MANAGEMENTAL EFFECTS OF SYNCHRONIZATION OF OESTRUS IN GOATS

By

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THESIS

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DECLARATION

I hereby declare that this thesis, entitled **Managemental effects of synchronization of oestrus in goats** is a bonafide record of research work done by me during the course of research and that this 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.

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Dedicated to my parents

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Introduction

INTRODUCTION

Goat is one of the earliest animals to be domesticated by man. India has the largest population of goats in the world numbering about 110 millions. Although there have been very few measures to develop goats in this country, the population has shown a steady increase of 1.8 per cent per year during the last 30 years. Geographically goats are distributed widely in India and thrive on various agroclimatic conditions. Goat is mainly reared by the rural population who constitute more than 72 per cent of the total population of the country.

Goats have certain special characteristics, which largely determine their place in the rural agricultural economy of India and the role they play for the rural poor. These characteristics are the capacity to adapt to different agro-climatic conditions, small body size, high digestive efficiency of feed, high reproductive efficiency and short generation interval.

Apart from these char
relatively better returns
goats an invaluable ani
landless labourers.

Goats contribute more than 40 per cent of the total meat production, three per cent of the milk production and eight per cent of the total skin production in the country.

Both sheep and goats are found to be seasonally poly-oestrous in the temperate regions, and in the tropical zones, where there is less variation in the day length, sheep and goats tend to breed throughout the year. The duration of oestrous cycle in goats is 20 to 21 days (Arthur et al., 1989a). Reproductive rates of domestic animals are maximized when females are bred at the earliest opportunity. The reproductive efficiency in the goat is affected by fertility, fecundity and the survival rate of kids.

By employing the methods of synchronization of oestrus in the domestic animals, a large percentage of a group of females can be brought into oestrus at a predetermined time. This is expected to bring about the kiddings at a favourable time, which in turn will facilitate the general management of goats, through optimum labour utilization, fodder availability and favourable climatic conditions. Goats in India are generally raised on marginal lands in the extensive system. They are by and large dependent on rain-fed browse and grasses for their nutrition. Most of the regions in the country have distinct rainy and dry seasons

with consequent periods of abundance and scarcity of browse and forages. It will be, therefore, highly advantageous to synchronize and plan kiddings to occur at a time so that during their growth period, plenty of forages and grazing are available.

Ideally, an oestrus synchronization system should elicit a fertile, tightly synchronized oestrous response in a high percentage of treated females. Various hormones can be used to synchronize oestrus in goats. These are

1. preparations which stimulate the release of anterior pituitary hormones,
2. preparations which mimic the actions of the anterior pituitary gonadotrophins,
3. oestrogens,
4. progestogens, and
5. prostaglandins.

Very little information is available on the synchronization of oestrous in the native Indian breeds of goats, and its effects on the various managemental aspects of goat husbandry. In the present study prostaglandin F_2 Alpha (PGF_2) was used to synchronize oestrus in the goats and its effect on various aspects of reproduction, management, behaviour and performance were investigated.

2.1. Synchronization of Oestrus

The length of inter oestrus interval in most domestic species is controlled by the duration of life span of the corpus luteum (Arthur et al., 1989b). Prostaglandin F_2 alpha and its synthetic analogues have luteolytic properties (Perera et al., 1978; Bosu et al., 1978; Ott et al., 1980; Bretzlaff et al., 1981; Alacam et al., 1985 and Cox et al., 1987). So they can be used to synchronize oestrus in animals.

Arthur and co-workers (1989b) reported that in the cow, mare, ewe and doe, the new developing corpus luteum is refractory to the actions of PGF_2alpha for three to five days after ovulation. Bosu and associates (1978) observed that prostaglandin F_2alpha is luteolytic when administered to does more tnan 4 days after the end of oestrum, whereas Ott and coworkers (1980) reported that prostaglandin F_2alpha was luteolytic to goats as early as day 4 of the cycle. Bretzlaff and associates (1981) found that between days 7 and 10 of the oestrus cycle, injection of PGF_2alpha is effective in inducing luteolysis and oestrus in goats.

As the prostaglandin F_2alpha is not effective in causing luteolysis in the early part of the oestrus cycle in

goats, in a group of randomly cycling animals which are at different stages of oestrus, all animals may not come to oestrus after a single injection of PGF_2alpha. Oestrus synchronization system using two injections of prostaglandin separated by an interval of 10 to 14 days was developed to circumvent this problem (Perera et al., 1978; Westhuysen, 1979; Ott et al., 1980; Ogunbiyi et al., 1980; D'urso and Dell'Aquila, 1981; Pandey et al., 1985; Pandiya and Rathor, 1986; Greyling and Neiker, 1986; Ishwar and Pandey, 1990; Simplicio and Machado, 1991).

2.2. Interval Between Injection of PGF_2alpha and the Onset of Oestrus

Bosu and co-workers (1978) and Moore and Eppleston (1979) observed that oestrus was induced 2 to 3 days after the injection of PGF_2alpha to cycling goats. Ott and associates (1980a) treated 20 female goats at different stages of cycle with two doses of 8 mg PGF_2alpha, 11 days apart and observed that the mean interval from the administration of PGF_2alpha to the onset of oestrus was 53 ± 2 h after the first injection and 50 ± 1 h after the second injection respectively. Similar findings were reported by the same authors (1980b) and by Westhuysen (1979) using 125 µg of a PGF_2alpha analogue in Angora goats. Bretzlaff and

co-workers (1981) observed that after injections of PGF_2alpha at 4 different doses of 1.25, 2.5, 5 or 7.5 mg, the mean time interval from injection to oestrus in goats were 47±3.1, 42±4.3, 44±8.5 and 43±5.5 h respectively whereas D'urso and Dell'Aquila (1981) reported that after the administration of PGF_2alpha, twice 11 days apart to cycling does at doses of 5 mg and 10 mg, the animals came to oestrus with an interval of 1.85 and 2.25 days respectively.

Sanwal and associates (1982) observed that in a group of anoestrous goats with high progesterone levels, after treatment with PGF_2alpha, the goats showed oestrous after 96 to 120 h. In Black Bengal goats after 2 injections of 10 mg PGF_2alpha 11 days apart, it was found that interval from injection of prostaglandin and oestrus varied from 4 to 6 days (Pandey et al., 1985). Alacam and co-workers (1985) noted that within 4 days after the second PGF_2alpha injection, the goats came to oestrus. Ishwar and Pandey (1990) comparing the effect of double injection of prostaglandin with a gap of 11 days and long term progesterone treatment reported that the time interval between the administration of prostaglandin or progesterone and the onset of oestrous was found to be nearly the same (94.86±21.12 Vs 93.66±5.05 hrs).

Sang and Park (1984) observed in Korean native goats that interval between injection of PGF_2alpha to the onset of oestrous was shorter in goats injected on day 5 or 6 (38.0±2.0 to 38.4±2.4 h) than in goats injected on day 7, 8 or 12 (52.8±4.8 to 56.0±4.3 h). Mahmood and Koul (1990) reported that after injection of a PG analogue to Pashmina goats between day 5 and 6, days 9 and 12 and days 13 and 17 of estrus cycle, oestrus was induced 54.4±4.62, 71.1±5.14 and 61.9±3.75 h after injection. Greyling and Neiker (1986) observed that in a group of Boer goats receiving 2 injections of cloprostenol (a PG analogue) 14 days apart, the interval between the second injection and oestrus was significantly shorter than oestrus after the first injection (55.3 Vs 62.4 h). Cox and associates (1987) found an interval of 48.2±15.7 h from treatment with Tiaprost (a PG analogue) to oestrus. Pandey and co-workers (1991) reported a shorter interval between PGF_2alpha injection and onset of oestrous (39.33±2.15 h) when cycling goats were treated with 750 I.U of pregnant mare serum Gonadotrophin (PMSG) on day 10 of the oestrous cycle and an injection of 5 mg PGF_2alpha on day 11 of the cycle.

2.3. Percentage of Animals in Oestrus after Injection of PGF_2alpha

Perera and co-workers (1978) reported that after 2 injections of cloprostenol 10 days apart to goats at unknown

stages of oestrus 5 out of 6 goats came to oestrus. Moor and Eppleston (1979) found a similar result (82 per cent) in a larger group of does using a single injection of cloprostenol. In 20 cyclic does given 2 doses of 3 mg PGF_2alpha, 11 days apart, 17 and 20 does came into oestrus after the first and second injection respectively (Ott et al., 1980). In another experiment by the same authors (1980) employing the same dosage of prostaglandin with an interval of 11 days between the injections on 17 crossbred goats, 70.6 per cent and 94 per cent of the treated goats came to oestrus after the 1st and 2nd injection respectively. Two injections of 7.5 mg PGF_2alpha separated by 10 days given to 25 goats evoked 64 and 84 per cent synchronized oestrus in them respectively after the 1st and 2nd injections (Ogunbiyi et al.,1980).

Cardenas Vazquez (1985) on Murcian-Granada goats using 0.15 mg of Tiaprost (a PG analogue) 11 days apart also reported similar result (88 per cent). Cox and associates (1987) observed 95 per cent oestrus synchrony after the 2nd injection of 0.12 mg Tiaprost.

Out of eleven does given 15 mg of PGF_2alpha injections (single) on days 2, 4, 5, 12 or 16 of the oestrous cycle, 10 does treated with PG on days 4-16 of the cycle exhibited oestrus (Serna et al., 1978). Sang and Park (1984) observed

that 3 mg of prostaglandin given to goats intramuscularly on day 5, 6, 7, 8 or 12 of the oestrous cycle induced oestrus in 83-100 per cent of the goats.

D'urso and Dell'Aquila (1981) reported that, 2 groups of goats given 2 injections 11 days apart of 5 mg PGF_2alpha or 10 mg PGF_2alpha each showed 80.9 and 76.2 per cent oestrus synchrony respectively. Molockwu (1984) employing three different dose levels of prostaglandin injections observed synchronized oestrus in 84, 77 and 77 per cent of the goats in the three groups. Greyling and Neiker (1986) reported that in 3 groups of goats injected twice with 62.5, 125 or 250 ug of cloprostenol separated by 14 days, oestrus was induced in 75.0, 75.0 and 81.3 per cent after the first injection and 93.8, 87.5 and 100 per cent after the second. In two groups of Pashmina goats injected with 5 or 6 ug Carboprost tromethamine, (PG analogue) Mahmood and Koul (1990) observed that 53.19 and 46.67 per cent of the females exhibited oestrus.

In Black Bengal goats after 2 injections of 10 mg PGF_2alpha with an interval of 11 days, 70 per cent of the non-cycling group, 86 per cent of the short cycling group and 100 per cent of the normal cycling group came into oestrus (Pandey et al., 1985).

Westhuysen (1979) in three groups of Angora goats, treated during the breeding season with intravaginal sponges containing 60 mg medroxy progesterone acetate (MAP sponges), MAP sponges and 125 ug Estrumate (a PG analogue) or 2 injections of Estrumate 12 days apart, found that oestrus was induced in 75.0, 75.0 and 100 per cent of the females in the three groups respectively. Ishwar and Pandey (1990) also reported similar findings in two groups of Black Bengal goats receiving long term progesterone treatment or 2 doses of PGF_2alpha (90 per cent Vs. 100 per cent). Synchronization rates of 96 per cent with intravaginal MAP sponges and 84.6 per cent with double injection of prostaglandin were reported in Saanen goats (Kilicoglu et al., 1985).

2.4. Oestrus Duration

2.4.1. Oestrus duration in cyclic goats

Oestrus lasts 24 to 48 hours in the doe. Duration of oestrus is influenced by breed, age, season and the presence of the male. Oestrus is of shorter duration at the beginning and end of the breeding season, and in the presence of male (Hafez, 1987b).

Mishra and Biswas (1966) observed that the length of oestrus in Deshi goats in Bihar was 37.6±1.3 hours.

Ramachandriah and associates (1986) also found similar oestrus duration (36.28 h; range 24-72 h) in the local native goats.

The mean duration of oestrus in Pashmina goats was found to be 24.83±1.67 hours (Bhattacharya et al., 1981). Sahni and Roy (1967) observed that the oestrus in Barbari goats was 24 to 36 hours. Prasad and Bhattacharyya (1979b) found the average duration of oestrus to be 38.16±0.86 h and 1.78±0.38 days, respectively in nullipara and bipara nannies. Mittal (1981) reported the oestrus duration in Jamnapari goats to be 36.42±0.86 hours. Prasad and Bhattacharyya (1979a) observed that the duration of pubertal oestrus was significantly shorter than that of second oestrus in Barbari nannies (1.62 Vs. 1.86 days). The average duration of heat in a group of Black Bengal goats was found to be 39.9 hours (Pandey et al., 1985). Ishwar and Pandey (1990) also reported similar oestrus duration (33.33±2.75 h) in the same breed.

Krishnakumar (1992) observed in a large herd consisting of Malabari, Saanen x Malabari and Alpine x Malabari goats in Kerala that in majority of the does, the oestrus duration varied from 12 to 48 hours. Whereas Singh et al. (1992) reported that in majority of Beetal crossbred goats oestrus duration varied between 16 to 18 hours.

Carmenate (1977) found the oestrus length of Saanen and Toggenberg goats varied from 16 to 48 hours, majority of them having a duration of 24-36 hours.

In the Savanna brown goats the oestrus duration was about 27 hours (Molockwu, 1984). In nulliparous Creole goats it has been reported to be 23.3±8.2 hours (Chemineau et al., 1983).

2.4.2. Oestrus duration in the synchronized goats

Wani and associates (1985) after administration of PGF_2alpha on day 15-16 of the oestrous cycle to a group of miniature and crossbred goats, the duration of oestrus averaged 54.7 hours, whereas in India on Barbari goats with the same treatment the average duration of oestrus was 34.9 hours.

After 2 injections of PGF_2alpha on a group of Black Bengal goats, the duration of oestrus averaged 20.0±2.5, 17.3±1.8, 16.0±1.6 and 20 hours in non cycling, short cycling, normal cycling and nymphomaniac goats (Pandey et al., 1985). Ishwar and Pandey (1990) comparing the effect of administration of progesterone and prostaglandin on Black Bengal goats found that the duration of oestrus was 36.55±2.86 and 35.29±3.09 hours respectively in the two groups.

Pandiya and Rathor (1986) reported that in Amritsar goats the mean duration of oestrus was 44.0±3.7 hours (range 24-72) after synchronization with prostaglandin. Greyling and Neiker (1986) in a synchronization programme with 2 injections of Estrumate, 14 days apart found that duration of oestrus was significantly longer after the second injection than the first injection (41.9 Vs 30.9 h).

Pandey and associates (1991) reported that the duration of oestrus averaged 21.33±2.6, 18.66±2.6 and 24.0±0 hours respectively in three groups of cycling goats receiving pregnant mare serum Gonadotrophin (PMSG), PMSG + PGF_2alpha or PMSG + human chorionic Gonadotrophin (HCG).

2.5. Oestrus Behaviour and Intensity of Oestrus

2.5.1. Oestrus behaviour in cyclic goats

During the evolution, male and female vertebrates have evolved specific behavioural, physiological and neurological mechanisms which ensure the occurrence of sexual behaviour at a time when it is most likely to be fertile (Clemens and Christensen, 1975). The abilitation of reproductive behaviour is dependent on a wide range of factors including neural mechanisms, hormones, pheromones and the sensory reception of a variety of stimuli (Schein and Hale, 1965).

Hafez (1987a) reported that the doe in oestrus shows increased motor activity, increased frequency of non specific bleats, immobility when approached and teased by the male and sniffs males' body and genitals. Arthur and associates (1989a) however observed that detection of heat in doe is difficult without male goat.

Frazer and Broom (1990) found that goats are restless in pro-oestrus and in heat the most striking behaviour includes repeated bleating, vigorous, rapid tail waving and poor appetite.

Bhattacharya and co-workers (1981) categorised oestrus as pronounced, normal or weak in Pashmina goats and found that in most of the goats of the breed, the signs were limited to vulval swelling and mounting other goats. In local Nellore goats Ramachandraiah and associates (1986) observed switching of tail, tendency to seek the buck and allowing to be ridden as salient signs of oestrus. Angora and crossbred does in oestrus show switching of tail, swelling and congestion of vulva, mucous discharge from the genital tract, mounting and allowing mounting by other does (Srivastava et al., 1991).

In two breeds of sheep in oestrus Fabre-Nys and Venier (1989) measured receptivity by counting the stand and still

reaction when courted by male and proceptivity was studied by measuring the time ewe spent close to a fence behind which males are placed.

2.5.2. Oestrus behaviour in synchronized goats

Perera and associates (1978) observed vulval swelling, relaxation of vaginal orifice, raised tail and mucous discharge as the principal signs of oestrus in goats synchronized with injections of estrumate. Oestrus synchronized goats showed typical standing oestrus behaviour on being induced (Pandey et al.,1985; Mahmood and Koul, 1990). Ishwar and Pandey (1990) concluded that oestrus activity remains normal and not affected by oestrus synchronization with hormones.

2.6. Conception rate

2.6.1. Conception rate in cyclic goats

Measurement of fertility is a very important aspect of any breeding programme, and as such this should be given due attention in any husbandry practice.

In Malabari goats Sudarsanan and Raja (1973) reported that conception rate to first insemination was 55.2 per cent and 75.8 per cent with three inseminations. Krishnakumar (1992) reported that in a herd of goats consisting of

Malabari, Saanen x Malabari and Alpine x Malabari in Kerala, overall pregnancy rate by single artificial inseminations was 71.42 per cent and by double insemination 82.14 per cent. Greesh Mohan and associates (1983) observed overall fertility rate of 80.9 per cent with artificial insemination in Pashmina goats.

Moor and Appleston (1979) in a large group of Angora and Angora crossbred goats found that the kidding percentage was 67, after artificial insemination, whereas Oszar and co-workers (1987) reported a conception rate of 75 per cent in a small group of Angora goats inseminated with fresh whole semen.

Cardenas Vazquez (1985) observed that 72.7 per cent of the mated Murcian-Granada goats conceived. Prasad and Pandey (1982) reported that in Barbari nannies the conception rate in summer and winter respectively was 74.7 and 72.7 per cent for females inseminated in the first oestrous cycle.

2.6.2. Conception rate in the synchronized goats

Bosu and associates (1978) reported a fertility rate of 77 per cent following breeding in goats after synchronization of oestrus using PGF_2alpha, whereas conception rates as high as 90 per cent have been reported

with double matings at the second induced oestrus following prostaglandin injection (Ogunbiyi et al., 1980; Molockwu, 1984).

Moore and Eppleston (1979) concluded that overall treatment with progestogens and prostaglandin depressed fertility in goats. Simplicio and Machado (1991) also observed lowered kidding rate with single insemination between 60 to 84 hours after the second PGF_2alpha injection.

However, Ott and co-workers (1980à)found no difference in conception rate to first service between oestrus synchronized goats using prostaglandin and the untreated controls.

D'urso and Dell'Aquila (1981) observed that in two groups of goats, the kidding percentages were 88.2 and 81.2, after mating at induced oestrus using 5 and 10 mg PGF_2alpha respectively. Greyling and Neiker (1986) compared the effect of three different doses of PGF_2alpha analogue on three groups of goats, conception rates following multiple insemination at induced oestrus in the three groups were 73.3, 57.1 and 43.8 per cent.

Westhuysen (1979) compared the effect of prostaglandin treatment with that of intravaginal MAP sponges and MAP

sponges and prostaglandin injection in three groups of goats, and reported that the conception rates were 75.0, 83.3 and 66.7 per cent respectively in the three groups. On the other hand Kilicoglu and associates (1985) in Saanen goats found that the pregnancy rates after using intravaginal MAP sponges and prostaglandin injections were almost similar in both the groups (60 per cent Vs 61.5 per cent).

In two groups of Black Bengal goats, Ishwar and Pandey (1990) reported 100 per cent conception rate after mating following induced oestrus with either progesterone or prostaglandin.

2.7. Gestation Period

2.7.1. Gestation period in non synchronized goats

Gestation period of goats varies from 144 to 149 days Hafez, 1987b). The range of gestation length in Sirohi goats is reported to be 139 to 159 days (Mishra et al., 1979). Khan and associates (1981) observed the gestation period in Jamnapari goats to be 149.78±0.41 days whereas Sinha and Sahni (1982) reported gestation length of 149.56, 150.23, 145.44 and 144.92 days respectively in Jamnapari, Beetal, Barbari and Black Bengal goats. The gestation length of Jhakrana and Marwari goats were found to be 148.5 and 146.8 days respectively (Mittal, 1991).

Sudarsanan and Raja (1973) reported that the gestation length of Malabari goats was 146.2 days, while Mukundan and associates (1983a) observed a mean gestation length of 147.4±1.2 days in a flock consisting of Malabari and Saanen x Malabari goats in Kerala.

Peaker (1978) reported an overall median gestation length of 150 days in British Saanen goats.

Sinha and Sahni (1982) observed that the effect of breed was highly significant, while the effect of sex and type of birth of offsprings and season of kidding had no significant effect on gestation length. On the other hand Peaker (1978) reported a tendency for median gestation period to be shorter as the litter size increased. Singh and Singh (1983) found that overall gestation period in goats producing single was 1.2 per cent more than the ones having twins. Gangwar and Yadav (1987) however, have reported that parity had no significant influence on gestation.

2.7.2. Gestation period in Synchronized goats

In the African brown goats, the gestation period following mating after induced oestrus with prostaglandin was 141-158 days (Ogunbiyi *et al.*, 1980). Ishwar and Pandey (1990) observed that the average gestation length was

148.33, 149.44 and 149.66 days in goats mated after synchronization with PGF_2alpha, progesterone treatment and untreated controls respectively, the difference being non significant.

Simplicio and Machado (1991) found the gestation periods in Alpine, Alpine x Moxoto and Saanen goats mated after prostaglandin treatment was 146.30±0.41, 147.90±1.08 and 146.00±0.69 days respectively.

2.8. Behaviour associated with parturition in goats and behaviour of new born kids

Lickliter (1985) reported that 76 per cent of the parturient goats separate themselves from herd mates several hours prior to giving birth. Frazer and Broom (1990) observed that goats in immediate pre-partum period show sluggish walking, becomes restless and agitated and during parturition show signs of pain, repeated straining and occasional bleating.

Matter (1970) observed that in karakul lambs significantly more lambs were born in the period 0600 to 1200 hours, than other periods of the day. Lickliter (1985) found that 65 per cent of the births in goats occurred about midday between 1100 and 1600 hours.

Das (1986) reported that parturitions in Beetal, Saanen, Alpine x Beetal and their crosses during 0000-0600, 0600-1200 h, 1200-1800 h and 1800-2400 h, were found to be 6.34, 27.32, 52.68 and 13.66 per cent respectively in the four periods. Bosc and associates (1988) observed that frequency of birth in goat showed a unimodal distribution with maximum number of birth at mid day and minimum around mid night.

Following parturition the maternal animal acquires repertoire of behaviour oriented towards acceptance and maintenance of the new born (Frazer and Broom 1990). Hafez (1975a) stated that maternal behaviour in the mammalian species was expressed in diversity of ways as per the requirement of survival of the litter. Frazer and Broom (1990) reported that during grooming after parturition both the dam and the offspring vocalize, which is important for the development of 'Maternal-Newborn' bond.

Buddenberg and associates (1986) observed the maternal behaviour of beef cows and formed a arbitrary scale, assigning numerical values for maternal rating.

Lickliter (1985) reported that most new borns attempted to stand within 15 minutes of birth and 77 per cent suckled within an hour of birth. Frazer and Broom (1990) observed

that within 48 h of birth newborn goats have the perceptual and locomoter ability to recognise their mothers.

2.9.Prolificacy - Incidence of Multiple Pregnancies in goats

2.9.1. Multiple pregnancies in non synchronized goats

The number of kids born in a pregnancy is influenced mainly by age, breed, parity and nutritional status of the doe.

Sudarsanan and Raja (1973) reported a mean litter size of 1.7±0.9 in Malabari goats, whereas Mukundan (1976) observed that the litter size in Malabari goats was 1.44. In a flock of Malabari, Alpine x Malabari and Saanen x Malabari goats the incidence of multiple pregnancies was found to be 51.2 per cent (Kuriakose et al., 1983). On the other hand Krishnakumar (1992) reported that the percentage of single and multiple pregnancies was 60.83 and 39.17 respectively in the same breed. Prakasam and associates (1987) observed that the average litter size in Tellichery (Malabari) goats was 1.33.

Gill and Dev (1972) reported that the kidding rate of French Alpine and Anglo Nubian goats in India was 1.56 and 1.63 respectively. Frequency of twins and triplets in Jamnapari goats was 33.33 and 4.76 per cent (Khan et al., 1981). Prakash and co-workers (1986) observed that the

percentage of multiple births was 53.01 in Barbari and 39.39 in Jamnapari goats. In Beetal and Black Bengal goats incidence of multiple births was 60.97 and 70.69 per cent respectively (Kannaujia et al., 1986).

Mukundan and Rajagopalan (1971) reported that age of dam had a significant influence on the incidence of multiple births. Genetic groups, parity, age and weight of females had significant effects on the incidence of multiple births (Prakash and Singh, 1985) while the effect of sire was not significant on it (Prakash et al., 1986).

2.9.2. Incidence of Multiple pregnancies in the synchronized goats

D'urso and Dell'Aquila (1981) reported that litter sizes in goats after making at natural oestrus and synchronized oestrus following administration of 5 or 10 mg PGF_2alpha were 2.00, 1.87 and 1.54 respectively. Costa and associates (1982) observed that the litter size was 1.17 in goats after prostaglandin treatment. In Alpine, Alpine x Moxoto and Saanen goats Simplicio and Machado (1991) found that following PG induced oestrus, the litter size was 1.0, 1.35 and 1.33 respectively.

Greyling and Neiker (1986) using 3 dose levels of a PG analogue to induce oestrus in 3 groups of African Boer goats

found that the litter size was 2.2, 2.1 and 2.4 in the three groups.

Ishwar and Pandey (1990) reported that in Black Bengal goats the incidence of twin birth was higher in the groups treated with progesterone or prostaglandin than the untreated control group.

2.10. Growth of Kids

2.10.1. Birth weight of kids

Birth weight in goats is influenced mainly by breed, sex and type of birth of the kid and nutritional status of the dam during pregnancy.

Mukundan (1976) reported that in Saanen x Malabari, Alpine x Malabari and Malabari goats the birth weight of kids averaged 2.39, 1.95 and 1.79 kg for the males and 2.11, 2.33 and 1.76 for the females respectively. In another study it has been found that the birth weight of Tellichery (Malabari) kids averaged 2.22±0.01 kg for males and 1.81±0.01 kg for females (Prakasan et al., 1987).

Birth weight of French Alpine and Anglo-Nubian kids in India averaged 3.5 and 2.9 kg respectively (Gill and Dev, 1972). Singh and associates (1984) observed that the birth weight of Jamnapari and Barbari kids averaged 3.55 and

2.05 kg respectively. Setiadi (1988) reported an average birth weight of 2.8 kg in Jamnapari goats.

The average birth weights for Black Bengal, Chegu, Beetal, Kutchi and Marwari goats were reported to be 1.20, 2.02±0.20, 2.74±0.10, 3.14±0.21 and 2.12±0.15 kg respectively (Pattanaik and Mishra, 1985; Koul and Biswas, 1987; Rana and Godara, 1991; Mittal, 1991). Singh and Prakash (1985) observed that the birth weight of Changthang goats averaged 2.22 and 2.04 kg for males and females respectively.

Nath and Chawla (1978), Darokhan and Tomar (1983) and Jagtap and Patil (1986) reported that sex of kid had significant effect on birth weight. On the other hand Khan and co-workers (1979) observed that birth weight was not significantly affected by sex of kid.

Mittal (1979) found that breed and season of kidding had a significant effect on birth weight. Mukundan and associates (1981) reported that genetic group and month and year of kidding did not affect the birth weight significantly. They observed that sex of kid, type of birth and dam's body weight at kidding had highly significant effect on birth weight. Khan and co-workers (1979) reported that type of birth had a significant effect on the birth weight.

2.10.2. Growth of kids upto three months of age

Mukundan and associates (1983b) reported that in Malabari and Saanen x Malabari kids, body weight averaged 2.83 and 3.91 kg respectively at one month age and 3.97 and 5.16 kg at 2 months and 4.96 and 6.48 kg at 3 months age. In Jamnapari and Barbari kids body weight averaged 3.55 and 2.05 kg respectively at birth and 7.45 and 7.19 kg at weaning (Singh et al., 1984). Setiadi (1988) observed that the weaning weight (at 90 days) for Jamnapari kids was 9.0 kg.

Sarma and co-workers (1981) reported that the daily gain in weight upto 90 days for Assam local goats averaged 35 gm. The pre-weaning daily gain in Beetal and Black Bengal kids averaged 59.82 and 50.52 g respectively (Malik et al., 1986).

Sex of kid had significant effect on growth of kids (Mukundan et al., 1984). On the other hand Roy and associates (1989) found no significant effect of sex on body weight of kids at any stage of growth.

Type of birth (single, twins etc.) is another factor affecting growth of kids (Sarma et al., 1981; Khan and Sahni 1983 and Sarma et al., 1984).

Das and associates (1989) reported that birth type affected body length upto 3 months of age, height at all ages except at birth and heart girth at all ages in Barbari goats. It was observed that sex of kid had significant effect on body measurements at 45 and 90 days (Sarma et al., 1984).

2.11. Suckling Behaviour in Kids

Suckling behaviour is one of the components of ingestive behaviour. This involves the pattern of taking milk directly from the dam by the kids.

Hafez (1975b) reported that suckling behaviour is present in mammals almost immediately after birth. Improper orientation of this behaviour in kids may lead to poor health and poor growth. Information on this behaviour in goats is scanty.

In range beef calves it was observed that, most suckling events in a single hour occurred between 0500 to 0600 hour and least between 2200 and 2300 h. Heavier calves suckled less frequently while age, breed and sex of the calves did not influence the duration of suckling (Odde et al., 1985). Boggs and asociates (1980) reported that milk intake in the calves declined from 6.14 to 3.37 kg per head per day from April to August and September.

It was observed that in the Hungarian Merino sheep, 32.8 per cent of the lambs suckled from the left side, 59.6 per cent from the right side and 7.6 per cent from behind the dam (Keszthelyi et al., 1987).

In Black Bengal kids Das and Pan (1990) reported that among twins, the kids with lighter body weight reached the doe first in 57.5 per cent of the occasions and preferred approaching the doe through the left side. The overall mean rate of suckling was 16.91±1.37 g/min. and overall mean number of butting per minute during suckling was 4.94±0.22.

2.12. Milk Yield in Goats

Rao and associates (1976) reported that the daily milk yield in Alpine, Beetal and Alpine x Beetal goats reared in India averaged 1.61, 1.71 and 2.16 kg respectively. Daily milk yield for Jamnapari and Barbari goats averaged 1.39 and 1.09 kg respectively in the first week and 0.81 and 0.52 kg in the 10th week (Mittal et al., 1977). Agarwal and Bhattacharyya (1978) found that in the Black Bengal and Barbari goats daily milk yield during days 7 to 97 of lactation averaged 344.4 and 665.8 g.

Mukundan and associates (1983c) reported that the lactation milk yield in Malabari and Saanen x Malabari goats averaged 49.4 and 117.3 kg. Lactation milk yield in

Jhakrana and Marwari goats was found to be 55.4 and 86.3 kg respectively (Mittal, 1991).

It has been observed that the year and season of kidding had significant effect on the lactation yield and lactation length (Prakash et al., 1971; Barhat and Chowdhary, 1978). Mukundan and associates (1983c) found that season of kidding significantly affected lactation milk yield only. Khan and co-workers (1980) reported that daily milk yield in summer was significantly higher than in winter.

It is but natural that goats belonging to different breeds and genetic groups differed in milk producing ability. Many workers observed significant genetic group effect on milk yield (Mittal et al., 1977; Agarwal and Bhattacharyya, 1978 and Kumar et al., 1984).

Dam's weight at kidding significantly affected lactation milk yield in goats (Mukundan et al., 1983c; Joshi and Singh, 1986). Constantinov (1989) found that, in the Damascus goats, each kg of net weight gain during pregnancy accounted for 2.4 kg more lactation yield and extended lactation by 0.77 days.

Raats and associates (1983) reported that in the 2 years old Boer goats, milk yield increased significantly with litter size and the effect of litter size on milk yield decreased with age. Mellado and Borrego (1991) observed that the body weight and parity accounted for 44 per cent of variation in the milk yield in crossbred Mexican goats.

2.13. Effect of Environmental Temperature on Reproduction in Goats

Hafez (1987c) reported that embryonic mortality increases in a number of species following exposure of dam to elevated ambient temperatures. Exposure of pregnant mothers to high ambient temperature causes abortion, fetal stunting or give rise to congenital malformations of the nervous system (Arthur et al., 1989c). On the other hand Prasad and associates (1979) observed that when two groups of does in early pregnancy were subjected to respective temperature of 25.5 to 46.7°C, and absolute humidity 18.5 to 31.5 mm Hg, the proportion of early embryonic mortality was 37.5 and 42.11 per cent. It has been observed that goats subjected to elevated ambient temperature during the later half of pregnancy gave rise to birth of lighter kids (Holmes et al., 1986).

Prasad and Pandey (1982) observed that in summer and winter respectively the conception rate was 83.64 and 100

per cent for Barbari nannies inseminated in the second oestrous cycle. Greesh Mohan and associates (1983) reported that the conception rate in Pashmina goats is almost double during the period from October to March in comparison to April to September. However others (Khan et al., 1979 and Mukundan et al., 1981) found no significant effect of season of birth on birth weight of kids.

The native goats in India are widely distributed, in the various agro-climatic conditions and thrive and adapt everywhere (Mishra, 1979). Therefore, the ambient temperature in a region by itself may not have any adverse effect on the reproduction and growth in the goats.

Materials and Methods

The study was conducted at the goat farm, College of Veterinary and Animal Sciences, Kerala Agricultural University, Mannuthy between December 1991 to November, 1992.

3.1. Selection of experimental animals

Forty cyclic non-pregnant Malabari, Malabari x Alpine and Malabari x Saanen female goats were selected in pairs. The members of each pair being near to their pair mates with respect to body weight, age and genetic make up. The does from each pair was allotted at random to two groups of 20 each. One of them at random constituted the treatment group and the other the control.

3.2. Housing

The goats were housed in raised platform wooden slatted floored, asbestos-cement roofed shed. They were kept loose in pens of 4.6 m x 2.7 m area in groups of 20 each. The house had its long axis in the east-west direction, with two rows of pens on either side of a central passage. Both the control and treatment groups were housed in pens on the northern side of the central passage. The raised wooden platform was at a height of 1.23 m from the ground and the roof at 3.47 m from the raised floor at the middle and at 2.23 m at the eaves.

3.3. Feeding and management

Both control and treatment groups were fed and managed similarly. The does were fed ad libitum on green fodder, which consisted of grasses like congo-signel, gunea or hybrid napier and leaves of trees like subabul and jack tree. In addition, each doe was fed daily 500 g of a concentrate mixture with 70 per cent T.D.N. and 12.6 per cent DCP. At times they were also taken out for grazing, eventhough grazing was not a regular practice.

3.4. Management of reproduction

3.4.1. Detection of oestrus

Oestrus detection was carried out by observing behavioural manifestations of heat and by parading vasectomised bucks twice daily at 0800 h and 1600 h for about 30 minutes in both the groups. Signs of oestrus like bleating, rapid waving of the tail, mounting activity, vaginal discharges and male seeking behaviour were observed during the day as well as during dusk and early morning.

3.4.2. Mating of does

All the does in the treatment group were mated with bucks at the oestrus following the second injection of PGF_2alpha. The animals that did not conceive at the synchronized oestrus were not mated again.

In the control group the does were mated as and when they came to oestrus. The does that did not conceive at the first oestrus were mated again at the second oestrus and the ones that did not conceive were mated at the third oestrus also. The does were not mated after the third oestrus. All the animals in both the groups were mated between 8-12 hours after the observed oestrus and thereafter they were mated again after every 10-12 hours, as long as they were in oestrus.

3.4.3. Kidding

At 140 days of gestation the does were shifted to the kidding shed for convenient and safe parturition and to facilitate monitoring of parturition. Gestation period was calculated from the date of successful mating. The animals in the kidding shed were constantly observed. One month after parturition the lactating does were shifted to a separate shed.

3.4.4. Early kid feeding and management

The does and kids were allowed to stay together for four days during which period the kids received colostrum. The naval was painted with tincture of Iodine. The kids were separated from their mothers after four days and were placed in a separate enclosure in the same shed and provided with

infra-red lamps for warmth. The kids were allowed to suckle directly from the dam. At 15 days of age they were also provided with 100 g of concentrate mixture and tender green fodder ad libitum. At one month of age the kids were shifted to another shed and were allowed to be with the dams only during suckling, two times in a day. From 75th day to 90 days age the kids were provided with 150 g @ concentrate mixture in addition to ad-libitum green fodder and suckling.

3.5. Treatment

Synchronization of oestrus in the treatment group of goats was carried out in two batches of 10 animals each, separated by 16 days, in order to facilitate the observations of oestrus duration, oestrus behaviour and parturition etc. The goats were injected intramuscularly (randomly at any stage of oestrous cycle) with 10 mg @ Dinoprost Tromethamine (PGF_2alpha). All the goats were given a second injection of the PGF_2alpha at the same dosage after an interval of 11 days, and the animals were observed for the beginning of sings of oestrus till the cessation of oestrus.

3.6. Observation

3.6.1. Interval between injection of PGF_2alpha and the onset of oestrus and percentage of animals in oestrus

Interval between each injection of PGF_2alpha and the onset of oestrus was recorded. The percentage of animals coming in oestrus after each prostaglandin injection was also noted.

3.6.2. Oestrus characteristics

3.6.2.1. Duration of oestrus

Any one or more of the signs of oestrus when first noticed or detected by the buck was taken as the beginning of oestrus and cessation of the sign or signs or failure to be detected was taken as the end of oestrus. The period between beginning of oestrus and cessation of oestrus was taken as duration of oestrus. Oestrus duration both in the control and the treatment groups were recorded.

3.6.2.2. Oestrus behaviour and intensity of oestrus

After the detection of oestrus in the does of both the control and treatment groups, the animals were subjected to detailed observation for the presence or absence of the following signs, during the entire duration of oestrus, and the observations were recorded.

i. Bleating

ii. Rapid waving of tail.

iii. Mounting behaviour

iv. Vaginal discharge

v. Sniffing of males body

3.6.2.3. Receptivity

Fabre-Nys and Venier (1989) measured receptivity in two breeds of sheep in oestrus by counting the "stand still reaction" characteristic of oestrus, made by ewes when courted by the male, and by calculation of a receptivity index as a percentage of these immobilizations over the total number of courtship interactions involving a minimum of 10 interactions and a minimum test duration of two minutes.

The same procedure was followed to measure receptivity in all the oestrus goats of both the control and treatment groups. Between 8 to 10 hours after the observed oestrus the does were placed in a shed individually, with the vasectomised buck for a minimum test duration of two minutes and for a minimum of 10 courtship interactions. The number of courtship interactions and mounts accepted by the female was recorded. Receptivity was measured on a receptivity index as mentioned below.

I. Out of 10 mounts made by the male and all accepted by the females taken as 100 per cent

II Out of 10 mounts made by the male, 9 accepted by the female taken as 90 per cent

III. Out of 10 mounts made by the male, 8 accepted by the females taken as 80 per cent

IV. Out of 10 mounts made by the male, 7 accepted by the females taken as 70 per cent

V. Out of 10 mounts made by the male, 6 accepted by the females taken as 60 per cent

VI. Out of 10 mounts made by the male, 5 accepted by the females taken as 50 per cent

VII. Out of 10 mounts made by the male, 4 accepted by the females taken as 40 per cent

VIII. Out of 10 mounts made by the male, 3 accepted by the females taken as 30 per cent

IX. Out of 10 mounts made by the male, 2 accepted by the females taken as 20 per cent

X. Out of 10 mounts made by the male, 1 accepted by the females taken as 10 per cent

XI. Out of 10 mounts made by the male, non accepted by the females taken as 0 per cent.

3.6.3. Post coital reactions

Post coital reactions in the does were recorded.

3.6.4. Conception rate and service per conception

Anoestrus following mating was considered as the first indication of pregnancy. Pregnancy was confirmed at 3 months following service by abdominal ballotment as described by Chakurkar and associates (1991).

Following confirmation of pregnancy after mating, conception rate and service per conception were found out in both the groups of animals.

3.6.5. Body weight changes

Body weight of all the animals in both the groups were taken before mating, and at 30 days interval upto 4 months and just before kidding. Post kidding body weight of all the animals were taken immediately after the passage of after birth by the does. All the body weight recordings were carried out on a platform balance with the maximum capacity of 200 kg and 100 g precision. The body weight recordings on all the does were done between 1100 to 1200 h, after the morning feeding.

3.6.6. Gestation period

Gestation period in days was calculated from the date of successful mating to the date of parturition.

3.6.7. Behaviour associated with parturition in does and kids

3.6.7.1 Behaviour associated with parturition in does

3.6.7.1.1. Distribution of parturition in goats

The date and time of each parturitions of goats in both the groups were recorded. Time of parturitions were grouped under the four categories of 0001 h-0600 h, 0601 h-1200 h, 1201 h to 1800 h and 1801 h to 2400 h.

3.6.7.1.2. Behaviour of does immediately following parturitic

The time taken by the dam in licking and grooming the new born kid was recorded.

3.6.7.1.3. Maternal behaviour in does

Maternal behaviour of the dams were observed after parturition and for subsequent 5 days and during the time when the kids were allowed to suckle, three times in a day for 15 to 20 minutes.

Buddenberg and associates (1986) observed the maternal behaviour of beef cows and formed an arbitrary scale

assigning numerical values for maternal rating. The scale was suitably modified for measuring the maternal behaviour in the goats as given below.

	Description	Values assigned
a.	Goats in this category behaved aggressively. They properly groomed the kids and tended to them after parturition. They were willing to fight to protect their kid. Always willing to nurse the kid and were more protective of the kid and more attentive towards the kid.	4 (very good)
b.	Goats in this category were not aggressive. They properly groomed and tended to the kid after parturition. Exhibited attentiveness for the kid, but would not fight to protect the kid. Willing to nurse the kid.	3 (good)
c.	Goats in this category showed less concern for the kid. They groomed and tend to the kid after parturition. They were initially shy in nursing the kid, but on subsequent days, were less shy and nursed the kid.	2 (average)
d.	Goats in this category showed no concern for the kid. Did not tend to the kid after parturition. Not willing to nurse the kid.	1 (poor)

3.6.7.2. Behaviour associated with parturition in kids

The behaviour of kids immediately after parturition such as time taken for attempts to stand up, and suckling from the dam etc. were recorded.

3.6.8. Prolificacy in goats

Incidence of singles and twins born to the dams were recorded. Total number of kids and sex of the kids born to the does in both the group were recorded.

3.6.9. Growth of kids

One hour after the birth of the kids, they were mopped with a dry towell and weighed on a platform scale, and the weights were recorded.

Body measurements of the new born kids were taken by making them stand close to the wall and using a measuring tape. Body length was taken from point of elbow to the pin bone. Height was measured from the floor to the wither and chest girth was measured at the region just posterior to the shoulder joint.

Body weight and body measurements were taken at 15 days intervals upto three months (90 days) of age at 1400 h before the afternoon feeding on each occasion. All

measurements were taken two times to avoid any error, and the measurements were taken in centimeters.

3.6.10. Suckling behaviour in kids

Suckling behaviour was studied on all the kids born to does of both control and treatment groups. The observations were recorded once daily during the afternoon feeding for 7 days, from day 8 to day 14 of parturition. The kids were separated from the does for 6 hours before recording the daily observations. The observations on each doe-kid(s) unit was recorded separately inside the kidding shed. Duration of each suckling bout was recorded with the help of a stop watch. The total milk consumed by the kid was recorded by weigh-suckle-weigh method. The number of each suckling bout was counted directly. The intensity of tail wagging was scaled visually into mild, moderate and vigorous.

3.6.11. Milk yield in goats

Milk yield in the does were recorded upto 13th week (90 days) of lactation. Milk yield in the goats was recorded weekly once, two times in a day by first allowing the kids to directly suckle from the mother, and finding the milk consumed by each kid by weigh-suckle-weigh method and then stripping the balance milk from the doe and weighing the

same on a platform scale. The total milk yield of each doe for the day was calculated by adding the milk consumed by the kid and weight of milk stripped from the udder.

3.6.12. Environmental temperature and Relative Humidity

During the period of the study minimum and maximum temperature were recorded at 0725 and 1425 h from the thermometers of the range -40 to 50°C and -35 to 55°C installed in one of the sheds. Dry and wet bulb thermometers were also kept side by side to measure humidity at 0725 and 1500 h.

3.6.13. Man hours required to look after the does and kids

The experiment was started on December 1st 1991 and one labour was engaged 8 hours a day to look after the 40 does, of 20 animals each in two groups housed in different sheds, from the beginning of the experiment (@ 4 hrs per day for each group of animals).

In the control group the breeding activities were started from January Ist, 1992 whereas in the treatment group the oestrus synchronization study commenced on January 30th 1992. For detection of heat in the does, two times a day, 15 minutes for each group was spent on every occasion.

Following detection of heat and mating all the animals were again subjected to heat detection for two subsequent oestrus cycles, and labour requirement for each group was calculated accordingly.

On 140th day of gestation, the parturient does were shifted to the kidding shed and labour was placed to look after the does and new born kids upto 30 days of age. One month old kids were raised separately in a shed upto 3 months of age and labour requirement for each group was calculated.

The labour requirement for studying the oestrus duration, oestrus behaviour and mating of does, as well as for measuring the milk yield for animals in both the groups were not taken into account.

3.7. Statistical analysis

The data were analysed mainly by T tests and Chi square tests, as described by Snedecor and Cochran (1967).

RESULTS

4.1. Synchronization of oestrus

Figure 1 and 2 respectively show the distribution of successful matings in the control and treatment group, monthwise. Each month has been divided into four weeks to precisely indicate the period of matings during each month.

From figure 1, it is seen that in the control group the breeding activity reaches a peak during the fourth week of January when 11 does were successfully mated, but the entire matings were spread over from January to March. In the treatment group one batch of does were successfully mated during the second week of February and the second batch in the first week of March as the synchronization of oestrus was done in two batches to facilitate oestrus behaviour studies. The oestrus synchrony in this group was tight.

4.2. Interval between injection of PGF_2alpha and the onset of oestrus and percentage of animals in oestrus

The interval between the first injection of PGF_2alpha (given randomly at any stage of oestrous cycle) and the onset of oestrus as well as the second injection of PGF_2alpha (given on the 12th day after the Ist injection) and the onset of oestrus is given in Table 1.

Fig.1 DISTRIBUTION OF SUCCESSFUL MATINGS IN DOES FROM JANUARY TO MARCH - CONTROL

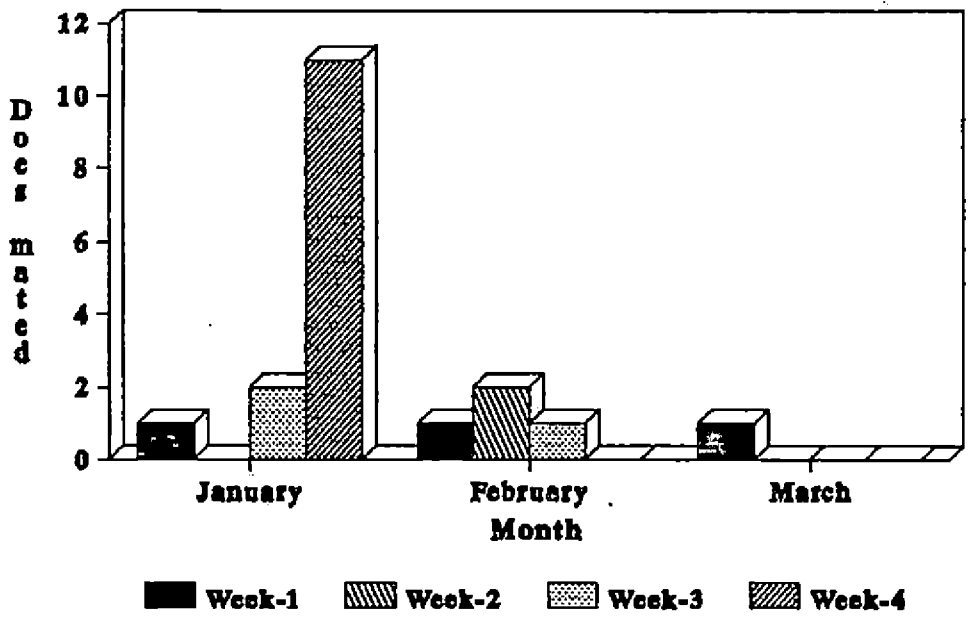


Fig.2 DISTRIBUTION OF SUCCESSFUL MATINGS IN DOES FROM JANUARY TO MARCH - TREATED

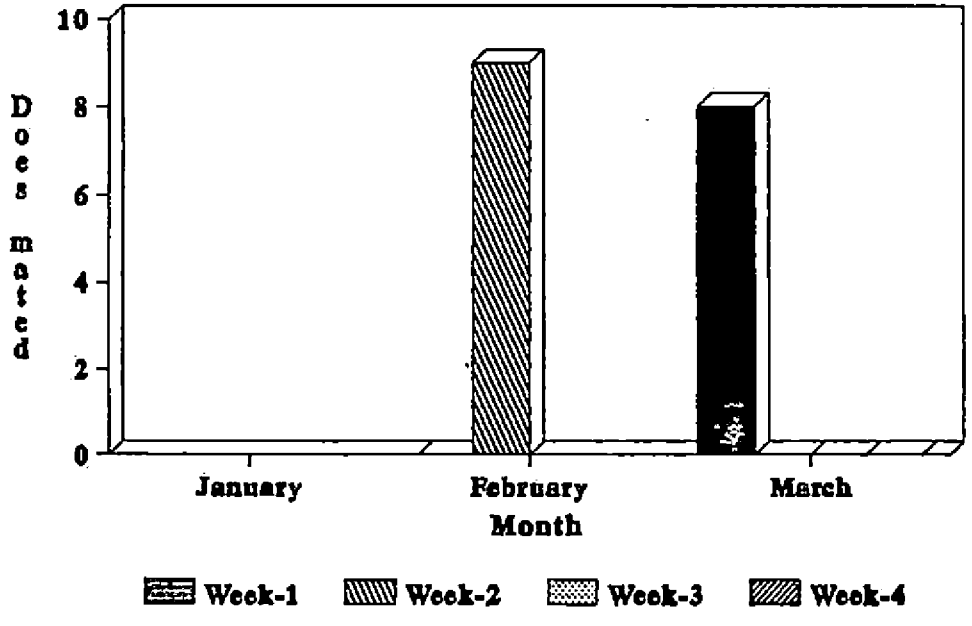


Table 1. Interval between injection of PGF_2alpha and the onset of oestrus - treatment group

Animal No	Interval after Ist injection	Intervel after IInd injection
1	Not in oestrus	65.0
2	40.0	41.0
3	48.0	49.5
4	48.0	65.0
5	40.0	41.5
6	Not in oestrus	49.0
7	42.0	43.0
8	49.0	43.0
9	40.0	42.0
10	64.0	40.0
11	42.0	42.0
12	65.0	42.0
13	47.0	49.0
14	42.0	43.0
15	38.0	66.0
16	Not in oestrus	66.0
17	42.0	49.0
18	Not in oestrus	45.0
19	Not in oestrus	44.0
20	42.0	42.0
Mean	45.93±2.19	48.35±2.06

Percentage of goats in oestrus after the first injection of PGF_2alpha - 75

Percentage of goats in oestrus after the seconddd injection of PGF_2alpha - 100

After the first injection of PGF_2alpha, the onset of oestrus in goats varied from 38 h to 65 h with a mean interval of 45.93±2.19 h, whereas after the second injection the same varied from 41 h to 66 h, with a mean interval of 48.35±2.06 h. The interval from injection of PGF_2alpha to oestrus was found to be 2.42 h more in the case of the second injection than the first, but the difference was not significant at 5 per cent level.

It was observed that the majority of goats came to oestrus within 50 h of the PGF_2alpha injection. After the first injection, 86.67 per cent and after the second injection 80 per cent of the goats showing oestrus came to oestrus within 50 h of PG administration.

Out of the twenty goats that received the first prostaglandin injection, only fifteen animals came to oestrus, showing a 75 per cent response, whereas after the second injection all the twenty goats showed oestrus.

4.3. Oestrus Characteristics

4.3.1. Duration of oestrus

The oestrus duration in the control group has been presented in Table 2 and the same in the treatment group after the first and second injections of PGF_2alpha in Table 3.

Table 2. Duration of oestrus - control group (Hrs)

Animal no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Mean
Duration of olstrus	24	24	24	32	32	24	32	60	48	24	32	32	24	24	20	24	24	32	56	38	31.9±2.46

Table 3. Duration of oestrus - treatment group (Hrs)

Animal no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Mean
Oestrus duration after Ist injection of PG.	*	24.0	12.0	24.0	24.0	*	24.0	32.0	60.0	32.0	32.0	16.0	24.0	41.0	30.0	*	40.0	*	*	48.0	30.86±3.19
Oestrus duration after IInd injection of PG.	32.0	62.0	26.0	38.0	48.0	24.0	24.0	24.0	58.0	32.0	48.0	24.0	24.0	32.0	30.0	32.0	28.0	22.0	24.0	26.0	32.90±2.65

* Not in oestrus.

In the control group the oestrus duration varied from 20 h to 60 h, with a mean duration of 31.9±2.46 h. In 75 per cent of the goats in this group, oestrus duration ranged from 24 to 32 h.

In the treatment group after the first injection of PGF_2alpha the duration of oestrus varied from 12 h to 60 h with a mean duration of 30.86±3.19 h. In 60 per cent of the goats in this group the oestrus ranged from 24 to 32 h. After the second injection of PGF_2alpha the duration of oestrus varied from 22 to 62 h, with a mean duration of 32.9±2.65 h. In 70 per cent of the animals the same ranged between 24 to 32 h. The difference in oestrus duration between the control group and the treatment group after the first injection as well as after the second injection were not found to be significant at 5 per cent level.

4.3.2. Oestrus behaviour and intensity of oestrus

Observations on oestrus behaviour of goats consisting of bleating, rapid waving of tail in the presence of male, mounting behaviour, vaginal mucous discharge and sniffing of male's body as well as the receptive behaviour score for the control and treatment groups have been presented in Tables 4 and 5 respectively.

Table 4. oestrus behaviour - control group

Sl. No.	Animal No.	Bleating	Rapid waving ot tail	Mounting behaviour	Vaginal discharge	sniffing male's body	Receptive behaviour score
1	1	-	+	+	+	+	80
2	2	-	+	-	+	+	70
3	3	+	+	+	+	+	90
4	4	-	+	-	+	+	80
5	5	-	+	-	+	-	50
6	6	+	+	-	+	-	60
7	7	-	+	-	+	+	70
8	8	-	+	-	+	+	70
9	9*	+	+	-	+	-	30
10	10*	+	+	+	+	-	40
11	11	+	+	-	+	-	30
12	12	-	+	+	+	+	100
13	13	-	+	-	+	+	80
14	14	-	+	-	+	+	60
15	15	-	+	-	+	-	60
16	16	-	+	+	+	+	90
17	17	+	+	-	+	-	60
18	18*	+	+	+	+	-	30
19	19*	+	+	-	+	-	20
20	20*	-	+	-	+	-	20
						Mean	59.50±5.46

+ Behaviour present
- Behaviour absent
* Nullipara

Table 5. Oestrus Behaviour - Treatement Group

Sl. No.	Animal No.	Bleating	Rapid waving of tail	Mounting behaviour	Vaginal discharge	sniffing male's body	Receptive behaviour score
1	1	-	+	+	+	+	90
2	2	-	+	+	+	+	70
3	3	-	+	+	+	+	70
4	4	-	+	-	+	-	60
5	5	+	+	+	+	+	100
6	6	-	+	-	+	-	60
7	7	-	+	+	+	+	100
8	8	-	+	+	+	+	70
9	9	+	+	-	+	+	80
10	10*	+	+	-	+	-	50
11	11*	+	+	-	+	-	30
12	12	-	+	+	+	+	90
13	13	-	+	-	+	+	70
14	14	-	+	-	+	+	70
15	15	-	+	-	+	+	70
16	16	+	+	-	+	+	70
17	17	-	+	+	+	+	80
18	18*	+	+	-	+	-	20
19	19*	+	+	-	+	-	30
20	20*	+	+	-	+	-	30
						Mean	65.5±5.46

+ Behaviour present
- Behaviour absent
* Nullipara

Bleating was observed in only 40 per cent of the goats in both the control and the treatment groups. This behaviour was more common among the nulliparas in both the groups than in the multipara goats. Overall bleating was observed in 90 per cent of the nullipara does in oestrus from both the control and treatment groups. Rapid waving of tail by the does in oestrus in the presence of male was noticed in all the goats throughout from the beginning to the cessation of oestrus.

In the control group mounting behaviour was found to be present only in 25 per cent of the does, whereas in the treatment group this behaviour was observed in 40 per cent of the animals.

Vaginal mucous discharge was observed in all the animals of both the control and treatment groups.

When the vasectomised buck was paraded for the detection of oestrus, sniffing of male's body was observed in only 50 per cent of the oestrus goats in the control group, whereas this behaviour was observed in 65 per cent of the goats in the treatment group.

4.3.3. Receptivity

Receptive behaviour in oestrus does, which was measured on a scale of 0-100 by allowing courtship interactions and

mounts, showed a higher mean value in the treatment group (65.50±5.21) than in the control group (59.50±5.46). The difference in the receptive behaviour between the two groups was not found to be statistically significant. It was observed that the receptive behaviour was weaker in the nullipara than in the multiparous goats in both the groups.

4.4. Post coital reaction

Immediately after the ejaculation and just before penile withdrawal and dismounting by the male 90 per cent of does showed characteristic pricking of the ears, and the same lasted only for a few seconds. Arching of back was also noticed in 90 per cent of the mated does immediately after dismounting by the male. Pricking of ears was found to be invariably followed by arching of back in the mated does.

4.5. Conception rate and service required per conception

In the control group the breeding activities started during January and it continued till the first week of march. Out of the 20 goats in this group 15 of them conceived at the first mating, 3 goats conceived after the second mating and one goat conceived after the third mating at the third oestrus. One animal did not conceive even after three matings. The overall conception rate at first,

second and third mating was found to be 75 per cent, 90 per cent and 95 per cent respectively.

In the treatment group the animals were mated only once during the oestrus following the second injection of PGF_2alpha. In this group 17 out of the 20 goats mated conceived showing a higher conception rate of 85 per cent, as compared to the controls in which the percentage of conception after mating in the first oestrus was 75. However, the overall conception rate in the controls after mating in the third consecutive oestrus was found to be 95 per cent.

Service required per conception was found out by calculating the total number of matings in each group and dividing the same by the total number of animals conceived in each group. In the controls 1.42 services were required per conception which was higher than in the treatment group, where the same was found to be only 1.18. It was observed that the treatment group of goats showed better performance than the controls in respect of service required per conception.

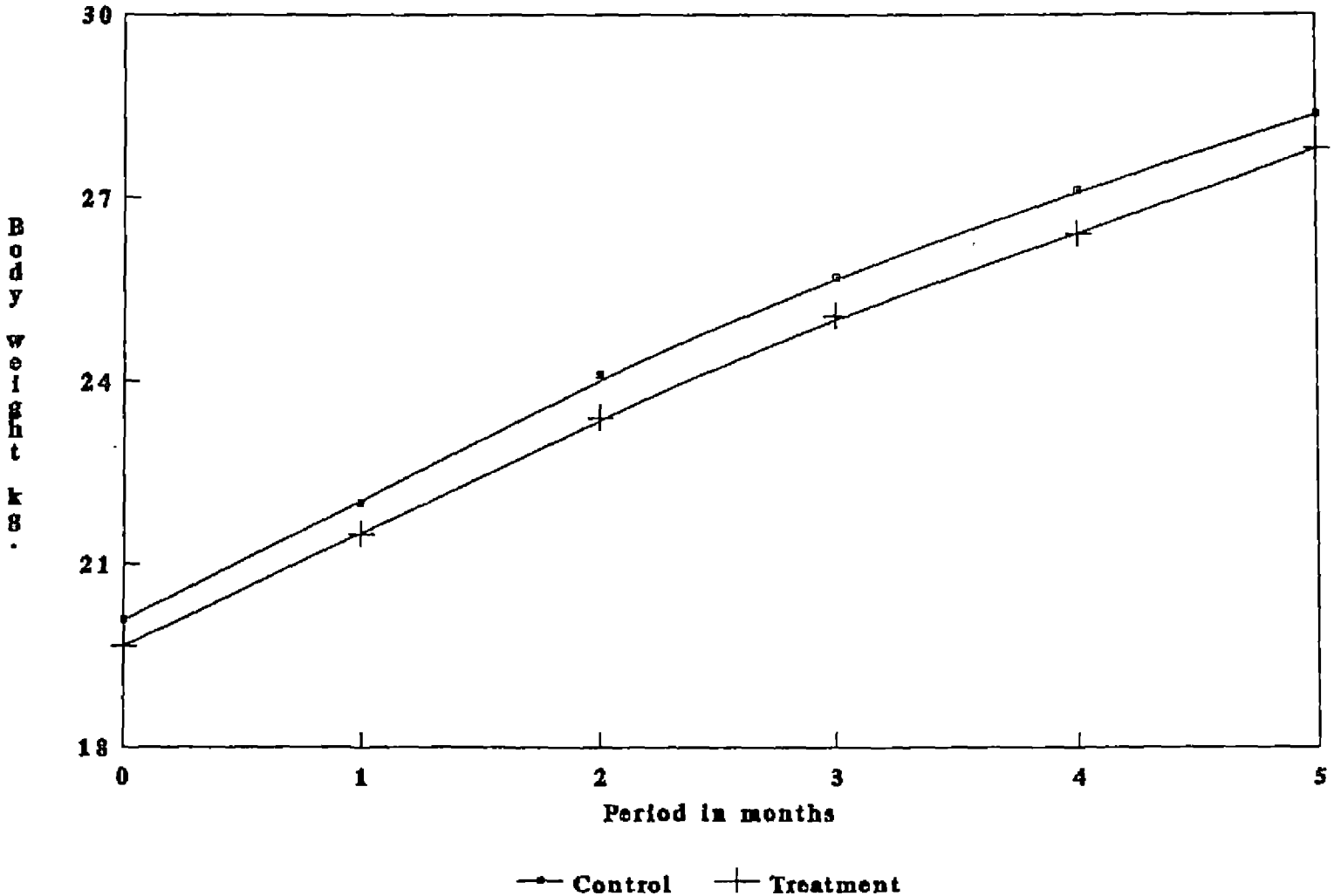
4.6. Body weight changes

Table 6 and figure 3 show the mean monthly body weight of does from mating to just before kidding. It is seen from

Table 6. Monthly body weight of goats from mating to just before kidding

Groups	At mating Mean SE (kg)	30 days Mean SE (kg)	60 days Mean SE (kg)	90 days Mean SE (kg)	120 days Mean SE (kg)	Just before kidding Mean SE (kg)
Control	20.08 ± 1.21	22.01 ± 1.23	24.10 ± 1.22	25.69 ± 1.18	27.13 ± 1.16	28.35 ± 1.13
Treatment	19.65 ± 0.93	21.49 ± 0.96	23.39 ± 0.95	25.07 ± 0.99	26.41 ± 0.95	27.79 ± 0.93

Fig.3 **MONTHLY BODY WEIGHT OF GOATS FROM MATING TO JUST BEFORE KIDDING**



the figure 3 that the body weight changes followed the similar trend in both the groups of animals. The mean increase in body weight from mating to just before kidding in the control group was 8.27±0.30 kg and in the treatment group 8.14±0.20 kg and were found to be similar.

The difference between body weight at mating and post kidding body weight showing the weight gain during pregnancy was also found to be similar in both the groups. The mean increase in body weight during pregnancy in the control and treatment groups were found to be 4.45±0.30 kg and 4.32±0.30 kg respectively.

4.7. Gestation period

Of the 19 does that conceived in the control group one doe aborted the foetus after 70 days of gestation and there was one premature kidding at 138 days. In the treatment group of goats there were 17 conceptions, out of which one animal aborted at 80th day of gestation, and there were two pre mature births, one on 126th and the other on 135th day of gestation.

The gestation periods in days for both the treatment and control groups are given in Table 7. The mean gestation

Table 7. Gestation period in goats

Sl. No.	Control group (days)	Treatment group (days)
1	146	153
2	141	145
3	147	149
4	143	143
5	141	150
6	154	148
7	140	147
8	142	147
9	144	150
10	145	152
11	144	145
12	144	146
13	143	152
14	145	147
15	141	-
16	142	-
17	144	-
Mean±SE	143.88±0.78	148.14±0.80

period in the treatment group was 148.14±0.80 days compared to 143.88±0.78 days in the control group. In the treatment group the mean gestation period extended by 4.26 days as compared to the controls. The difference in the gestation period between the two groups was found to be significant ($P < 0.05$). In the control group the gestation period varied from 140 days to 154 days, and 82.35 per cent of the goats in this group had a gestation period of less than 146 days. In the treatment group the gestation length varied from 143 days to 153 days, but only 21.43 per cent of the goats had a gestation period of less than 146 days.

4.8. Behaviour associated with parturition in does and kids

4.8.1. Behaviour associated with parturition in the does

4.8.1.1. Distribution of parturition in goats

Figures 4 and 5 respectively show the distribution of parturition in the control and treatment group of goats. In the control group the parturition started from the first week of June and continued upto the first week of August, whereas in the treatment group the same was distributed from the first week of July to first week of August.

The time of parturition in goats were recorded for both the control and treatment groups to study the distribution of parturition in the 24 hours. The parturition in the 24

Fig.4 DISTRIBUTION OF PARTURITION IN DOES FROM JUNE TO AUGUST - CONTROL

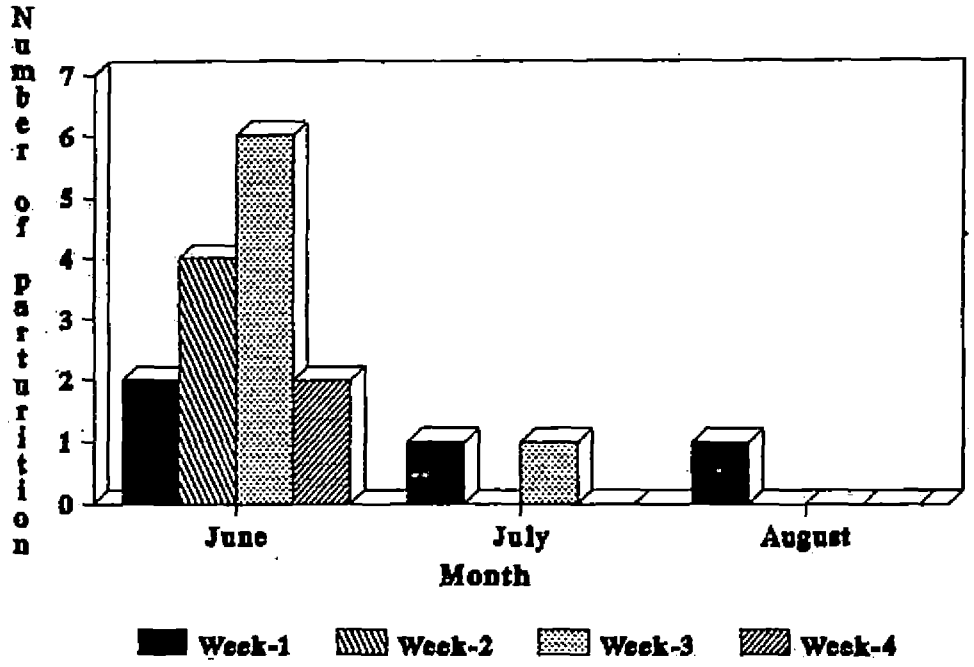
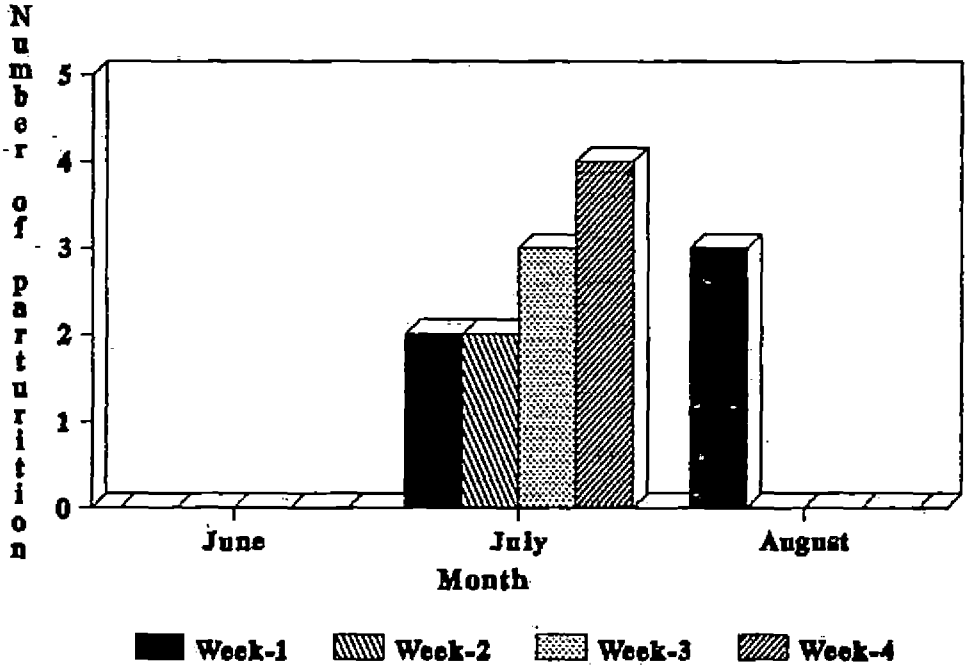


Fig.5 DISTRIBUTION OF PARTURITION IN DOES FROM JUNE TO AUGUST - TREATED



hour cycle were grouped under 4 periods of 000 h-0600 h, 0601 - 1200 h, 1201 h - 1800 h and 1801 h - 2400 h. The distribution of parturition in the 24 hours for both the control and treatment groups are given in table 8. In the control group 70.59 per cent of the parturitions occurred during the period between 0601 h to 1800 h. On the other hand, in the treatment group only 50 per cent of the parturitions occurred during this period as it was evenly distributed between the day time and night. Overall, 61.3 per cent of the parturitions were observed during 0600 h to 1800 h, during the day hours.

Table 8. Distribution of parturition in the 24 hours

Sl. No.	Period	Control group	Treatment group	Total parturition
1	0000h-0600h	3	4	7
2	0601-1200h	8	2	10
3	1201-1800h	4	5	9
4	1801-2400h	2	3	5

4.8.1.2. Behaviour of does immediately following parturition

Immediately after expulsion of foetus, the does started licking the young ones vigorously for 15 to 20 minutes, and thereafter continued licking and grooming intermittently for one to three hours. In most of the cases the grooming was completed within two hours of birth of the kid.

Immediately after the birth of the kids, while grooming the new-born kid, the mother does and their kids made a series of vocal exchanges.

4.8.1.3. Maternal behaviour in goats

The maternal behaviour of the dams were observed after parturition and for subsequent 5 days. On the basis of the observations they were classified into 4 groups of poor, average, good and very good. The distribution of maternal instinct of the does in both the control and treatment groups are given in table 9. The effect of treatment on the maternal instinct was tested by using the chi square test, and the difference in maternal instinct among the groups was not found to be significant. It was observed that the scores of maternal instinct in the primiparas of both the groups varied from average to good (average 2.4) whereas in multiparas it varied from poor to very good (average 3.1).

Table 9. Distribution of maternal instinct among does.

Score	POOR (1)	AVERAGE (2)	GOOD (3)	VERY GOOD (4)
control group	0	4	9	4
treatement group	1	3	8	2

4.8.2. Behaviour associated with parturition in kids

The behaviour of kids immediately after parturition was observed in 11 kids from the control group and 8 kids from the treatment group.

Within seconds of the birth, the kids lifted their heads up, and with in 5 to 10 minutes attempted to crawl in an effort to reach dam's teat. All the kids attempted to stand up within 8 to 15 minutes and 68 per cent of the kids suckled within an hour of birth. There was no difference between the groups.

4.9. **Prolificacy**

Number of singles and twins born in the treatment and control groups is shown in table 10. There were 17 kiddings

in the control group and 14 in the treatment group. The trend of type of birth were similar in both the control and treatment groups. In the control group the percentage of singles and twins born were 88.28 and 11.77 respectively, whereas in the treatment group 85.71 per cent were singles and 14.29 per cent of the births were twins. There were no triplets in either of the groups.

Table 10. Prolificacy in goats

Gruoups	Singles	Twins	Triplets
Control	15 (88.23%)	2 (11.77%)	0
Treatement	12 (85.71%)	2 (14.29%)	0

Figures in parenthesis indicate the percentage of singles and twins of the total kiddings in each group

4.10. Growth of kids

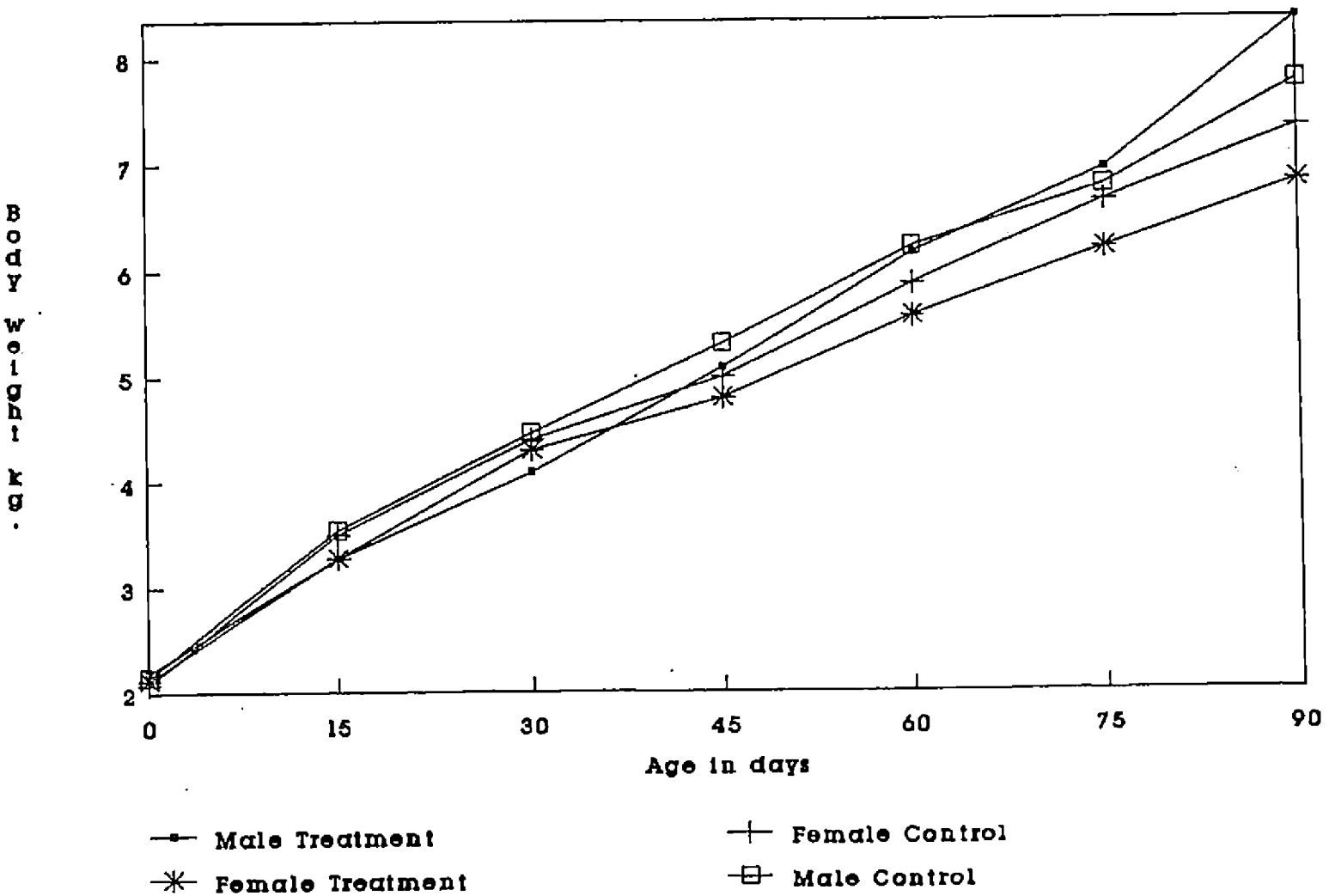
The average fortnightly body weight of control and treatment groups of kids from birth to 90 days of age for both males and females are presented in table 11 and figure 6.

Table 11. Body weight of kids from birth to 90 days (kg)

Sl. No.	Age of kids (days)	Male		Female		T-value	
		Control group	Treatment group	Control group	Treatment group	Male	Female
1	Birth	2.15±0.08	2.19±0.08	2.08±0.10	2.12±0.07	0.3453^{NS}	0.3098^{NS}
2	15	3.54±0.09	3.27±0.20	3.50±0.08	3.27±0.26	1.1732^{NS}	0.8497^{NS}
3	30	4.46±0.13	4.09±0.18	4.40±0.15	4.30±0.32	1.5536^{NS}	0.2440^{NS}
4	45	5.31±0.21	5.08±0.35	4.99±0.16	4.79±0.44	0.5311^{NS}	0.4199^{NS}
5	60	6.22±0.27	6.15±0.41	5.87±0.33	5.57±0.39	0.1283^{NS}	0.5742^{NS}
6	75	6.79±0.33	6.94±0.52	6.65±0.41	6.20±0.42	0.2398^{NS}	0.7397^{NS}
7	90	7.76±0.40	8.35±0.54	7.33±0.44	6.82±0.53	0.8635^{NS}	0.7308^{NS}

NS - Not significant ($P > 0.05$)

Fig:6.BODY WEIGHT OF KIDS FROM BIRTH TO 90 DAYS AGE



The average birth weight of male kids in the control and treatment groups were found to be 2.15±0.08 kg and 2.19±0.08 kg respectively. The body weight of the kids increased to 7.76±0.40 kg and 8.35±0.54 kg respectively at 90 days of age.

In the case of female kids the average weight of birth in the control group was 2.08±0.1 kg and in the treatment group 2.12±0.07 kg. At 90 days of age the body weight in the same groups of kids increased to 7.33±0.44 kg and 6.82±0.53 kg respectively.

The differences in body weights observed between the control and treatment groups from birth to 90 days of age for both male and female kids were found to be statistically non significant ($P > 0.05$).

The average daily gain of kids from birth to 90 days in both the control and treatment groups, for male and female kids are given in table 12.

Table 12. Averge daily gain of kids from birth to 90 days (g)

Sex	Control group	Treatment group
Male	62.4±4	68.4±6
Female	58.3±5	52.3±6
Overall	60.3±3	60.4±5

The average daily gain of males in the control group was 62.4±4 g and in the treatment group the same was 68.4±6 g and the difference was not found to be significant at 5 per cent level. In the case of females of both the control and experimental groups the average daily gain was found to be similar (control: 58.3±5 g; treatment: 52.3±6 g) and there was no significant difference among the groups ($P>0.05$).

On comparing the average daily gains of male and female kids in the same group, it was observed that in the control group the average daily gain among the males was more than the females by 4 g. In the treatment group also the males grew faster than the females by 16 g. However, the difference in both these cases were found to be non significant ($P > 0.05$).

Table 13. Body length of kids from birth to 90 days (cm)

Sl. No.	Age of kids (days)	Male		Female		T-value	
		Control group	Treatment group	Control group	Treatment group	Male	Female
1	Birth	28.92±0.67	28.92±0.33	27.87±0.72	27.57±0.72	0.0000^{NS}	0.2944^{NS}
2	15	32.71±0.50	30.57±0.46	32.93±0.48	32.00±0.44	0.6124^{NS}	1.4014^{NS}
3	30	35.07±0.68	34.57±0.31	35.18±0.48	34.64±0.60	0.6426^{NS}	0.7067^{NS}
4	45	37.42±0.55	37.21±0.79	36.31±0.42	36.42±1.20	0.2192^{NS}	0.0908^{NS}
5	60	39.92±0.77	40.07±0.78	38.43±0.85	38.00±1.01	0.1297^{NS}	0.3321^{NS}
6	75	41.20±0.82	42.00±0.90	40.25±0.86	39.50±1.12	0.6394^{NS}	0.5333^{NS}
7	90	42.78±0.72	44.35±0.97	41.81±0.93	41.50±1.21	1.2556^{NS}	0.2067^{NS}

NS - Not Significant ($P > 0.05$)

Table 14. Body girth of kids from birth to 90 days (cm)

Sl. No.	Age of kids (days)	Male		Female		T-value	
		Control group	Treatment group	Control group	Treatment group	Male	Female
1	Birth	29.71±0.52	29.97±0.58	29.50±0.45	28.14±0.67	0.3277^{NS}	1.0548^{NS}
2	15	32.71±0.26	32.35±0.48	31.18±0.57	32.70±0.56	0.6473^{NS}	0.5792^{NS}
3	30	34.00±0.35	33.42±0.27	34.75±0.45	34.14±0.55	1.2545^{NS}	0.8570^{NS}
4	45	35.71±0.55	36.14±0.49	35.68±0.53	35.62±0.90	0.5756^{NS}	0.0438^{NS}
5	60	38.50±0.89	38.20±0.73	37.81±1.08	37.28±0.97	0.2419^{NS}	0.3566^{NS}
6	75	39.42±0.89	41.28±0.94	39.43±1.08	39.21±0.98	0.8643^{NS}	0.1502^{NS}
7	90	41.42±1.02	43.07±0.92	40.68±1.09	40.28±1.12	1.1872^{NS}	0.2556^{NS}

NS - Not Significant ($P > 0.05$)

significantly ($P > 0.05$) at any stage of growth upto 90 days in both the males and the females between the control and treatment groups.

Table 15 gives the average fortnightly body height of experimental kids upto 90 days of age.

In the males the mean body height at birth for the control and treatment groups were found to be 29.85 ± 0.44 cm and 30.57 ± 0.46 cm respectively. At 90 days of age the same increased to 42.92 ± 0.88 cm and 44.92 ± 1.02 cm respectively. Body height measurements for the females at birth were 30.25 ± 0.52 cm and 30.28 ± 0.30 cm respectively for both the groups. The mean body height at 90 days were also similar in both the control and treatment groups.

4.11. Suckling behaviour in kids

Suckling behaviour in the kids was studied in terms of milk consumed per minute, butting per minute, and the approach pattern of the kids towards the dam.

Table 16 gives the mean milk consumed per minute and the mean butting per minute for seven days, from 8th day to 14th day of birth. The data revealed that the mean milk consumed per minute increased from 34.22 g on the first day to 61.85 g on the seventh day of observation.

Table 15. Body height of kids from birth to 90 days (cm)

Sl. No.	Age of kids (days)	Male		Female		T-value	
		Control group	Treatment group	Control group	Treatment group	Male	Female
1	Birth	29.85±0.44	30.57±0.46	30.25±0.52	30.28±0.30	1.1547^{NS}	0.0564^{NS}
2	15	33.14±0.63	33.14±0.46	33.18±0.31	32.70±0.50	0.0000^{NS}	0.6912^{NS}
3	30	35.57±0.44	35.00±0.35	34.93±0.35	35.50±0.66	1.0000^{NS}	0.7653^{NS}
4	45	37.35±0.35	38.07±0.68	36.43±0.39	37.14±0.96	0.9245^{NS}	0.6748^{NS}
5	60	39.71±0.58	40.42±0.95	39.56±0.89	39.21±0.86	0.6380^{NS}	0.2780^{NS}
6	75	40.92±0.73	42.42±0.83	41.43±1.02	40.92±0.98	1.3426^{NS}	0.3792^{NS}
7	90	42.92±0.88	44.92±1.02	42.81±1.24	42.00±0.98	1.4730^{NS}	0.5041^{NS}

NS - Not Significant ($P > 0.05$)

Table 16. Suckling behaviour in kids

Days	Mean milk consumed/ minute (g)	Mean butting/ minute
1	34.22±1.23	4.58±0.18
2	41.75±1.59	4.90±0.20
3	47.17±1.74	5.23±0.20
4	50.08±1.76	5.47±0.19
5	54.63±1.66	5.75±0.22
6	57.88±1.77	5.93±0.18
7	61.85±1.87	6.16±0.20

There was also a corresponding increase in the mean rate of butting per minute from 4.58 on the first day to 6.16 on the seventh day of observation. There was a highly positive correlation ($r = 0.997$) between milk consumed per minute and butting. However, butting was noticed initially when the kids started suckling, while changing from one teat to another and towards the end of the suckling bout, when the butting was found to be more frequent. During the period when the kid gets a steady supply of milk the butting was

relatively less or absent. Tail wagging was found to be associated with butting, when ever the frequency of butting increased the tail wagging was also found to be vigorous. During the time when there was steady flow of milk, the same was found to be less or absent.

Among the twins the rate of butting per minute was found to be 6.56 whereas in the single born kids the rate of butting was 4.87 per minute. Tail wagging was also more vigorous and the same was observed almost throughout the suckling bout among the twins. The rate of milk consumed per minute among the single born kids was 50.02 g, whereas in the twins the same was lesser at 43.73 g. The amount of milk consumed in the single born kids (135.16 g) was more than that of the twins (97.41 g). The overall mean duration of suckling was found to be 2.61 minutes, and mean rate of suckling was 49.65 g per minute.

On observing the approach pattern of the kids, paired contests among the twins revealed that on 61.54 per cent of occasions, the kids having heavier body weight reached the dam first whereas the kids with lesser body weight reached the dam first only on 38.46 per cent of occasions.

Among the kids reaching first 53.85 per cent preferred left side approach and 46.15 per cent preferred right side approach. In the single born kids also the preferences for left side was 55.55 per cent and for the right side 44.44 per cent. On overall basis, the difference in preference of left side approach over the right was not found to be significant at 5 per cent level.

4.12. Milk yield in goats

The mean daily milk yield of the experimental goats from the first to thirteenth week of lactation are presented in table 17 and figure 7.

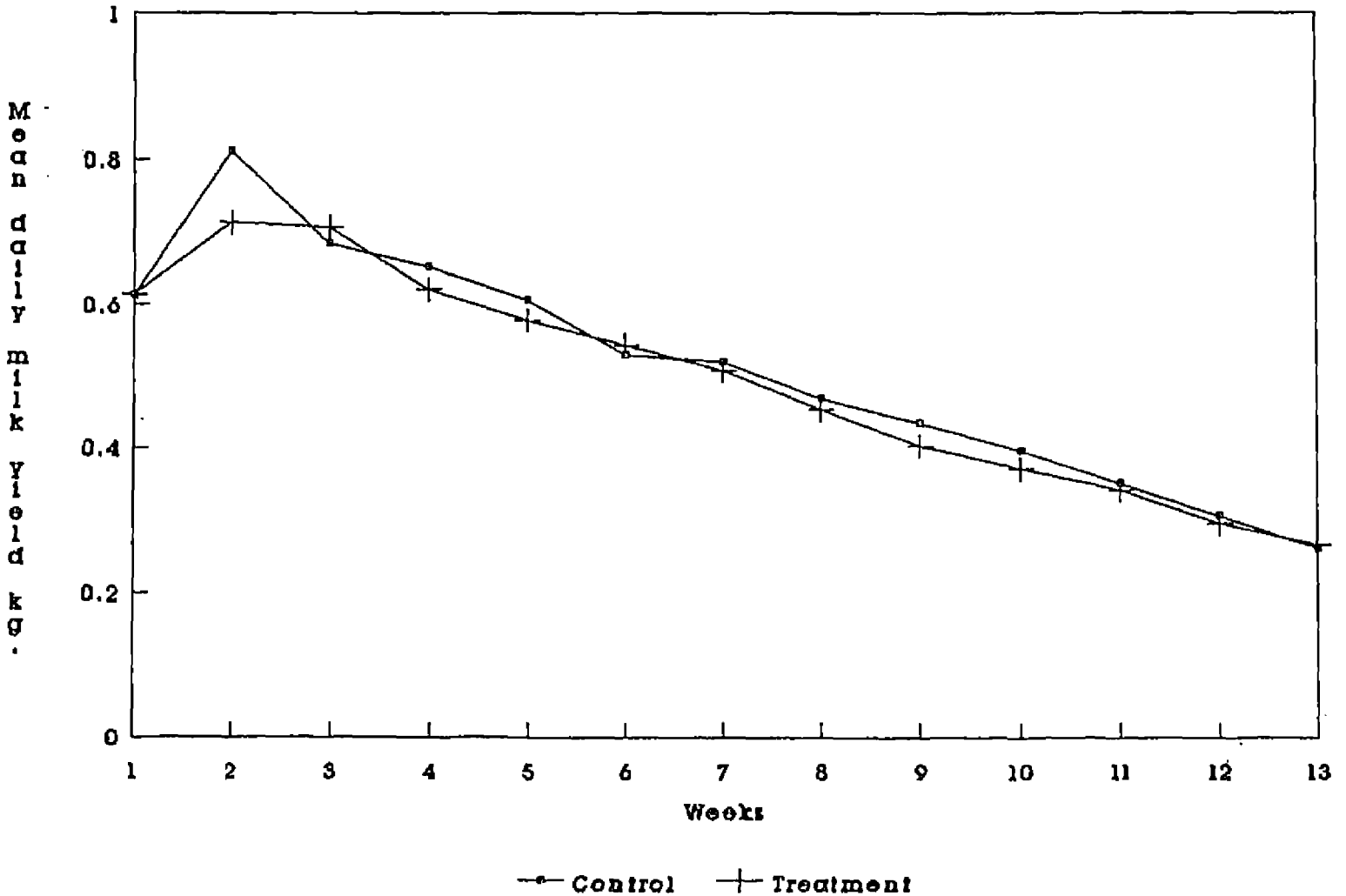
The average daily milk yield during the first week of lactation in the control group was found to be 0.612±0.05 kg and in the treatment group 0.614±0.042 kg. In both the groups the milk yield increased during the second week of lactation, and thereafter steadily declined. However, during the third week the decline in the milk yield among the control group was rather sharp as compared to the treatment group in which it was more gradual. At the thirteenth week of lactation, the daily milk yield in the control and treatment groups averaged 0.262±0.02 kg and 0.267±0.026 kg respectively.

Table 17. Mean daily milk yield of goats from 1st to 13th week of lactation.

Week	Control (kg)		Treatment (kg)		T-value
	Mean	SE	Mean	SE	
1st	0.612	± 0.050	0.614	± 0.042	0.0262 NS
2nd	0.812	± 0.082	0.714	± 0.042	1.0449 NS
3rd	0.684	± 0.042	0.707	± 0.040	0.4356 NS
4th	0.653	± 0.035	0.621	± 0.637	0.5816 NS
5th	0.606	± 0.042	0.578	± 0.034	0.4843 NS
6th	0.528	± 0.033	0.542	± 0.032	0.3110 NS
7th	0.518	± 0.035	0.507	± 0.032	1.0167 NS
8th	0.468	± 0.032	0.453	± 0.026	0.3420 NS
9th	0.434	± 0.032	0.403	± 0.026	0.7034 NS
10th	0.396	± 0.027	0.371	± 0.026	0.6348 NS
11th	0.350	± 0.025	0.342	± 0.026	0.1937 NS
12th	0.306	± 0.025	0.296	± 0.024	0.2676 NS
13th	0.262	± 0.020	0.267	± 0.026	0.1548 NS

NS - Not significant ($P > 0.05$)

Fig.7 DAILY MILK YIELD OF GOATS FROM FIRST TO THIRTEENTH WEEEK OF LACTATION.



The difference in daily milk yield from the first to thirteenth week of lactation between the groups were not found to be statistically significant ($P > 0.05$) at any stage. The overall mean daily milk yield upto thirteenth week of lactation in the control and treatment groups was 0.509 ± 0.015 kg and 0.493 ± 0.014 kg respectively.

4.13. Environmental temperature and Relative Humidity

The monthly averages of maximum and minimum and mean daily environmental temperatures as well as the Relative Humidity in per cent recorded during the experiment (from December 1991 to November 1992) is presented in table 18. The maximum temperature varied from 28.8°C during July to 37.2°C in March and the minimum temperature from 20.9°C in January to 24.9°C during May. There was very small variation in the mean environmental temperature.

The relative humidity varied from 55 per cent during January to 88 per cent in July and August. During most of the months the relative humidity was above 73 per cent.

Table 18 Environmental temperature (°C) and Relative Humidity (%) inside the experimental shed

Month	December	January	February	March	April	May	June	July	August	September	October	November
Maximum temperature	31.9	32.6	34.5	37.2	36.8	34.2	30.2	28.8	29.2	30.8	31.2	31.5
Minimum temperature	21.5	20.9	21.8	23.1	24.5	24.9	23.7	22.8	23.3	23.2	22.8	23.2
Mean environmental temperature	26.7	26.8	28.2	30.2	30.7	29.6	27.0	25.8	26.3	27.0	27.0	27.0
Relative humidity	64	55	66	63	67	73	85	88	88	82	82	75

Table 19. Man hour required to look after the goats and their offsprings

Group	For heat detection (h)	To maintain the goats upto 139th day of gestation (h)	To look afer the parturition does and kids from 140th day of gestation to one month after parturition (h)	To look after kids from one month to 90 days of age (h)	Total (h)
Control	51	365	826	577	1819
Treatment	15	902	241	437	1595

Discussion

DISCUSSION

5.1. Synchronization of oestrus

From figure 1 it is seen that in the control group, there is a peak in breeding activity during the fourth week of January when 11 does were successfully mated. However, the entire matings in this group was spread over from January to March.

The experimental animals were brought under the study by the 1st of December, 1991. They were dewormed and were regularly taken for grazing from 1st January 1992. The animals were fed under better supervision. Vasectomised bucks were also paraded daily 2 times a day where these goats were housed.

These measures might have resulted in some degree of synchronization in the control group also, as evident from the results.

Improved nutrition and the presence of males are known to produce synchronization of oestrus in many farm animal species. Hafez (1987b) reported that high environmental temperature and lack of feed restrict sexual activity. Stabling of mare and provision of good feeding assist in stimulating the onset of cyclical activity (Arthur et al.,

1989b). Chemineau (1986) observed that concentrate supplementation in goats significantly reduced the frequency of short cycle.

Many workers have also reported that the presence of buck has been shown to initiate some degree of synchronization of oestrus in goat and sheep early in the breeding season (Ott, 1980; Chemineau et al. 1983; Arthur et al., 1989b).

Therefore, some degree of natural synchronization of oestrus observed in the control group during the fourth week of January may be attributed to the effect of improved nutrition and the presence of buck.

Synchronization of oestrus in the treatment group of goats was carried out in two batches of 10 animals each by giving the injection of PGF_2alpha separated by 11 days in both the batches to facilitate observations related to reproduction. The oestrus synchrony observed in the treatment group was more tight. In this group the first batch of does were mated during the second week of February and the second batch in the first week of March, as seen in figure 2.

5.2. Interval between injection of PGF_2alpha and the onset of oestrus and percentage of animals in oestrus

In the present study, the mean interval between the first injection of PGF_2alpha and the onset of oestrus was 45.93±2.19 h and after the second injection given after 11 days, the interval was 48.38±2.06 h. These findings are in agreement with the reports of many workers, while using PGF_2alpha or its synthetic analogue on goats for oestrus synchronization. Westhuysen (1979) reported a time interval of 55.5 h from PG administration to the onset of oestrus. Ott and associates (1980a) observed that the time interval between injection of PGF_2alpha and the onset of oestrus was 53±2 h and 50±1 h after the first and second injections respectively. D'urso and Dell Aquila (1981) reported the onset of oestrus after 53 h of the second PG administration. Cox and associates (1987) found a mean interval of 48.2±15.7 h from treatment with Tiaprost (a PG analogue) to onset of oestrus.

Several other workers (Sanwal *et al.* 1982; Pandey *et al.*, 1985; Alacam *et al.* 1985; Ishwar and Pandey, 1990; Pandey *et al.* 1991) reported a longer interval between prostaglandin (or its analogue) injection and the onset of oestrus in goats, which varied from 93 h to 6 days.

Some workers have also reported a shorter interval for the onset of oestrus after prostaglandin administration (Pandiya and Rathor, 1986, Pandey and associates, 1991) where the interval from PG administration to onset of oestrus varied from 36.3±3.43 h to 39.33±2.15 h.

After the first injection of prostaglandin 75 per cent of the does came to oestrus, whereas after the second injection 100 per cent of them were found to be in oestrus. This result is in confirmity with the findings of Ott et al. (1980) and Greyling and Neiker (1986) who have reported oestrus synchrony percentage of 85 and 75 respectively after the first injection and 100 per cent after the second injection of PGF_2alpha or its analogue in cyclic goats. Several other authors have also reported 90 to 100 per cent oestrus synchronization in goats following a double injection of prostaglandin or its analogue (Westhuysen, 1979; Pandey et al., 1985; Kilicoglu et al., 1985; Ishwar and Pandey, 1990). Contrary to these reports, Mahmood and Koul (1990) observed that 53.19 and 46.67 per cent of the females exhibited oestrus when two groups of Pashmina goats were injected with 5 or 6 µg carboprost tromethamine (a PG analogue).

The length of inter-oestrus interval in most domestic species is controlled by the duration of life span of corpus

luteum (Arther et al., 1989b). Many workers (Perera et al., 1978; Basu et al., 1978; Ott et al., 1980; Alacam et al., 1985 and Cox et al., 1987) have reported that PGF_2alpha or its synthetic analogues have luteolytic properties and can be used to synchronize oestrus in goats. As the early corpus luteum is refractory to the effects of PGF_2alpha for a few days (as reported by the above mentioned authors) in randomly cycling animals which are at different stages of oestrus all animals may not come to oestrus after a single injection of PGF_2alpha. The oestrus synchronization system using two injection of PGF_2alpha separated by an interval of 10 to 14 days will place most of the animals in oestrual phase, where the prostaglandin will be effective in causing luteolysis at the time of second injection of PGF_2alpha. Therefore at the second injection of PGF_2alpha the oestrus synchrony was found to be 100 per cent. The study confirmed earlier reports that two injections of PGF_2alpha at 11 days interval is effective in synchronizing the oestrous in cyclic goats.

5.3. Oestrus Characteristics

5.3.1. Duration of oestrus

The results presented in table 2 revealed that the mean oestrus duration was 31.9±2.46 h (20 to 40 h) in the control

group compared to 30.86±3.19 h (12 to 60 h) in the treatment group after the first injection of prostaglandin and 32.9±2.65 h (22 to 62 h) after the second.

Ishwar and Pandey (1991) reported that the oestrus duration in the cyclic Black Bengal goats was 33.33±2.75 h. However, several workers have reported a slightly longer oestrus duration varying from 36 h to 40 h (Mishra and Biswas, 1966; Prasad and Bhattacharyya, 1979b; Pandey et al., 1985; Ramachandraiah et al., 1986). On the other hand in Pashmina goats, Bhattacharya and co-workers (1981) and Molockwu (1984) working on Savanna brown goats have reported oestrus duration shorter than the present one. As the reports are from different breeds in different locations under varying management and feeding such variations in oestrus length are but natural.

Wani and associates (1985) and Ishwar and Pandey (1991) reported average oestrus duration following PGF_2alpha administration similar to the present study (34.9 h and 35.29 h respectively).

Pandiya and Rathor (1986) reported a longer oestrus duration of 44.0±3.7 hours after synchronization with prostaglandin, whereas Pandey and co-workers (1985) observed that the duration of oestrus in the normal cycling goats was

shorter (16.0±1.6 h) in the oestrus following treatment with PGF_2alpha.

The results indicate that the administration of prostaglandin for the induction of oestrus in goats did not affect the oestrus duration. Ishwar and Pandey (1991) also reported similar findings.

5.3.2. Oestrus behaviour and intensity of oestrus

Of the various signs of oestrus reported in goats, only rapid waving of tail in the presence of male and vaginal mucous discharge were observed in all the does in oestrus in both the control treatment groups.

In the treatment group of animals the other signs of oestrus such as mounting behaviour and showing interest in the males by sniffing the males body, were observed in 40 per cent and 65 per cent of the does respectively, whereas these two behaviours were found in 25 per cent and 50 per cent of the does in the control group respectively. Overall, bleating was observed in 90 per cent of the nulliparas from both the groups. This behaviour was evident in very few multiparas.

Literatures on the various aspects of oestrus behaviour in goats are scanty. Bhattacharya and co-workers (1981)

found that in most of the Pashmina goats in oestrus, the signs were limited to vulval swelling and mounting other goats, whereas in the present study rapid waving of tail and vaginal discharge were the signs observed in all the oestrual does.

5.3.3. Receptivity

The receptive behaviour in oestrus does were measured on a scale of 0-100 by observing the extent to which they allowed courtship interactions and mounts. Although statistically non significant, the does in the treatment group showed a trend of being more receptive (65.50±5.21) than the does in the control group (59.50±5.46). The receptive behaviour was observed to be weaker in the nulliparas than in the multiparas in both the groups.

The observations from the study showed that the oestrous behaviour was not at all affected by oestrous synchronization. If the trend observed is taken into account, these behaviours were only strengthened by the hormonal induction of oestrus. This may aid in better reproductive success. Ishwar and Pandey (1990) also observed that oestrus activity of does remain normal and unaffected by oestrus synchronization with hormones.

The oestrus behaviour following treatment with PGF_2alpha was more pronounced than in the control. One reason presumably for this may be that due to the large number of does in a herd coming to oestrus at the same period, which may lead to competition between them for seeking males and each acts of oestrus behaviour by some animals may stimulate the behaviour in other does in oestrus. In the controls as they came to oestrus on different days this phenomenon may not apply and hence show comparatively weaker oestrus.

5.4. Post coital reactions

Pricking of the ears in mated does just after ijaculation by the male followed by arching of back immediately after dismounting by the male were observed in 90 per cent of the does. The pricking of ear lasts only for a few seconds and arching of backs lasts for a little longer.

Hafez (1987a) reported arching of back in the mated cows, but no reports of post coital reactions in goats were found. The results reveal that the goats show pricking of ears and arching of back as post coital reactions.

5.5. Conception rate and service requied per conception

In the control group the overall conception rates following mating at the first, second and third consecutive oestrus were found to be 75 per cent, 90 per cent and 95 per cent respectively whereas in the treatment group conception after mating at the oestrus following the second PG injection was 85 per cent.

Service required per conception in the former group was 1.42, whereas in the latter group the same was only 1.18. Cardenas Vazquez (1985) and D'urso and Dell'Aquila (1981) reported a better conception rate in the matings following first oestrus in the goats treated with PGF_2alpha than the untreated controls. The results in the present study concurred with the above findings. However, others found no difference in conception rates at first matings between oestrus synchronized goats using prostaglandin and the untreated controls (Ott et al., 1980a; Ishwar and Pandey, 1990). While Moor and Eppleston (1979) observed that treatment with prostaglandin depressed fertility.

The present study showed that synchronization of oestrus with PGF_2alpha resulted in better conception rate on mating at first oestrus and lower rate of service per conception than in the untreated controls. Hence it can be

concluded that treatment with PGF_2alpha for synchronisation of oestrus in goats do not produce any depression of fertility.

5.6. Body weight changes

The average increase in body weight from mating to just before kidding were similar in both the treatment (8.27 kg) and control group (8.14 kg).

The difference between body weights at mating and post kidding body weights showing the absolute increase in body weight of does during pregnancy in the two groups were found to be 4.45 ± 0.30 kg and 4.32 ± 0.30 kg respectively.

Several workers have reported that dam's body weight at kidding affects weight at birth and milk yield (Khan et al., 1982; Malik et al., 1986; Das et al., 1989; Mukundan et al., 1982). Constantinov (1989) found that in the Damascus goats each kg of net weight gain during pregnancy accounted for 2.4 kg more lactation yield.

The observations in this study revealed that treatment with PGF_2alpha in goats to synchronize oestrus did not have any effect on the increase in body weight of goats during pregnancy.

5.7. Gestation period

The distribution of gestation length in both the controls (140-154 days) and the treatment group of goats (143-153 days) were found to be similar to that reported by Sudarsanan and Raja in Malabari goats (1973).

The mean gestation period in days were found to be longer ($P < 0.05$) in the treatment group (148.88±0.80 days) compared to the controls (143.88±00.78 days). Contrary to this, Ishwar and Pandey (1991) did not find any significant difference in the gestation periods between animals mated at synchronized oestrus using PGF_2alpha and the untreated controls.

Several workers have reported wide variations among the gestation periods of various Indian breeds (Sinha and Sahni, 1982; Mukundan *et al.*, 1983a; Gangwar and Yadav, 1987). Gestation period in goats is influenced by breed, season of kidding, litter size etc. (Singh and Singh, 1983; Mukundan *et al.*, 1982; Peaker, 1978).

Gestation period was found to be longer in the goats kidding after being mated at the oestrus following prostaglandin injection than the untreated controls.

5.8. Behaviour associated with parturition in does and kids

5.8.1. Behaviour associated with parturition in does

5.8.1.1. Distribution of parturition in the goats

Figures 4 and 5 show the distribution of parturition in the control and treatment groups of goats respectively. In the control group the parturitions were distributed from the first week of June to first week of August, whereas in the treatment group the same was spread over a shorter period from the first week of July to first week of August. The distribution of parturitions in this group could have been condensed further, had the synchronization of oestrus not been done in two batches.

The parturitions in the 24 hour cycle were grouped under 4 periods of 000 h-0600 h, 0601h - 1200 h, 1201 h - 1800 h and 1801 h - 2400 h.

Overall 61.3 per cent of the parturitions were observed during 0600 h to 1800 h (during the day hours). This is in agreement with the findings of Bosc and associates (1988) who have observed that births in goats were more frequent between 0700 and 1900 h (70.2%) than between 1900 and 0700 h.

On comparing the distribution of parturition between the control and treatment groups, it was observed that in the former group 70.6 per cent of the parturition occurred during 0600 to 1800 h, while in the latter group only 50 per cent of the parturition occurred during this period and the parturitions were evenly distributed between the day time and night. The observations in the control group concurred with the findings of Lickliter (1985) and Bosc and associates (1988) who have also observed that frequency of births during mid day was more than during night, where as the findings in the treatment group is not in agreement with most of the reports.

Distribution of parturition in the goats showed that frequency of parturition was more during the period between 0600 to 1800 hour (61.3%) than during other periods of the day (38.7%).

5.8.1.2. Behaviour of does immediately after parturition.

Behaviour of the does following parturition were observed. The does started licking the young ones vigorously for 15 to 20 minutes, immediately after the birth of the kids, and thereafter continued licking and grooming for one to three hours. In most cases grooming was completed within two hours of the birth of the kids.

Soon after the birth of the kids, while grooming the new born kids, the does and their kids made a series of vocal exchanges. This is in agreement with the findings of Lickliter (1985) who has described similar behaviour in goats.

5.8.1.3. Maternal behaviour in goats

The maternal behaviour in goats were classified on the basis of observations into four groups of poor, average, good and very good and were assigned numerical values of 1-4 in that order. The scores in the control group averaged 3 and in the treatment group the same was found to be 2.8. No significant effect of treatment with PGF_2alpha for synchronization of oestrus in goats on the maternal behaviour was found as compared to the controls. It was observed that the maternal instinct scores in the multiparas averaged 3.1 as compared to 2.4 in primiparas.

Reports on the maternal behaviour in goats are not available. From the present study it appears that in the goats the expression of maternal behaviour and the ability to care for the young one improves after the first kidding, and many aspects of maternal case of the young one is learnt during course of the first parturition. Alexander et al. (1984) reported similar observations in sheep. However,

more observations in different groups and breeds are required in this area of behaviour in goats.

5.8.2. Behaviour associated with parturition in the kids

The behaviour of 19 kids immediately after their birth was observed.

With in seconds of the birth, the kids lifted their heads up, and within 5 to 10 minutes attempted to crawl in an effort to reach the dam's teat. All the kids attempted to stand up with in 8-15 minutes and 68 per cent of them suckled from the dam's teat with in one hour of birth.

These observations are in agreement with the findings of Lickliter (1985) describing similar findings in goats.

5.9. Prolificacy

The number of kids born in a pregnancy is mainly affected by breed, age, parity and weight of the females (Mukundan and Rajagopalan, 1971; Prakash and Singh, 1985; Prakash et al., 1986).

In the control group out of 17 kidding 88.23 per cent were singles and 11.77 per cent were twins, whereas in the

treatment group there were 14 kiddings, out of which 85.71 per cent were singles and 14.29 per cent were twins. There were no triplets in either of the groups.

In the same flock of goats, Kuriakose et al. (1983) reported 51.2 per cent and Krishnakumar (1992) found 39.17 per cent multiple pregnancies, whereas in the present study the percentage of multiple pregnancies were lesser (11.77 and 14.29) in both the groups. One possible reason for the lower incidence of twinning in the present study might be that the does were treated with the PGF_2alpha and mated (including controls) during the lean season when fodder availability was limited and the condition of the does just average. The observations also revealed that the trend of type of birth in both the control as well as the treatment group were similar. This finding concurred with the observations of Debenedetti et al. (1982) who have also reported that prolificacy following PGF_2alpha treatment was similar to that in the untreated controls.

Some authors namely Forcada Miranda et al. (1989) and Ishwar and Pandey (1990) have reported a larger litter size in goats following PG injection. On the other hand D'urso and Dell' Aquila (1981) have observed that the litter size was more in untreated controls than after prostaglandin treatment in goats.

Prolificacy was found to be similar in both the untreated controls and in animals mated after PGF_2alpha treatment.

5.10. Growth of kids

Fortnightly body weights and body measurements (Length, girth and height) of kids in control and treatment groups from birth to 90 days of age were recorded.

The birth weight in kids is reported to be influenced by genetic group, sex and type of birth of kids and dam's body weight (Nath and Chawla, 1978; Mittal, 1979; Mukundan et al., 1981).

The average birth weight of male kids in the control and treatment groups were found to be 2.15±0.08 kg and 2.19±0.08 kg respectively, whereas in the female kids the same was 2.08±0.1 kg in the former group and 2.12±0.07 kg in the latter group.

The average body weight of the male kids at 90 days increased to 7.76±0.40 kg and 8.35±0.54 kg respectively in the control and treatment groups. In the females at the same age the average body weights were found to be 7.33±0.44 kg and 6.82±0.53 kg respectively.

The differences in the body weights between the control and treatment groups from birth to 90 days of age for both males and females were not found to be significant at 5 per cent level, at any stage of growth (Table 11). The growth curve for male and female kids of both the groups was found to be linear.

These results indicate that although average weight of male kids was higher than the female kids at most of the ages, but the differences were not significant, which is in agreement with the report of Roy et al. (1989). Many other workers have reported significant influence of sex on body weight from birth to 90 days (Mukundan et al., 1984; Nagpal and Chawla, 1985; Malik et al., 1986).

From the results presented in the table 12, it is evident that the average daily gain upto 90 days in the males (62±4 g) was 4 g more than the females (58.0±5 g) in the control group, and in the treatment group the same was 16 g more in males (68±6 g) than in the females (52.0±6 g). However the difference in the average daily gains between the males in the control and treatment group and females in both these groups as well as between males and females in the same groups were not significant at 5 per cent level.

No reports on average daily gain or growth of kids born to does after synchronization with PGF_2alpha is available.

Many of the authors have reported that sex had a significant effect on the daily gain (Mukundan et al., 1982; Mukundan et al., 1984; Malik et al., 1986). In the present study also male kids weighed more at all ages than females. However, the differences were not wide enough for significance at 5 per cent level. Roy et al. (1989) also could not observe any significant difference between male and female kids at birth and at 90 days age. Malik et al. (1986) found that the preweaning average daily gain was 54.69 g for males and 46.41 g for females in Beetal, Black Bengal and their crosses, which is lesser than the values observed in this study.

The body length of male kids at birth in both the control and treatment group was found to be similar (28.92 cm) but at 90 days the same increased to 42.78±0.72 cm and 44.35±0.97 cm in the two groups respectively. Among females the body length at birth as well as at 90 days of age were found to be similar between the groups.

Sarma et al. (1984) has observed that sex had significant effect on body measurements at 45 days and 90 days, whereas Das et al. (1989) reported that body length was not significantly affected by sex at birth, one month and 2 months age. The results in the present study comes close to the findings of Das et al. (1989).

The girth at birth in males averaged 29.71±0.52 cm in the control compared to 29.97±0.58 cm in the treatment group. The same was found to be 41.42±1.02 cm and 43.07±0.92 cm respectively for the control and treatment groups at 90 days of age.

In the case of females the girth among the controls and treatment group at birth was observed be 29.5±0.45 cm and 28.14±0.067 cm and at 90 days 40.68±1.09 cm and 40.28±1.12 cm respectively. The girth was not found to differ significantly ($P > 0.05$) at any stage from birth to 90 days in both the males and females between the control and treatment group.

Darokhan and Tomar (1983) reported that heart girth at birth in male kids was 29.53 cm and in the females 28.45 cm and observed that sex had significant effect on heart girth. Sarma et al. (1984) noted that sex had a significant effect on chest circumference at 45 and 90 days. Sex affected heart girth in Jamnapari kids only at birth (Das et al., 1989).

The mean height at withers at birth for males in the control group was 29.85±0.44 cm and 30.57±0.46 cm in the treatment group. At 90 days of age the same increased to 42.92 cm and 44.92 cm respectively. The average height in the females for both control and treatment group were found

to be similar at birth (30.25 cm and 30.28 cm) and also at 90 days (42.81 cm and 42.0 cm).

Khan and Sahni (1983) observed that the effect of sex was significant on body height only at weaning, whereas Darokhan and Tomar (1983) reported that sex of kid had highly significant effect on height at withers at birth.

The fortnightly body weights and body measurements (length, girth and height) at birth and upto 90 days for males and females were compared among the control and treatment groups. The results showed that there was no significant difference between the kids born to PGF_2alpha treated goats and the untreated controls.

While in most of the earlier reports on oestrus synchronization, the study was stopped soon after kidding. In the present study the observations were continued upto the stage of weaning at 90 days age. On the basis of observations it can be concluded that the kids born out of synchronous oestrus performed as good as controls with respect to pre-weaning growth.

5.11. Suckling behaviour in kids

Milk suckling behaviour of the kids with respect to the milk consumed per minute, butting per minute and approach

pattern of the kids towards the does were studied from 8th day to 14th day of parturition.

The rate of milk consumption and rate of butting per minute for seven days, is shown in table 17.

The overall mean duration of sucking was 2.61 minutes and mean rate of sucking was 49.65 g per minute, which is more than the values (16.91±1.37 g/min) reported in Black Bengal kids by Das and Pan (1990). The mean rate of suckling by the single born kids (50.02 g) was more than the twins (43.73 g). This is in agreement with the findings of Das and Pan (1990).

Butting action of the kid is reported to be an important associate behaviour with suckling (Hafez, 1975b). Overall a positive correlation between rate of suckling and butting per minutes was observed. However the butting action was noticed initially, when the kids started suckling, while changing from one teat to another and towards the end of the suckling bout, when it was found to be more vigorous. While there was a steady supply of milk the butting was relatively less or absent. Among the twins the rate of butting was more (6.56) than in the single born kids (4.87).

Tail wagging was found to be associated with butting as it was found to be increased in frequency and vigorous as the frequency of butting increased. Among the twins the tail wagging was also more vigorous and was observed through out the sucking bout.

The increased frequency of butting and tail wagging among the twins may be due to completion between the kids for the milk. While the positive correlation between the overall mean rate of milk consumed and mean rate of butting could not be explained, from this it appears that kids increased tail wagging and butting when the milk flow from the teats get reduced, apparently as an effort to solicit let down of more milk from the mother. Hafez (1975b) was of the opinion that butting and tail wagging may be expressions of frustration on the part of the kids. Since tail wagging is also observed in kids while being groomed by their mothers, it may be more appropriate to consider butting and tail wagging as attempts to solicit let down of milk rather than as expressions of frustrations.

On observing the approach pattern of the kids, paired contest among the twins revealed that kids with heavier body weight reached the dam first on significant more number of occasions (61.54%) than the kids with lighter body weight (38.46%).

This finding is contrary to the findings of Das and Pan (1990), that the kids with heavier body weight were sluggish and kids with lesser body weight reached the dam first.

Among the kids reaching first 53.85 per cent preferred left side approach and 46.15 per cent preferred right side. In the single born kids also, when there was no competition, similar preference for left side was observed. However, the preference for left side approach was not significant in both the cases.

Das and Pan (1990) have reported that among the twins there was significant preference for left side approach while in the single born kids the preference for left side was not significant. The results of the study are in partial agreement with the findings of Das and Pan (1990). However, a higher preference for right side approach over left side (59.6% Vs 32.8%) was reported by Keszthelyi et al. (1987) in sheep.

5.12. Milk yield in goats

The milk yield in goats is affected by genetic group, dam's weight at kidding parity and season of kidding.

The mean daily milk yield upto thirteenth week of lactation in the control group was 0.509±0.15 kg and in the

treatment group the same was 0.493±0.014 kg. Mukundan and associates (1983c) reported that the mean lactation milk yield in a flock of Malabari and Malabari x Saanen goats during a mean lactation length of 177.2 days averaged 83.6 kg (0.471 kg/day) whereas, Agarwal and Bhattcharyya (1978) found that daily milk yield during days 7 to 97 of lactation in Black Bengal and Barbari nannies were 344.4 g and 665.8 g respectively.

The mean daily milk yield of goats from the first to thirteenth week of lactation for the two groups are presented in table 18 and figure 3.

In both the groups the milk yield increased during the second week of lactation. The peak yield (observed during the second week) in the controls was 0.812±0.082 kg and in the treatment group the same was 0.714±0.042 kg. Mukundan and co-workers (1983c) has reported that the peak yield in Malabari and their Saanen crosses were 0.80±0.07 kg and 1.0±0.15 kg respectively. The values observed in the study for both the groups come close to the values reported for Malabari goats.

After the second week the milk yield started declining in both the groups. However during the third week the decline in the control group was rather sharp as compared to

the treatment group. At the thirteenth week of lactation the daily milk yield in the two groups averaged 0.262±0.02 kg and 0.267±0.026 kg respectively. The difference in daily milk yield from the first to thirteenth week of lactation were not found to be significant ($P > 0.05$) at any stage between the two groups.

Thus the daily milk yield in both the control and treatment group were found to be similar.

5.13. Environmental temperature and Relative humidity

Table 19 gives the monthly averages of maximum and minimum, mean environmental temperature and Relative Humidity (from December 1991 to November, 1992) recorded inside the sheds where the animals were housed.

The maximum temperature varied from 28.8°C during July to 37.2°C in March and the minimum temperature from 20.9°C in January to 24.9°C during May. The variation in the mean environmental temperature was very less. During most of the months the relative humidity was above 73 per cent.

Exposure of dam to elevated temperature causes abortions, fetal stunting or gives rise to congenital malformations of the nervous system (Arthur et al., 1989c)

Prasad and Pandey (1982) observed that in summer and winter respectively the conception rate was 83.64 and 100 per cent for Barbari nannies inseminated in the second oestrous cycle. However, others (Khan et al., 1979 and Mukundan et al., 1981) found no significant effect of season of birth on birth weight of kids.

During the period of the present study the variation in the environmental temperature was very less, therefore these factors may not have any significant effect on the growth and production characteristics of the goats. This is in agreement with the observations of Mishra (1979) that the native goats in India are widely distributed, in the various agro-climatic conditions and they thrive and adapt every where.

5.14. Man hours required to look after the does and kids

An attempt has been made to study the man hour requirement to look after the does from the beginning of the experiment upto raising the kids born to them to 90 days of age.

The man hour requirements in the control and treatment groups in respect of requirements for heat detection, maintenance of does upto 139th days of gestation, looking

after the parturient does and kids born to them from 140th day of gestation to one month after parturition and for care and management of kids upto 90 days of age is presented in table 19.

The variations in the man hour requirement between the two groups is mainly due to the periods of matings in these animals. Figures 1 and 2 show the distribution of successful matings (monthwise) in the control and treatment groups respectively.

Distribution of parturitions in the control and treatment group is shown in figures 4 and 5 respectively. Parturition in the control group started from the first week of June and continued upto first week of August whereas in the treatment group the same was distributed from 1st week of July to 1st week of August. This aspect has been discussed under section "distribution of parturition". It is seen from figure 1 that during the fourth week of January 11 does were mated and it is evident that some degree of oestrus synchronization occurred in the control group also due to improving the nutrition and resorting to buck parade as a means of heat detection. These have been discussed under section "Synchronization of oestrus". Had this not taken place the labour requirement for mating associated activities would have been larger in this group.

In the treatment group synchronization was started only by January 30th in two batches to facilitate taking observations related to reproduction. The goats in this group were mated only at the oestrus following the second injection of PGF_2alpha given after 11 days of the first injection. Had this requirement not been there, as under commercial field conditions all the animals could have been treated with PGF_2alpha at the same time. This would have further reduced the labour requirement in the treated group by further condensing the periods in which the does came into oestrus and subsequently kid.

It was observed that 224 more man hours were required for the control group than the treatment group of goats. There was a man hour saving of 12.3 per cent in the oestrus synchronized group as compared to the untreated controls. The savings in the man hour requirement would have been more if the entire animals in the treatment group had been synchronized to come to oestrus at one time. Similarly if natural synchronization of oestrus had not taken place in the controls in case they were well fed and in good conditions at the time of selection for the experiment, the differences could have been wider. Thus under commercial field application of this technique on a larger herd of animals we can anticipate even greater savings.

The observations reveal that it would be more economical to breed the does coming to oestrus after the first injection of PGF_2alpha and a second injection may be given to only those animals which do not show oestrus at the first instance, as in the present study 75 per cent of the does showed oestrus following the first injection of PGF_2alpha.

Summary

SUMMARY

Forty cyclic, Malabari, Malabari x Alpine and Malabari x Saanen female goats were selected in pairs, the members of each pair being near to their pair mate with respect to body weight, age and genetic make up. The does from each pair were allotted at random to two groups. Out of this one group at random formed the control and the other treatment group. Feeding and management were similar for both the groups except for the treatment.

The treatment group of goats were given two injections of prostaglandin F_2alpha (10 mg 1/m) at an interval of eleven days, in two batches of 10 goats each for synchronization of oestrus. The does were mated at the synchronized oestrus following the second injection of PGF_2 alpha. The animals that did not conceive at synchronized oestrus were not mated again.

In the control group the does were mated as and when they came to oestrus. The does that did not conceive at the first oestrus were mate at the second oestrus and the ones that did not conceive were mated again at third oestrus also. The does were not mated after the third oestrus.

Heat detection in the does was carried out by observing the behavioural manifestations of oestrus and by parading vasectomised bucks twice daily at 0800 h and 1600 h.

In the present study after the first injection of PGF_2 alpha, 75 per cent of the goats came to oestrus, whereas after the second injection 100 per cent of the goats showed oestrus. The oestrus synchrony observed in these goats was tight. In the control group also some degree of synchronization was observed as 11 does were mated during the fourth week of January. This may be attributed to better nutrition, and the presence of buck due to buck parade from the time the does were selected for the experiment.

The mean interval between the first injection of PGF_2 alpha and the onset of oestrus was 45.92 ± 2.19 h and after the second injection of the same oestrus was observed after 48.38 ± 2.06 h.

The mean duration of oestrus in the control group was found to be 31.9 ± 2.46 h (20-40 h) compared to 30.86 ± 3.19 h (12-60h) in the treatment group after the first injection of PGF_2 alpha and 32.9 ± 2.65 h (22-62 h) after the second. In majority of the animals in both the treatment and control groups the oestrus duration ranged between 24 to 32 hours.

Oestrus behaviour of goats consisting of bleating, rapid waving of tail in the presence of male, mounting behaviour, presence of vaginal mucous discharge, sniffing of males body and the receptive behaviour were observed.

Of the various signs of oestrus in goats, only rapid waving of tail in the presence of male and vaginal mucous discharge were observed in all the does in oestrus in both the treatment and control groups. Bleating was observed in 90 per cent of the multiparas from both the groups. The goats in the treatment group were found to be more receptive (65.50±5.21) than the does in the control group (59.50±5.46). Receptive behaviour was weaker in the primiparas than in the multiparas. Overall, synchronized oestrus in the PGF_2alpha treated group was more pronounced than in the control.

Mated does showed pricking of ear and arching of back as post costal reactions.

Conception rates following mating at the first oestrus in the control group was 75 per cent, whereas the same after synchronized mating in the treatment group was 85 per cent. Service required per conception in the former group was 1.42 and in the latter group 1.18. The differences in the two groups were not found to be significant.

The average increase in body weight of does from mating to just before kidding were similar in both the treatment (8.27 kg) and control groups (8.14 kg).

The mean gestation period in the treatment group was 138.14±0.80 days, compared to 143.88±0.78 days in the controls. The mean gestation period in the treatment extended by 4.26 days as compared to the control group, the difference between the groups being significant ($P < 0.05$).

The distribution of parturition in the 24 hour cycle revealed that 70.6 per cent of the parturition in the control group occurred during 0600 to 1800 h, while in the treatment group only 50 per cent of the parturitions occurred during this period. Overall, 61.3 per cent of the parturitions were observed between 0600 to 1800 hours in both the groups.

Immediately after parturition the does started licking and grooming the young ones vigorously for 15 to 20 minutes, and the same continued for one to three hours.

The maternal behaviour in goats were classified into four groups of poor, average, good and very good and were assigned numerical values of 1 to 4 in that order. The scores in the control group averaged 3 and in the treatment group 2.8, the difference being non significant. It was observed that multiparas had better maternal instinct (3.1) as compared to primiparous does (2.4)

Within seconds of the birth, the kids lifted their heads up, within 8 to 15 minutes attempted to stand up and 68 per cent of them suckled from the dam's teat in less than one hour.

Out of 17 kiddings in the control group 88.23 per cent were singles and 11.77 per cent twins, whereas in the treatment group there were 14 kiddings out of which 85.71 per cent singles and 14.29 per cent twins. There were no triplets in either of the groups.

Fortnightly body weights and body measurements of kids, in both the control and treatment groups from birth to 90 days of age were recorded. The average birth weight of males in the control and treatment groups were found to be 2.15 ± 0.08 kg and 2.19 ± 0.08 kg respectively. The female kids in the control group had a birth weight of 2.08 ± 0.1 kg compared to 2.12 ± 0.07 kg in the treatment group. At 90 days of age the body weight in male kids increased to 7.76 ± 0.40 kg and 8.35 ± 0.54 kg in the control and treatment groups respectively. In the females the body weights at the same age averaged 7.33 ± 0.44 kg and 6.82 ± 0.53 kg respectively in the two groups. The average daily gain in the males was 62 ± 4 g and 68 ± 6 g respectively in the control and treatment groups, whereas in the females the same was 58.0 ± 5 g in former and 52.0 ± 6.0 g in the latter group.

The difference in body weight and body measurements (length, girth and height) between the kids in the control and treatment groups, sex-wise or combined, from birth to 90 days, were not found to be significant ($P > 0.05$) at any stage. There was a trend showing heavier weight and larger dimensions in the males compared to females in both the groups. But the differences between the sexes were not statistically significant ($P < 0.05$).

Suckling behaviour in the kids revealed that the overall mean duration of suckling was 2.61 minutes and mean rate of suckling was 49.65 g per minute. Overall, a positive correlation was observed between milk consumed per minute and mean rate of butting ($r = 0.997$), but the frequency of tail wagging and rate of butting was more in the twins (6.56) than in the single born kids (4.87). However, from the observations it appears that increased rate of butting and tail wagging is seen in the kids when milk flow from the teats got reduced.

Paired contest among kids for observing the approach pattern revealed that kids with heavier body weight reached the dam first on more number of occasions (61.54%) than kids with lighter body weight (38.46%). A slight preference for left side approach was observed in the kids, but the same was not significant.

The mean daily milk yield from first to thirteenth week of lactation in the control group was 0.509±0.15 kg and in the treatment group 0.493±0.014 kg. The milk yield increased during the second week of lactation both in the control (0.812±0.082 kg) and in the treatment (0.714±0.042 kg) group, and thereafter it started declining in both the groups. At the thirteenth week the daily milk yield in the two groups averaged 0.262±0.02 kg and 0.267±0.026 kg respectively. The difference in daily milk yield from first to thirteenth week of lactation were not found to be significant.

Inside the experimental sheds the mean monthly maximum temperature varied from 28.8°C during July to 37.2°C in March and the minimum temperature from 20.9°C in January to 24.9°C during May. The variations in the mean environmental temperature was very less. During most of the months the relative humidity was above 73 per cent.

An attempt was made to study the man hour requirements to look after the does from the beginning of the experiment upto raising the kids born to them to 90 days of age in both the control and treatment groups. It was observed that 224 more man hours were required for the control group than the treatment group of goats. There was a man hour saving of 12.3 per cent in the oestrus synchronized (treatment) group than the untreated controls.

The study in general showed that oestrus synchronization in goats through PGF_2alpha injections do not produce any apparent ill effects on the does or kids born. Various aspects like onset and duration of oestrus, oestrus behaviour, fertility, parturition and associated behaviour, maternal behaviour, suckling behaviour of kids, milk yield of does and growth and vitality of kids are not adversely affected by it. On the contrary synchronization resulted in considerable savings in man-hour requirements to look after these goats.

Conclusions

1. Treatment with PGF_2alpha to induce synchronized oestrus results in pronounced oestrus behaviour in goats.

2. Goats showed post coital reactions.

3. Fertility in goats is not depressed by treatment with PGF_2alpha

4. PGF_2alpha treatment to induce oestrus did not affect the increase in body weight during pregnancy and the maternal behaviour in goats.

5. The milk yield of does in the treatment and control groups was similar.

6. The growth of kids born to PG treated goats were found to be similar to those born to untreated controls.

7. Synchronization of oestrus in goats and subsequent mating results in saving of labour to look after them, and thus labour can be better utilized by re-deployment.

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MANAGEMENTAL EFFECTS OF SYNCHRONIZATION OF OESTRUS IN GOATS

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ABSTRACT OF A THESIS

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ABSTRACT

An experiment was conducted to study the managemental effects of synchronization of oestrus in goats using parentral administration of PGF_2alpha, on a flock of Malabari, Malabari x Saanen and Malabari x Alpine goats maintained at the Agricultural University Goat Farm, Mannuthy.

Forty cyclic goats were selected in pairs on the basis of similarity in genetic group, body weight and age. The does from each pair were allotted to two groups at random. Out of these one group at random formed the treatment group and the other control.

The goats in the treatment group were given two injections of 10 mg (I/M) each of PGF_2alpha separated by 11 days, in two batches of 10 goats each. The animals were mated at the synchronized oestrus following the second PG injection. The does in the control group were mated as and when they came to oestrus. Heat detection in the does was carried out by parading the vasectomised bucks twice daily and by observing the behavioural manifestations of oestrus. The results and conclusions of the study are given below.

The PGF_2alpha treated goats showed 75 and 100 per cent oestrus synchrony after a mean interval of 45.93 ± 2.19h and 48.38 ± 2.06 h following the first and second injection of PGF_2alpha respectively.

Of the various signs of oestrus only rapid waving of tail in the presence of male and vaginal mucous discharge were observed in all the does in oestrus. Various signs of oestrus behaviour including receptivity was found to be more pronounced in oestrus synchronized does using PGF_2alpha than in the controls. Mated does showed pricking of ear and arching of back as post coital reactions.

Conception rate following mating at the first oestrus was better in the treatment group (85%) than the controls (75%). Body weight changes during pregnancy was not found to be affected by synchronization of oestrus with prostaglandin F_2alpha.

Mean gestation period in the treatment group was 148.14±0.80 days compared to 143.88±0.78 days in the controls, the difference being significant ($P < 0.05$).

Overall 61.3 per cent of the parturitions were observed to occur between 0600 to 1800 hours. Maternal behaviour studies showed no significant difference between the does in the control (av. score 3) and treatment group (av. score 2.8). Multiparas were observed to possess better maternal instinct than the primipara does.

The new born kids attempted to stand up within 8 to 15 minutes and 68 per cent of them suckled from the dam's teat

within one hour of birth. In the control group 88 per cent of the kiddings were singles and 11.77 per cent twins compared to 85.71 per cent singles and 14.29 per cent twins in the treatment group.

Comparing the growth of kids with respect to body weights and body measurements at fortnightly intervals from birth to 90 days of age, showed that the growth rate of kids born from synchronized oestrus was similar to that of control kids.

Suckling behaviour in the kids revealed that the overall mean duration of suckling was 2.61 minutes and mean rate of suckling was 49.65 g per minute. It was observed that the rate of butting and intensity of tail wagging increased as the flow of milk from the teats got reduced.

The mean daily milk yield from first to thirteenth week of lactation in the control and treatment groups were found to be 0.509 ± 0.015 kg and 0.493 ± 0.014 kg respectively.

Man hours requirements to look after the does and raising the kids born to tham to 90 days of age in both the control and treatment group, revealed that there was a man hour saving of 12.3 per cent in the oestrus synchronized group (treatment) than the untreated controls.