic traits like cocoon weight, shell weight, shell ratio, effective rearing rate, filament length, reelability and computed parameters like growth index and growth rate were also recorded. Among the different seasons, August-September and December-January were identified as the favourable seasons. October-November, February-April and May-July seasons were found to be the stress seasons as the biological and economic traits of the different silkworm races during these seasons were not compromising in comparison with other seasons. Maximum temperature and minimum temperature show direct correlations whereas maximum humidity indirectly showed negative correlations with the economic traits like larval weight, silkgland weight, shell ratio, cocoon weight and yield.

Second and third experiments were conducted to identify suitable cost effective and efficient rearing house for these stress seasons and also to evolve rearing technology so as to reduce cost of production. The treatments for the second experiment were five different rearing houses along with three different larval spacings. The rearings were conducted by using the same crossbreed and bivoltine race used in the first experiment. The rearings were carried out during

1995 and 1996 in the three stress seasons *viz* May-July, October-November and February-March.

The observations were recorded in terms of the larval characters and economic traits of the silkworms NB_4D_2 and PM x NB_4D_2 in these seasons. The results revealed that wider spacing was superior to medium and close spacings in both races. The rearing houses made of mud brick and thatched roof and burnt brick and thatched roof were found superior to other rearing houses in all the three stress seasons during the two year period. Among the different feeding schedules studied in the third experiment, three feeding a day was mostly on par with four feeding a day but was advantageous in terms of convenience of feeding time over other feeding schedules though four feedings recorded higher values for some biological and economic traits in the different silkworm types during different seasons. The incorporation of new techniques of rearing the crossbreed silkworm types in thatched mud wall rearing house, medium spacing of worms and three feeding a day was found to be an ideal profitable package during unfavourable seasons as comparable to that of favourable seasons.