EFFECT OF HARVESTING TIME ON SEEDNUT CHARACTERS IN COCONUT

BY

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THESIS

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DECLARATION

I here by declare that this thesis entitled "**Effect of harvesting time on seednut characters in coconut**" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled "**Effect of harvesting time on seednut characters in Coconut**" is a record of research work done independently by Mrs. Vanaja, T. under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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INTRODUCTION

1. INTRODUCTION

Weather is known to play a very important role in the growth and yield of any crop and coconut is not an exception. As such knowledge of the pattern of variation in the various economic parameters of the crop as a result of the influence of weather elements helps its good management. Patel (1938) reported very low sapdix production during March in WCT palms at Nileswar. Female flower production was reported to be high during March to May but low during September to January. Sreelatha and Kumaran (1991) observed that spadix and female flower production was low during January and increased gradually reaching a peak by the middle of March. There after it decreased sharply and attained zero by the month of October. They observed high setting percentage during August, September and October.

In a regular bearing coconut plam, every leaf axil will have an inflorescence developing at intervals of about a month. After fertilization, it takes about eleven to twelve months for the female flower to develop into a mature nut. During the period of development the coconut bunches are fully exposed to the micro climate around the crown and hence the final yield and also the quality of nuts will bear the imprint of the cumulative effect of this impact. On the west coast of India, seednuts are being harvested during the summer months (February - May). Studies conducted by Patel (1938) and Menon and Pandalai (1958) have shown that the nuts coming up for harvest during these months had relatively much better development than those harvested during the other months. They were bigger in size, contain large quantity of meat, showed better germination and higher percentage of quality seedlings. It was also reported that small sized nuts occur during the North - East monsoon (October - November) period (Marar and Pandalai, 1957; Pillai and Satyabalan, 1960; Bhaskaran and Leela, (1983). Aiyadurai (1954) was of the opinion that the optimum period for the harvest of seednuts might vary from tract to tract.

The present investigation was taken up to study the seasonal influence of harvesting time on the seednut characters and related floral characters to find out the optimum time for the harvest of superior seednuts in two varieties of coconut viz., Komadan and WCT.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Coconut essentially a crop of humid tropics, is one of the nature's greatest gifts to man. It is beset with many unique breeding problems. Yield variations due to weather factors are much more pronounced in coconut than any other tree crops. This is mainly due to the fact that the reproductive cycle of coconut is very long, and consequently a bunch of coconuts during its development faces the vagaries of the weather in all its extreme manifestations. An overview of literature on the influence of harvesting time on mother palm characters and seednut characters and other related studies are listed here under.

2.1 Selection and breeding

Femond et al. (1966), Apacibla and Mendoza (1968), Silva and George (1970) and Kannan and Nambiar (1979) stressed the need and applicability of three tier selection programme in coconut improvement. viz., selection of mother palms, selection of seednuts and selection of vigorous seedlings.

2.2.1 Mother palm selection (Mass selection, maternal selection of maternal line selection)

Marechal (1928) reported high female flower production in dwarf palms during November to March in Fiji.

Jack (1930) suggested that it is possible to bring about improvement in coconut culture through the application of a scientifically based motherpalm selection procedure. He estimated that by mother palm selection alone, the first generation performance could be enhanced to the order of 25 to 35 per cent, irrespective of any knowledge or identity of the pollen parent.

Smith (1933) put forward a method for the selection of economically more desirable mother palms based on the per tree annual yield of nuts and the wet meat content in the nuts. Further, importance is given to the size of individual nuts as well. It was also pointed out that palms bearing an annual yield of not less than 100 medium sized nuts with a mean per nut wet meat content of 500 g at least, alone need be chosen for the purpose of collecting seednuts.

Peries (1934) specified the following attributes as reliable and important for selection.

a) stout straight stem with closely spaced leaf scars.

b) short and well oriented fronds in the crown which itself should carry a larger number of leaves and inflorescence.

c) short bunch stalks having no tendency to droop and

d) good number of female flowers in each inflorescence preferably a number ranging up to 100.

Patel (1938) suggested that progenies of high setting mother palms are superior to the rest in respect of early germination. It was noted much variation in the number of female flowers produced during the different months, partly due to the differences in the number of spadices opened in these months. According to him, they were generally high during march to may, the highest being in may and lowest being in September to January.

Umali (1940) reported that early germination and better performance of seedlings from palms having higher setting percentage and higher number of female flower bearing rachillae.

Liyanage (1953) stated that palm improvement in coconut could be effected to an additional 50 per cent efficiency by mother palm selection alone. The efficiency could be raised even up to 90 per cent or above through permitted open pollination among selected palms grown in isolation.

Liyanage (1958) observed that when seednuts were taken from high yielding palms, low yielding palms and from the heap, the differences in yielding capacity of the progenies turned out to be very small and insignificant. The progeny of the low yielding palms produced the highest number of nuts per palm and had a high average copra content per nut than the other groups. It was concluded that phenotypic motherpalm selection is not effective as a means of genetic improvement. Apparently all mother palms selected had been selected on a phenotypic base only and their good performance was not the results of genotypic superiority. Estimates of heritability for yield of nuts have shown that it is about 0.5 indicating that selection of mother palms on the basis of yield of nuts alone is not likely to give the expected results.

In a study conducted by Liyanage and Sakai (1960) to assess the relative importance of four palm characters viz., the flowering period, yield of nuts, yield of copra and weight per husked nut, it was found that the expected genetic progress in the yield of copra of the progenies would be more, if the seed parent is selected on high yield of copra and nuts rather than on the other two criteria. From the stand point of practice, efficiency of selection should be considered taking into account other factors, beside yield of copra and nuts.

Marar (1960) recommended confining selection of mother palms to gardens in reputed coconut growing areas alone. Only superior yielders, giving per tree mean nut yield of around 100 per year with regularity in bearing, maintaining healthy and vigorous looks, characterised by thick set spherical crowns, short thick leaf stalks and stout bunch stalks and medium sized, nearly round nuts should be selected. Trees growing in specifically favourable stray environmental pockets and those producing barren nuts should be eliminated.

Pillai and Satyabalan (1960) reported that the effect of season is not the same in all the varieties.

Marar and Shambu (1961) suggested a simpler method to facilitate initial screening of mother palms by noticing the posture of seednuts floated on water. Those that remained vertically erect were found to develop into more vigorous seedling than those that remained oblique or horizontal.

Aiyadurai (1962) reported that one of the features of the bunches produced during summer months is that as against the normal production of one bunch per month during the other months of the year, during the summer the emergence of two bunches in the same month is a common occurence. Thus it so happens that the maximum production of nuts suited for seednut collection takes place during the summer months.

Liyanage (1962) proposed inclusion of characters like number of bunches produced per year, number of nuts per bunch, weight per husked nut, number of female flowers per bunch and setting percentage, while formulating a satisfactory complement of reliable criteria for mother palm selection in coconut. The other criteria valid in this regard are earliness in bearing initiation and yield of nuts especially when an increase in copra production is expected of the progeny. The formula of the said index was formulated as follows.

$$I = X_1 - 14.70\ X_2 - 4.47\ X_3 \text{ where}$$

X_1 = number of nuts per palm per year

X_2 = weight per husked nut (lbs)

X_3 = flowering period of palm (months)

Radha et al. (1962) observed considerable fluctuations in the yield of palms in all groups during different harvests. However the general trend indicated seasonal variation in the yield of healthy and diseased palms. Higher yield was recorded during January to April and May to August in all the palms, the period of maximum yield remaining inconsistent for the healthy as well as diseased. Yield of nuts during September to December was consistently poor in all the palms through out the period of observation.

Abeywardena and Fernando (1963) reported that studies were made on seasonal variations in the weight of copra, number of bunches, number of female flowers/bunch, percentage of setting, immature nut fall, barren nuts and weight per husked nut. The final crop pattern and the patterns of all components were highly repeatable except for number of bunches (significant but less marked) and number of female flowers per bunch (bordering on significance). It was estimated that percentage setting controlled about 50 percentage of the fluctuations in the annual crop pattern, and female flowers per bunch about 20 percentage. Immature nutfall and barren nuts together accounted for not more than 2-3 percentage of crop variations within the year.

Pankajakshan et al. (1963) on the basis of a study conducted for a continuous period of four years, recommended selection of palms characterised by a higher value for the mean of the quantified yield factor with a low and steady value for standard deviation. Further, they pointed out that a percentage increase in efficiency to 79 could be achieved in the selection of motherpalms by restricting selection to the best 10 per cent palms in a standing population. This benefit in terms of percentage could be enhanced to even 100 per cent, if the proportion of palms selected is to a still lower percentage of around five.

Liyanage (1964) carried out mass selection on a sample of 104 individuals in favour of nut weight and selected the best 10 per cent and consequently genetic gain to the extent of 12.8 per cent was attained.

In the 14 macapuno coconut palms studied by Zuniga et al. (1965) in Philippines, the number of bunches and nuts produced per palm per year ranged from 6.8 to 12.6 and from 20.6 to 58.0 respectively.

Liyanage (1967) concluded in a trial testing the progeny of unselected seed parents that, the progenies of the best five per cent of the parents, selected on their phenotypic values gave yields of 14 percentage above the progeny population mean, indicating that mass selection is effective. There was considerable variation in breeding values between the palms tested and a higher frequency of desirable genotypes could be isolated when the parents were selected on yield of copra rather than when they were taken at random.

Apacibla and Mendoza (1968) opined that for the choice of superior mother palms, seednuts and seedlings emphasis is given in favour of steady average bearing nature among palms belonging to a group yielding not less than 100 nuts per year, comparatively heavier medium sized spherical or near spherical seednuts, and relatively taller, one year old seedlings with noticeably greater girth at the collar and presence of more number of split leaves.

Tammes and White head (1969) considered five years of yield estimation to allow for biennial or polyannial differences. They were also of the opinion that harvest records are only valuable after the twelfth year of age, though earlier records may be of much help in the interpretation of later data.

Zuniga et al. (1969) selected potentially high yielders in three coconut plantations. They put forward recommendations in favour of a three year yield study, sufficient to predict the yield potential of parent palm, provided only five to ten per cent of the best trees were selected.

Manthriratna (1970 a) opined that substantial increase in yield can be obtained by selection of seed parents in favour of heavier husked nuts, followed by a further rigid selection of seedlings in the nursery.

A study of the production of coconut spathes, female flowers and nut under Indian East Coast condition by Muhammad et al. (1970) revealed that female flower production is high from February to June but fruit set is poor.

Abeywardana (1971), out of six harvests conducted in an year, reported that crop harvested during January to February is normally 27% below the average for the six picks and is the second lowest crop for the year. It has the lowest percentage setting, the lowest number of bunches and heaviest immature nut fall. These adverse conditions are off set to a certain extent by the fact that it has the best copra out turn. Crop harvested during March to April is 14% above the average for the six picks. It is conditioned by slightly above average values in all the crop components. It records the second best copra out-turn. The crop harvested during May-June has the highest crop within the year, being 42% above the average. This is brought about primarily by very heavy setting. The number of bunches harvested is also the highest. It records the lowest immature nut fall. The copra out-turn is slightly above average and third best. The incidence of barren nuts is very high. The fourth crop (ie., July to August) constitutes the second best crop being 21% above average. Its percentage setting and the number of bunches is appreciably lower than the best crop. The outturn is very poor. The immature nut fall is relatively low while the incidence of barren nuts is appreciable. A compensatory feature in this crop is that it records the highest number of female flowers per bunch. The fifth crop (ie., September to October) is a low crop being 20% below the average. The percentage setting is slightly below normal, the number of female flowers per bunch is very low and copra out-turn the worst. However it is very favourable from the point of view of the number of bunches. The sixth crop (ie., November or December) records a drop of 31% below average and is the poorest crop. All the crop components show below average values in this crop. It is the worst from the point of view of the number of female flowers per bunch.

Bavappa *et al*. (1976) suggested the necessity for selection pressure on number of nuts, keeping in view of variability and heritability for this character.

Kannan and Nambiar (1979) reported the unsuitability of palms yielding less than 20 nuts per year for seednut collection.

Abeywardana and Mathes (1980) presented an index for selecting vigorous seed parents through the technique of principal component analysis. The component characters are (1) trunk girth below the crown (2) Number of opened inflorescences (including mature bunches) (3) average number of nuts per bunch and (4) number of green fronds at any one time.

Louis and Annappan (1980) reported that significant variation could be found in the yield during the four different seasons of the year, the maximum yield being obtained during the summer months.

Louis (1981) stated that the selection strategy for yield of nuts may be indirectly based on component characters, such as number of leaves, leaves on the crown, number of spathes per year and female flowers with high nut set. Phenotypic coefficient of variation for number of nuts per year was found to be 58.69 and for number of female flowers it was 66.66.

Davis and Ghosh (1982) revealed that, low precipitation which is associated with clear sky and low relative humidity during the month July are ideal for the emergence of large number of spadices and fertilization of flowers. Therefore the large number of female flowers fertilized in July are harvested 12 months later as ripe nuts. Production of spadices and female flowers per spadix is affected during the colder months of December - March which result in the low production of ripe nuts during this season. During heavy rainfall, pollination is hampered which eventually depresses the yield during November - December of the ensuing year.

Gopimony (1982) reported that regarding the average nut yield, 99 per cent of the Komadan population gave more than 80 nuts per tree per year while only 15 per cent of WCT gave the same yield. The mean values of morphological characters also showed superiority of Komadan for all the nine quantitative characters studied. He further opined that since Komadan is considered to be of self pollinated nature, it is assumed that the prepotency carried by Komadan types will be transmitted to its progenies.

Monthly fluctuations in flower number were determined over two years by Bai and Ramadasan (1982). The maximum production of female flowers was found during March and April.

Satyabalan (1982) reported that hybrid performance depends on the combining ability of the parents used and that these should be selected for high numbers of nuts with high copra content.

Genetic studies undertaken with 24 coconut cultivars revealed that the collection contained very high amount of variability for all the 17 economic characters. A major portion of the observed variability in all the characters except weight of unhusked and husked nuts, weight of meat per nut and copra contents was found to be environmental. Number of rachis/inflorescence and number of female flowers in an inflorescence contributed maximum and weight of husked and unhusked nuts minimum to total divergence (Anonymous 1982).

Balingasa and Carpio (1983) in Philippines reported that six tall and two dwarf coconut populations observed to study their genetic potentials, the number of productive bunches/tree/year was found to be the most stable character with a coefficient of variation 22%. The number of harvested nuts and the number of female flowers varied widely among populations. The degree of variation was higher for number of bunches. Similarly, the rate of fruitset varied among populations. This is one character, which although partly governed by genetic factors, is influenced considerably by climatic variations.

Bhaskaran and Leela (1983) suggested that in WCT and Tall x Dwarf cultivars studied, 43-50% of the spadices produced in an year are harvested during hot weather period (February - May). The number of bunches harvested during North-East monsoon (October-November) is the lowest (23.26%). In the West Coast Tall, 72.6% of the aborted spadices are accounted for in South west monsoon (June - September). This inturn reduces the yield in this season. Spadix abortion is lowest in February - May. In both the cultivars, about 50% of annual female flower production is accounted for in February - May (Hot weather period). Female flower/spadix is also high during this season. Button setting is highest during October-November (North-East monsoon), but the differences among seasons are not applicable. About 50% of the annual yield is obtained during February-May (Hot weather period). Annual yield fluctuations are more during June-September (South west monsoon).

Mathew et al. (1984) reported that the super motherpalms are significantly superior to control mother palm in relation to two mother palm characters viz., number of bunches and number of nuts per bunch.

Ohler (1984) reported that mother palms were selected "on sight" within a population in Mosambique, the average yield of which was about 40 nuts per palm per year. Three of the selected palms yielded 160-175 nuts per palm per year during three consecutive years, or about four times as many as the general average. He further pointed out that number of nuts per year showed a moderately high phenotypic coefficient of variation. It was also reported that a selection strategy for yeild of nuts might be indirectly based on component characters, such as number of leaves produced, number of leaves on the crown, number of spathes per year and number of female flowers with high setting percentage.

Panda <u>et al</u>. (1985) evaluated fifteen introduced exotic varieties of coconut against the local cultivar at the Regional Coconut Research Station, Sakhigopal, Orissa. Varieties like Orissa selection - 1 strait settlements, Laccadive micro, Fiji, Cochin China and Philippines showed a pronounced peak period of production which suggests a clear weather - sensitiveness of these types. Thus during April to August there is higher production of bunches having proportionately more female flowers resulting in higher nut yields. These qualities are naturally attributed to higher temperature, relative humidity and rainfall favouring vigorous biochemical activities. The varieties like Java, Laccadive ordinary, Andaman ordinary, Hybrid and Siam yielded nuts more or less uniformily throughout the year. The influence of given weather on these varieties is insignificant which means that higher production is possible through manipulation, that is suitable management. Irregular bearing trend was observed in cases of Orange dwarf, spikeless and others. Besides, the hybrid failed to produce any fruit during January and February. This is mostly due to the inhibitive effect of very low night temperature as well as low humidity.

Goh hock Swee (1988) opined that selection of mother palms has been based on visual basis, and to a certain extent on actual yield records.

A study conducted by Vijayaraghavan et al. (1988) at the coconut research station, Veppankulam to assess the influence of weather factors such as rainfall and temperature on rainfed coconut of the cultivar East Coast Tall, the highest nut yield was recorded during south west monsoon season.

Chadha and Rethinam (1989) reported that for more number of good quality seedlings, rigorous re-selection of existing mother palms and selection of additional palms in the farmers garden based on yield performance and collection of seednuts from all the selected standard mother palm should be exercised.

Ramanathan (1989 b) reported that in a random selection of five per cent of mother palms which were open pollinated, 60 per cent of the palms chosen were found to have the ability to transmit the yield potential resulting in progenies with yield increase ranging from 41.5 per cent to 95.8 per cent over the parental yield.

Vijayaraghavan and Ramachandran (1989) suggested that, among the four seasons, south-west monsoon recorded highest nut yield in both ECT and hybrids. During winter the yield level in both ECT and hybrids was low. It was also reported that production of spadices is affected during winter seasons resulting in low production of nuts.

Bourdeix _et al_. (1991 b) reported that the initial results from six trials made it possible to estimate a genetic gain of 20 to 30 per cent for selection of the best seven to eight per cent of parents. The progress achieved is basically due to improvement in the number of nuts. Prior phenotypic selection within the ecotypes seems to be effective, but cannot replace the progeny test.

Darwis (1991) reported that, result of an experiment conducted in Indonesia showed that the selection process for improved yields from every generation can be based on the total leaf width on each generative phase, the number of leaf scars, number of bunches and number of female flowers.

Liyanage (1991) suggested that selection of seed parents of short internode length, high setting of female flowers into fruits, weight per husked nut and copra per palm brings about genetic progress in the progenies.

Louis and Rethinakumar (1991) opined that though selection continuously removes the deleterious mutant genes in the population, linkage, inversion and continuous mutation are assumed for building up and maintaining heterozygosity within this limited genetic load in coconut.

Ovasuru et al. (1991) reported that nut production and number of female flowers per spadix are more variable than other characters as shown by very high coefficients of variation.

Pillai et al. (1991) reported that, there is not much variation in the number of female flowers produced in an inflorescence between cultivars.

Shylaraj et al. (1991) concluded that, of the seven mother palm characters studied Komadan palms were found superior in all characters except difference in nut yield between peak and lean harvests compared to WCT. Komadan mother palms were found significantly superior in girth of stem, number of fronds, number of bunches per palm, number of female flowers per spadix, percentage of fruit set and annual nut yield per palm. The mean annual nut yield of Komadan palm

(126.0) was found to be more than that of WCT (83.1).

Sreelatha and Kumaran (1991) reported that, in WCT x CDO coconut hybrid, spadix production initiated in January and increased gradually reaching a peak in the middle of March. Thereafter, it decreased sharply and attained zero by the month of October. Female flower production also had a similar trend. Button setting exhibited a uniform trend for the whole year, ranging from 30 to 47% except the last week of June when it was only 1.8%, possibly, due to the heavy rains prevailed during this period. A high setting percentage was observed during August, September and October due to the favourable weather. More female flowers were produced during the months February, March, April and May and low production - September to January.

Manju et al. (1992 b) reported that Komadan type showed significant superiority for majority of the mother palm characters. Medium to high phenotypic and genotypic coefficients of variation were observed for number of nuts per palm per year number of female flowers per bunch and number of nuts per bunch indicating the scope for selection based on these characters.

Manju (1992) reported that the five coconut varieties/types viz., first generation Komadan, second generation Komadan, third generation Komadan, West Coast Tall and NCD showed significant differences among themselves for characters number of bunches and spadices, number of nuts per bunch, number of female flowers per bunch, number of nuts per palm per year and for number of leaves. She also reported that number of nuts per palm per year showed the highest phenotypic coefficient of variation (33.75 per cent) followed by number of female flowers per bunch (33 per cent) and number of nuts per bunch (27.25 per cent).

2.2.2 Correlation studies on mother palm characters

Pieris (1934), Narayana and John (1942) reported that number of female flowers were positively and significantly correlated with yield.

According to Patel (1938), the yield of nuts depends on the number of spadices opened, the number of female flowers produced and the number of female flowers set and developed into nuts.

Menon and Pandalai (1958) stated that high yields are the resultant effect of abundant female flowers and high setting percentage.

A knowledge of the association among floral characters, vegetative characters and yield of nuts is a prerequisite for any selection programme (Satyabalan et al.

1969). They established a positive correlation between yield and female flower production except when female flower production was high. The variation in female flower production appeared to be related more to the number of opened spadices that to the number of female flowers per bunch.

Nampoothiri et al. (1975) observed positive significant correlation of number of female flowers with yield.

Path coefficient analysis done by Sukumaran et al. (1981) for yield of nuts during stabilised period of yield showed that the major contributing characters which influenced yield directly or indirectly are the average number of female flowers, number functioning leaves at 19 years and internodal distance at a fixed mark. These characters influenced the yield negatively indicating their value in selection.

Balingasa and Carpio (1983) reported that the rate of fruitset varied inversely with the number of female flowers.

Ramanathan (1984) studied the correlation coefficients of yield per plant and eight of its components for four dwarf and 26 tall cultivars and observed that a number of characters were significantly and positively correlated with yield, stem height was most highly correlated (r = 0.6223).

Balakrishnan et al. (1991), in an experiment with 15 different hybrid combinations of coconut involving T x D and D x T, reported high correlation between number of nuts produced per year with total nut production (r = 0.904) and followed by total number of leaf production to total number of nut production (r=0.602).

Kalathiya and Sen (1991), worked out correlation coefficients between floral and yield trials in coconut variety Dwarf green. The nut yield was found to be significantly and positively correlated with number of spadices (0.400). Number of opened spadices showed a significant positive association with fruit set (0.546). It is therefore suggested that number of spadices considered as selection criteria for nut yield improvement in coconut variety dwarf Green.

Liyanage (1991) reported that the genetic correlation between yield of nuts and copra per palm, is high and positive.

Mathew and Gopimony (1991 a) in their studies conducted with supermother palms and WCT found that the number of bunches per tree failed to show significant correlation with number of spadices per year, number of nut per bunch.

The correlation coefficients estimated over the five varieties / types viz., three generations of Komadan, WCT & NCD by Manju (1992) showed that the number of bunches and spadices significantly and positively correlated with number of female flowers per bunch, number of nuts per bunch and number of nuts per palm per year. Number of nuts per bunch, number of female flowers per bunch and nut yield per year showed significant positive correlation among themselves and with number of bunches and spadices.

2.3.1 Seednut characters

Smith (1933) emphasized the need for seednut selection as well as study of nursery results in view of the fact that certain palms constantly yield nuts of low germination and poor growth characteristics.

Patel (1938), Pillai and Satyabalan (1960), Rao and Nair (1989) and Satyabalan and Mathew (1984) reported that nuts harvested during different months of an year vary in their nut and copra characters. That is, there was a definite variation in yield, nut characters, copra and oil content among the varieties and seasons.

According to Patel (1938) the average volume and weight of copra per nut of the West Coast Tall variety are at their maximum in May (Summer) and minimum in October (North-East monsoon) indicating that when the volume of the husked nut is at its maximum the weight of copra is also at its maximum. He also pointed out that the percentage of oil is rather high during the cold season (November to February) when the production of copra is rather low.

The oil content in copra is reported to vary widely in different countries (Child, 1939; Gorgi, 1929; Brill, et al. 1917).

Narayana (1940), Patel (1938) and Menon and Pandalai (1958) reported that February to may is the best period for the collection of seednuts judged from early germination, total germination and quality of seedlings. Nuts harvested during these months show relatively better development than those harvested in the other months of the year. They are bigger in size, contain large quantity of meat, give a high percentage of germination and larger out turn of seedlings.

Umali (1940) reported high germination percentage and better quality seedlings from thin husked nuts than from the nuts with husk thickness of 3.0 cm or above. Similarly light nuts weighing 0.95 - 1.35 kg germinated much later than heavy nuts (1.85 - 2.45 kg) and produced poor quality seedlings.

Aiyadurai (1954) from his nursery studies made earlier in Nileshwar and Pattambi in Kerala and Coimbatore and Pattukottai in Tamil Nadu suggested that the procurement of seednuts should be done from February to May in west coast and March to June in East coast.

Kutty (1955) pointed out that only fully ripe nuts should be selected for seednuts and that the nuts from the top and the bottom of the bunches were less suitable for planting than those of the middle portion.

Marar and Pandalai (1957), Pillai and Satyabalan (1960), Bhaskaran and Leela (1983) concluded that big sized nuts and higher yields are obtained during the summer months and small sized nuts and lower yields in the north east monsoon period.

Liyanage and Abeywardena (1958) reported in Sri Lanka that, large size and greater weight of seednuts with low sprouting period are recognised as desirable qualities for selection.

Marar and Varma (1958) suggested that the nuts of 11, 12, 13 and 14 month old bunches were equally suitable as seednuts.

Liyanage and Sakai (1960) pointed out that instances have been reported that in some hybrid combinations, the proportion of copra to the weight of husked nut is unusually low because of the higher contribution of shell and water to the total weight.

Pillai and Satyabalan (1960) reported that there are seasonal variations in yield, nut character and copra content in some of the exotic forms of coconut growing at central coconut research station, Kasaragod variation in yield is high during the different seasons. In the majority of cases highest yield is observed in summer and lowest during north east monsoon period. In the case of the West Coast Tall, it is during summer that large nut and maximum copra content are obtained. This relationship between the volume of husked nut and weight of copra is noted only in some cultivars. In majority of the cultivars studied the thickness of kernel is at its maximum during north - east monsoon. But this thickness of kernel does not have any influence on the weight of copra as seen in Philippines Kalambahim variety where the maximum thickness 11.6 mm is obtained during north east monsoon with the lowest amount of copra during the same season. The variations observed may be a peculiarity of the cultivars.

Aiyadurai (1962) concluded that the quantity of kernel contained in the nut will have a direct bearing on the germination of the nut and growth of seedling. It has been observed that the nuts harvested during the summer months contain the maximum quantity of kernel. The size of nuts and germination capacity vary during different months and it is found to be the maximum during the summer months. In actual practice it is seen that the optimum period of collection of seednuts vary from tract to tract based on the climatic and other local conditions prevailing in the tracts. In the west coast, the season starts in the month of February and ends in May that is, before the onset of the south west monsoon, while the best months are February to April. In the east coast however though harvest of seednuts could be taken up from March onwards; it can be prolonged up to June without any pronounced adverse effects. The best months for harvest of seednuts in the east coast are April, May and June. Difference in the seednut collection seasons between the west coast and east coast is mainly due to prevailing summer period and the distribution of rainfall in the respective tracts.

Viajayalakshmi <u>et</u> <u>al</u>. (1962) reported that in general the weight and volume of the unhusked and husked nut were higher in those inflorescences which reached the stage of stigmatic respectively during summer months than those of rainy or cold weather periods. Copra content per nut was also high in the summer months.

Marar and Balakrishnan (1963) have indicated that the period from March to June is the best for collection of seednuts on the west coast from the point of view of germination of seednuts and performance of resulting seedlings.

Rao and Rao (1968) found the period January to June as the suitable period for collection of seednuts.

Manthriratna (1970 b) emphasised the importance of seednut selection in generalized coconut improvement.

Silva and George (1970) concluded that the medium sized (17.5 cm short axis) drupes of the ripe first bunch displayed the best performance with respect to rate of sprouting and growth of seedlings.

Abeywardana (1971), out of six harvests conducted in an year pointed out that the first crop (harvested during January to February) has the best copra-out-turn (weight/nut) followed by the second crop (i.e., March to April). Nuts harvested during May to June has the third best copra out turn. The copra out turn is worst for nuts harvested during September to October. The second worst copra out turn during the harvest July to August, followed by November to December harvests.

Liyanage (1972) reported that nuts from the first bunch with a short axis diameter of about 17.5 cm (medium sized) displayed the best performance with respect to rate of germination and growth of seedling, less matured nuts from the second bunch with short axis about 20 cm diameter corresponded closely without any significant difference in the performance.

Romney (1972) opined that the oil content of copra varies more between coconut varieties than between different environments, although even varietal differences are usually small. However, the difference between Jamaica Tall and Malayan dwarf may necessitate grading on the basis of oil content.

Sundaresan, Rangaswamy and Mohammed Ibrahim (1974) from a study on periods of collection of seed coconuts under East Coast conditions revealed that:

1) the seed coconuts can be collected from February to August

2) the seednuts harvested during June, July and August can be planted with or without storage as there is not much difference in germination percentage and out-turn of quality seedlings.

3) the seednuts harvested in the month of June and July produce more percentage of quality seedlings.

Thampan (1975) reported that the period from January to May or June is the best for seednut collection from the point of view of early germination and vigour of seedlings.

Nelliat et al. (1976) reported that the nuts germinated satisfactorily irrespective of the month of harvest, but nuts sown during June-September (harvested during April-June) germinated early. Nuts harvested from August to December germinated late.

Rognon and Lamothe (1976) pollinated three groups of cameroon Red dwarf palms with pollen of the same variety, with pollen of west African Tall and Tahiti tall respectively and observed that the copra content of the three crosses were 220g, 258g and 260g respectively. The shell weight of the DxT crosses was significantly heavier than that of the control, but as the shell is a maternal tissue this phenomenon needs to be accounted for.

Peter and Jayaraman (1977) reported variations for the nut characters in a cultivar of tall variety in the east coast and stressed the need for selecting mother palms with desirable seednut characters.

Thomas (1978) studied the influence of seed size on the germination and growth of the seedlings in the nursery, and found that the size influences earliness as well as increased percentage of germination, though not to the level of significance.

Out of 10 cultivars studied by Reddy et al. (1979), Sanramon produced the heaviest nuts (2670g) and Dwarf green the lightest (258 g). Percentage of kernel was the highest (41%) in Ganga Bondam where as WCT gave the highest percentage of oil in dried kernel (77%).

Out of 11 coconut cultivars studied by Reddy et al. (1980), Tall x Dwarf had the heaviest nuts (av. 995g) followed by Dwarf x Tall (696g). The highest amount of kernel oil was found in Laccadive ordinary (70.8%) followed by Laccadive small (70.4%).

Louis and Ramachandran (1981) reported that the tall varieties in general, recorded high oil content with a few exceptions. Oil content in the hybrids were medium and it was closer to the female parents. The dwarf varieties though possess leathery copra possess comparatively good percentage of oil.

Santos, et al. (1981) pointed out that in estimating copra yield, the weights of the fresh meat or split nut are more reliable bases than that of whole, or husked nuts. This support the hypothesis that copra recovery is influenced by some genetic factors. It was noted that in coconuts of Philippines weight of the fresh meat is even higher than the weight of the husk. Because of this, the present concept in coconut breeding should therefore lead towards the improvement of this character (meat) to the detriment of the other principal components of the nut, that is, husk, shell and coconut water. As regards the variability of the character, the study revealed that the coefficient of variation - the split nut and flesh meat bases are lower. This is a clear indication that the split nut and fresh meat recovery rates could be used with confidence in any preliminary evaluation of coconut germplasm. It was also reported relatively higher percentage of copra recovery rates (weight of fresh meat basis) contrary to earlier belief that the husk forms the greater bulk of the nut, majority of the populations observed showed higher weights of fresh meat than husk.

Satyabalan and Vijayakumar (1981) reported that the mean copra outturn and oil content were highest in those obtained by selfing (unemasculated) followed by those from hybridisation with WCT (emasculated).

Meunier _et al_. (1982) studied seven characters viz., weight of nut, weight of husked nut, weight of husk, weight of water, weight of shell, weight of endosperm and weight of copra in West African and Polynasian varieties with the exception of the weight of water and copra, both of which were too variable. One year's observation was found enough to compare trees or lines planted in the same trial. There is a marked difference between West African Tall and polynesia for all characters, and variability between palms was greater in polynesia.

Rao and Pillai (1982) reported that fruit components are more or less stable throughout the stabilized yield period. The Kernal was given higher importance, where by the selection pressure was always in the direction of bigger nuts (to realize higher kernel / copra) with lesser husk. The WCT which is the most commonly grown tall variety in the west coast of India, showed higher husk proportion.

Shylaraj (1982) suggested that in 'Komadan' it is desirable to have fairly large number of medium sized, round or near round nuts in the bunches and discard all malformed and defective ones before sowing in the nursery.

Bavappa and Sukumaran (1983) pointed out the necessity for exercising selection pressure towards weight of copra per nut and oil per cent in addition to number of nuts.

Among different coconut populations in Philippines, Tagnanan and Baybay possessed the highest copra content/nut (304g and 288g) respectively. (Balingasa and Carpio 1983).

Bhaskaran and Leela (1983) reported that in WCT and Tall x Dwarf cultivars studied, size and weight of whole nut and dehusked nut, kernel thickness and copra content were maximum during February - May (hot wether period). Lowest value for all the characters except kernel thickness is recorded in October to November (North East monsoon). Kernel thickness is lowest in June to September (South East monsoon). Between the cultivars, WCT showed higher values for all these characters in all the seasons.

Rajamony et al. (1983) conducted studies on the early performance of the hybrids with WCT as check variety and found that all hybrids were superior to WCT in respect of all characters studied. Maximum out turn of copra per palm per annum was also recorded by two hybrids.

Ramanathan and Louis (1983) reported that East Coast Tall x Malayan Dwarf green hybrids had big nuts which gave the highest copra and oil yield. East Coast Tall x Malayan Dwarf yellow was better than its reciprocal in nut and copra yield.

Satyabalan (1983) conducted studies on the germination trend of WCT seednuts harvested during the different months and observed that the percentage of germination was high (83.3 to 96.2) in the case of nuts harvested during January to April and low (52.2) in the case of nuts harvested in May. This indicated that on the basis of germination percentage the period from January to April is the best for collection of seednuts.

Mathew et al. (1984) concluded that super mother palm and control mother palm were on par with respect to seednut and seedling characters. Medium to high GCV and PCV have been obtained for weight of unhusked nut, husked nut and meat, thus offering scope for formulating selection on the basis of these characters.

Satyabalan and Mathew (1984) reported that the values obtained for the months of January, February, June and September were on par for weight of fruit and weight of husk and for the remaining eight months also the values were more or less similar. In the case of weight of husked nut and weight of copra comparable values were recorded during the months of April, May, June and September. The values obtained for the remaining eight months for the above two characters were also similar. Husk content in the fruit was less than 50% of the weight of fruit during March, April, May and November while it varied between 52.2 - 61.5% during the rest of the months. In the husked nut, the kernel content varied from 53.0 to 55.6% during November, January and March while it was less that 50% during the remaining months. The shell content in the husked nut was 28% and above during February, March, October, November, December while it was less than 28% during the remaining months. The recovery of copra from the wet kernel was 58-60% during February, March, April, September, October and December indicating that the moisture content in the wet kernel was low when compared to other months when it was less than 58% which indicated that the moisture content in the wet kernel was high during these months.

Lamothe and Benard (1985) reported that the annual yield of hybrid PB-111 is 100-150 nuts/tree with 200-140 g of copra/nut and oil content is 68 per cent (on dry matter basis).

Liyanage and Abeywardena (1985) opined preference for big and heavy nuts in seednut selection.

Louis et al. (1985) reported that irresepective of size and shape, nuts weighing low and medium recorded the highest rate of germination. It is also reported that nuts having normal round uniform oblong or egg shape and medium size produce seedlings with high value for girth, while it is low in nuts of irregular and abnormal shapes and big and small sizes. Germination was attributed to the smaller value of the weight of nut and thickness of husk. The growth of the seedling at the collar was positively correlated with weight, length, and volume of the whole nut and thickness of the mesocarp. The number of leaves and the height of the seedling are independent of the four accompanying characters of the nut viz., nut weight, thickness of husk, length of the nut and volume of the nut.

Panda _et al_. (1985) suggested that longer nuts and higher quantity of dry copra (sun-dried) were observed in the varieties New Guinea, Java, Philippines and Fiji. As against these studies for the high side, the low side points towards Laccadive Micro which produced the smallest nuts concurrently with the least quantity of dry copra. Considering the total dry copra yield and oil recovery per palm per year, the varieties like Java, Laccadive small, Lavcccadive Micro, Hybrid, Cochin China and Philippines were at par or slightly superior to the tested local type.

Satyabalan (1985) pointed out that the quality of seednuts at the time of harvest and weather conditions during germination and development of the seedlings rather than storage period largely account for the variation in germination, growth of seedling and recovery of seedlings of vigorous growth characters. Hence on the west coast of India seednuts harvested during the summer months may be stored and planted in the nursery during the onset of South-West monsoon in June or July to obtain maximum germination and a high percentage of recovery of quality seedlings.

Nallathampi et al. (1986) evaluated six hybrids and the seven parental genotypes for the oil content of their copra and observed that the highest heterosis over the mean and better parental values for this trait were in ECT x Gangabondam and ECT x Kanyakumari Dwarf yellow (13.4 and 12.4 per cent respectively, for both hybrids), ECT being the better parent.

Foale (1987), based on a survey of coconut improvement work in various islands, reported that several types with potential breeding value were identified and a wide spread of nut types were found, ranging in diameter from 158 mm in Niu Vai from Samoa to 90 mm or less.

Ghose and Debnath (1987), reported that the nuts of Arasampatty tall cultivar of East Coast Tall variety appears to have morphological characters as length circumference range 52-60 cm width, circumstances range 44-52 cm, husk thickness range 1.8 cm to 2.9 cm and nut weight range of 650-920 g. He opined that the morphological characters of seednuts were found to be related with the quality of planting material.

Ramanathan (1987) observed that in ECT x Ayiramkachi hybrid, seednut weight was found to be positively associated with seedling height. Girth at collar and number of leaves were not related to seednut weight in this hybrid.

While there was significant positive relationship between seednut weight on the one hand and the seedling characters, girth at collar, height of seedling and number of leaves on the other in ECT x MDG hybrid, there was no such correlation in the case of ECT x MDY hybrid as well as ECT cultivar.

Ramanathan and Nallathambi (1988) reported that the fruit components viz., whole nut weight, dehusked weight, kernel weight and copra weight were not significant statistically. The hybrid ECT x DG gave the highest copra yield per annum as compared to the other hybrid ECT x CDO and ECT cultivar.

Louis and Chopra (1989) adopted a discriminant function to formulate a selection index used in identifying two economic characters of coconut, namely, the number of nuts and copra weight/nut against 17 common growth reproductive characters. Three characters had common and positive role, and two had common but negative role, in the selection for either the number of nuts or copra weight per nut. The number of leaves and the height of juvenile palm were traced as additional requisites for identifying palm with increased number of nuts, while the thickness of kernel and shell served as additional characters for identifying palms with good copra weight. The expected genetic advances in selecting palms for the number of nuts and copra weight/nut through the selection index are 36.5 per cent and 68.88 per cent respectively. Index score was highest for ecotypes from the Philippines (San Raman) and from S. America (San Blas) in both selections.

Nambiar and Govindan (1989) studied the influence of season on the size of nuts and reported that nuts harvested during April / May were the biggest and those harvested during December / January the smallest. The nuts harvested in the month of October were the smallest in volume. In copra recovery, the nuts harvested in the hot summer (March - April) were superior to those of the other months. They yielded more copra/nut. The nuts harvested in the cold winter months of December and January yielded more oil. It was also reported that the best time for the selection of the seednuts was February to May coincided with summer season in Kerala.

Ramanathan (1989 a) reported that the hybrids produced utilizing the traditionally grown East Coast Tall as female parent, have exhibited different degrees of heterosis for the characters studied viz., nut and copra yield, nut components and oil content ECT x MDG hybrids were found to express the highest vigour exceeding the values of parent and also other hybrid in terms of nut and copra yield, nut components and oil content and was released as VHC-1.

The monthly variation in nut development of three different coconut hybrids viz., T x CDO, CDO x T and CDO x LO was studied at the Regional Agricultural Research Station, Pilicode during 1985 - 86 (Rao and Nair 1989). All the three hybrids recorded higher nut weight and copra content in the summer months of March, April and May. There occured a slight reduction in the weight and copra in winter months (December to February). The fall in nut weight and copra yield was conspicuous in the rainy and post rainy periods. There was a marked decline in nutsize from July to December in response to as increase total heat units.

Satyabalan (1990) reported that earlier harvested seednuts germinated early whereas later harvested nuts germinated late.

Valsala and Kannan (1990) observed positive significant correlation of polar circumference of seednut with girth of seeding (0.393) and also with equatorial circumference (0.472). Similarly the weight and volume of nut showed positive significant correlation with seedling girth. They also noticed that the correlation coefficient between nut characters and seedling characters like height and total leaf production, were not significant. They concluded that bigger nuts in terms of volume and weight will give rise to vigorous seedlings and that for getting quality seedlings seednut selection should be practiced.

Balakrishnan and Kannan (1991) reported that among the hybrids evaluated (DXT & TXD), large number of variations were observed in almost all the characters. There was significant difference in mean number of nut production of the hybrids. Among the characters studied polar diameter of the nut and thickness of kernel varied significantly at one per cent level. There was no significant difference among the hybrids in equatorial diameter of the nut.

Bourdeix et al. (1991 a) stated that yield expressed as copra per palm can be broken down into three multiplicative factors. Number of bunches, number of nuts per bunch and copra per nut. Copra per nut is usually the most variable character.

Mathew and Gopimony (1991 b) based on the study of linear relationship between seedling vigour index and seedling characters concluded that while selecting mother trees, more emphasis has to be given to weight of unhusked nut, husked nut and meat.

Nambiar and Rao (1991), in a study conducted among WCT, Laccadive ordinary, Gangabondam, Chowghat Dwarf Orange and Laccadive Dwarf and their hybrids, WCT recorded the maximum (160.9 g/nut) copra, followed by CDO (142.5 g/nut) and the minimum (102.4 g/nut) by Laccadive ordinary. It was seen that the mean weight of copra of different hybrids and their parents was maximum (181.8 g/nut) during the summer (March - May), followed by the winter (152.9 g/nut) and the minimum (119.1 g/nut) in the post monsoon (October - November) while the percentage of oil was minimum (66.8) in summer and maximum (71.2) in winter. As regards the variety x season interaction, in the case of copra per nut, all the five hybrids and their parents followed the same trend that is, copra per nut was maximum in summer followed by winter and minimum in the post monsoon period. However, WCT and Ganabondom differed as they showed slight variations in the South West monsoon season. All the hybrids and their parents recorded the maximum percentage of oil content during the winter (December - February) except CDO.

Shylaraj et al. (1991) reported that in seednut characters the two coconut types viz., Komadan and WCT did not show any significant difference.

Taffin et al. (1991) reported that the dwarf hybrids proved to be greatly superior to local WAT coconuts in terns of precocity number of nuts per hectare and copra per nut. Estimate of copra = weight of whole dehusked nut x 0.29.

Manju et al. (1992 a) reported that the WCT variety falls into a group with nuts having 51-67 percentage husk and weighing 416-1340 g. These parameters match closely to those of the primitive Niukafa type. The natural cross Dwarf (NCD) type with percentage of husk varying from 25 to 40 and nut weight from 688 to 977 g falls closely towards the highly evolved Niuvia type. The three generations of Komadan were seen accommodated in an area midway between NCD and WCT with a clear progression through generations towards better fruit weight. From fruit component analysis it was seen that the three generations of Komadan were found significantly superior to WCT and NCD for thickness of meat and this might have influenced the increase in kernel and copra weights of Komadan considerably. The Komadan types were significantly superior to WCT in all seed nut characters except oil content, thickness of husk and husk/nut ratio, where as NCD was found to be on par with Komadan for most of the seednut characters.

2.3.2. Correlation studies on seednut characters

Cooke (1933) reported a remarkably close correlation between the weight of husked nut and the meat content in Malaya and Ceylon respectively.

Harland (1957) observed that varieties with heavy husked nuts had a higher weight of copra per nut and considered the correlation between the weight of copra per nut as the most important.

Inter relations among the different seednut characters was studied by Vijayalakshmi et al. (1962). The results showed a positive and significant (at 5% level) correlation between weight of husked nut and volume of husked nut (0.6054), weight of unhusked nut and volume of unhusked nut (0.6915), weight of husked and unhusked nut (0.6040). The correlation between weight of copra and weight of husked nut and between volume of husked nut and volume of unhusked nut was found to be not significant. There is indication to show that the effect of season is not operating in the same way or to the same extent in the different characters. Probably this is why the amount of variation explained on the basis of association of characters is less than 50 per cent even where significance has been attained.

Davis and Gosh (1982) came to the conclusion that the female flowers getting fertilized during the dry months of July are 4-5 month old when the palms receives heavy rains which has the beneficial effect on the fast enlarging young fruits. This contributes the larger size of the fruit that yields more copra/nut competed to nuts harvested during other months.

Sathyabalan and Mathew (1984) conducted correlation studies on nut and copra characters of nuts, harvested during different months of the year from West Coast Tall palms grown under rainfed conditions at CPCRI, Kasargod. There was significant correlation between

1) Weight of fruit (unhusked nut) and weight of husked nut

2) The weight of fruit and weight of husk

3) Weight of husked nut and wet weight of kernel

4) Weight of husked nut and wet weight of shell

5) Weight of husked nut and weight of copra

6) Wet weight of kernel and weight of copra

7) Weight of shell and weight of copra in the nuts harvested during the different months of the year irrespective of seasonal effects on these characters. Slight differences in the magnitude of the association noticed in the different months can be attributed to the effect of season prevailing during development. In the case of inter relationship between weight of fruit and weight of kernel, weight of fruit and weight of copra and weight of kernel and weight of shell, the correlations are significant except during December for the first two combinations and October for the third. Slight difference in the magnitude of association noticed in the different months can be attributed to the effect of the season prevailing during development.

Balakrishnan and Vijayakumar (1988) reported that the four nut characters viz., equatorial diameter of nut, weight of unhusked nut, weight of husked nut and weight of opened nut are positively correlated with copra content of the nut. There was no correlation between the weight of shell and copra content in the cultivars studied. But the weight of opened nut and copra content were highly correlated than any other characters with a correlation coefficient of 0.9447. Equatorial diameter of the nut is more related with copra content than polar diameter of nut.

Louis and Chopra (1991) pointed out that among the five characters significantly correlating with copra weight, kernel weight, length of petiole and thickness of shell had positive direct effects. Negative direct effects on copra weight were observed with the pre-flowering period and thickness of kernel. Highest direct and positive effects on copra were observed by the kernel weigh per nut, followed by leaflets and number of leaves produced in an year. The thickness of the shell had the least direct positive effect on copra.

Mathew and Gopimany (1991 b) pointed out that the weight of unhusked nut showed significant positive correlation with weight of husked nut, meat, all seedling characters and percentage recovery of quality seedlings from total number of seedlings as well as seednut sown. Weight of husked nut exhibited very high positive correlation with weight of meat, diameter of eye and percentage recovery of quality seedlings from total number of seelings and seednuts. Weight of meat also showed similar correlation with all seedling characters and recovery of quality seedlings. Meat thickness and eye diameter fail to show significant correlation with any seedling characters.

Manju (1992) reported that economically important characters viz., kernel and copra were positively influenced by most of the seednut characters except thickness of husk and husk/nut ratio in the Komadan types. But in WCT, the thickness of husk was found to be positively correlated with kernel and copra content. Oil content in all the five varieties/types studied was found to be either uncorrelated or negatively correlated with majority of seednut characters. In all the varieties/types, the the weight of opened nut, weight of kernel and weight of husked nut have shown very high positive correlation among themselves.

2.4. Correlation between mother palm characters and seednut characters

Pieris (1934, 1937) has worked out correlations between ten characters of the coconut palms including yield, and has specified standards for selection of seed palms.

According to him the size of nut is not important, provide larger numbers are present, a medium sized nut is the best, palms with extra large nuts should be avoided; the weight per husked nut should be high. The number of nuts per palm and their weight provided the best standards of selection.

Pieris (1934) and John (1938) concluded that as the number of nuts and weight of copra are highly correlated, there is little danger in taking the number of nuts produced as giving an idea of the copra yield, though the number of nuts and weight of husked nuts provided the best standards of selection. John also reported that colour, shape and size of the nuts are not related to yield.

Liyanage and Sakai (1960) reported that since the yield of nuts and yield of copra are highly correlated positively ($r_G = 0.79$), and the flowering period and yield of copra are highly correlated negatively ($r_G = -0.80$), selection of seed parent, for early flowering and number of nuts tends to increase the yield of the progeny population with respect to copra production.

Santos et al. (1981) had seen inspite of the low copra per nut in LAG tall variety of Philippines, it manifested the highest yield (copra/ha) and highest number of nuts/tree/year. But among the dwarfs, the computed yield was highest coinciding with high copra per nut.

Satyabalan (1982) observed that in WCT the mean yield of nuts were significantly and positively correlated with both annual outturn of copra and oil, whereas with mean copra content per nut it was negative and significant. The oil percentage in copra was not significantly related to yield of nuts. Studies on the relationship between yield of nut, copra content per nut, total yield of copra and yield of oil per palm in WCT showed that the mean copra content per nut although negatively correlated with yield, did not affect the annual outturn of copra per palm, the threshold value being 162.6 nuts.

Bavappa and Sukumaran (1983) based on their studies on the relationship between yield of nuts, copra content per nut, total yield of copra/palm and yield of oil /palm showed that in West Coast Tall the mean yield of nut is significantly and positively correlated with both annual outturn of copra and oil, were as with mean copra content/nut, the relationship was negative and significant. The percentage of oil in copra was not significantly related to yield of nuts. The mean copra content per nut, though negatively correlated with yield, doesn't affect the annual outturn of copra/palm, threshold value being 162.6 nuts. The necessity for applying selection pressure on weight of copra/nut and oil percentage in addition to number of nuts, has been indicated keeping in view the variability and heretability data available for these characters.

Satyabalan (1984) reported a high positive linear correlation between yield of nuts and total outturn of copra as well as copra content per nut in WCT palms.

It was reported that negative correlation exist between the number of nuts in a bunch and the size of nuts (Anonymous, 1984).

Mathew and Gopimany (1991 a) suggested that number of nuts per bunch is negatively correlated with weight of unhusked nut, husked nut and meat.

Mathew and Gopimany (1991 b), pointed out that number of nuts per bunch showed negative correlation with most of the important nut and seedling characters.

MATERIALS AND METHODS

3. MATERIALS AND METHODS

The investigation was conducted in the Department of Plant Breeding, College of Agriculture, Vellayani for a period of one year commencing from September 1991 to August 1992 to study the effect of harvesting time on seednut characters of coconut.

3.1 Materials

The materials consisted of two coconut varieties viz., Komadan and West Coast Tall (Plate 1 & 2) - of the same age group; i.e., above 30 years old available at the Instructional Farm, Vellayani. Komadan types are grouped in 'D' block and West Coast Tall in 'F' block of the Instructional Farm.

Ten mother palms from each variety were selected based on typical identification characters of each type as well as the mean nut yield per tree per year assessed for the previous three consecutive years. The top ranking ten trees showing the type characteristics (Menon and Pandalai 1958; Ohler, 1984) were selected for the study. For identifying the selected palms from others a red ring having 5" width was marked on each palm.

Details of palms selected are given in Table - 1.

Table 1. Details of experimental materials

Name of the variety	Palm Number according to the farm register	Mean nut yield/palm/ year
Komadan	51	160
	65	90
	69	130
	72	122
	75	71
	80	115
	30	142
	23	130
	39	101
	36	81
W.C.T	118	82
	125	94
	64	83
	57	89
	53	75
	46	110
	72	89
	87	120
	90	130
	105	91

Plate. 1 Komadan mother palm

Plate. 2 WCT mother palm

PLATE - 1

PLATE - 2

3.2 Methods

Harvesting of nuts from the selected palms started during September 1991 and subsequent harvests were conducted at an interval of 45 days (Santos, <u>et al</u>., 1981). Thus during the period of one year eight harvests were conducted.

3.2.1 Studies on mother palms

Observations on the following productivity attributes of the selected mother palms of both varieties were recorded.

i) <u>Number of spadices/year</u>

During the time of each harvest the number of bunches and number of barren bunches were counted. The number of spadices produced/year was obtained by adding the number of bunches and barren bunches together in each harvest.

ii) <u>Number of female flowers/spadix</u>

Number of female flower sockets in each harvested bunch were added with number of nuts in that particular bunch which gives the number of female flowers in that spadix. Total number of female flowers in total number of bunches harvested in an year was counted and mean number of female flowers per spadix was obtained as follows.

$$X = \frac{a}{b}$$

Where X - mean number of female flowers/spadix

a = total number of female flowers produced in an year

b = total number of inflorescence produced during the year

iii) <u>Number of bunches/year</u>

Number of bunches harvested in each harvest added together to obtain number of bunches per year.

iv) <u>Number of nuts/bunch</u>

Number of nuts per bunch in each harvest was added together and mean number of nuts per bunch was obtained as follows.

$$X = \frac{a}{b} \quad \text{where}$$

x - mean number of nuts/bunch

a - total number of nuts produced in an year

b - total number of bunches produced during the year

v) <u>Number of nuts per palm per year</u>

This was obtained by adding the total number of nuts harvested in each harvest for one year.

vi) Nut per female flower ratio (Percentage of fruit set)

This was estimated for each season as follows:

$$X = \frac{a}{b} \times 100 \quad \text{where}$$

x - percentage fruitset

a - total number of nuts produced during a particular season

b - total number of female flowers produced during the previous corresponding season.

3.2.2 Seednut collection and fruit component analysis

A single medium sized nut was selected from each palm during every harvest in an year (Vijayalakshmi *et al*., 1962; Silva and George, 1970; Balingasa and Carpio, 1983).

Nut, kernel and copra characters were recorded as follows:

i) Polar diameter of the nut

The length of the nut from one pole to the other measured by set square blocking of the nut and measuring the distance using a meter scale, gave the polar diameter of the nut in centimeters.

ii) Equatorial diameter of the nut

The breadth of the nut at the middle portion measured by setsquare blocking of the nut and measuring the distance using a meter scale gave the equatorial diameter of the nut in centimeters.

iii) Thickness of husk

The husk was pierced, with a sharp needle, on three flat surfaces of the nut till it reached the shell. Mean length of the needle from shell to the outer surface of the husk gave the thickness of the husk in centimeters.

iv) Weight of unhusked nut (fruit)

Weight of unhusked nut found out by using a pan balance and expressed in Kilograms.

v) Weight of husked nut

Each nut was husked, cleaned and weighed and weight expressed in grams.

vi) Weight of husk

Weight of husk was obtained by deducting weight of husked nut from weight of unhusked nut and expressed in grams.

vii) <u>Volume of nut water</u>

The volume of water in each nut was measured by using a measuring cylinder and expressed in millilitres.

viii) <u>Weight of split nut</u>

The husked nut was split into two halves and weighed after completely draining the nut water. Weight expressed in grams.

ix) <u>Thickness of meat</u>

Meat thickness was measured by using vernier calipers at three different places on the circumference of the opened nut and the mean meat thickness expressed in centimeters.

x) <u>Diameter of eye</u>

The hole on the shell corresponding to the soft eye, which was seen on the widest side of the nut was cleaned and diameter recorded along two axes. Mean of these two values gave the mean eye diameter of a nut expressed in centimeters.

xi) <u>Weight of embryo</u>

Embryo lying beneath the soft eye was scooped out carefully and weighed and weight expressed in grams.

xii) Weight of shell

Weight of shell was recorded after removing the kernel from the shell and weight expressed in grams.

xiii) Weight of kernel

Weight of kernel was obtained by deducting the shell weight from the corresponding split nut weight and expressed in grams.

xiv) Weight of copra

The wet cups with shell intact are placed on trays and kernel exposed to direct sunlight for drying. After a day or two of sundrying, the kernel get loosened from the shell so that it could be scooped out with a metal lever. The kernel was further dried in the sun for a period of another 4-5 days depending upon the sunlight, after which the level of moisture will be 6-7 percentage (Ramachandra, 1987). At this stage weight was taken and expressed in grams.

xv) Oil Content

Copra from each nut was separately made into pieces and random sample of 0.5 g was taken for estimation of oil content. The percentage of oil content estimated by cold percolation method. (Kartha and Sethi, 1957). The analysis was repeated for each sample till consecutive values were obtained.

xvi) Husk/nut ratio

The difference in weight of unhusked nut and husked nut divided by weight of unhusked nut gave the husk/nut ratio.

3.2.3 Statistaical analysis

3.2.3.1 Mother palm characters

Ten palms each of the two varieties - Komadan and WCT were selected for the study. Mother palm characters viz., number of spadices, total number of female flowers, number of female flowers per spadix, number of bunches, number of nuts per bunch, total number of nuts and percentage fruitset were recorded for each season. These were subjected to analysis of variance to test the significance of difference between the two varieties and also among seasons within varieties with respect to the characters mentioned above. Mother palm characters over the year viz., number of spadices per year, number of bunches per year and number of nuts per year, number of female flowers per spadix, number of nuts per bunch and fruitset were obtained from data recorded for the corresponding character during each season and subjected to student's 't'-test to test the significance of the difference between the two varieties.

3.2.3.2 Fruit component analysis

The sixteen seednut characters viz., polar diameter of nut, equatorial diameter of nut, thickness of husk, weight of unhusked nut, weight of husked nut, weight of husk, weight of opened nut, volume of nut water, thickness of meat, diameter of eye, weight of embryo, weight of shell, weight of kernel, weight of copra, oil content and husk/nut ratio, in each harvest were subjected to analysis of variance to test the difference in nut characters between varieties and among harvests within the varieties.

3.2.3.3 Seednut quality index

Quality index was defined in terms of $w_1x_1 + w_2x_2 + \ldots\ldots w_ix_i + \ldots\ldots\ldots\ldots + w_nx_n$

where

$w_i = 1/\sigma_i^2$ where σ_i^2 = variance for i^{th} character which provides information on the character based in the sample.

Seednut quality index was worked out for each harvest for both Komadan and WCT and subjected to analysis of variance.

3.2.3.4 Coefficient of variation

Phenotypic coefficient of variation was estimated for mother palm characters and seednut characters.

3.2.3.5 Correlation coefficients

Correlation between different mother palm characters and seednut characters in different harvests and that of different nut characters with mother palm characters for each harvest were estimated.

3.2.3.6 Chi-square test of homogenity of correlation coefficients

Chi-square test of homogenity of correlation (Snedecor and Cochran, 1968) was used to test the homogenity of the correlation coefficients in different months of harvests for each variety. Those correlation which were found homogeneous in different harvests were pooled and pooled estimate of these correlations were found out.

$$\chi^2_{k-1} = \sum_{i=1}^{k} (n_i - 3)\, Zi_2 - \frac{[\sum (n_1 - 3)\, Zi]^2}{\sum (n_i - 3)}$$

where k - the number of correlations to be pooled

n_i - sample size,

Z_i - transformed value of the correlation coefficients

$$Z_i = \frac{1}{2} \log_e \frac{1+r}{1-r} \quad \text{and pooled} \quad Z = \frac{(n_i - 3)\, Zi}{(n_i - 3)}$$

and hence r, the pooled correlation coefficient.

Correlation coefficents which were found homogeneous over the harvest periods, subjected to normal deviation test, using Z transformation technique to see whether varietal difference affected the correlations.

$$Z = \frac{| Z_1 - Z_2 |}{\dfrac{1}{(n_1 - 3)} + \dfrac{1}{(n_2 - 3)}} \; ; \text{ where } Z_1 = \frac{1}{2} \log_e \frac{(1+r_1)}{(1-r_1)}$$

$$Z_2 = \frac{1}{2} \log_e \frac{(1+r_2)}{(1-r_2)}$$

r_1 - correlation coefficient of first variety

r_2 - correlation coefficient of second variety

If Z value is greater than 1.96, it is said to be significant.

3.2.3.7 <u>Path coefficient analysis</u>

Path coefficient analysis suggested by Wright (1923) was applied to study the cause and effect relationship in a system of correlated variables.

Let a variable 'y' be determined completely and linearly by a set of 'n' variables $x_1, x_2, x_3, \ldots\ldots\ldots x_n$.

The solution of a system of simultaneous equations provide the estimates of path coefficients, which are the standardised partial regression coefficients, where the system is given by

$$R_{ij}\ P_i = R_iY$$

where

R_{ij} is the nxn matrix of inter correlations

P_i is the vector of path coefficients and

R_iY is the vector of correlations between x_i and y, i = 1,2, ... n. The indirect effect of x_i on y via x_j is given by $r_{ij}p_j$. T he residual R is determined from the relation $R^2 = (1 - r_{ij}p_i)$.

RESULTS

4. RESULTS

4.1.1 Mother palm characters

The mean values for seven mother palm characters at different seasons are given in Table 2. and in Fig.1. The two varieties showed significant difference with respect to three characters viz., number of spadices, number of nuts per bunch and total number of nuts. There was high significant difference among seasons for all characters except for number of nuts per bunch. Variety x season interaction was significant for number of nuts per bunch and total number of nuts per harvest.

Mean number of spadices was found to be higher in Komadan (1.9) than in WCT (1.7). In both varieties maximum number of spadix production was observed during summer months (March to May) while it was low during post monsoon period (October to December). No interaction was observed between the varieties and seasons.

Regarding average number of female flower production per season, Komadan and WCT did not differ significantly. But monthly fluctuations in female flower production were observed in both varieties with peak period of production during the month of February (75) and lowest during July (31). Female flower production was significantly

Table 2. Mean values of seven mother palm characters of Komadan and WCT at different seasons

Time of harvest	Number of spadices			Total number of female flowers			Number of female flowers per spadix			Number of bunches			Number of nuts/bunch			Total number of nuts			Percentage fruit set		
	Komadan	WCT	Mean	Komadan	WCT	Mean	Komadan	WCT	Mean	Komadan	WCT	Mean	Komadan	WCT	Mean	Komadan	WCT	Mean	Komadan	WCT	Mean
September	1.80	1.80	1.80	76.30	44.70	60.50	40.20	24.05	32.13	1.80	1.80	1.80	6.95	5.35	6.15	12.00	9.40	10.70	0.252	0.280	0.266
October	1.20	1.20	1.20	57.90	30.30	44.10	48.35	24.75	36.55	1.20	1.20	1.20	9.70	6.45	8.08	11.40	7.80	9.60	0.271	0.333	0.302
December	1.30	1.00	1.15	58.70	28.30	43.50	46.55	28.30	37.43	1.20	1.00	1.10	8.70	6.20	7.45	10.40	6.20	8.30	0.281	0.243	0.262
February	2.00	2.00	2.00	92.70	57.60	75.15	46.35	28.80	37.58	1.90	1.90	1.90	10.20	6.05	8.13	20.20	11.80	16.00	0.324	0.242	0.283
March	2.50	1.80	2.15	86.10	42.60	64.35	32.02	23.55	27.78	2.20	1.80	2.00	9.80	7.50	8.65	21.40	31.40	17.30	0.348	0.367	0.357
May	2.40	2.20	2.30	60.10	50.40	55.25	25.58	22.60	24.09	2.20	2.10	2.15	7.32	8.10	7.71	15.50	16.60	16.05	0.357	0.384	0.371
June	2.00	1.90	1.95	42.00	37.50	39.75	21.80	19.92	20.86	1.70	1.80	1.75	8.00	8.85	8.43	13.00	16.30	14.65	0.417	0.476	0.447
August	1.70	1.70	1.70	40.80	20.40	30.60	24.20	11.45	17.83	1.70	1.60	1.65	9.10	4.45	6.78	15.20	8.10	11.65	0.425	0.425	0.425
	1.86	1.70		64.33	38.98		35.63	22.93		1.74	1.65		8.72	6.62		14.89	11.16		0.334	0.344	

	Number of spadices	Total number of female flowers	Number of female flowers per spadix	Number of bunches	Number of nuts/bunch	Total number of nuts	Percentage fruit set
...riety $F_{1,18}$	5.871*	3.885	3.522	1.960	4.979*	4.631	0.022
S E	0.049	9.094	4.787	0.044	0.666	1.224	0.045
C D (0.05)	0.145	—	—	—	1.978	3.635	—
...st $F_{7,126}$	15.586**	5.781**	6.952**	13.846**	1.600	6.941**	5.747**
S E	0.106	6.114	2.964	0.099	0.672	1.282	0.030
C D (0.05)	0.297	17.121	8.299	0.278	—	3.589	0.084
$F_{7,126}$					2.331*	2.789*	
S E	1.332	1.145	1.685	[illegible]0	0.951	1.813	0.664
...D1 (0.05)	0.150	8.647	4.1[illegible]	0.141	2.662	5.076	0.042
...D2 (0.05)	—	—		—	3.110	5.853	—
	—	—		—			—

...paring varieties within same harvest
...erent harvests

CD2-For comparing harvests within the same variety

** ...at 1 percent level

* ...ant at 5 percent level

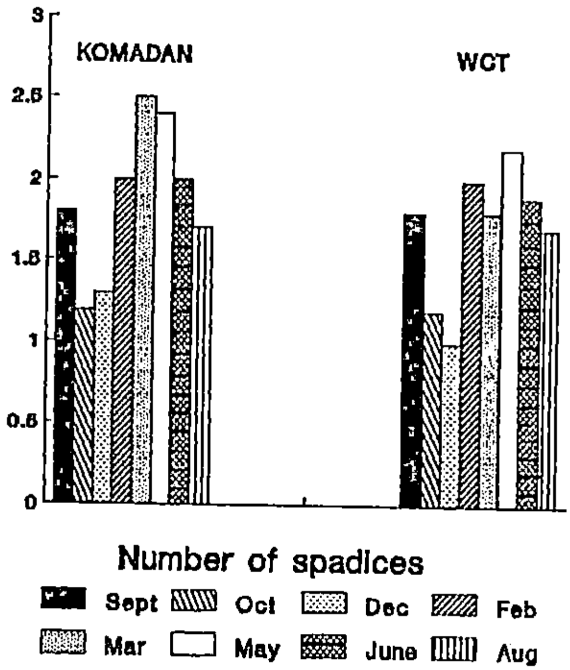
Table 2. Mean values of seven mother palm characters of Komadan and WCT at different seasons

Time of harvest	Number of spadices			Total number of female flowers			Number of female flowers per spadix			Number of bunches			Number of nuts/bunch			Total number of nuts			Percentage fruit set		
	Koma-dan	WCT	Mean	Koma-dan	WCT	Mean	Koma-dan	WCT	Mean	Koma-dan	WCT	Mean	Koma-dan	WCT	Mean	Koma-dan	WCT	Mean	Koma-dan	WCT	Mean
September	1.80	1.80	1.80	76.30	44.70	60.50	40.20	24.05	32.13	1.80	1.80	1.80	6.95	5.35	6.15	12.00	9.40	10.70	0.252	0.280	0.266
October	1.20	1.20	1.20	57.90	30.30	44.10	48.35	24.75	36.55	1.20	1.20	1.20	9.70	6.45	8.08	11.40	7.80	9.60	0.271	0.333	0.302
December	1.30	1.00	1.15	58.70	28.30	43.50	46.55	28.30	37.43	1.20	1.00	1.10	8.70	6.20	7.45	10.40	6.20	8.30	0.281	0.243	0.262
February	2.00	2.00	2.00	92.70	57.60	75.15	46.35	28.80	37.58	1.90	1.90	1.90	10.20	6.05	8.13	20.20	11.80	16.00	0.324	0.242	0.283
March	2.50	1.80	2.15	86.10	42.60	64.35	32.02	23.55	27.78	2.20	1.80	2.00	9.80	7.50	8.65	21.40	31.40	17.30	0.348	0.367	0.357
May	2.40	2.20	2.30	60.10	50.40	55.25	25.58	22.60	24.09	2.20	2.10	2.15	7.32	8.10	7.71	15.50	16.60	16.05	0.357	0.384	0.371
June	2.00	1.90	1.95	42.00	37.50	39.75	21.80	19.92	20.86	1.70	1.80	1.75	8.00	8.85	8.43	13.00	16,30	14.65	0.417	0.476	0.447
August	1.70	1.70	1.70	40.80	20.40	30.60	24.20	11.45	17.83	1.70	1.60	1.65	9.10	4.45	6.78	15.20	8.10	11.65	0.425	0.425	0.425
Mean	1.86	1.70		64.33	38.98		35.63	22.93		1.74	1.65		8.72	6.62		14.89	11.16		0.334	0.344	
$F_{1,18}$		5.871*			3.885			3.522			1.960			4.979*			4.631			0.022	
S E		0.049			9.094			4.787			0.044			0.666			1.224			0.045	
C D (0.05)		0.145			---			---			---			1.978			3.635			---	
$F_{7,126}$		15.586**			5.781**			6.952**			13.846**			1.600			6.941**			5.747**	
S E		0.106			6.114			2.964			0.099			0.672			1.282			0.030	
C D (0.05)		0.297			17.121			8.299			0.278			---			3.589			0.084	
$F_{7,126}$		1.332			1.145			1.685			0.610			2.331*			2.789*			0.664	
S E		0.150			8.647			4.191			0.141			0.951			1.813			0.042	
C D1 (0.05)		---			---			---			---			2.662			5.076			---	
C D2 (0.05)		---			---			---			---			3.110			5.853			---	

comparing varieties within same harvest or in different harvests CD2-For comparing harvests within the same variety

icant at 1 percent level * significant at 5 percent level

Fig. 1. Influence of different seasons on mother palm characters of Komadan and WCT



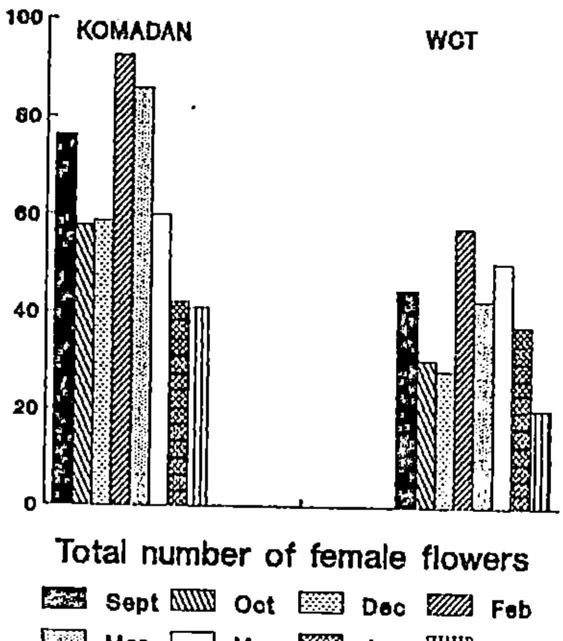
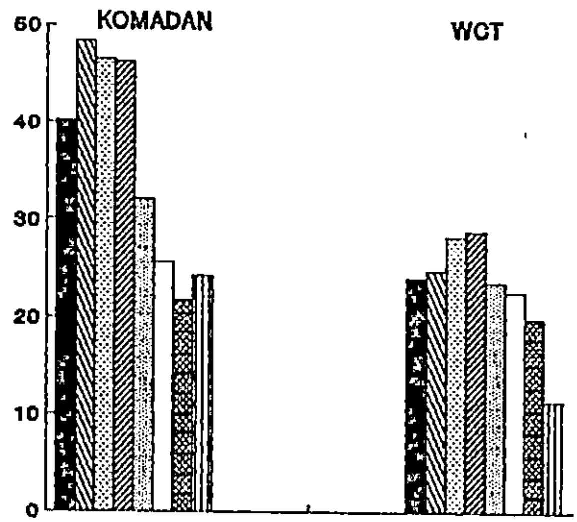
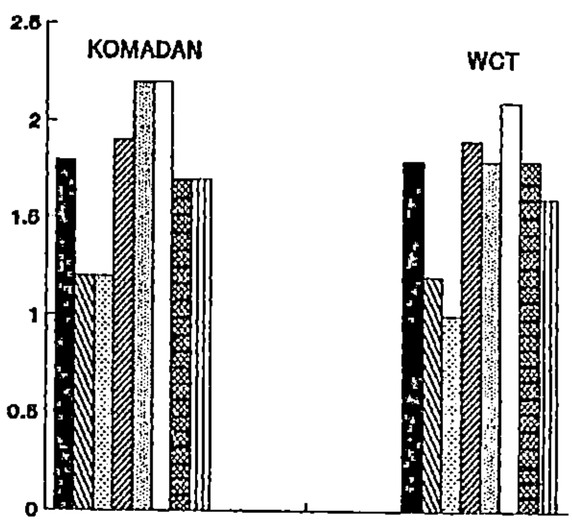


Fig. 1. (Contd...)

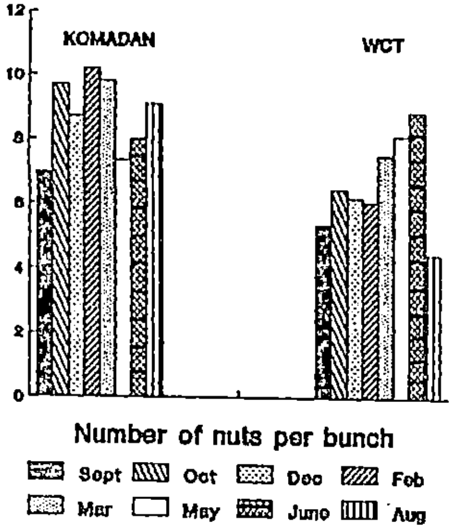


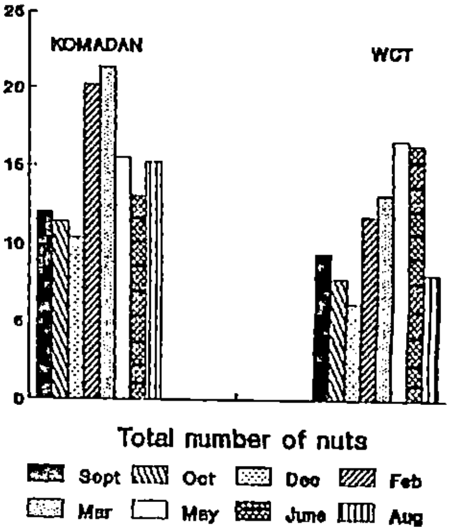
Number of female flowers per spadix

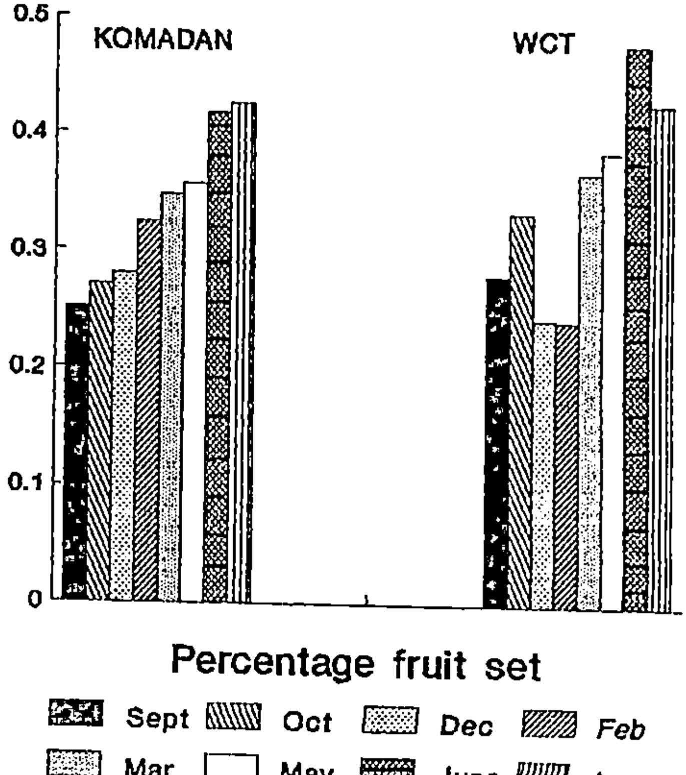


Number of bunches

Fig. 1. (Contd...)


12
10
8
6
4
2
0
KOMADAN
WCT
Number of nuts per bunch
Sept
Oct
Dec
Feb
Mar
May
June
Aug


25
20
15
10
5
0
KOMADAN
WCT
Total number of nuts
Sept
Oct
Dec
Feb
Mar
May
June
Aug


0.5
0.4
0.3
0.2
0.1
0
KOMADAN
WCT
Percentage fruit set
Sept
Oct
Dec
Feb
Mar

high during summer months (March to May) compared to post monsoon period (October to November). In both the varieties, about 62 per cent of annual female flower production was observed during February to May (Hot weather period). There was no significant interaction between variety and season with respect to female flower production.

Varietal difference was not significant for the character number of female flowers per spadix. But female flowers per spadix was more during September to February (postmonsoon and winter periods) and less during May to July in both the varieties. Variety x season interaction was found to be not significant for this character.

Bunch production was more or less same in both Komadan and WCT. Highest number of bunch production was observed during February to May (Hot weather period). In both the varieties, 44 per cent of the bunches produced in an year were harvested during this hot weather period, with maximum number during May (2.2). Bunch production was lowest during October to December (17 per cent). Variety x season interaction was absent for this character.

Number of nuts per bunch was found to be significantly superior in Komadan (9) than in WCT (7). There was no significant difference among seasons in both the varieties, but significant interaction between variety and season was observed. Bunches harvested in Komadan during February recorded maximum value for nuts per bunch (10) which was on par with that of summer months (March to May) of both varieties and that of monsoon periods (June to december) in Komadan and June in WCT.

Significant variation could be found between varieties and among seasons with respect to the character number of nuts produced per season. It was also seen that the response of varieties with respect to this character was not consistent over seasons. Nut production per season was found to be more in Komadan (15) than in WCT (11). In both varieties nut production was poor during post monsoon and beginning of winter periods (October to December) with minimum value during December. In WCT maximum nut production was recorded during February to June and in Komadan during February to March.

There was no significant difference between Komadan and WCT for percentage fruit set, but monthly variation was seen. In both varieties lowest fruitset was recorded during September to February and highest during May to August with maximum setting during June (45%). Variety x season interaction was absent for this character.

Table 3. Mean values of six mother palm characters over the year

Sl. No.	Characters	Komadan mean	Komadan SE	WCT mean	WCT SE	t-value
1.	Number of spadices per palm	14.90	1.449	13.60	0.966	2.36*
2.	Number of female flowers per spadix	33.10	17.123	22.80	9.508	1.66
3.	Number of bunches per palm	13.9	1.287	13.20	0.919	1.40
4.	Number of nuts per bunch	8.60	2.271	6.80	1.932	1.91
5.	Number of nuts per palm	119.10	34.834	89.30	26.537	2.15*
6.	Percentage fruitset	0.32	0.168	0.35	0.159	0.4093

* significant at 5 per cent level

The year wise variations of six mother palm characters viz., number of spadices per year, number of female flowers per spadix, number of bunches per palm, number of nuts per bunch, number of nuts per palm and percentage fruit set are given in Table 3. Significant difference between varieties was seen only for two characters viz., number of spadices per palm per year and annual nut yield per palm. Komadan expressed the maximum values for these characters.

Komadan palms were found significantly superior to WCT for annual spadix production per palm and annual nut yield per palm. The mean annual nut yield of Komadan palm (119) was found to be more than that of WCT (89). All other mother palm characters were found to be not significant between varieties.

4.1.2 Correlation coefficients among mother palm characters

Correlation coefficients between different floral and yield traits in Komadan and WCT during different seasons are presented in Table 4. Those correlations which were found homogeneous during different seasons were pooled and pooled estimate is presented in Table 5. Those correlations which were found heterogeneous during different seasons were presented in Table 6a and Table 6b.

Correlation coefficients among mother palm characters of Komadan and WCT at different seasons.

Characters

X_1	Number of nuts per bunch
X_2	Number of female flowers per bunch
X_3	Number of bunches
X_4	Percentage fruit set
X_5	Total number of nuts per harvest
X_6	Total number of female flowers
X_7	Number of spadices

Table 4. Correlation coefficients among mother palm characters

and WCT at different seasons.

SEPTEMBER

KOMADAN

WCT

	x1	x2	x3	x4	x5	x6	x7
x1	--	0.0809	-0.3029	0.5303	0.7449*	0.0129	-0.3029
x2	0.4511	--	0.2480	-0.7347*	0.2616	0.9767**	0.2480
x3	-0.3387	0.2692	--	-0.4075	0.3898	0.4495	1.0000**
x4	0.2144	-0.5291	-0.8241**	--	0.1891	-0.7623*	-0.4075
x5	0.8210**	0.6535*	0.1986	-0.1542	--	0.3299	0.3898
x6	0.3624	0.9914**	0.3711	-0.5847	0.6340*	--	0.4495
x7	-0.3387	0.2692	1.0000**	-0.8241**	0.1986	0.3711	--

DECEMBER

KOMADAN

	x1	x2	x3	x4	x5
x1	--	0.8560**	N.E	-0.2031	1.0000**
x2	0.1050	--	N.E	-0.5839	0.8560**
x3	-0.0216	-0.1564	--	N.E	N.E
x4	0.4377	-0.6805*	-0.0150	--	-0.2031
x5	0.8253**	-0.0547	0.4647	0.4185	--
x6	-0.2196	0.8099**	0.2595	-0.8136**	-0.1026
x7	-0.3820	-0.1408	0.7638*	-0.2685	0.1168

OCTOBER

KOMADAN

WCT

	x1	x2	x3	x4	x5	x6	x7
x1	--	-0.0343	0.0721	0.3039	0.7288*	-0.0414	0.0721
x2	-0.1817	--	0.1315	-0.8801**	0.0192	0.7643**	0.1315
x3	-0.1309	-0.0120	--	-0.1915	0.6920*	0.7306*	1.0000**
x4	0.7717**	-0.6415*	-0.2088	--	0.1320	-0.7438*	-0.1915
x5	0.7754**	-0.1679	0.5232	0.5313	--	0.3923	0.6920*
x6	-0.2268	0.7928**	0.5935	-0.6393*	0.1754	--	0.7306*
x7	-0.1309	-0.0120	1.0000**	-0.2088	0.5232	0.5935	--

FEBRUARY

KOMADAN

	x1	x2	x3	x4	x5
x1	--	0.8337**	0.5620	-0.4326	0.984
x2	-0.2623	--	0.4407	-0.7761**	0.814
x3	0.5655	0.0462	--	-0.0335	0.700
x4	0.7872**	-0.6680*	0.3776	--	-0.380
x5	0.9988**	-0.2503	0.6056	0.7822**	--
x6	-0.2623	1.0000**	0.0462	-0.6680*	-0.250
x7	N.E	N.E	N.E	N.E	N.E

(Table 4. Contd...)

MARCH

KOMADAN (lower triangle) / WCT (upper triangle)

	x1	x2	x3	x4	x5	x6	x7
x1	--	0.6435*	-0.4264	-0.1384	0.6639*	0.4256	-0.4264
x2	0.1701	--	0.0479	-0.7297	0.6819*	0.9122**	0.0479
x3	-0.0626	0.6830*	--	-0.3529	0.3920	0.4296	1.0000**
x4	0.2111	-0.6293	-0.3412	--	-0.4129	-0.7596*	-0.3529
x5	0.6021	0.5993	0.7440*	-0.1215	--	0.7832**	0.3920
x6	0.0487	0.9721**	0.7467*	-0.7143*	0.5889	--	0.4296
x7	-0.2182	0.5208	0.5976	-0.8053**	0.3661	0.6967*	--

JUNE

KOMADAN (lower triangle) / WCT (upper triangle)

	x1	x2	x3	x4	x5	x6	x7
x1	--	0.7035*	0.3483	-0.0256	0.9228**	0.6892*	-0.0105
x2	0.2397	--	0.3761	-0.7150*	0.7030*	0.9443**	-0.0807
x3	-0.3403	-0.1518	--	-0.0939	0.6826*	0.6562*	0.8356**
x4	0.4422	-0.6504*	0.1446	--	-0.0586	-0.6109	0.2428
x5	0.6862*	0.1424	0.3928	0.4498	--	0.8070**	0.3353
x6	-0.1967	0.8632**	-0.0159	-0.8938**	-0.1208	--	0.2437
x7	-0.7603*	-0.2046	0.3450	-0.3841	-0.4743	0.2646	--

MAY

KOMADAN (lower triangle) / WCT (upper triangle)

	x1	x2	x3	x4	x5	x6	x7
x1	--	0.7097*	-0.3821	0.1036	0.9866**	0.5821	-0.0839
x2	0.1423	--	-0.2356	-0.5894	0.7064*	0.9113**	0.1733
x3	-0.4789	-0.2250	--	-0.2615	-0.2260	-0.0438	0.6667*
x4	0.4091	-0.7214*	-0.0797	--	0.0629	-0.6498*	-0.4737
x5	0.9562**	0.0602	-0.2168	0.4734	--	0.6059	0.0295
x6	-0.0210	0.8726**	0.1350	-0.8453**	-0.0346	--	0.5329
x7	-0.3194	-0.1250	0.8292**	-0.3001	-0.1307	0.3577	--

AUGUST

KOMADAN (lower triangle) / WCT (upper triangle)

	x1	x2	x3	x4	x5	x6	x7
x1	--	0.4616	0.8474**	0.6285	0.9788**	0.6054	0.5870
x2	0.4206	--	0.6223	-0.3365	0.5226	0.9548**	0.3223
x3	-0.1610	-0.0593	--	0.2698	0.9203**	0.7810**	0.8018**
x4	0.4271	-0.5092	0.1676	--	0.5195	-0.1863	0.1972
x5	0.6657*	0.3751	0.5807	0.3696	--	0.6748*	0.6976*
x6	0.2501	0.8902**	0.3849	-0.4377	0.5638	--	0.5639
x7	-0.1610	-0.0593	1.0000**	0.1676	0.5807	0.3849	--

Table 9. Pooled correlation coefficients among mother palm characters

Characters	Komadan	WCT	Characters	Komadan	WCT
x1 & x2	0.1422	0.6003**	x3 & x4	-0.1390	-0.1383
x1 & x3	-0.1202	XX	x3 & x5	0.4427**	XX
x1 & x4	0.4964**	0.1137	x3 & x6	0.3447**	0.4755**
x1 & x6	-0.0324	0.5647**	x4 & x5	0.3798**	-0.0754
x1 & x7	-0.3139*	-0.0145	x4 & x6	-0.7292**	-0.6095**
x2 & x3	0.0681	0.2202	x4 & x7	-0.3922**	XX
x2 & x4	-0.6333**	-0.6957**	x5 & x6	0.2123	0.6037**
x2 & x5	0.1963	0.6254**	x5 & x7	0.1611	XX
x2 & x7	0.0384	0.1073	x6 & x7	0.4085**	XX

x1 Number of nuts/bunch x2 Number of female flowers/spadix x3 Number of bunches

x4 Percentage fruit set x5 Total number of nuts x6 Total number of female flowers

x7 Number of spadices XX - heterogeneous correlations

* Significant at 5 per cent level ** Significant at 1 per cent level

In both varieties, correlation between number of nuts per bunch and number of nuts per harvest, number of female flowers per spadix and total number of female flower production per season, number of bunches and number of spadices were found to be heterogeneous in different seasons. Correlation between number of nuts per bunch and number of bunches, total number of nuts and number of bunches, percentage fruitset and number of spadices, total number of nuts and number of spadices and total number of female flowers and number of spadices were heterogeneous during different seasons in WCT, while these correlations were homogeneous in Komadan. It was also seen that heterogeneity among intercorrelations was more in WCT than in Komadan.

In both Komadan and WCT percentage fruitset showed a negative and significant correlation with number of female flowers per spadix (r_p = -0.6957 & -0.6333) and total number of female flowers (r_p = -0.7292 & -0.6095). Number of bunches showed significant positive association with total number of female flowers in both varieties (r_p = 0.3447 & 0.4755). The positive and significant correlation of number of nuts per bunch with number of female flowers per spadix (r_p = 0.6003) and with total number of female flowers (r_p =0.5647) and correlation of total number of nuts with number of female flowers per spadix (r_p =0.6254) and with total

Table 6a. Correlation coefficients among mother palm characters of Komadan which were heterogeneous at different seasons

Harvest Time	Characters		
	x1 & x5	x2 & x6	x3 & x7
September	0.8210**	0.9914**	1.0000**
October	0.7754**	0.7928**	1.0000**
December	0.8253**	0.8099**	0.7638*
February	0.9988**	1.0000**	N.E.
March	0.6021	0.9721**	0.5976
May	0.9562**	0.8726**	0.8292**
June	0.6862*	0.8632**	0.3450
August	0.6657*	0.8902**	1.0000**

x1 No. of nuts/bunch

x2 No. of female flowers/spadix

x3 No. of bunches

x5 Total No.of nuts

x6 Total No. of female flowers

x7 No. of spadices

N.E. Not estimable

* Significant at 5 per cent level

** Significant at 1 per cent level

Table 6b. Correlation coefficients among monther palm characters of WCT which were heterogeneous at different seasons

Harvest time	Characters							
	x1 & x3	x1 & x5	x2 & x6	x3 & x5	x7 & x3	x7 & x4	x7 & x5	x7 & x6
September	-0.3029	0.7449*	0.9767**	0.3898	1.0000**	-0.4075	0.3898	0.4495
October	0.0721	0.7288*	0.7643*	0.6920*	1.0000**	-0.1915	0.6920*	0.7306*
December	N.E.	1.0000**	1.0000**	N.E.	N.E.	N.E.	N.E.	N.E.
February	0.5620	0.9841**	1.0000**	0.7000*	N.E.	N.E.	N.E.	N.E.
March	-0.4264	0.6639*	0.9122**	0.3920	1.0000**	-0.3529	0.3920	0.4296
May	-0.3821	0.9866**	0.9113**	-0.2260	0.6667*	-0.4737	0.0295	0.5329
June	0.3483	0.9228**	0.9443**	0.6826*	0.8356**	0.2428	0.3353	0.2437
August	0.8474**	0.9788**	0.9548**	0.9203**	0.8018**	0.1972	0.6976*	0.5639

x1 Number of nuts/bunch
x2 Number of female flowers/spadix
x3 Number of bunches
x4 Percentage fruit set
x5 Total number of nuts
x6 Total number of female flowers
x7 number of spadices
N.E. Not estimable

* Significant at 5 per cent level
** Significant at 1 per cent level

number of female flowers (r_p = 0.6037) seen in WCT were not observed in Komadan. Positive and significant correlation of total number of nuts with number of bunches (r_p =0.4427) and percentage fruitset observed in Komadan (r_p =0.3798) was absent in WCT. In Komadan number of nuts per bunch and percentage fruitset significantly varied inversely with number of spadices (r_p = -0.3139 and -0.3922), but this relation was not seen in WCT. In Komadan positive and significant correlation was seen between number of nuts per bunch and percentage fruitset (r_p =0.4964) and total number of female flowers and number of spadices (r_p =0.4085).

Positive and significant correlation, was observed between number of nuts per bunch and total number of nuts at all harvests for both the varieties with an exception for Komadan in March. In both Komadan and WCT, number of female flowers per spadix was highly correlated with total number of female flowers during all seasons with perfect correlation during February (r = 1.0000) and minimum during October (r = 0.7928 & 0.7643). Number of bunches were perfectly correlated with number of spadices during September and October (r = 1.0000) in both Komadan and WCT. During all other seasons except during February, March and June in Komadan and December and February in WCT, the correlation between these two characters was positive and significant. In WCT the correlation between number of nuts per bunch and number of bunches were found to be positive and significant during August (r = 0.8474). Positive and significant correlation was seen between number of bunches and total number of nuts during the months of October, February, June and August (r = 0.6826 to 0.9203) in WCT. No significant correlation exist between number of spadices and percentage fruitset during any season in WCT but it was negative and significant in Komadan during all seasons. In WCT number of spadices was positively and significantly correlated with total number of female flowers (r = 0.7306) only during October, while it's positive and significant correlation with total number of nuts was observed during October and August.

In Komadan total number of nuts per harvest was positively and significantly correlated with number of nuts per bunch, number of bunches and percentage fruitset. In WCT, yield of nuts was positively correlated with nuts per bunch, number of female flowers per spadix, number of bunches, total number of female flowers and number of spadices. Among the yield components, number of nuts per bunch was found to be highly correlated with nut production in both the varieties. It was observed that the variation in female flower production appeared to be more related to the number of female flowers per spadix, than to the number of spadices.

4.2.1 Seed nut characters

Table 7. gives the mean values for various seednut characters at different times of harvest in Komadan and WCT from September 1991 to August 1992. They are represented by Bar diagrams in Fig.2. Salient features observed are summarised below.

All seednut characters studied differ significantly among harvests except thickness of meat. The varieties significantly differed for five characters only viz., Volume of nut water, weight of kernel, weight of embryo, weight of copra and husk/nut ratio. Variety x time of harvest interaction was significant for characters viz., equatorial diameter, weight of unhusked nut, weight of husk and husk/nut ratio.

There was no significant difference in polar diameter of Komadan and WCT. But harvest wise differences were observed in both varieties. Polar diameter was found to be low for nuts harvested during March (20.81 cm) in comparison with September to December. During the other months it was on par. Both the varieties performed consistently during the harvests with respect to this character.

Table 7. Mean values of sixteen seednut characters at different times of harvest.

Time of harvest		Polar diameter (cm)			Equatorial diameter (cm)			Thickness of husk (cm)			Weight of unhusked nut (Kg)		
		Komadan	WCT	Mean	Komadan	WCT	Mean	Komadan	WCT	Mean	Komadan	WCT	Mean
September		21.73	22.62	22.18	15.75	15.01	15.38	2.67	2.83	2.75	1.54	1.59	1.56
October		22.02	22.12	22.07	15.57	15.36	15.47	2.93	3.28	3.11	1.62	1.68	1.65
December		22.33	21.91	22.12	15.55	16.15	15.85	2.95	3.74	3.35	1.44	1.60	1.52
February		21.33	21.75	21.54	15.84	16.88	16.36	2.59	2.88	2.74	1.14	1.31	1.22
March		20.95	20.67	20.81	16.43	15.57	16.00	2.79	2.95	2.87	1.58	1.07	1.32
May		21.50	20.78	21.14	16.85	15.77	16.31	3.04	3.23	3.14	1.67	1.34	1.51
June		21.35	20.55	20.95	15.38	14.53	14.96	2.61	2.66	2.63	1.39	1.22	1.30
August		21.10	21.76	21.43	16.25	15.80	16.03	2.76	2.99	2.88	1.62	1.75	1.69
Mean		21.54	21.52		15.95	15.64		2.79	3.07		1.50	1.45	
Variety	$F_{1,18}$		0.00094			0.229			1.404			0.112	
	SE		0.456			0.470			0.165			0.114	
	$CD_{(0.05)}$		--			--			--			--	
Harvest	$F_{7,126}$		3.094**			4.724**			5.919**			6.465**	
	SE		0.309			0.224			0.100			0.067	
	$CD_{(0.05)}$		0.866			0.628			0.280			0.187	
Interaction	$F_{7,126}$		1.054			2.863**			1.265			3.604**	
	SE		0.438			0.317			0.142			0.095	
	$CD_{1(0.05)}$					0.888			--			0.265	
	$CD_{2(0.05)}$					1.555			--			0.404	

* Significant at 5 per cent level ** Significant at 1 per cent level

CD_1 For comparing varieties within same harvest or different harvests

CD_2 For comparing harvests within a variety

Contd.....

(Table 7. Contd....)

Time of harvest	Weight of husked nut (g) Komadan	WCT	Mean	Weight of husk (g) Komadan	WCT	Mean	Weight of split nut (g) Komadan	WCT	Mean	Volume of nut water (m Komadan	WCT	Mean
September	590.10	440.50	515.30	945.40	1146.50	1045.95	432.95	344.55	388.75	147.40	92.40	119.9
October	571.50	413.65	492.58	1047.50	1268.15	1157.83	422.35	328.45	375.40	139.40	81.90	110.6
December	545.15	468.25	506.70	893.60	1135.70	1014.65	417.30	352.75	385.03	122.10	99.75	110.9
February	514.00	471.20	492.60	623.80	833.90	728.85	396.30	379.75	388.03	107.50	82.40	94.9
March	650.00	453.80	551.90	931.00	613.90	772.45	461.00	364.10	412.55	176.70	81.80	129.2
May	628.50	505.25	566.88	1040.20	838.15	939.18	478.60	397.00	437.80	167.80	105.90	136.8
June	551.55	470.25	480.90	834.55	808.05	821.30	401.00	325.55	363.28	138.95	77.00	107.9
August	613.80	463.35	538.58	1009.00	1287.15	1148.08	455.65	359.80	407.73	155.40	98.40	126.9
Mean	583.08	453.28		915.63	991.44		433.14	356.49		144.41	89.94	
Variety $F_{1,18}$		4.365			0.450			4.078			4.684*	
SE		43.930			79.869			26.839			17.794	
$CD_{(0.05)}$		--			--			--			52.844	
Harvest $F_{7,126}$		2.391*			8.927**			3.274**			2.177**	
SE		20.103			55.549			13.011			8.218	
$CD_{(0.05)}$		56.290			155.545			36.432			25.811	
Interaction $F_{7,126}$		1.463			4.229**			1.054			1.537	
SE		28.429			78.558			18.400			13.036	
$CD_{1(0.05)}$		--			219.974			--			--	
$CD_{2(0.05)}$		--			303.750			--			--	

* Significant at 5 per cent level ** Significant at 1 per cent level

CD_1 For comparing varieties within same harvest or different harvests

CD_2 For comparing harvests within a variety

Contd....

Table 7. (Contd...)

Time of harvest	Weight of shell (g)			Weight of kernel (g)			Thickness of meat (cm)			Diameter of eye (cm)		
	Komadan	WCT	Mean	Komadan	WCT	Mean	Komadan	WCT	Mean	Komadan	WCT	Mean
September	136.45	121.35	128.90	296.50	223.20	259.85	1.25	1.20	1.23	1.17	0.95	1.06
October	166.35	166.35	123.38	291.95	212.10	252.03	1.29	1.24	1.26	1.26	1.13	1.20
December	127.40	125.00	126.20	289.90	227.75	258.83	1.29	1.22	1.25	1.17	1.18	1.17
February	166.70	129.40	123.05	279.60	250.35	264.98	1.28	1.20	1.24	1.19	1.26	1.23
March	133.40	117.55	125.48	327.60	246.55	287.08	1.25	1.24	1.24	1.27	1.26	1.26
May	139.30	130.25	134.78	339.30	266.75	303.03	1.27	1.21	1.24	1.32	1.10	1.21
June	121.70	106.85	114.28	279.30	218.70	249.00	1.22	1.17	1.20	1.07	0.92	1.00
August	132.15	126.25	129.20	323.50	233.55	278.53	1.27	1.20	1.23	1.10	0.94	1.02
Mean	129.69	121.63		303.46	234.87		1.26	1.21		1.19	1.09	

		Weight of shell (g)	Weight of kernel (g)	Thickness of meat (cm)	Diameter of eye (cm)
Variety	$F_{1,18}$	0.412	6.967*	3.419	1.411
	SE	8.882	18.374	0.021	0.061
	$CD_{(0.05)}$	--	54.567	--	--
Harvest	$F_{7,126}$	2.367*	3.759**	0.718	4.044*
	SE	3.870	9.682	0.024	0.050
	$CD_{(0.05)}$	10.836	27.111	--	0.141
Inter-action	$F_{7,126}$	1.578	0.928	0.222	1.212
	SE	5.473	13.692	0.033	0.071
	$CD_{1(0.05)}$	--	--	--	--
	$CD_{2(0.05)}$	--	--	--	--

* Significant at 5 per cent level ** Significant at 1 per cent level

CD_1 For comparing varieties within same harvest or different harvests

CD_2 For comparing harvests within a variety

(Table 7. Contd....)

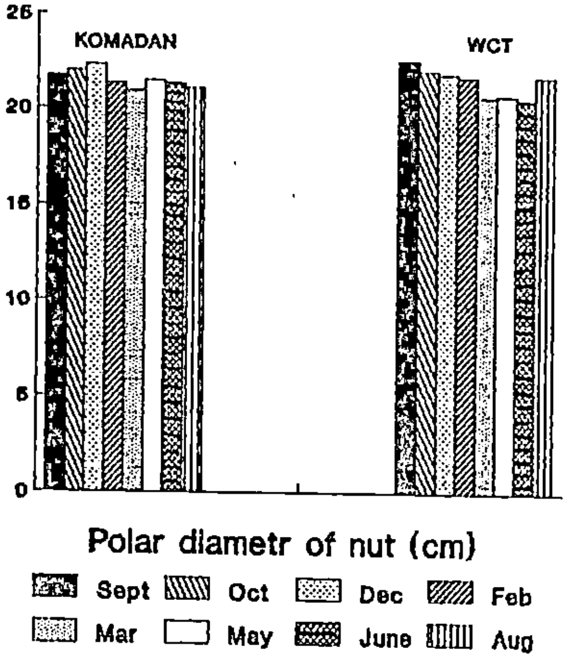
Time of harvest	Weight of embryo (g) Komadan	WCT	Mean	Weight of copra (g) Komadan	WCT	Mean	Oil content (%) Komadan	WCT	Mean	Husk / nut ratio Komadan	WCT	Mean
September	0.089	0.072	0.080	169.25	127.55	148.40	66.28	65.52	65.90	0.61	0.72	0.67
October	0.089	0.089	0.089	156.95	108.35	132.65	65.83	69.04	67.44	0.65	0.75	0.70
December	0.096	0.084	0.090	164.90	124.75	144.83	65.16	65.74	65.45	0.62	0.71	0.67
February	0.095	0.091	0.093	171.15	149.90	160.53	64.36	64.74	64.55	0.55	0.64	0.59
March	0.098	0.095	0.097	170.35	148.85	159.60	68.30	65.65	66.98	0.58	0.56	0.57
May	0.091	0.085	0.088	182.00	153.30	167.65	64.80	65.20	65.00	0.61	0.62	0.62
June	0.096	0.088	0.092	159.15	125.90	142.53	66.00	64.80	65.40	0.60	0.66	0.63
August	0.098	0.088	0.093	174.05	126.75	150.40	65.20	65.70	65.45	0.62	0.73	0.67
Mean	0.094	0.086		168.48	133.17		65.74	65.80		0.61	0.67	
Variety $F_{1,18}$		4.994*			11.811**			0.030			11.368**	
SE		0.002			7.264			0.279			0.015	
$CD_{(0.05)}$		0.007			21.574			--			0.043	
Harvest $F_{7,126}$		2.260*			4.330**			2.153*			18.204**	
SE		0.003			5.436			0.665			0.010	
$CD_{(0.05)}$		0.009			15.220			1.863			0.029	
Interaction $F_{7,126}$		0.766			0.992			1.630			5.005**	
SE		0.005			7.687			0.941			0.015	
$CD_{1(0.05)}$		--			--			--			0.041	
$CD_{2(0.05)}$		--			--			--			0.056	

* Significant at 5 per cent level ** Significant at 1 per cent level

CD_1 For comparing varieties within same harvest or different harvests

CD_2 For comparing harvests within a variety

Fig. 2. Effect of harvesting time on seednut characters of Komadan and WCT



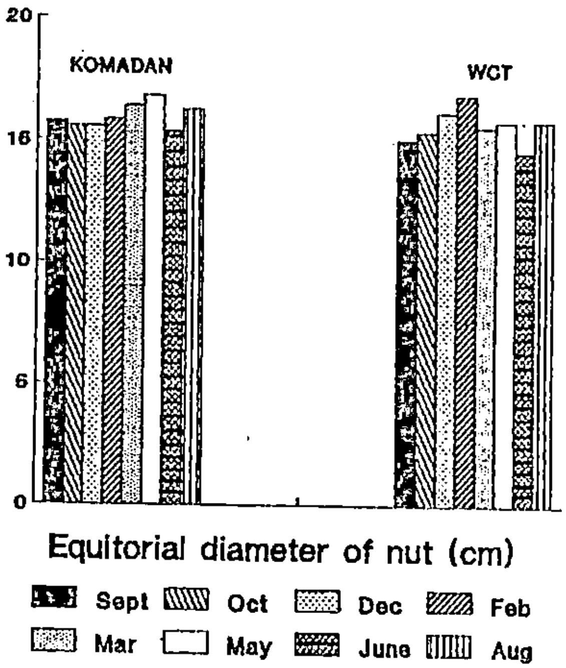
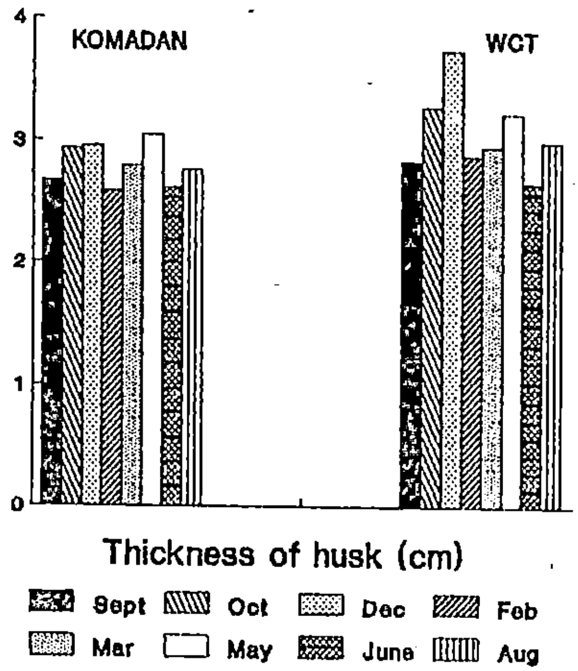
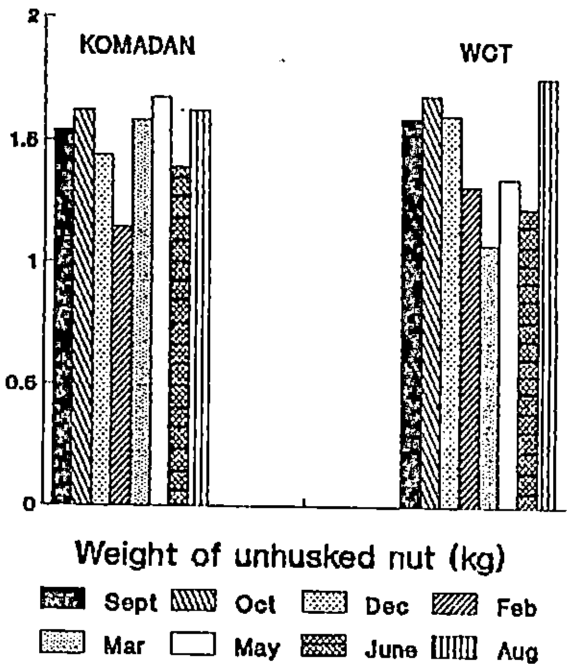


Fig 2. (Contd.)

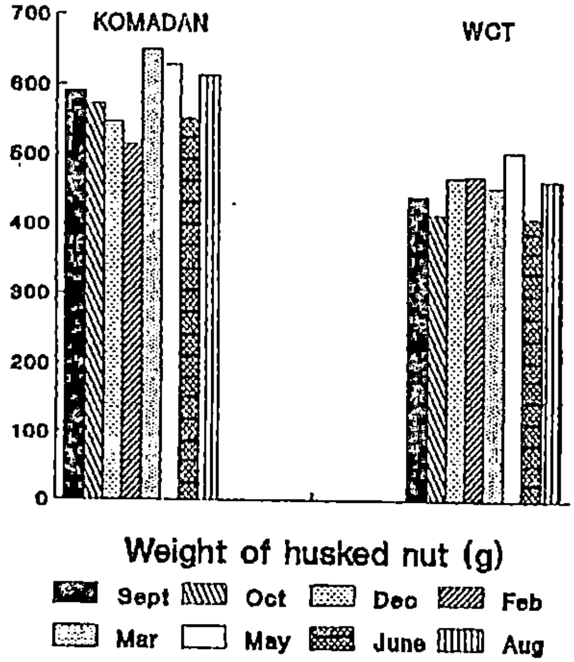


KOMADAN
WCT
4
3
2
1
0
Thickness of husk (cm)
Sept
Oct
Dec
Feb
Mar
May
June
Aug

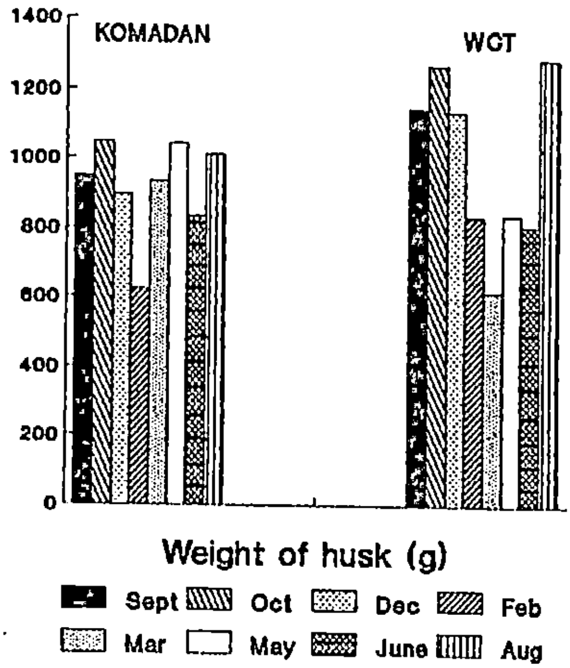


KOMADAN
WCT
2
1.5
1
0.5
0
Weight of unhusked nut (kg)
Sept
Oct
Dec
Feb
Mar
May
June
Aug

Fig. 2. (Contd...)

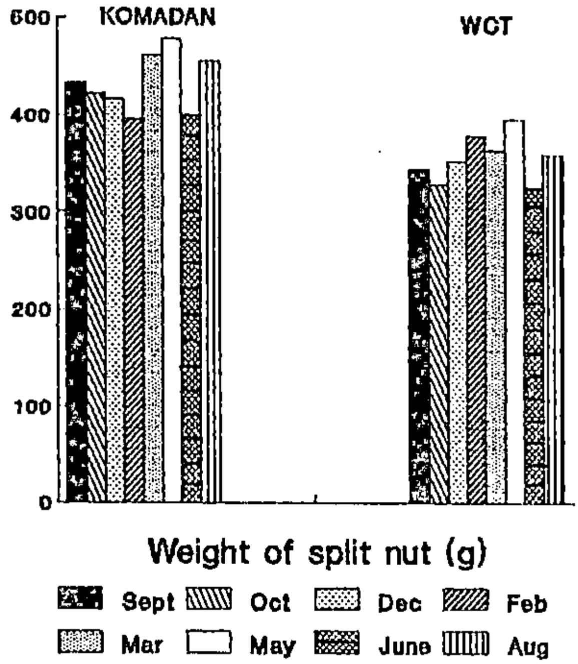


700
600
500
400
300
200
100
0
KOMADAN
WCT
Weight of husked nut (g)
Sept
Oct
Dec
Feb
Mar
May
June
Aug

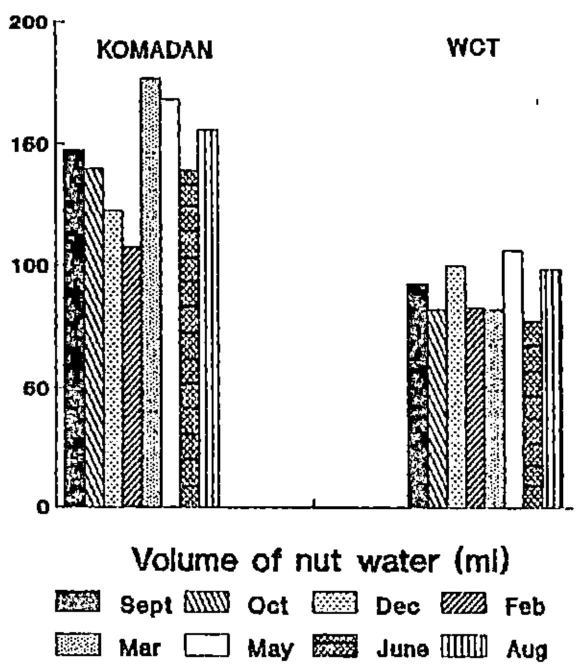


1400
1200
1000
800
600
400
200
0
KOMADAN
WCT
Weight of husk (g)
Sept
Oct
Dec
Feb
Mar
May
June
Aug

Fig. 2. (Contd...)

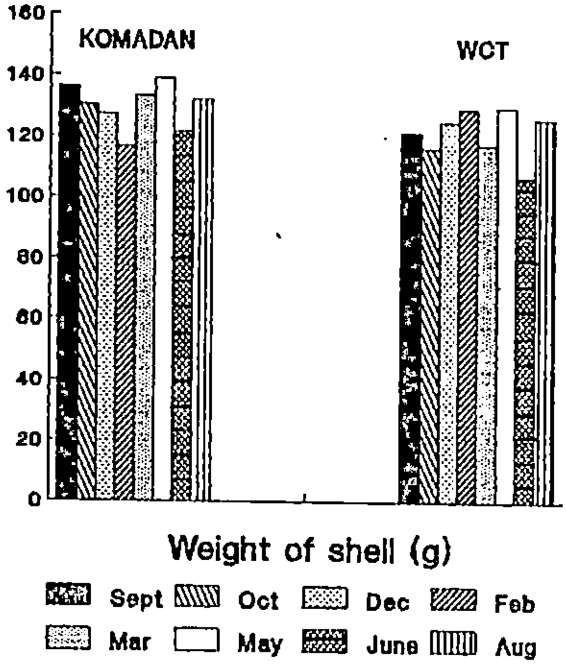


600
400
300
200
100
0
KOMADAN
WCT
Weight of split nut (g)
Sept
Oct
Dec
Feb
Mar
May
June
Aug

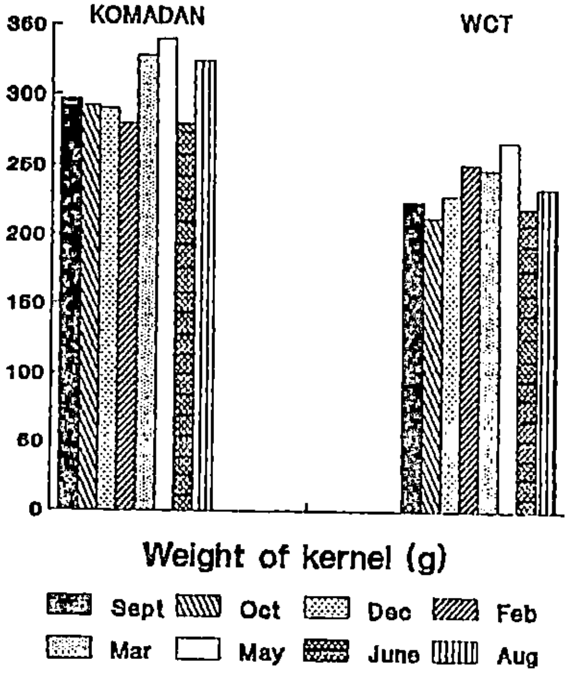


200
150
100
50
0
KOMADAN
WCT
Volume of nut water (ml)
Sept
Oct
Dec
Feb
Mar
May
June
Aug

Fig. 2. (Contd...)

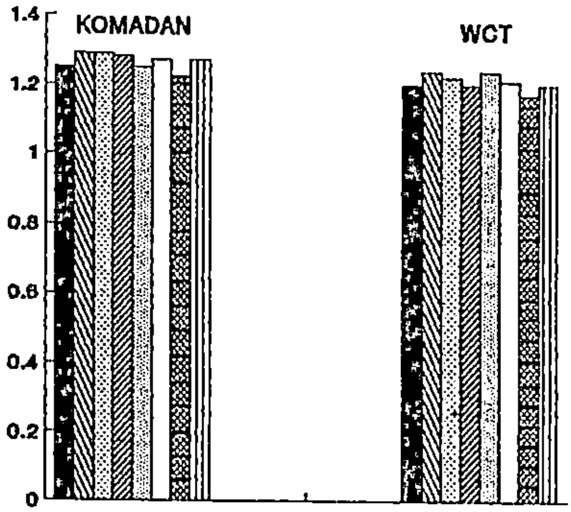


Weight of shell (g)

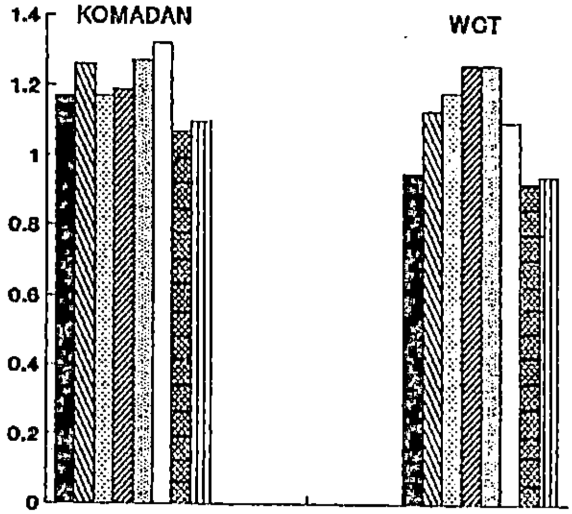


Weight of kernel (g)

Fig. 2. (Contd...)

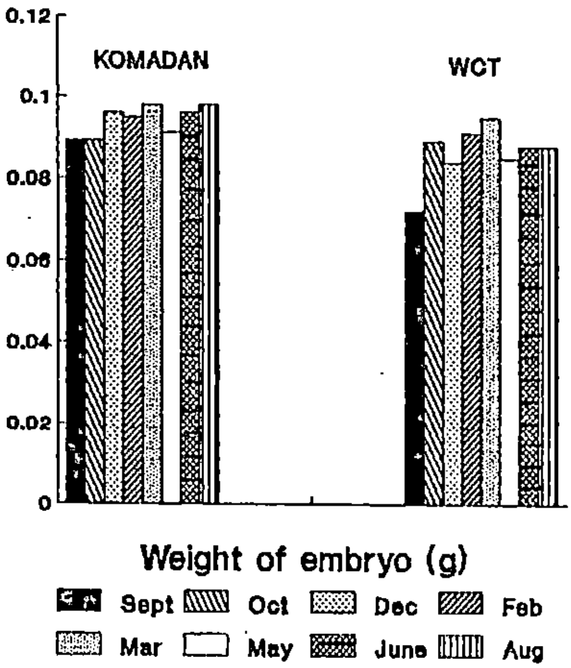


Thickness of meat (cm)

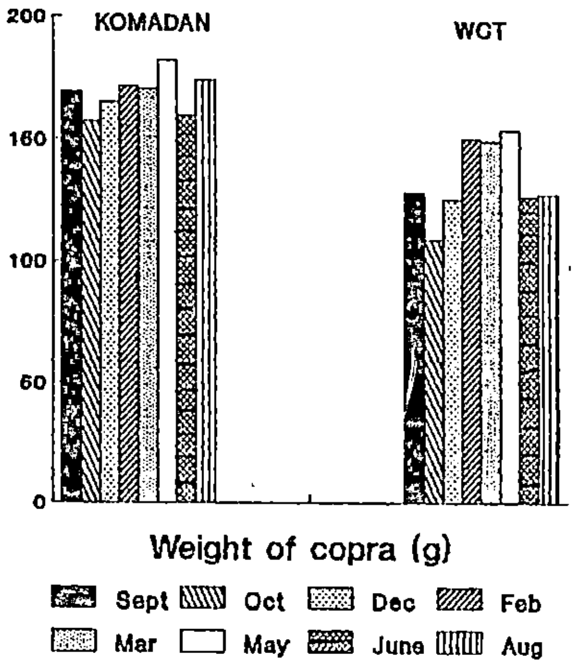


Diameter of eye (cm)

Fig. 2. (Contd...)

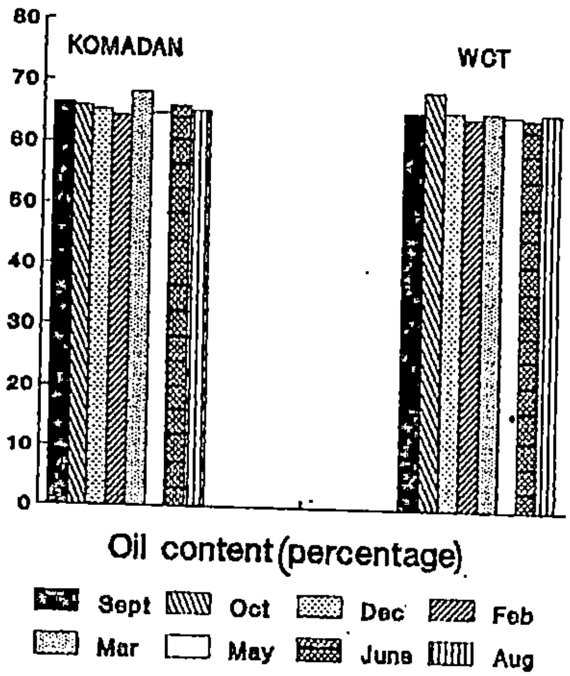


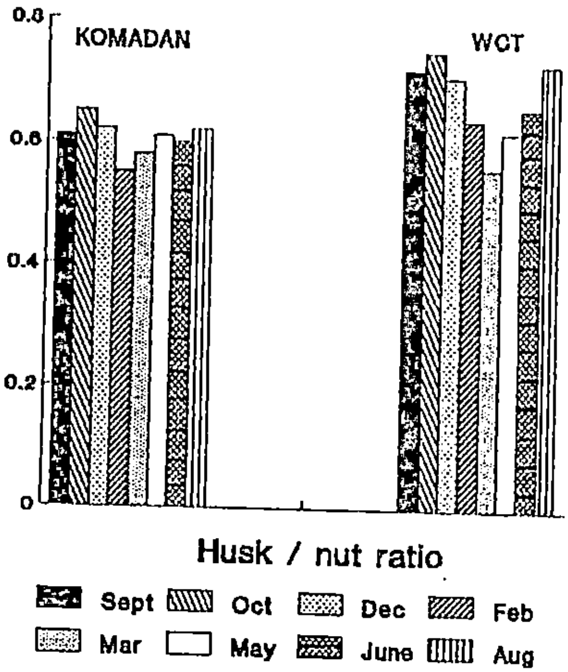
Weight of embryo (g)



Weight of copra (g)

Fig. 2. (Contd...)


80
70
60
50
40
30
20
10
0
KOMADAN
WCT
Oil content (percentage)
Sept
Oct
Dec
Feb
Mar
May
June
Aug


0.8
0.6
0.4
0.2
0
KOMADAN
WCT
Husk / nut ratio
Sept
Oct
Dec
Feb
Mar
May
June
Aug

In the case of equatorial diameter also there was no significant difference between varieties, but significant differences were observed among harvests. The response of varieties with respect to the character equatorial diameter was not consistent during the harvests. Equatorial diameter was maximum for nuts harvested during May for Komadan (16.85 cm) which was on par with that of March and August. During the other months it was on par. While in WCT maximum value was recorded during February and December and lowest during September to October and during June.

Thickness of husk in Komadan and WCT was not significantly different but it was maximum during December (3.35 cm) and this was on par with that of May and October. Husk thickness was found to be less for nut harvested during the month June (2.63 cm) but on par with that of February - March and August - September. Variety x harvest interaction was absent for this character.

The weight of unhusked nut was more or less same in both Komadan and WCT. Harvest wise differences and variety x harvest interaction were observed. In Komadan, nuts harvested during February recorded minimum value for unhusked nut weight (1.14 kg) which was on par with that of June. During the other months it was on par, with maximum value during May (1.67 kg). In WCT nuts harvested during August to December, recorded higher value for unhusked nut weight compared to other months with maximum value during August (1.75 kg). Lowest unhusked nut weight (1.07 Kg) was recorded during March in WCT but on par with that of February and June.

Weight of husked nut on an average was not significantly different in Komadan and in WCT, but significant differences were observed among harvests. Both varieties gave highest husked nut weight during summer (March - May) which was more or less same during the end of south west monsoon period (August to September). During the other months it was on par with lowest husked nut weight during June (480.9 g). Both the varieties performed consistently during the harvests with respect to this character.

The mean weight of husk was not significantly different in Komadan and WCT; but significant differences were observed among harvests. Weight of husk was at its minimum during February (623.8 g) in Komadan which was on par with that of June (834.55 g). During the other months it was on par. In WCT the lowest value for husk weight was recorded during the months of March (613.9 g) and June (808.05 g).

There was no significant difference in split nut weight of Komadan and WCT. Both Komadan and WCT recorded highest split nut weight during May (437.8 g) which was on par with that of March and August. During the other months it was on par, with lowest split nut weight during the month of June (363.28 g). Variety x harvest interaction was absent.

Volume of nut water was high in Komadan (144.41 ml) than in WCT (89.94 ml). Amount of nut water was maximum during summer months (March - May) compared to other months in both varieties.

There was no significant difference between Komadan and WCT with respect to the character weight of shell. Nuts harvested during June was found to have least shell weight (114.28 g) but on par with that of February and October. During the other months it was on par, with maximum shell weight during May (134.78 g). Variety x harvest interaction was not significant.

Komadan gave maximum quantity of kernel (303.46 g) compared to WCT (234.87 g) - Plate 3. There was significant difference among harvests for this character. The response of varieties with respect to kernel weight was consistent during different times of harvest. It was observed that nuts

Plate. 3 Split nut of Komadan and WCT

Plate. 4 Embryo of Komadan (a) and WCT (b)

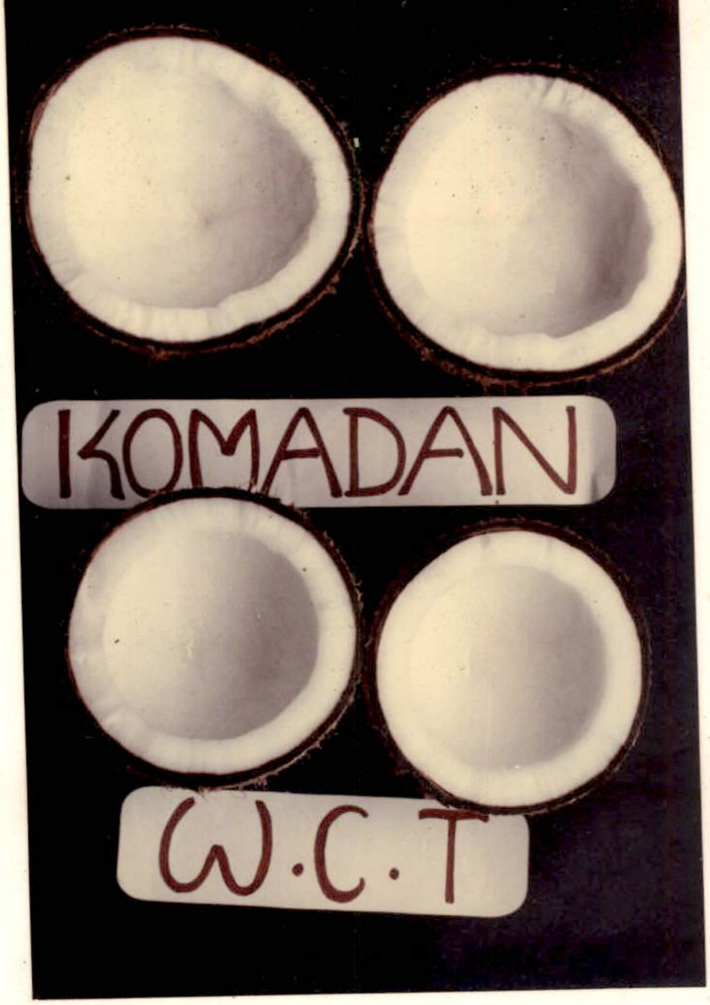


PLATE - 3

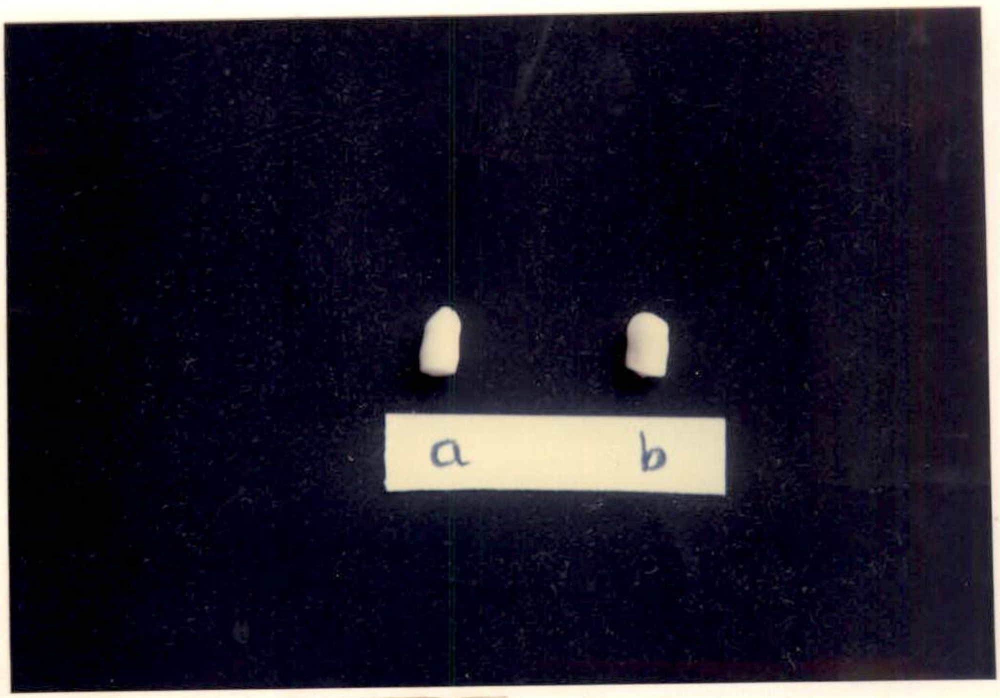
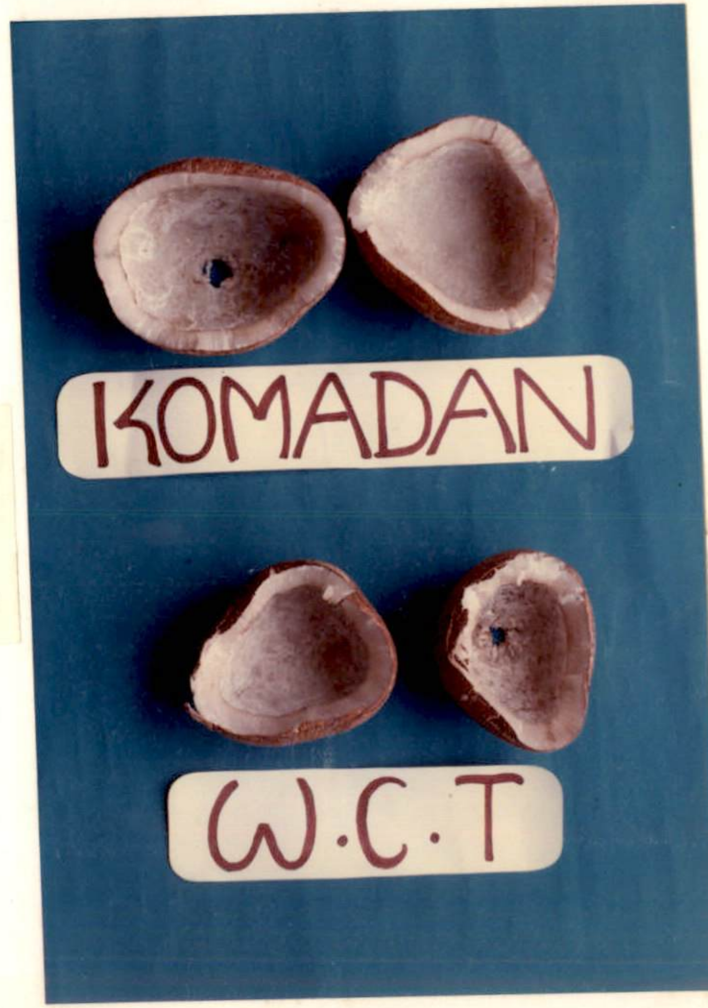
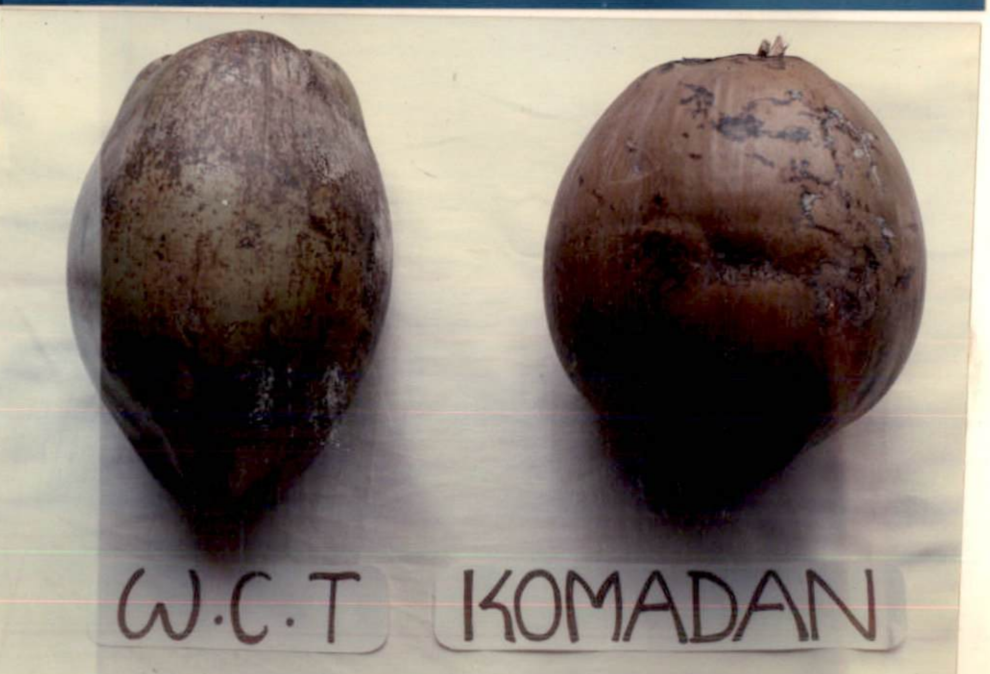


Plate. 5 Copra of Komadan and WCT

Plate. 6 Unhusked nut and husked nut of Komadan and WC

PLATE - 5





harvested during summer months (March - May) contain the maximum quantity of kernel compared to those harvested during south west monsoon (June - September), post monsoom (October to November) and winter periods (December to February).

Thickness of meat was not significantly different between varieties and among harvests. No interaction was observed between varieties and times of harvest.

Diameter of eye was more or less same in both Komadan and WCT, but minimum during June (1.00 cm) which was on par with that of August to September. During other months it was on par, with maximum value during March (1.26 cm).

Komadan was found to be significantly superior with respect to embryo weight (0.094 g) - Plate 4. Embryo weight significantly differ in different harvests with minimum value during September (0.080 g) compared to other months of harvests during which it was on par. Both the varieties performed consistently during the harvests with respect to this character.

Copra content/nut was significantly high in Komādan (168.48 g) than in WCT (133.17 g) - Plate 5. It was significantly different in different harvests also. In both varieties the highest amount of copra was obtained during the hot weather period (February to May) with maximum value during May (167.65 g) and lowest value during post monsoon period (October - November) and during June.

Oil content of Komadan and WCT did not differ significantly. But nuts harvested during September to October and March were found to have more oil than those harvested during other months in both the varieties.

Husk/nut ratio differed significantly between varieties (Plate 6) and among harvests. Significant interaction was also observed between varieties and times of harvest. Husk/nut ratio was high for WCT (0.67). In Komadan this ratio was low during February and March while in WCT it was low during March. During August to December this ratio was on par for both the varieties.

4.2.2. Correlations among seednut characters

Inter correlations among different seednut characters of the two varieties at different times of harvest are presented in Table 8.1 to 8.8. The pooled estimate of those correlation coefficients which were found homogeneous at different times of harvest in both varieties are presented in Table 9a and 9b. Heterogeneous correlations

Correlation coefficients among seednut characters of Komadan and WCT at different times of harvest.

Characters

X_1	Polar diameter of the nut (cm)
X_2	Equatorial diameter of nut (cm)
X_3	Thickness of husk (cm)
X_4	Weight of un husked nut (kg)
X_5	Weight of husked nut (g)
X_6	Volume of nut water (ml)
X_7	Weight of shell (g)
X_8	Weight of kernel (g)
X_9	Thickness of meat (cm)
X_{10}	Diameter of eye (cm)
X_{11}	Weight of embryo (g)
X_{12}	Weight of copra (g)
X_{13}	Oil content (%)
X_{14}	Weight of split nut (g)
X_{15}	Weight of husk (g)

Correlation coefficients among seed nut characters of Komadan and WCT at different times of harvest

Table B.1. SEPTEMBER

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17
x1	--	0.3197	0.3097	0.7233*	0.2732	0.2198	0.3899	0.2298	0.5404	0.3675	-0.4729	0.1239	-0.0345	0.2784	0.7446*	0.3761	0.6857*
x2	0.4215	--	0.7620*	0.7856**	0.3321	0.3820	0.3472	0.1870	0.0340	0.6354*	0.3183	0.2090	-0.5241	0.2352	0.7904**	0.3209	0.8340**
x3	0.4592	0.7515*	--	0.4554	-0.3090	-0.2521	-0.2816	-0.4436	-0.1138	0.2679	0.1622	-0.4231	-0.1795	-0.4005	0.7167*	0.8019**	0.5209
x4	0.2671	0.8038**	0.6044	--	0.6055	0.5873	0.6557*	0.5103	0.4396	0.6536*	-0.0312	0.4505	-0.3440	0.5571	0.9120	0.2139	0.9948**
x5	-0.1383	0.4719	-0.1015	0.6328*	--	0.9826**	0.9720**	0.9797**	0.3979	0.5722	0.1367	0.9716**	-0.5320	0.9862**	0.2257	-0.6332	0.5594
x6	-0.3520	0.3189	-0.2172	0.4943	0.9034**	--	0.9373**	0.9449**	0.2606	0.6756*	0.2012	0.9501**	-0.6306	0.9511**	0.2124	-0.6395	0.5457
x7	-0.1579	0.3086	-0.1812	0.5024	0.9416**	0.8032**	--	0.9568**	0.4018	0.5684	-0.0387	0.9154**	-0.4656	0.9780**	0.3016	-0.5687	0.6101
x8	0.0567	0.5797	0.0332	0.6816*	0.9439**	0.7205*	0.8872**	--	0.4086	0.4797	0.0969	0.9607**	-0.4677	0.9964**	0.1197	-0.6975*	0.4541
x9	0.4975	0.5893	0.4226	0.7631*	0.5233	0.2549	0.4589	0.6761*	--	-0.1472	0.0058	0.4232	0.0886	0.4103	0.3330	0.0596	0.3979
x10	-0.0943	0.1567	-0.0362	0.5171	0.6126	0.4022	0.6230	0.6856*	0.5500	--	0.1854	0.4337	-0.6875*	0.5098	0.5052	-0.1268	0.6414*
x11	-0.6787*	-0.4665	-0.4508	-0.3021	-0.1303	0.0919	-0.2505	-0.2475	-0.2845	-0.1220	--	0.2254	-0.5504	0.0583	-0.1086	-0.1212	0.0044
x12	0.2230	0.5606	0.0447	0.5724	0.8484**	0.6715*	0.7750**	0.8964**	0.6465*	0.6341*	-0.3844	--	-0.5331	0.9562**	0.0507	-0.7196*	0.4020
x13	0.2043	0.1869	0.3016	-0.0320	-0.4630	-0.2822	-0.7155*	-0.4532	-0.2613	-0.4540	0.2079	-0.3472	--	-0.4713	-0.1469	0.2825	-0.3302
x14	-0.0034	0.5158	-0.0274	0.6464*	0.9655**	0.7611*	0.9403**	0.9912**	0.6299*	0.6838*	-0.2542	0.8828**	-0.5389	--	0.1737	-0.6663*	0.5035
x15	0.4061	0.7529*	0.8071**	0.9125**	0.2607	0.1391	0.1290	0.3512	0.6750	0.3211	-0.3078	0.2655	0.2046	0.2959	--	0.5881	0.9294**
x16	0.4868	0.3315	0.7797**	0.3550	-0.4881	-0.5774	-0.5511	-0.3323	0.2635	-0.1433	-0.1752	-0.3905	0.4759	-0.4028	0.7004*	--	0.2583
x17	0.3330	0.8871**	0.6870*	0.9758**	0.5494	0.4312	0.3726	0.6125	0.7063*	0.3911	-0.3112	0.5355	0.1556	0.5583	0.9263**	0.4220	--

KOMADAN

WCT

Table 8.2. OCTOBER

KOMADAN

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17
x1	--	0.2479	0.2409	0.3644	0.3117	0.3139	0.3745	0.2877	0.1848	0.4097	0.1783	0.1981	-0.5398	0.3185	0.3452	0.1815	0.3428
x2	0.0457	--	0.4808	** 0.7993	0.5868	0.5538	0.5766	0.5073	-0.4947	* 0.6581	0.1438	0.3926	-0.4438	0.5343	** 0.8010	0.1031	** 0.8671
x3	0.2547	** 0.8305	--	0.0821	-0.3222	-0.3665	-0.2927	-0.4053	-0.2133	-0.0456	0.4372	-0.4406	0.1489	-0.3722	0.2549	* 0.6746	0.1638
x4	-0.0852	** 0.8874	0.5737	--	** 0.8158	** 0.8261	* 0.7539	* 0.7639	-0.3843	** 0.8039	0.0032	0.6188	* -0.7483	** 0.7673	** 0.9653	0.0479	** 0.9920
x5	-0.1628	0.5964	0.1307	** 0.8254	--	** 0.9859	** 0.9688	** 0.9914	-0.2704	** 0.8534	0.0417	** 0.9120	-0.5913	** 0.9926	* 0.6365	-0.5172	** 0.8020
x6	-0.1285	0.5737	0.1479	* 0.7517	** 0.9345	--	** 0.9385	** 0.9742	-0.2445	** 0.8762	-0.0719	** 0.8504	* -0.6406	** 0.9710	* 0.6565	-0.4662	** 0.8022
x7	0.0551	0.5786	0.1818	* 0.7050	** 0.8938	** 0.8493	--	** 0.9610	-0.2893	** 0.8225	0.0177	** 0.9019	-0.6079	** 0.9820	0.5680	-0.5354	* 0.7460
x8	-0.2360	0.5083	0.0797	** 0.7740	** 0.8941	* 0.6904	* 0.7028	--	-0.2349	** 0.8124	0.0488	** 0.9429	-0.5507	** 0.9959	0.5712	-0.5875	* 0.7440
x9	-0.1609	-0.0495	-0.1697	0.1417	0.0579	-0.2740	-0.0539	0.4449	--	-0.5233	-0.2229	-0.2320	0.1183	-0.2547	-0.3905	0.0390	-0.4235
x10	-0.0052	0.3295	0.1379	0.5378	0.5165	0.4279	0.2883	0.6014	0.3243	--	0.0955	* 0.6406	-0.5506	** 0.8227	* 0.6868	-0.2641	** 0.8045
x11	0.3121	-0.0609	0.0546	0.0032	-0.1884	-0.0797	-0.4222	-0.1619	-0.0873	0.4493	--	0.2101	0.4245	0.0391	-0.0146	-0.1025	0.0483
x12	0.0754	0.3929	0.1761	0.5368	* 0.6519	0.4766	0.4988	** 0.7883	0.3058	* 0.7590	0.0863	--	-0.4115	** 0.9377	0.4135	* -0.6952	0.6026
x13	0.0908	0.3790	0.5418	0.1777	-0.1058	-0.0427	0.0727	-0.2121	-0.3209	-0.4325	-0.1458	-0.2136	--	-0.5741	* -0.7310	-0.1581	* -0.6954
x14	-0.1583	0.5662	0.1182	** 0.8053	** 0.9559	** 0.7895	** 0.8474	** 0.9733	0.3146	0.5419	-0.2571	* 0.7494	-0.1348	--	0.5751	-0.5756	* 0.7511
x15	-0.0301	** 0.9183	* 0.7338	** 0.9506	0.6094	0.5419	0.4987	0.5954	0.1671	0.4713	0.1081	0.3955	0.3078	0.6054	--	0.2973	** 0.9608
x16	0.1043	0.2695	0.5972	0.0308	-0.5334	-0.5175	-0.5094	-0.4451	0.0904	-0.2031	0.2668	-0.4453	0.4866	-0.4967	0.3364	--	0.0473
x17	-0.0301	** 0.9573	* 0.7146	** 0.9720	* 0.7291	* 0.6792	* 0.6659	* 0.6549	0.0395	0.4105	-0.0368	0.4630	0.3687	* 0.7037	** 0.9642	0.1634	--

WCT

Table 8.3. DECEMBER

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17
x1	--	0.7884**	0.4385	0.6612*	0.5610	0.5633	0.5628	0.3633	-0.1073	0.8019**	0.4094	0.3014	-0.7009*	0.4320	0.6857*	0.2872	0.6994*
x2	-0.2790	--	0.5272	0.7305*	0.5819	0.5686	0.5920	0.4339	-0.2001	0.7744**	0.1351	0.3860	-0.5518	0.4902	0.7744**	0.4467	0.8281**
x3	0.4821	0.4893	--	0.0101	-0.2029	-0.1941	-0.1939	-0.3426	0.3608	0.3590	0.1520	-0.2502	-0.1608	-0.2990	0.1040	0.7274*	0.1118
x4	-0.4056	0.6652*	-0.0310	--	0.9527**	0.9566**	0.9144**	0.8822**	-0.4118	0.7797**	-0.0984	0.5165	-0.7573*	0.9035**	0.9909**	0.1044	0.9844**
x5	-0.7318*	0.5657	-0.3460	0.8482**	--	0.9930**	0.9791**	0.9438**	-0.5546	0.7157*	-0.0322	0.6277	-0.6592*	0.9669**	0.9032**	-0.1969	0.9194**
x6	-0.5840	0.5063	-0.1903	0.8776**	0.9205**	--	0.9527**	0.9214**	-0.5258	0.6809*	-0.1051	0.5334	-0.6619*	0.9429**	0.9118**	-0.1536	0.9188**
x7	-0.4768	0.4023	-0.4565	0.8384**	0.8792**	0.7563*	--	0.9440**	-0.6440*	0.7400*	0.1016	0.7469*	-0.5984	0.9737**	0.8583**	-0.2515	0.8953**
x8	-0.8241**	0.5795	-0.3779	0.7033	0.9555**	0.7809**	0.8053**	--	-0.6392*	0.6594*	-0.0160	0.7150*	-0.5806	0.9943**	0.8285**	-0.2715	0.8314**
x9	-0.4656	0.6478*	0.0327	0.2298	0.4167	0.1037	0.3279	0.6212	--	-0.2817	-0.1745	-0.5663	-0.1412	-0.6487*	-0.3363	0.4784	-0.4356
x10	-0.4375	0.4236	-0.0540	0.1513	0.5198	0.3495	0.3333	0.6439*	0.5439	--	0.4371	0.6256	-0.7637*	0.6935*	0.7846**	0.1150	0.7980**
x11	-0.0836	-0.4892	-0.3470	-0.1783	-0.0871	-0.0810	0.0447	-0.1085	-0.4247	0.0428	--	0.5081	-0.1260	0.0217	-0.1248	-0.2939	-0.0662
x12	-0.7207*	0.5186	-0.2770	0.3710	0.6817*	0.3940	0.5739	0.8422**	0.7842**	0.7493*	0.0840	--	-0.3646	0.7341*	0.4517	-0.4450	0.5196
x13	-0.2678	-0.1040	-0.6347*	0.1318	0.2625	0.0621	0.3782	0.3299	0.2849	-0.1010	-0.2099	0.3092	--	-0.5935	-0.7781**	-0.2408	-0.6973*
x14	-0.7616*	0.5540	-0.4147	0.7687**	0.9729**	0.8055**	0.8913**	0.9866**	0.5654	0.5843	-0.0707	0.8022**	0.3565	--	0.8483**	-0.2684	0.8623**
x15	0.0096	0.5768	0.2717	0.8691**	0.4752	0.5983	0.5716	0.2759	-0.0074	-0.2341	-0.2148	-0.0204	-0.0263	0.3684	--	0.2346	0.9873**
x16	0.8317**	-0.2316	0.5861	-0.3375	-0.7839**	-0.5966	-0.5878	-0.8809**	-0.4997	-0.7358	-0.0471	-0.7973**	-0.3454	-0.8356**	0.1715	--	0.1667
x17	-0.4497	0.8132**	0.0314	0.9496**	0.8480**	0.7973**	0.7978**	0.7754**	0.4762	0.2653	-0.3411	0.5325	0.2507	0.8127**	0.7856**	-0.4046	--

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Table 8.4. FEBRUARY

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17
x1	--	0.5269	0.2136	0.7004*	0.5332	0.5306	0.5910	0.4787	0.4337	0.6435*	0.3166	0.5555	0.0019	0.5236	0.6712*	0.1307	0.7092*
x2	-0.1455	--	0.7296*	0.6838*	0.2381	0.2821	0.3125	0.1667	-0.0823	0.4600	0.1811	0.2113	-0.0775	0.2190	0.8721**	0.5989	0.7532*
x3	0.4925	0.7214*	--	0.1141	-0.3967	-0.2955	-0.3191	-0.4853	-0.2567	0.0701	-0.0099	-0.4470	0.0349	-0.4346	0.4803	0.9143**	0.2073
x4	-0.0964	0.5975	0.3277	--	0.8314**	0.8138**	0.8496**	0.7972**	0.1615	0.5684	0.5971	0.8143**	-0.1350	0.8256**	0.9046**	0.0405	0.9904**
x5	-0.5163	0.5272	-0.0926	0.7564*	--	0.9729**	0.9649**	0.9872**	0.2566	0.4877	0.4828	0.9898**	-0.1750	0.9924**	0.5152	-0.5107	0.7728**
x6	-0.5505	0.5030	-0.1139	0.6365*	0.9431**	--	0.9110**	0.9330**	0.1554	0.4451	0.4213	0.9431**	-0.3081	0.9376**	0.5089	-0.4549	0.7509*
x7	-0.2327	0.4630	-0.0224	0.5782	0.8188**	0.6388*	--	0.9427**	0.2368	0.5290	0.4881	0.9554**	-0.0721	0.9747**	0.5702	-0.4380	0.8090**
x8	-0.5220	0.5166	-0.0792	0.8176**	0.9751**	0.8602**	0.8222**	--	0.3274	0.4863	0.4918	0.9913**	-0.1200	0.9934**	0.4723	-0.5575	0.7368*
x9	0.4171	-0.0225	0.3023	0.5019	-0.0776	-0.2542	-0.0435	0.0705	--	0.6827*	0.0822	0.3124	0.5921	0.3006	0.0522	-0.2833	0.1899
x10	0.2794	-0.1292	0.0275	0.2251	0.1002	0.2324	-0.1473	0.0061	0.2326	--	-0.0514	0.4872	0.1717	0.5073	0.5025	-0.0427	0.5967
x11	-0.4671	0.1559	-0.1459	0.2277	0.3960	0.6163	-0.1490	0.3024	-0.3236	0.4348	--	0.4728	0.2420	0.4970	0.5506	0.0586	0.5870
x12	-0.7047*	0.2695	-0.3378	0.4108	0.7001*	0.7355*	0.4330	0.6763*	-0.3867	-0.0128	0.5382	--	-0.1439	0.9919**	0.4966	-0.5360	0.7565*
x13	0.0539	-0.2764	-0.1398	0.3115	-0.0326	-0.2722	0.0719	0.1456	0.7786**	0.0120	-0.4399	-0.1288	--	-0.1051	-0.0740	-0.0101	-0.0420
x14	-0.4561	0.5205	-0.0654	0.7779**	0.9661**	0.8274**	0.9066**	0.9856**	0.0394	-0.0393	0.1798	0.6300	0.1293	--	0.5121	-0.5237	0.7713**
x15	0.2486	0.4642	0.5409	0.8714**	0.3382	0.2083	0.2178	0.4449	0.7803**	0.2487	0.0306	0.0659	0.4726	0.3945	--	0.4542	0.9318**
x16	0.6397*	-0.0072	0.5844	0.1541	-0.5241	-0.5965	-0.4939	-0.4063	0.7778**	0.1510	-0.2861	-0.5716	0.4661	-0.4480	0.6147	--	0.1169
x17	-0.1083	0.6516*	0.3848	0.9929**	0.7354*	0.5996	0.5852	0.8074**	0.5130	0.1663	0.1682	0.3873	0.3381	0.7724*	0.8769**	0.1807	--

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Table 8.5. MARCH

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17
x1	--	0.6669*	0.6334*	0.7765**	0.3248	0.5135	0.2115	0.1133	-0.4658	-0.3965	-0.1588	0.3018	-0.0669	0.1490	0.8212**	0.7246*	0.7588*
x2	0.2786	--	0.7807**	0.9395**	0.7500*	0.8005*	0.6904*	0.5910	-0.7214*	-0.1611	-0.1350	0.6829*	-0.1337	0.6492*	0.8624**	0.4493	0.9844**
x3	0.3440	0.8230**	--	0.7485*	0.3057	0.3433	0.3708	0.1735	-0.6472*	-0.5707	-0.2446	0.3455	0.1672	0.2426	0.7943**	0.6265	0.8259**
x4	0.4346	0.8914**	0.7874**	--	0.6763*	0.7825**	0.5585	0.4954	-0.5753	-0.2959	-0.2477	0.5637	-0.3379	0.5380	0.9628**	0.6016	0.9622**
x5	0.2981	0.7934**	0.4029	0.8061**	--	0.9307**	0.8751**	0.9487**	-0.4766	0.3032	0.2024	0.9143**	-0.4303	0.9700**	0.4519	-0.1577	0.6659*
x6	0.2066	0.8225**	0.5762	0.8755**	0.9241**	--	0.7346*	0.7990**	-0.4110	0.0997	-0.0548	0.7847**	-0.4961	0.8161**	0.6060	0.0763	0.7402*
x7	0.3132	0.6642*	0.2427	0.6655*	0.9199**	0.7505*	--	0.7918**	-0.6702*	0.2213	0.2642	0.7925**	-0.1769	0.8931**	0.3551	-0.1755	0.6102
x8	0.3282	0.6299	0.1390	0.5809	0.9106**	0.6928*	0.9007**	--	-0.3364	0.4857	0.3728	0.9334**	-0.4234	0.9819**	0.2517	-0.3690	0.4883
x9	0.4781	-0.0780	-0.3690	-0.1176	0.1650	-0.1791	0.3177	0.5116	--	0.1356	0.0221	-0.4069	-0.4275	-0.4554	-0.5218	-0.3498	-0.7394*
x10	0.3580	0.4834	0.2527	0.5049	0.5712	0.4030	0.5490	0.6632*	0.2756	--	0.7738**	0.4325	-0.1049	0.4263	-0.4696	-0.7276*	-0.2681
x11	-0.2238	-0.5387	-0.4783	-0.6698*	-0.4748	-0.5864	-0.4655	-0.2260	0.2353	-0.1366	--	0.4807	0.0529	0.3564	-0.3743	-0.6061	-0.1953
x12	-0.1059	-0.2350	-0.5969	-0.4082	0.0959	-0.2252	0.2180	0.4506	0.7143*	0.2252	0.6366*	--	-0.2889	0.9331**	0.3471	-0.2693	0.5941
x13	-0.1108	-0.0269	0.1382	0.0195	-0.1543	-0.0184	-0.1770	-0.2891	-0.2991	-0.0274	-0.5403	-0.4359	--	-0.3667	-0.2512	0.0844	-0.0926
x14	0.3306	0.6558*	0.1772	0.6227	0.9344**	0.7280*	0.9547**	0.9892**	0.4577	0.6397*	-0.3120	0.3823	-0.2578	--	0.2954	-0.3262	0.5487
x15	0.4432	0.8371**	0.8572**	0.9722**	0.6452*	0.7648**	0.4954	0.3899	-0.2170	0.4259	-0.6770*	-0.5650	0.0862	0.4344	--	0.7864**	0.9208**
x16	0.3573	0.3478	0.7420*	0.5004	-0.1042	0.0994	-0.1894	-0.3358	-0.3926	0.0440	-0.4376	-0.8108**	0.2392	-0.2940	0.6872*	--	0.5781
x17	0.3920	0.9264**	0.8154**	0.8891**	0.8032**	0.8746**	0.6622*	0.5786	-0.1327	0.5104	-0.7047*	-0.4087	0.1178	0.6200	0.9593**	0.4869	-

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Table B.6. MAY

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17
x1	--	0.3065	0.2679	0.6508*	0.4769	0.3331	0.4756	0.2756	0.3221	0.3877	0.4240	0.0488	-0.1762	0.3515	0.6792*	0.2481	0.6161
x2	0.0980	--	0.8459**	0.7456*	0.5587	0.2474	0.5450	0.5422	-0.5158	0.7436*	0.1654	0.4849	-0.0613	0.5522	0.7696**	0.2057	0.8797**
x3	0.3844	0.8474**	--	0.5081	0.3314	-0.1018	0.2650	0.3062	-0.4866	0.7642*	0.1592	0.3155	0.2383	0.2966	0.5583	0.2162	0.6995*
x4	0.2515	0.8158**	0.5433	--	0.8774**	0.6798*	0.8560**	0.8308**	0.0677	0.7655**	0.2625	0.6633*	-0.5163	0.8537**	0.9443**	0.0071	0.9549**
x5	-0.1141	0.7643*	0.3539	0.8681**	--	0.8791**	0.9835**	0.9550**	0.0910	0.5385	0.1958	0.8656**	-0.7655**	0.9811**	0.6706*	-0.4682	0.7493*
x6	-0.2126	0.6825*	0.2672	0.8124**	0.8830**	--	0.9066**	0.8662**	0.2536	0.1896	0.1851	0.7872**	-0.9095**	0.8951**	0.4480	-0.5520	0.4695
x7	-0.1626	0.6277	0.1737	0.7011*	0.9012**	0.8279**	--	0.9283**	0.1069	0.4417	0.2880	0.8272**	-0.7499*	0.9694**	0.6489*	-0.4558	0.7301*
x8	-0.2060	0.6552*	0.2532	0.6625*	0.9331**	0.7856**	0.9318**	--	0.1125	0.5573	0.0912	0.9523**	-0.7816**	0.9912**	0.6294	-0.4877	0.7010*
x9	0.2752	-0.0429	0.1091	-0.1840	0.0003	-0.2495	-0.0088	0.2307	--	-0.1043	0.2921	0.0140	-0.2666	0.1124	0.0423	-0.0853	-0.1073
x10	-0.2932	0.2581	-0.0722	0.2325	0.3963	0.0931	0.3003	0.3728	-0.1407	--	0.1486	0.4942	-0.1449	0.5255	0.8142**	0.2352	0.8252**
x11	0.2650	-0.1306	-0.0103	-0.1228	-0.1061	-0.4170	-0.0800	-0.0569	0.0763	0.5533	--	0.0238	0.0992	0.1628	0.2715	0.1611	0.2976
x12	-0.1395	0.5179	0.2298	0.4293	0.7568*	0.5319	0.8113**	0.9189**	0.4524	0.3778	0.1200	--	-0.7626*	0.9236**	0.4318	-0.6172	0.5416
x13	-0.2929	-0.1270	-0.0827	-0.3346	-0.0782	-0.0757	-0.0239	0.0984	0.3471	-0.2383	-0.1116	0.3430	--	-0.7834**	-0.2730	0.6433*	-0.2598
x14	-0.1941	0.6559*	0.2294	0.6864*	0.9367**	0.8127**	0.9703**	0.9919**	0.1508	0.3534	-0.0659	0.8958**	0.0573	--	0.6469*	-0.4845	0.7231*
x15	0.3687	0.7818**	0.5773	0.9834**	0.7637*	0.7341*	0.5827	0.5208	-0.2393	0.1577	-0.1209	0.2820	-0.4065	0.5506	--	0.3323	0.9624**
x16	0.6802*	0.3962	0.4574	0.6300	0.1852	0.2791	0.0784	-0.0866	-0.3836	-0.1194	-0.0772	-0.2502	-0.5596	-0.0304	0.7516*	--	0.1890
x17	0.1919	-0.8891**	0.6272	0.9795**	0.8959**	0.8293**	0.7339*	0.7245*	-0.1131	0.2244	-0.1451	0.5314	-0.1726	0.7392*	0.9466**	0.5384	--

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Table B.7. JUNE

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17
x1	--	0.4976	0.2364	0.8671**	0.7260*	0.5460	0.8012**	0.7764**	0.6502*	0.6469*	0.6010	0.7521*	0.1210	0.7904**	0.8806**	0.1295	0.8556**
x2	0.1909	--	0.8654**	0.6210	0.4127	0.3920	0.4540	0.3989	-0.0502	0.6470*	0.4025	0.4368	-0.2592	0.4202	0.7011*	0.3048	0.6811*
x3	0.3497	0.8951**	--	0.2509	0.0055	-0.0297	0.0243	0.0277	-0.0100	0.5663	0.1438	0.0631	-0.2812	0.0267	0.3890	0.5003	0.3313
x4	0.5248	0.6774*	0.5481	--	0.9152**	0.8197**	0.9490**	0.9275**	0.3941	0.6515*	0.7031*	0.9301**	0.1000	0.9415**	0.9644**	-0.0726	0.9912**
x5	0.3516	0.5536	0.4455	0.8327**	--	0.9629**	0.9803**	0.9872**	0.3801	0.5496	0.7800**	0.9869**	0.3626	0.9922**	0.7761**	-0.4627	0.9128**
x6	-0.0641	0.4751	0.2326	0.6626**	0.7558*	--	0.9203**	0.9133**	0.1767	0.4439	0.7557*	0.9212**	0.3080	0.9223**	0.6510*	-0.5862	0.8201**
x7	0.4511	0.5020	0.4464	0.6242	0.8464**	0.5744	--	0.9672**	0.3543	0.5403	0.7855**	0.9651**	0.2747	0.9853**	0.8419**	-0.3466	0.9390**
x8	0.3584	0.5454	0.4918	0.7483*	0.9260**	0.5188	0.7167*	--	0.4948	0.5907	0.7442*	0.9970**	0.4035	0.9964**	0.8037**	-0.4012	0.9257**
x9	0.4110	0.1618	0.3038	0.0706	0.1562	-0.3041	0.0899	0.4540	--	0.4643	0.3119	0.4465	0.4572	0.4515	0.3673	0.0000	0.3881
x10	0.3443	-0.0083	0.0406	0.4048	0.2981	-0.0281	0.1011	0.4272	0.3826	--	0.6204	0.5884	0.3137	0.5782	0.6589*	0.0916	0.7133*
x11	0.3724	0.1862	0.0158	0.7792**	0.5124	0.4848	0.2301	0.3887	-0.2509	0.3726	--	0.7341*	0.3959	0.7635*	0.5885	-0.3938	0.7282*
x12	0.2865	0.2415	0.3684	0.4038	0.6077	0.1338	0.4332	0.7732**	0.5986	0.5128	0.1668	--	0.3928	0.9937**	0.8079**	-0.4035	0.9331**
x13	0.1489	-0.5268	-0.3509	-0.0683	-0.1880	-0.4301	-0.3389	-0.0996	-0.1049	0.3879	0.3817	0.2318	--	0.3635	-0.0814	-0.6784*	0.1581
x14	0.4276	0.5679	0.5093	0.7501*	0.9615**	0.5837	0.8990**	0.9497**	0.3254	0.3136	0.3474	0.6800*	-0.2147	--	0.8223**	-0.3859	0.9361**
x15	0.5451	0.6675*	0.5409	0.9797**	0.7047*	0.5752	0.4932	0.6233	0.0340	0.4107	0.8129**	0.2973	-0.0195	0.6129	--	0.1900	0.9522**
x16	0.4981	0.4117	0.3692	0.6521*	0.1363	0.1085	-0.0467	0.1170	-0.0051	0.4689	0.6744*	-0.0358	0.1914	0.0525	0.7862**	--	-0.0920
x17	0.5208	0.6928*	0.5890	0.9922**	0.8066**	0.6006	0.5889	0.7463*	0.0794	0.4194	0.7793**	0.4429	0.0051	0.7330*	0.9792**	0.6756*	--

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Table 8.8. AUGUST

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17
1	--	0.4845	0.2741	0.6292	0.7077 *	0.6980 *	0.5279	0.7438 *	0.3070	0.7179 *	0.0184	0.6776 *	0.1884	0.7206 *	0.5160	0.0666	0.5927
2	-0.6826 *	--	0.8986 **	0.8653 **	0.4113	0.4835	0.2866	0.3620	-0.0773	0.5025	0.2506	0.2168	0.5421	0.3590	0.8664 **	0.4565	0.9062 **
3	-0.3884	0.8844 **	--	0.7990 **	0.0398	0.1488	-0.0851	-0.0062	-0.2972	0.3032	0.0661	-0.1898	0.3897	-0.0287	0.8949 **	0.7708 **	0.8102 **
4	-0.6864 *	0.8212 **	0.6510	--	0.5746	0.6695 *	0.3800	0.5134	-0.0862	0.4801	-0.0302	0.3410	0.5294	0.5017	0.9736 **	0.4231	0.9850 **
5	-0.8112 **	0.8153 **	0.5171	0.8986 **	--	0.9793 **	0.8725 **	0.9703 **	0.3827	0.5305	0.1617	0.9540 **	0.4645	0.9916 **	0.3726	-0.4522	0.5868
6	-0.7945 **	0.8186 **	0.5429	0.8595 **	0.9700 **	--	0.8508 **	0.9210 **	0.1997	0.5458	0.1241	0.8875 **	0.4964	0.9475 **	0.4860	-0.3433	0.6744 *
7	-0.7472 *	0.7356 *	0.4141	0.8273 **	0.9473 **	0.8539 **	--	0.7615 *	0.2868	0.2316	0.1738	0.8867 **	0.4716	0.8668 **	0.1875	-0.4993	0.4193
8	-0.7844 *	0.7891 *	0.4928	0.9027 **	0.9874 **	0.9228 **	0.9637 **	--	0.5069	0.6227 *	0.1848	0.9459 **	0.3710	0.9833 **	0.3115	-0.4731	0.5177
9	-0.1883	0.1270	-0.0156	0.3565	0.4045	0.2512	0.5209	0.4946	--	0.0280	0.1676	0.5369	0.0593	0.4705	-0.2045	-0.4544	-0.0615
	-0.7385 *	0.7032 *	0.4616	0.8384 **	0.8100 **	0.7648 *	0.7744 **	0.8092 **	0.0365	--	0.1367	0.4507	0.1668	0.5441	0.3964	0.0408	0.4775
	-0.2141	0.0748	-0.2427	0.4775	0.5362	0.4448	0.5824	0.5910	0.4720	0.4599	--	0.2088	-0.2715	0.1910	-0.0793	-0.3503	-0.0216
	-0.5355	0.6782 *	0.3930	0.7421 *	0.8522 **	0.7402 *	0.9082 **	0.9031 **	0.5153	0.6908 *	0.6871 *	--	0.3645	0.9768 **	0.1205	-0.6115	0.3636
	0.2542	-0.6777 *	-0.7333 *	-0.4970	-0.3544	-0.2688	-0.4344	-0.3820	-0.1696	-0.4494	0.2231	-0.3708	--	0.4179	0.4707	0.1028	0.6515 *
	-0.7792 **	0.7790 **	0.4728	0.8868 **	0.9829 **	0.9091 **	0.9821 **	0.9967 **	0.5064	0.8049 **	0.5930	0.9116 **	-0.4008	--	0.2923	-0.5043	0.5161
	-0.5264	0.7334 *	0.6678 *	0.9561 **	0.7306 *	0.6897 *	0.6548 *	0.7453 *	0.2847	0.7638 *	0.3851	0.5858	-0.5368	0.7236 *	--	0.6059	0.9532 **
	0.3871	-0.1536	0.1910	-0.0060	-0.4393	-0.4451	-0.4643	-0.4122	-0.2547	-0.1088	-0.3257	-0.4615	-0.2318	-0.4312	0.2840	--	0.4028
	-0.7341 *	0.7953 **	0.5832	0.9585 **	0.9271 **	0.9263 **	0.8082 **	0.9115 **	0.2919	0.7972 *	0.5324	0.7408 *	-0.2762	0.8873 **	0.8726 **	-0.1561	--

W
C
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Table 9a. Pooled correlation coefficients among seednut characters in Komadan

Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
X1 Polar diameter																	
X2 Equatorial diameter	-0.0243																
X3 Thickness of husk	0.3073**	0.8035**															
X4 Wt. of nut	0.0157	0.7898**	0.5306**														
X5 Wt. of husked nut	XX	0.6616**	0.1762	0.8202**													
X6 Vol. of nut water	-0.3516**	0.6171**	0.1729	0.7727**	0.9183**												
X7 Wt. of shell	-0.1465	0.5492**	0.1033	0.6968**	0.9013**	0.7711**											
X8 Wt. of kernel	XX	0.6093**	0.1382	0.7510**	0.9501**	0.7716**	0.8681**										
X9 Thickness of meat	0.1699	0.1909	0.0804	0.2533	0.2163	-0.0835	0.2126	0.4552**									
X10 Diameter of eye	-0.0994	0.3003*	0.1178	0.4614**	0.5065**	0.3568**	0.3889**	0.5612**	0.2893*								
X11 Wt. of embryo	-0.1091	-0.1750	-0.2097	XX	0.0689	0.0676	-0.0619	0.0736	-0.0744	0.2734*							
X12 Wt. of copra	-0.2488	0.3912**	-0.0082	0.4101**	0.6900**	0.4756**	0.6374**	0.8159**	0.4985**	0.5320**	0.2742*						
X13 oil content	0.0093	-0.1750	-0.1511	-0.0425	-0.1447	-0.1708	-0.1704	-0.1140	0.0639	-0.1717	-0.0884	-0.0813					
X14 Wt. of opened nut	XX	0.6100**	0.1333	0.7558**	0.9625**	0.7919**	0.9373**	0.9873**	0.3894**	0.5224**	0.0305	0.7830**	-0.1347				
X15 Wt. of husk	0.1918	0.7466**	0.6565**	0.9513**	0.5901**	0.5629**	0.4702**	0.5095**	0.2319*	0.3491**	XX	0.1688	0.0061	0.5120**			
X16 husk/nut ratio	0.5323**	0.1784	0.5635**	0.2764*	-0.3602**	-0.3129*	-0.3649**	-0.4003**	-0.0292	-0.1016	-0.0388	-0.5147**	0.0951	-0.4014**	0.5813**		
X17 seednut quality index	-0.0001	0.8612**	0.5923**	0.9831**	0.8102**	0.7612**	0.6741**	0.7520**	0.2600*	0.4241**	XX	0.4310**	0.1048	0.7423**	0.9301**	0.2613*	—

** significant at 1 per cent level

* significant at 5 per cent level

XX represents heterogeneous correlations.

Table 9b. Pooled correlation coefficients among seednut characters in WCT

Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X
X1 Polar diameter																	
X2 Equatorial diameter	0.5037**																
X3 Thickness of husk	0.3361**	0.7672**															
X4 Wt. of nut	0.6933**	0.7941**	0.4199**														
X5 Wt. of husked nut	0.5089**	0.5011**	-0.0716	0.8218**													
X6 Vol. of nut water	0.4784**	0.4869**	-0.0956	0.7977**	0.9726**												
X7 Wt. of shell	0.5136**	0.4881**	-0.0647	0.7962**	0.9630**	0.9081**											
X8 Wt. of kernel	0.4446**	0.4084**	-0.1587	0.7609**	0.9759**	0.9214**	0.9383**										
X9 Thickness of meat	0.2532	-0.2916*	-0.2253	-0.0581	0.0197	-0.0259	XX	0.0800									
X10 Diameter of eye	0.4960**	0.5706**	0.2435	0.6033**	0.5943**	0.5433**	0.5449**	0.6002**	0.0510								
X11 Wt. of embryo	0.1774	0.1862	0.1117	0.1758	0.2782*	0.2116	0.2932*	0.2796*	0.0624	0.3301*							
X12 Wt. of copra	0.4038**	0.3907**	-0.1370	0.6620**	XX	0.8074**	0.8951**	XX	0.0697	0.5241**	0.3814**						
X13 oil content	-0.1779	-0.1988	0.0469	-0.3238*	XX	XX	-0.2833*	-0.3134*	0.0711	-0.2510	0.0309	-0.2521					
X14 Wt. of opened nut	0.4773**	0.4436**	-0.1290	0.7857**	0.9867**	0.9328**	0.9660**	0.9931**	0.0414	0.5924**	0.2912*	XX	-0.3102*				
X15 Wt. of husk	0.6982**	0.8117**	0.5849**	0.9610**	0.6174**	0.6039**	0.5925**	0.5501**	-0.0901	0.5413**	0.1060	0.4207**	-0.2811*	0.5705**			
X16 husk/nut ratio	0.2883*	0.3701**	0.6993**	0.1844	-0.4359**	-0.4098**	-0.4167**	-0.4914**	-0.0800	-0.1091	-0.2202	-0.5526**	0.0001	-0.4810**	0.4633**		
X17 seednut quality index	0.6820**	0.8712**	0.5200**	0.9861**	0.7802**	0.7522**	0.7600**	0.7212**	-0.1310	0.6323**	0.2021	0.6432**	XX	0.7444**	0.9540**	0.2232	-

** significant at 1 per cent level

* significant at 5 per cent level

XX represents heterogeneous correlations

Table 10a. Correlation coefficients among seednut characters of Komadan which were heterogeneous at different times of harvest

Harvest time	Komadan Characters					
	x1 & x5	x1 & x8	x1 & x14	x11 & x4	x11 & x15	x11 & x17
September	-0.1383	0.0567	-0.0034	-0.3021	-0.3078	-0.3112
October	-0.1628	-0.2360	-0.1583	0.0032	0.1081	-0.0368
December	-0.7318*	-0.8241**	-0.7616*	-0.1783	-0.2148	-0.3411
February	-0.5163	-0.5220	-0.4561	0.2277	0.0306	0.1682
March	0.2981	0.3282	0.3306	-0.6698*	-0.6770*	-0.7047*
May	-0.1141	-0.2060	-0.1941	-0.1228	-0.1209	-0.1451
June	0.3516	0.3584	0.4276	0.7792**	0.8129**	0.7793**
August	-0.8112**	-0.7844**	-0.7792**	0.4775	0.3851	0.5324

x1 Polar diameter(cm)
x4 weight of nut(kg)
x5 weight of husked nut(g)
x8 weight of kernel(g)
x11 weight of embryo(g)
x14 weight of opened nut(g)
x15 weight of husk(g)
x17 seed nut quality index

* Significant at 5 per cent level
** Significant at 1 per cent level

Table. 10b. Correlation coefficients among seednut characters of WCT which were heterogeneous at different times of harvest

Harvest time	WCT Characters						
	x5 & x12	x13 & x5	x13 & x6	x7 & x9	x12 & x8	x12 & x14	x13 & x17
September	0.9716**	-0.5320	-0.6306	0.4018	0.9607**	0.9562**	-0.3302
October	0.9120**	-0.5913	-0.6406*	-0.2893	0.9429**	0.9377**	-0.6954*
December	0.6277	-0.6592*	-0.6619*	-0.6440*	0.7150*	0.7341*	-0.6973*
February	0.9898**	-0.1750	-0.3081	0.2368	0.9913**	0.9919**	-0.0420
March	0.9143**	-0.4303	-0.4961	-0.6702*	0.9334**	0.9331**	-0.0926
May	0.8656**	-0.7655**	-0.9095**	0.1069	0.9523**	0.9236**	-0.2598
June	0.9869**	0.3626	0.3080	0.3543	0.9970**	0.9937**	0.1581
August	0.9540**	0.4645	0.4964	0.2868	0.9459**	0.9768**	0.6515*

x5 weight of husked nut (g)
x6 volume of nut water(ml)
x7 weight of shell(g)
x8 weight of kernel(g)
x9 thickness of meat(cm)
x12 Weight of copra(g)
x13 oil content(%)
x14 weight of opened nut(g)
x17 seed nut quality index

* Significant at 5 per cent level
** Significant at 1 per cent level

at different times of harvest are presented in Table 10a and 10b. In both varieties most of the correlations were found to be homogeneous at different times of harvest. Correlations which were found heterogeneous in one variety were found to be homogeneous in the other variety.

Komadan

In Komadan all intercorrelations among seednut characters were found to be homogeneous except the correlation of polar diameter with weight of kernel, weight of opened nut and weight of husked nut and correlation of weight of embryo with weight of unhusked nut, weight of husk and seednut quality index. Unhusked nut weight, husked nut weight, kernel weight split nut weight and copra content per nut were interrelated among themselves in Komadan. Irrespective of time of harvest, weight of unhusked nut showed positive and significant correlation with all other seednut characters except with polar diameter, thickness of meat and weight of embryo (showed negative significant correlation during March and positive correlation during June). Weight of husked nut was found to be positively and significantly correlated with all characters except thickness of meat, weight of embryo and oil content and varied inversely with husk/nut ratio. Weight of kernel and opened nut were significantly and positively correlated with all other seednut characters except with polar diameter (negatively correlated during December and August harvests); thickness of husk, weight of embryo and oil content. Copra content was seen positively and significantly correlated with all seednut characters except polar diameter of the nut, thickness of husk, oil content and weight of husk and negatively correlated with husk/nut ratio at all times of harvest. Kernel weight showed highest correlation (r_p = 0.8159) with copra content followed by split nut weight (r_p = 0.7830). Oil content was correlated with none of the seednut characters in Komadan. Seednut quality index showed positive significant correlation with all seednut characters except polar diameter, oil content and weight of embryo (showed negative correlation during March and positive significant correlation during June). Seednut quality index was found to be highly correlated with weight of husked nut (r_p = 0.9831).

WCT

In WCT all the inter relations except correlation of copra content with weight of husked nut, weight of kernel and split nut weight; correlation of oil content with husked nut weight, volume of nut water and seednut quality index and correlation between weight of shell and thickness of meat were found to be homogeneous at all times of harvest. Both polar diameter and equatorial diameter were positively and significantly correlated with all seednut characters except with thickness of meat, weight of embryo and oil content. Weight of nut was positively and significantly inter related with all seednut characters except with thickness of meat, weight of embryo and husk/nut ratio and varied inversely with oil content. Weight of unhusked nut, weight of husked nut, weight of kernel and weight of split nut have shown inter correlations among themselves. Weight of husked nut and copra content per nut have shown positive and significant correlation with all seednut characters except with thickness of husk, thickness of meat and oil content (showed negative correlation during December and May). They were found to be negatively correlated with husk/nut ratio. Kernel weight and husked nut weight were most highly correlated with copra content in WCT. Equatorial diameter and polar diameter were equally correlated with copra content unlike in Komadan. Kernel weight and split nut weight exhibited positive and significant correlation with all seednut characters except thickness of husk and thickness of meat and negatively correlated with oil content and husk/nut ratio. Unlike Komadan in WCT, oil content was found to be negatively correlated with weight of unhusked nut, weight of husked nut and volume of nut water (only during December and May), weight of shell, weight of kernel, weight of split nut, weight of husk and seednut quality index (only during October to December and August). Seednut quality index was highly and positively correlated with all seednut characters except with thickness of meat, weight of embryo, husk/nut ratio and oil content (negatively related during October and December and Positively related during August). In WCT seednut quality index was most closely related with seednut weight (r_p = 0.9861).

Effect of varietal difference on different homogeneous correlation among different seednut characters at different times of harvest were studied. Varietal difference affected only a very limited number of correlations among seednut characters.

The correlation of polar diameter with equatorial diameter, weight of shell, diameter of eye, weight of unhusked nut copra content per nut, and weight of husk were positive and significant in WCT but uncorrelated in Komadan. When equatorial diameter was inversely and significantly related with thickness of meat in WCT, this correlation was absent in Komadan. Positive and significant correlation of weight of husked nut with weight of kernel, weight of split nut, weight of shell and volume of nut water were more in WCT than in Komadan. Similarly positive and significant association of volume of nut water with weight of shell, weight of kernel, weight of copra and weight of split nut were more in WCT than in Komadan. When thickness of meat was positively and significantly related with weight of kernel and copra weight in Komadan, such relation was not significant in WCT. The correlation between polar diameter and seednut quality index was positive and significant in WCT, while such relation was totally absent in Komadan. Thickness of meat was positively and significantly correlated with seednut quality index in Komadan while it was absent in WCT. Varietal difference did not affect other correlations among seednut characters.

4.2.3.1. Direct and indirect effects of seednut characters on copra content/nut

Direct and indirect effects of 15 seednut characters on copra content per nut relating to two varieties are presented in Appendix - iii. The direct and total indirect effects of these characters on copra content per nut are given in Table 11 & 12. Direct and indirect effects of five important seednut characters viz., equatorial diameter, weight of unhusked nut, weight of husked nut, weight of kernel and oil content in both varieties are presented in Table 13 & 14. The path diagrams with path coefficients (direct effects) and the phenotypic correlations of the above mentioned five seednut characters are presented in Figures 3 & 4.

Komadan

In Komadan the contribution of 15 seednut characters on copra content per nut was 60.7 per cent. Out of this, 54.8 per cent of variation was explained by the five important seednut characters viz., equatorial diameter, weight of unhusked nut, weight of kernel, weight of husked nut and oil content (Table 13). Therefore only 5.9 per cent of variability in copra content per nut was explained by other ten seednut characters.

Among the five important seednut characters, weight of kernel had the maximum positive direct effect (1.5733) on copra content per nut. Its correlation with copra content per nut was 0.8201. The diminished correlation may be attributed to the negative indirect influence of weight of kernel through weight of unhusked nut (-0.3294), weight of husked nut (-0.4996) and oil content (-0.0026). Other characters among the important seednut characters, which had positive direct effect on copra content per nut were equatorial diameter (0.1284) and oil content (0.0237). The enhanced correlation of equatorial diameter with copra content (0.3900) may be due to its positive indirect effect through weight of kernel (0.9597). Correlation between oil content and copra content was found to be diminished (0.0820) compared to its direct effect. This may be attributed to the negative indirect effect of oil content through equatorial diameter (-0.0218) and weight of kernel (-0.1731). Weight of unhusked nut and weight of husked nut had got negative direct effect (-0.4392 & -0.5259) on copra content per nut. But their correlations with this characters were found to be positive (0.4099 & 0.6899). This may be due to positive indirect influence of these characters on copra content per nut through equatorial diameter and weight of kernel.

When 15 seednut characters were considered together, split nut weight had the maximum positive direct effect (2.8162) on copra content per nut, followed by weight of unhusked nut (1.0024). Correlation of these characters with copra content per nut was found to be diminished due to high negative indirect effect of these characters through some of the seednut characters with maximum inverse effect through kernel weight (-1.3736 & -1.0406). All the seednut characters, except polar diameter, thickness of husk, oil content and husk per nut ratio, had got maximum positive indirect effect on copra content per nut through split nut weight and maximum negative indirect effect through weight of kernel as evidenced from the Table 11.

WCT

In WCT, 88.9 per cent of variation in copra content per nut was attributed by 15 seednut characters studied. Out of this, 82 per cent of variation was explained by the five important seednut characters (Table 14). Only 6.9 per cent of variability in copra content per nut was explained by other ten seednut characters.

Among the five important seednut characters which explains maximum variability in copra content per nut, weight of husked nut followed by weight of kernel had got maximum positive direct effect (0.7542 and 0.5559) on copra content per nut. Correlation of these characters with copra content per nut were also high (0.9501 & 0.9607) which indicated that these characters contribute more to copra content per nut. The enhanced correlation of weight of husked nut with copra content may be attributed to the positive indirect effect of this character through weight of kernel (0.5448) and equatorial diameter (0.1108). Similarly positive indirect effect of weight of kernel through weight of husked nut (0.7391) and equatorial diameter (0.0908) resulted in enhanced correlation between weight of kernel and copra content, compared to its direct effect. The direct effect of equatorial diameter on copra content per nut was 0.2215. Correlation between these two characters were found to be 0.3901. Enhanced correlation may be due to positive indirect effect of equatorial diameter through weight of husked nut (0.3771) and weight of kernel (0.2279). Correlation between weight of unhusked nut and copra content was 0.6600, but its direct effect on copra content was -0.5399. Positive correlation may be attributed by positive indirect effect of weight of unhusked nut through weight of husked nut and weight of kernel (0.6185 & 0.4225). When the direct effect of oil content on copra content per nut was positive (0.0503), its correlation with copra content was found to be negative (-0.2501). Negative indirect effect of oil content through weight of husked nut (-0.2564) and weight of kernel (-0.1723) resulted in negative correlation between oil content and copra content per nut.

Considering the 15 seednut characters, weight of split nut had got maximum direct effect (2.0214) on copra content per nut. Its correlation with copra content was also high (r_p = 0.9601). It had got maximum positive indirect effect through equatorial diameter (0.2424) and maximum negative indirect effect through weight of shell (-0.9870). All other seednut characters except a few had got maximum positive indirect effect through split nut weight and maximum negative indirect effect through weight of shell on copra content per nut as evidenced from the Table 12.

4.2.3.2. Direct and indirect effects of different seednut characters on oil content

Direct and indirect effects of 15 seednut

Table 11. Direct and total indirect effects of 15 seednut characters on copra content per nut in Komadan

Seednut characters	Direct effects	Total indirect effects +ve	Total indirect effects -ve	Maximum indirect effects +ve	Maximum indirect effects -ve	Total correlation
x1 Polar diameter(cm)	0.0800	0.8263	-1.1564	0.4162(x8)	-0.7322(x13)	-0.2501
x2 Equatorial diameter(cm)	0.4104	2.5878	-2.6082	1.7179(x13)	-0.8464(x8)	0.3900
x3 Thickness of husk(cm)	-0.0209	1.282	-1.2712	0.5312(x4)	-0.5651(x14)	-0.0101
x4 Wt.of unhusked nut(kg)	1.0024	2.5915	-3.184	2.1403(x13)	-1.0406(x8)	0.4099
x5 Wt.of husked nut(g)	-0.8195	4.0632	-2.5538	2.7035(x13)	-1.3181(x8)	0.6899
x6 Volume of nut water(ml)	0.0059	3.4302	-2.9561	2.2248(x13)	-1.0684(x8)	0.4800
x7 Wt.of shell(g)	-0.7699	3.8027	-2.3929	2.6472(x13)	-1.2071(x8)	0.6399
x8 Wt.of kernel(g)	-1.3875	4.1278	-1.9202	2.7880(x13)	-1.3875(x8)	0.8201
x9 Thickness of meat(cm)	0.2121	1.4891	-1.2013	1.0983(x13)	-0.6382(x8)	0.4999
x10 Diameter of eye(cm)	0.1136	2.2347	-1.8183	1.4644(x13)	-0.7770(x8)	0.5324
x11 Wt.of embryo(g)	0.3147	0.2313	-0.2759	0.0845(x13)	-0.0971(x8)	0.2701
x12 Oil content(%)	0.0757	0.4905	-0.5707	0.1526(x8)	-0.3661(x13)	-0.0802
x13 Wt.of opened nut(g)	2.8162	1.3179	-3.354	0.7618(x4)	-1.3736(x8)	0.7801
x14 Wt.of husk(g)	-0.8562	2.8104	-1.7842	1.4362(x13)	-0.8562(x14)	0.1700
x15 Husk / nut ratio	-0.3748	1.5318	-1.667	0.5550(x8)	-1.1265(x13)	-0.5100

Residue = 0.3971

on copra content per nut in WCT

Seednut characters	Direct effects	Total indirect effects +ve	Total indirect effects -ve	Maximum indirect effects +ve	Maximum indirect effects -ve	Total Correlation
x1 Polar diameter(cm)	0.2417	1.3282	-1.1698	0.9703(x13)	-0.5189(x7)	0.4001
x2 Equatorial diameter(cm)	0.5509	1.1075	-1.2683	0.8894(x13)	-0.4986(x7)	0.3901
x3 Thickness of husk(cm)	-0.1451	0.6835	-0.6782	0.4242(x2)	-0.3249(x15)	-0.1398
x4 Wt.of unhusked nut(kg)	0.0825	2.2325	-1.655	1.5969(x13)	-0.8140(x7)	0.6600
x5 Wt.of husked nut(g)	-0.0779	2.7247	-1.6967	2.0012(x13)	-0.9768(x7)	0.9501
x6 Volume of nut water(ml)	-0.3953	2.5786	-1.3133	1.8799(x13)	-0.9259(x7)	0.8700
x7 Wt.of shell(g)	-1.0175	2.665	-0.7475	1.9607(x13)	-0.3597(x6)	0.9000
x8 Wt.of kernel(g)	-0.1424	2.6887	-1.5856	2.0012(x13)	-0.9463(x7)	0.9607
x9 Thickness of meat(cm)	-0.0156	0.2823	-0.1967	0.0809(x13)	-0.1598(x2)	0.0700
x10 Diameter of eye(cm)	-0.3076	1.7709	-0.9432	1.1926(x13)	-0.5495(x7)	0.5201
x11 Wt.of embryo(g)	-0.0911	0.8513	-0.5624	0.5862(x13)	-0.2951(x7)	0.3800
x12 Oil content(%)	-0.0509	0.6159	-0.8151	0.2849(x7)	-0.6266(x13)	-0.2501
x13 Wt.of opened nut(g)	2.0214	0.7075	-1.7688	0.2424(x2)	-0.9870(x7)	0.9601
x14 Wt.of husk(g)	-0.0245	1.8725	-1.4279	1.1522(x13)	-0.6003(x7)	0.4201
x15 Husk / nut ratio	-0.4641	1.0173	-1.1032	0.4274(x7)	-0.9703(x13)	-0.5500

Residue = 0.1109

Table 13. Direct and indirect effects of five important seednut characters on copra content per nut in Komadan

Seednut characters	Direct & Indirect effects					Total Correlations
	X1	X2	X3	X4	X5	
X1 Equatorial diameter (cm)	**0.1284**	-0.3470	-0.3471	0.9597	-0.0040	0.3900
X2 Wt. of unhusked nut (kg)	0.1014	**-0.4392**	-0.4313	1.1800	-0.0009	0.4099
X3 Wt. of husked nut (g)	0.0847	-0.3602	**-0.5259**	1.4947	-0.0033	0.6899
X4 Wt. of kernel (g)	0.0783	-0.3294	-0.4996	**1.5733**	-0.0026	0.8201
X5 Oil content (%)	-0.0218	0.0176	0.0736	-0.1731	**0.0237**	-0.0802

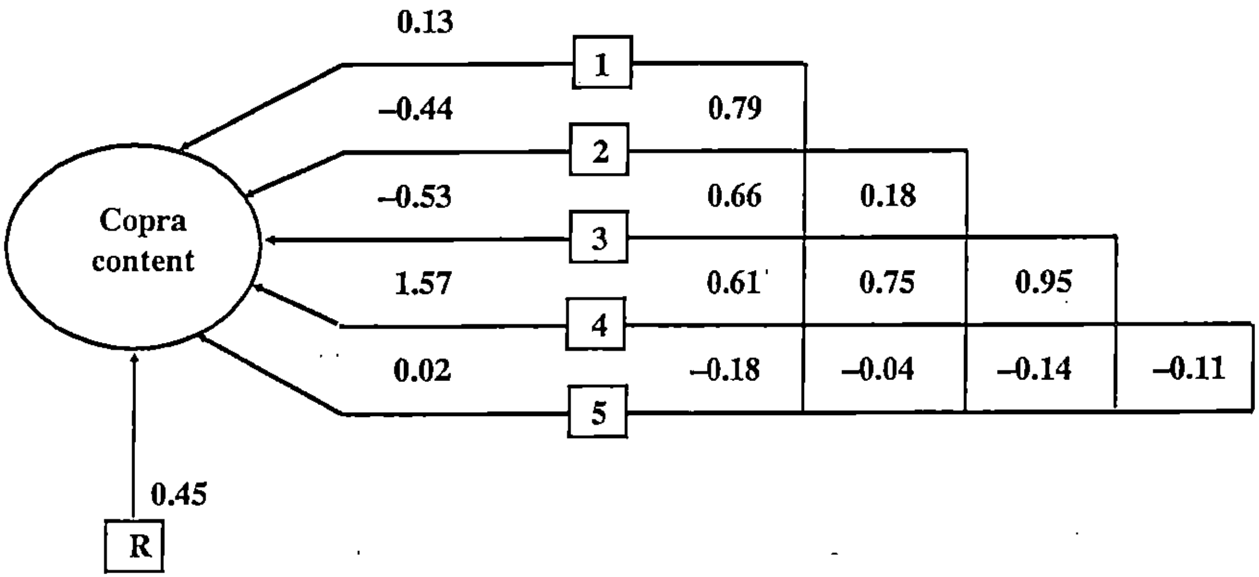
Residue = 0.4524 **Bold figures represent direct effects**

Table 14. Direct and indirect effects of five important seednut characters on copra content per nut in WCT

Seednut characters	Direct & Indirect effects					Total correlations
	X1	X2	X3	X4	X5	
X1 Equatorial diameter (cm)	**0.2215**	-0.4265	0.3771	0.2279	-0.0101	0.3901
X2 Wt. of unhusked nut (kg)	0.1750	**-0.5399**	0.6185	0.4225	-0.0161	0.6600
X3 Wt. of husked nut (g)	0.1108	-0.4427	**0.7542**	0.5448	-0.0171	0.9501
X4 Wt. of kernel (g)	0.0908	-0.4103	0.7391	**0.5559**	-0.0156	0.9607
X5 Oil content (%)	-0.0443	0.1728	-0.2564	-0.1723	**0.0503**	-0.2501

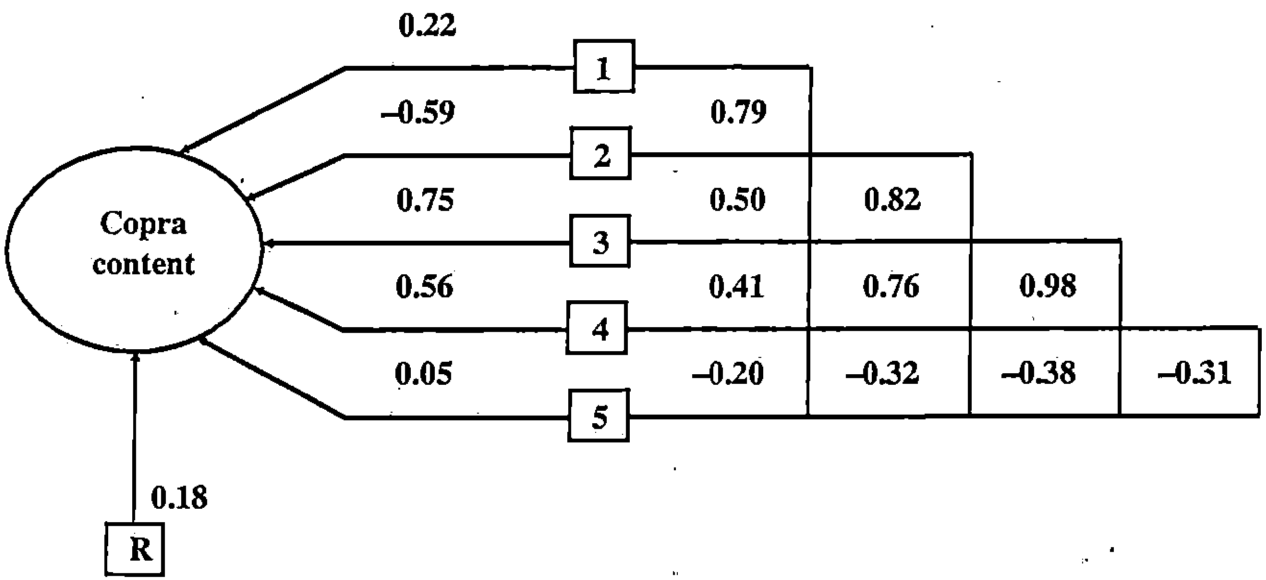
Residue = 0.1797 Bold figures represent direct effects

Fig. 3. Path diagram showing the direct and indirect effects and inter relationships of five important seednut characters on copra content per nut in Komadan



Direct effects shown in arrows. Inter relationships shown in steps

Fig. 4. Path diagram showing the direct and indirect effects and inter relationships of five important seednut characters on copra content per nut in WCT



Direct effects shown in arrows. Inter relationships shown in steps characters on oil content relating to two varieties are given in appendix - iv. In both varieties only very limited amount of variability in oil content was explained by the seednut characters (13 per cent in Komadan and 25 per cent in WCT).

4.2.4. Seednut quality index

Six seednut characters viz., equatorial diameter, weight of unhusked nut, weight of husked nut, weight of kernel, copra content per nut and oil content, which were found to be most important through path coefficient analysis were used to form the seednut quality index. The mean values of this index at different times of harvest for both Komadan and WCT are presented in Table 15 and Fig. 5.

Seed nut quality index of Komadan and WCT was not significantly different from each other. But significant difference was seen among harvests. The response of varieties with respect to this quality index was not consistent over harvests. In Komadan seednut quality index was at its maximum during June (30.33) which was comparable with that of February and August. In WCT maximum value for this index was recorded during February (31.58) followed by June to August. In both varieties during December this index was at its lowest level followed by October.

Table 15. Mean values of seednut quality index at different times of harvest

Variety	Time of Harvest								Mean
	September	October	December	February	March	May	June	August	
Komadan	26.89 (IV)	17.55 (VII)	14.31 (VIII)	29.25 (II)	24.55 (V)	24.35 (VI)	30.33 (I)	28.80 (III)	24.50
WCT	26.84 (IV)	17.89 (VII)	15.03 (VIII)	31.58 (I)	21.47 (VI)	22.44 (V)	28.30 (III)	29.18 (II)	24.09
Mean	26.87	17.72	14.67	30.42	23.01	23.39	29.32	28.99	

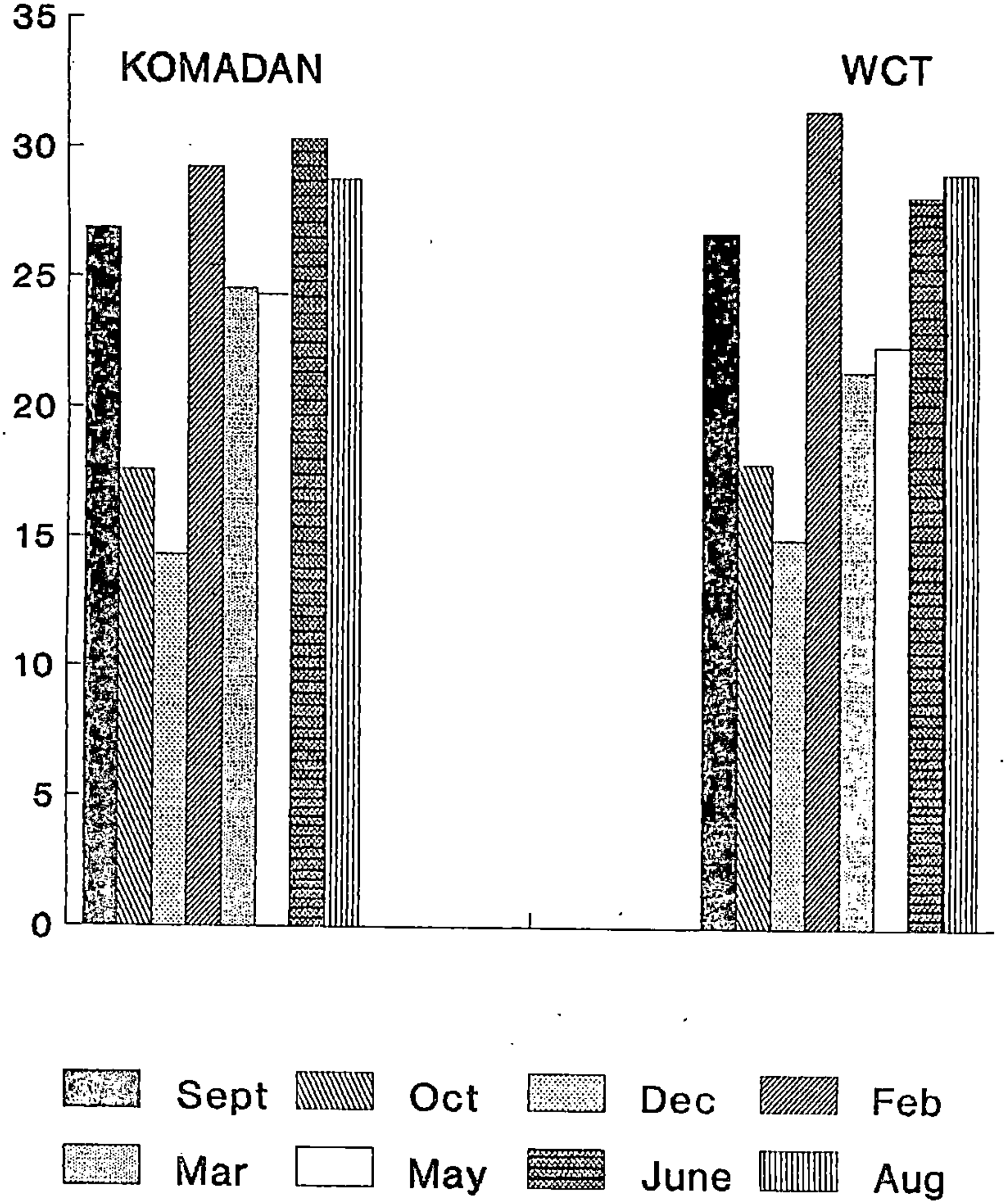
CD (0.05) for varieties -2.271

CD (0.05) for harvests - 1.133

CD_1 (0.05) for comparing harvests within a variety = 2.612

CD_2 (0.05) for comparing varieties within same harvest or in different harvests = 1.602

Fig. 5. Effect of harvesting time on seednut quality index of Komadan and WCT



4.3. Correlation between mother palm characters and seed nut characters

Correlation between mother palm characters and seednut characters of both Komadan and WCT at different times of harvest are presented in Table 16 & 17. Those correlation coefficients which were found homogeneous in different times of harvest were pooled and pooled correlation coefficients are presented in Table 18. Heterogeneous correlations are given in Table 19. In both Komadan and WCT most of the correlations between mother palm characters and seednut characters were found to be homogeneous at different times of harvest. Only a very limited number of correlations were found to be significant in Komadan compared to WCT. Heterogeneity was found to be more in WCT than in Komadan.

In Komadan variety, only the correlation between number of female flowers per spadix and oil content and number of bunches and equatorial diameter were found to be heterogeneous at different harvest times. While in WCT correlation of number of bunches with weight of husked nut, weight of kernel, copra content per nut and split nut weight and oil content with number of female flowers per spadix, percentage fruitset and number of female flowers were found to be heterogeneous at different times of harvest.

Table 16. Correlation Coefficients between mother palm characters and seed nut characters of Komadan at different times of harvest

Characters	September	October	December	February	March	May	June	August
y1 & x1	0.0844	-0.0996	0.3434	-0.0691	0.0369	0.3910	0.4227	0.4605
y1 & x2	-0.0011	-0.1560	-0.4310	-0.1771	-0.2138	-0.5843	-0.3628	-0.4519
y1 & x3	-0.0037	-0.0072	-0.5703	0.0758	-0.0051	-0.3405	-0.2416	-0.2559
y1 & x4	0.2257	-0.0451	-0.5854	-0.2558	-0.1918	-0.3727	-0.3231	-0.3631
y1 & x5	0.4251	-0.0931	-0.4404	-0.0991	-0.1651	-0.2914	-0.1258	-0.2624
y1 & x6	0.3998	-0.4465	-0.1863	0.0249	-0.0224	-0.2135	0.0936	0.0456
y1 & x7	-0.1095	-0.1179	0.4668	0.4800	-0.0632	0.1317	0.1368	0.3238
y1 & x8	0.3729	-0.0302	-0.4275	-0.1627	-0.2126	-0.3129	-0.1687	-0.2671
y1 & x9	-0.0158	-0.2118	-0.4567	0.0919	-0.0623	-0.3948	-0.2552	-0.2500
y2 & x1	0.2470	-0.2253	0.0798	0.0268	-0.4512	-0.5434	0.3418	0.0603
y2 & x2	-0.4337	-0.4529	-0.3272	-0.2945	-0.6869*	-0.2348	-0.5237	-0.2086
y2 & x3	-0.4531	-0.3352	-0.2297	-0.3821	-0.5044	-0.0943	-0.1078	0.0151
y2 & x4	-0.4290	-0.1193	-0.1075	-0.3953	-0.4518	0.2302	-0.0189	-0.0730
y2 & x5	-0.3391	0.1579	-0.0973	-0.4406	-0.4596	0.3619	0.0763	-0.0551
y2 & x6	-0.2647	0.2192	-0.0045	-0.3235	0.1393	0.3453	0.3543	0.0073
y2 & x7	0.0071	-0.8074**	0.5588	0.1591	0.0682	0.3326	0.6544*	0.3092
y2 & x8	-0.3280	0.0055	-0.1041	-0.4584	-0.4484	0.3357	-0.0150	-0.0295
y2 & x9	-0.4574	-0.4701	-0.1678	-0.3577	-0.5465	-0.0780	-0.0821	0.0609
y3 & x1	0.2977	0.6446*	-0.2630	-0.0133	-0.6779*	-0.1217	-0.0576	0.6378*
y3 & x2	-0.4690	0.0584	0.1685	-0.0039	-0.6975*	0.6709*	0.4123	-0.5742
y3 & x3	-0.3157	-0.2972	-0.0650	0.2024	-0.7032*	0.5204	0.0750	-0.7454*
y3 & x4	-0.6206	-0.4434	0.2734	-0.2650	-0.4320	0.5151	[illegible]	[illegible]

(Table 16 Contd....)

Characters	September	October	December	February	March	May	June	August
y3 & x5	-0.5964	-0.4333	0.3856	-0.1355	-0.2500	0.3800	0.2845	-0.6961*
y3 & x6	-0.4161	-0.2054	0.3781	-0.1295	0.4550	0.2067	0.3162	-0.6375*
y3 & x7	-0.1078	0.1942	0.0541	0.4424	-0.0366	-0.4041	-0.1914	0.4701
y3 & x8	-0.5721	-0.3756	0.3380	-0.2644	-0.2680	0.3361	0.1958	-0.6799*
y3 & x9	-0.3716	-0.1561	0.0449	0.2234	-0.7113*	0.5294	0.1122	-0.6638*
y4 & x1	-0.4649	-0.0320	-0.0122	0.0325	0.5630	0.5365	0.2169	0.5526
y4 & x2	0.3521	0.2672	0.0191	0.0142	0.0498	0.0128	0.4942	-0.1559
y4 & x3	0.4198	0.3855	0.0473	0.4734	0.0887	0.0173	0.2319	-0.2859
y4 & x4	0.6203	0.3254	-0.0988	0.1430	-0.1267	-0.2420	0.1397	-0.3331
y4 & x5	0.6029	0.1004	-0.0464	0.3089	0.0148	-0.3386	0.2526	-0.3091
y4 & x6	0.2722	-0.3460	0.0891	0.1861	-0.1472	-0.3288	0.0799	-0.0784
y4 & x7	-0.1095	0.2851	0.3547	0.4956	0.0155	0.0450	-0.5312	-0.0461
y4 & x8	0.5839	0.2392	0.0022	0.2803	-0.0374	-0.3327	0.2704	-0.3347
y4 & x9	0.4035	0.3742	0.0273	0.4649	0.0727	0.0181	0.2089	-0.3192
y5 & x1	0.1709	0.2999	0.3080	-0.0674	-0.5155	0.4331	0.1509	0.7301*
y5 & x2	-0.3253	-0.0813	-0.3306	-0.1717	-0.6508*	-0.4002	-0.1997	-0.7246*
y5 & x3	-0.1280	-0.1899	-0.4761	0.0853	-0.5220	-0.1531	-0.3529	-0.6415*
y5 & x4	-0.0936	-0.3242	-0.4244	-0.2627	-0.4178	-0.2272	0.2755	-0.6252
y5 & x5	0.1064	-0.3592	-0.3105	-0.1038	-0.2565	-0.2084	0.0291	-0.6190
y5 & x6	0.0871	-0.5244	-0.1772	0.0163	0.3514	-0.2002	0.2596	-0.3634
y5 & x7	-0.2389	0.0309	0.3547	0.4897	-0.1750	0.0000	0.0175	0.7078
y5 & x8	0.0798	-0.2688	-0.2991	-0.1728	-0.2947	-0.2412	-0.1106	-0.6162
y5 & x9	-0.2040	-0.1541	-0.3769	0.1020	-0.5763	-0.2150	-0.3408	-0.5311

(Table 16 Contd....)

Characters	September	October	December	February	March	May	June	August
y6 & x1	0.2473	0.2620	-0.1773	0.0268	-0.5318	-0.5356	0.0338	0.3030
y6 & x2	-0.4828	-0.3546	-0.1025	-0.2945	-0.5892	-0.0791	-0.5056	-0.3882
y6 & x3	-0.4599	-0.4547	0.0728	-0.3821	-0.4287	-0.0368	-0.1583	-0.2452
y6 & x4	-0.4827	-0.3534	0.3134	-0.3953	-0.3028	0.3236	-0.0270	-0.2739
y6 & x5	-0.4050	-0.1279	0.2879	-0.4406	-0.3169	0.4697	-0.0649	-0.3005
y6 & x6	-0.3356	0.0734	0.1475	-0.3235	0.1899	0.4673	0.0834	-0.2443
y6 & x7	-0.0148	-0.5389	0.5175	0.1591	0.0113	0.1125	0.5758	0.4921
y6 & x8	-0.3865	-0.2128	0.2766	-0.4584	-0.2979	0.4291	-0.1544	-0.2738
y6 & x9	-0.4767	-0.4847	0.1156	-0.3577	-0.4697	-0.0251	-0.1376	-0.1568
y7 & x1	0.2977	0.6446*	-0.3073	N.E	-0.6355*	-0.0073	-0.2386	0.6378*
y7 & x2	-0.4690	0.0584	0.2356	N.E	-0.0405	0.4308	0.1787	-0.5742
y7 & x3	-0.3157	-0.2972	0.3688	N.E	-0.0322	0.3124	0.1811	-0.7454*
y7 & x4	-0.6206	-0.4434	0.5742	N.E	0.3057	0.3681	0.0148	-0.6160
y7 & x5	-0.4050	-0.4333	0.5208	N.E	0.2612	0.3400	-0.1829	-0.6961*
y7 & x6	-0.3356	-0.2054	0.1647	N.E	0.3162	0.2836	-0.4592	-0.6375*
y7 & x7	-0.1078	0.1942	0.0708	N.E	-0.1699	-0.4874	-0.0693	0.4701
y7 & x8	-0.5721	-0.3756	0.5193	N.E	0.2963	0.3073	-0.1905	-0.6799*
y7 & x9	-0.3716	-0.1561	0.3544	0.0000	-0.4830	0.2930	0.1763	-0.6638*

* Significant at 5 percent level   ** Significant at 1 percent level

N.E - Not estimable

In Komadan number of nuts per bunch varied inversely with equatorial diameter (r_p = -0.3087). In WCT number of nuts per bunch negatively correlated with equatorial diameter (r_p = -0.4952), weight of unhusked nut (r_p = -0.4029), weight of husked nut (r_p = -0.4209), weight of kernel (r_p = -0.3826), copra content per nut (r_p = -0.3618), split nut weight (r_p = -0.3684) and seednut quality index (r_p = -0.3242). But number of nuts per bunch showed positive correlation with oil content in WCT (r_p = 0.3132).

In WCT, the number of female flowers per spadix was negatively correlated with all seednut characters except oil content, which showed positive correlation during the month of October (r = 0.6414) and August (r = 0.8262). But in Komadan number of female flowers per spadix was seen to be negatively correlated with equatorial diameter (r_p = -0.4085), weight of unhusked nut (r_p = -0.2702) and seednut quality index (r_p = -0.3011). Its correlation with oil content was found to be negative during October (r = -0.8074) and positive during June (r = 0.6544).

The negative influence of number of bunches and number of spadices on seednut quality index was more in WCT than in Komadan. The weight of unhusked nut and number of bunches showed significant negative correlation in WCT (r_p = -0.3378), but such relation was absent in Komadan. In both

Table 17. Correlation Coefficients between mother palm characters and seednut characters of WCT at different times of harvest

Characters	September	October	December	February	March	May	June	August
y1 & x1	0.3721	0.0043	-0.7981**	-0.1426	-0.4262	0.0899	0.0963	-0.0157
y1 & x2	-0.1876	-0.1865	-0.8202**	-0.5223	-0.4640	-0.6552*	-0.3864	-0.4884
y1 & x3	-0.0035	-0.2528	-0.5958	-0.5429	-0.4893	-0.4652	-0.3309	-0.4439
y1 & x4	-0.2256	-0.5772	-0.5035	-0.3988	-0.7153*	-0.4586	-0.3225	0.0013
y1 & x5	-0.2297	-0.5981	-0.2806	-0.3220	-0.6548*	-0.5353	-0.2830	-0.0066
y1 & x6	-0.1681	-0.5501	-0.0961	-0.3161	-0.6826*	-0.6583*	-0.3251	0.1401
y1 & x7	0.4587	-0.0156	0.3266	0.5895	0.5474	0.3253	0.2200	-0.0792
y1 & x8	-0.2055	-0.5962	-0.3464	-0.3089	-0.6312	-0.4869	-0.2714	0.0372
y1 & x9	-0.0075	-0.2605	-0.6884*	-0.5114	-0.4087	-0.4930	-0.3307	-0.4262
y2 & x1	-0.2886	-0.1176	-0.6986*	-0.4359	-0.2901	-0.2700	-0.2802	-0.2018
y2 & x2	-0.2384	-0.6517*	-0.7377*	-0.7718**	-0.7262*	-0.9278**	-0.8325**	-0.8041**
y2 & x3	-0.4101	-0.6465*	-0.6569*	-0.7004*	-0.5217	-0.8027**	-0.5531	-0.6667*
y2 & x4	-0.0090	-0.5196	-0.5144	-0.3231	-0.7611*	-0.5986	-0.3129	-0.4254
y2 & x5	-0.0755	-0.4674	-0.3676	-0.2441	-0.6709*	-0.6436*	-0.2858	-0.3045
y2 & x6	0.0936	-0.2565	-0.0141	-0.2544	-0.7447*	-0.5860	-0.3324	-0.2870
y2 & x7	-0.0337	0.6414*	0.5508	0.2819	0.0653	0.2300	0.5398	0.8262**
y2 & x8	-0.0587	-0.4776	-0.3883	-0.2625	-0.7127*	-0.6334*	-0.3114	-0.3626
y2 & x9	-0.4020	-0.6603*	-0.7005*	-0.7160*	-0.6174	-0.8785**	-0.5621	-0.7698**
y3 & x1	-0.0917	-0.6457*	N.E	-0.5654	0.5173	-0.1852	-0.5114	-0.0419
y3 & x2	0.0529	-0.3577	N.E	-0.2774	-0.0004	0.3449	-0.3268	-0.5107
y3 & x3	0.0936	-0.4443	N.E	-0.8100**	0.1225	0.0398	-0.7069*	-0.5258
y3 & x4	0.3408	-0.1286	N.E	-0.9374**	0.2308	0.3004	-0.7767**	-0.2360

(Table 17 Contd....)

Characters	September	October	December	February	March	May	June	August
y3 & x5	0.3075	-0.0644	N.E	-0.9113**	0.1971	0.2612	-0.7225*	-0.2239
y3 & x6	0.2871	0.1031	N.E	-0.9132**	0.3063	0.4188	-0.7264*	-0.0685
y3 & x7	-0.0667	0.5558	N.E	0.4062	-0.1882	-0.1562	-0.0479	-0.4607
y3 & x8	0.3179	-0.1130	N.E	-0.9055**	0.1629	0.3035	-0.7479*	-0.1946
y3 & x9	0.0897	-0.4288	0.0000	-0.7374*	0.0544	0.0778	-0.6805*	-0.5549
y4 & x1	0.4405	0.2595	0.2493	0.4068	0.0051	0.4808	0.3927	0.2544
y4 & x2	0.3159	0.6473*	0.3659	0.8166**	0.4974	0.5080	0.7635*	0.1536
y4 & x3	0.4433	0.7440*	0.7465*	0.4939	0.2460	0.6340*	0.3802	0.1375
y4 & x4	-0.0678	0.5175	0.6685*	0.0152	0.4626	0.3427	0.0483	0.5357
y4 & x5	-0.0443	0.4621	0.7159*	-0.0201	0.4361	0.3716	0.0553	0.4325
y4 & x6	-0.1269	0.3207	0.2684	0.0065	0.3707	0.1540	0.0889	0.5491
y4 & x7	0.1578	-0.7525*	0.6957*	0.1837	0.3166	-0.0413	-0.5092	0.5826
y4 & x8	-0.0276	0.4714	0.6748*	-0.0048	0.4628	0.3852	0.1000	0.5197
y4 & x9	0.4538	0.7392*	0.6776*	0.5774	0.4140	0.6759*	0.4011	0.2281
y5 & x1	0.3314	-0.2725	-0.7981**	-0.2445	0.0203	0.0620	-0.1351	0.0181
y5 & x2	-0.1608	-0.3641	0.8202**	-0.5106	-0.4570	-0.6297	-0.4356	-0.4971
y5 & x3	0.0786	-0.4326	-0.5958	-0.6427*	-0.3841	-0.4834	-0.5485	-0.4335
y5 & x4	-0.0048	-0.4161	-0.5035	-0.5456	-0.5412	-0.4302	-0.5707	-0.0478
y5 & x5	-0.0401	-0.3867	-0.2806	-0.4737	-0.5148	-0.5181	-0.5176	-0.0497
y5 & x6	0.0114	-0.2481	0.0961	-0.4690	-0.4467	-0.6199	-0.5520	0.0986
y5 & x7	0.4214	0.2397	0.3266	0.5962	0.4275	0.3153	0.1518	-0.1785
y5 & x8	-0.0082	-0.4187	-0.3464	-0.4612	-0.5153	-0.4596	-0.5190	-0.0111
y5 & x9	0.0680	-0.4361	-0.6884*	-0.5999	-0.3521	-0.5059	-0.5376	-0.4362

Contd...

(Table 17 Contd....)

Characters	September	October	December	February	March	May	June	August
y6 & x1	-0.2878	-0.5482	-0.6986*	-0.4359	0.0082	-0.2684	-0.4219	-0.2376
y6 & x2	-0.2077	-0.6482*	-0.7377*	-0.7718**	-0.6304	-0.8800**	-0.7915**	-0.7508*
y6 & x3	-0.3590	-0.7085*	-0.6569*	-0.7004*	-0.4001	-0.7639*	-0.7088*	-0.6388*
y6 & x4	0.0680	-0.4115	-0.5144	-0.3231	-0.6295	-0.4802	-0.5359	-0.4535
y6 & x5	-0.0001	-0.3348	-0.3676	-0.2441	-0.5802	-0.5238	-0.4931	-0.3663
y6 & x6	0.1511	-0.0893	-0.0141	-0.2544	-0.5891	-0.4175	-0.5300	-0.3327
y6 & x7	-0.0458	0.8250**	0.5308	0.2819	0.0598	0.0802	0.4386	0.0986
y6 & x8	0.0177	-0.3725	-0.3883	-0.2625	-0.6213	-0.5153	-0.5240	-0.2456
y6 & x9	-0.3521	-0.7039*	-0.7005*	-0.7160*	-0.4181	-0.5059	-0.7036*	-0.7332*
y7 & x1	-0.0917	-0.6457*	N.E	N.E	0.5173	-0.1927	-0.4059	0.0483
y7 & x2	0.0529	-0.3577	N.E	N.E	-0.0004	-0.1684	0.0664	-0.0652
y7 & x3	0.0936	-0.4443	N.E	N.E	0.1225	-0.2605	-0.4474	-0.0402
y7 & x4	0.3408	-0.1286	N.E	N.E	0.2308	0.0806	-0.6155	-0.2232
y7 & x5	0.3075	-0.0644	N.E	N.E	0.1971	0.0471	-0.5466	-0.2635
y7 & x6	0.2871	0.1031	N.E	N.E	0.3063	0.2259	-0.5155	-0.2210
y7 & x7	-0.0667	0.5558	N.E	N.E	-0.1882	-0.2342	-0.1067	-0.2924
y7 & x8	0.3179	-0.1130	N.E	N.E	0.1629	0.0664	-0.5747	-0.2456
y7 & x9	0.0897	-0.4288	0.0000	0.0000	0.0544	-0.3237	-0.3944	-0.0905

* Significant at 5 per cent level

** Significant at 1 per cent level

N.E - Not estimable

varieties the correlation between number of bunches and equatorial diameter was not significant during almost all times of harvest except during March (showed negative significant correlation r = -0.6975) and May harvest (showed positive significant correlation r = 0.6709) in Komadan. Except seednut quality index, no other seednut character was found to be associated with number of spadices in both the varieties.

Fruitset was positively and significantly correlated with all seednut characters except copra content, seednut quality index and oil content (negatively associated during October and positively associated during December) in WCT. But in Komadan fruitset was found to be not significantly related with any of the seednut character.

In WCT yield of nuts per harvest showed significant negative correlation with most of the seednut characters viz., equatorial diameter (r_p = -0.5109), weight of unhusked nut (r_p = -0.4469), weight of husked nut (r_p = -0.3986), weight of kernel (r_p = -0.3602), copra content per nut (r_p = -0.3112), split nut weight (r_p = -0.3548) and seednut quality index (r_p = -0.4103). In Komadan yield of nuts was negatively correlated with equatorial diameter (r_p = -0.3856), weight of unhusked nut (r_p = -0.3158) and weight of

Table 18. Pooled correlation coefficients between mother palm characters and seednut characters of Komadan and WCT

	Komadan									WCT								
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X1	X2	X3	X4	X5	X6	X7	X8	X9
Y1	0.2060	-0.3087*	-0.1794	-0.2507	-0.1334	-0.0400	0.1664	-0.1542	-0.1584	-0.1398	-0.4952**	-0.4029**	-0.4209**	-0.3826**	-0.3618**	0.3132*	-0.3684**	-0.3242*
Y2	-0.0685	-0.4085**	-0.2702*	-0.1792	-0.1072	0.0611	XX	-0.1382	-0.3011*	-0.3380**	-0.7542**	-0.6331**	-0.4578**	-0.4014**	-0.3270*	XX	-0.4218**	-0.4600**
Y3	0.0674	XX	-0.2066	-0.2014	-0.1615	-0.0137	0.0586	-0.1878	-0.2574*	-0.2120	-0.1427	-0.3378**	XX	XX	XX	0.0121	XX	-0.6801**
Y4	0.1930	0.1393	0.1798	0.0659	0.0838	-0.0365	0.0135	0.0933	-0.0693	0.3173*	0.5453**	0.5080**	0.3400**	0.3264*	0.2138	XX	0.3455**	-0.1415
Y5	0.2102	-0.3859**	-0.3158*	-0.3413**	-0.2287	-0.0760	0.1753	-0.2516	-0.1810	-0.1627	-0.5109**	-0.4469**	-0.3986**	-0.3602**	-0.3112*	0.3000*	-0.3548**	-0.4103**
Y6	-0.0594	-0.3612**	-0.2709*	-0.1623	-0.1155	0.0088	0.1775	-0.1391	0.1600	-0.3803**	-0.7115**	-0.6341**	-0.4244**	-0.3748**	-0.2762*	XX	-0.3976**	0.5412**
Y7	0.0635	-0.0328	-0.0916	-0.0687	-0.1240	-0.1386	-0.0130	-0.1082	-0.2800*	-0.1076	-0.0612	-0.1303	-0.0503	-0.0478	0.0188	-0.0346	-0.0572	-0.6927**

X1 - polar diameter (cm)
X2 - Equatorial diameter (cm)
X3 - weight of unhusked nut (kg)
X4 - weight of husked nut (g)
X5 - weight of kernel (g)
X6 - copra content per nut (g)
X7 - oil content (%)
X8 - split nut weight (g)
X9 - seednut quality index

Y1 - Number of nuts per bunch
Y2 - Number of female flowers per spadix
Y3 - Number of bunches
Y4 - percentage fruit set
Y5 - Total number of nuts
Y6 - Total number of female flowers
Y7 - Number of spadices
* significant at 5 per cent level
** significant at 1 per cent level
XX - Heterogeneous correlations.

Table 19. Correlation coefficients between mother palm characters and seednut characters which were heterogeneous at different times of harvest.

Time of Harvest	Komadan Characters		WCT Characters						
	Y_2 & X_7	Y_3 & X_2	Y_2 & X_7	Y_4 & X_7	Y_6 & X_7	Y_3 & X_4	Y_3 & X_5	Y_3 & X_6	Y_3 & X_8
September	0.0071	-0.4690	-0.0377	0.1578	-0.0458	0.3408	0.3075	0.2871	0.3179
October	-0.8074**	0.0584	0.6414	-0.7525*	0.8250**	-0.1286	-0.0644	0.1031	-0.1130
December	0.5588	0.1685	0.5508	0.6957*	0.5308	N.E.	N.E.	N.E.	N.E.
February	0.1591	-0.0039	0.2819	0.1837	0.2819	-0.9374**	-0.9113**	-0.9132**	-0.9055**
March	0.0682	-0.6975*	0.0653	0.3166	0.0598	0.2308	0.1971	0.3063	0.1629
May	0.3326	0.6709*	0.2300	-0.0413	0.0802	0.3004	0.2612	0.4188	0.3035
June	0.6544*	0.4123	0.5398	-0.5092	0.4386	-0.7767**	-0.7225*	-0.7264*	-0.7479*
August	0.3092	-0.5742	0.8262**	0.5826	0.0986	-0.2360	-0.2239	-0.0685	-0.1946

X_2 - Equatorial diameter of nut (cm)
X_4 - Weight of husked nut (g)
X_5 - Weight of kernel (g)
X_6 - Copra content per nut (g)
X_7 - Oil content (%)
X_8 - Split nut weight (g)
** Significant at 1 per cent level

Y_2 - Number of female flowers per spadix
Y_3 - Number of bunches
Y_4 - Percentage fruit set
Y_6 - Total number of female flowers
NE - Not estimable
* Significant at 5 per cent level

husked nut (r_p = -0.3413). There was positive and significant correlation between yield of nuts and oil content in WCT (r_p = 0.3000) but such relation was absent in Komadan.

Equatorial diameter was more inversely related with number of female flowers (r_p = -0.7115) than polar diameter (r_p = -0.3803) in WCT, while in Komadan only equatorial diameter was found to be related (negatively) with number of female flowers. Number of female flowers was also found to be negatively correlated with weight of unhusked nut (r_p = -0.6341), weight of husked nut (r_p = -0.4244), weight of kernel (r_p= -0.3748), copra content per nut (r_p = -0.2762) and split nut weight (r_p = -0.3976) and its relation with seednut quality index was positive and significant in WCT (r_p = 0.5412), but these correlations were absent in Komadan. The correlation of this particular mother palm character with oil content was not significant at any time of harvest in both varieties except during October harvest in WCT (r = 0.8250).

5. DISCUSSION

Coconut the most useful plantation crop to man, shows yield and nut component variations due to the influence of varying weather parameters. The present study is mainly concentrated to the effect of harvesting time on different seed nut characters of Coconut. Mother palm and seednut characters of Komadan and WCT coconut varieties and their correlations in different times of harvest were studied. The results obtained are discussed here under. The main point of importance arising from the results presented above is that, season has marked effect on different mother palm and seednut characters.

5.1.1 Motherpalm characters

Liyanage (1953) suggested that mother palm selection alone could increase the efficiency by 50 percentage. Jack (1930) estimated that by mother palm selection alone, the first generation performance could be enhanced to the order of 25 to 35 per cent, irrespective of any knowledge or identity of the pollen parent. Selection strategy for yield of nuts may be indirectly based on component characters such as, number of opened inflorescences (including mature bunches), number of nuts per bunch etc (Abeywardena and Mathes, 1980); number of spathes per year, number of female flowers with high nut set (Louis, 1981); number of bunches, female flowers and their retention or setting percentage (Ohler, 1984 and Panda _et_ _al_., 1985). Variations were observed between Komadan and WCT in respect of three characters viz., number of spadices, number of nuts per bunch and total number of nuts per harvest. All mother palm charaters except nuts per bunch showed high significant difference among seasons and variety x season interaction was significant for number of nuts per bunch and total number of nuts per harvest as evidenced by Table 2 and Fig. 1.

Mean number of spadices per season was found to be higher in Komadan than in WCT. Maximum number of spadix production was observed during summer months (March to May) while it was low during post monsoon period (October to December). This is in agreement with the findings of Sreelatha and Kumaran (1991). On the other hand Davis and Gosh (1982) obtained maximum spadix production during July and minimum during December to March.

Female flower production per season was more or less similar in both Komadan and WCT. High female flower production was observed during November to March (Marechal, 1928) and during March to April (Bai and Ramadasan. 1982).

In this study peak production of female flowers was observed during February (75) and lowest during July (31). Female flower production was found to be high during summer months compared to post monsoon period. Similar observations were made by Sreelatha and Kumaran(1991). In both varieties, about 62 per cent of annual female flower production was observed during hot weather period (February to May). This is in conformity with the results of Bhaskaran and Leela (1983) where 50 per cent of annual female flower production was observed during this period. Number of female flowers differ in different seasons which may be due to the differences in the number of spadices opened in these times (Patel, 1938).

Komadan and WCT behaved in a similar manner with respect to female flower production per spadix. This is in agreement with the findings of Pillai et al., (1991) who reported that there is not much variation in the number of female flowers produced in an inflorescence between cultivars. Pieris (1934) and Liyanage (1962) suggested this character as reliable and important for mother palm selection. Female flower production per spadix was found to be maximum during September to February and minimum during May to July in both varieties. This was as against the findings of Bhaskaran and Leela (1983) who reported high female flower production per spadix during February to May.

Number of bunches per harvest was not significantly different between Komadan and WCT. Highest number of bunches was observed during February to May (Hot weather period) and lowest during October to December in both Komadan and WCT. Similar results were obtained by Bhaskaran and Leela (1983). Abeywardena (1971) reported highest number of bunch production during May to June and lowest during January to February.

Average number of nut production per bunch per season was found to be significantly superior in Komadan (9) than in WCT (7). This yield component might have influenced increased nut production in Komadan. There was no significant difference among seasons in both varieties, but significant interaction between variety and season was observed.

Selection of mother palm on the basis of yield performance was suggested by Goh hock swee (1988) and Chadha and Rethinam (1989). Nut production per harvest was found to be more in Komadan (15) than in WCT (11). The response of varieties with respect to this character was not consistent over harvest. Maximum production of nuts suited for seednut collection takes place during summer months because of the emergence of two bunches during summer months as against the normal production of one bunch during the other months (Aiyadurai, 1962). Maximum nut production during summer months was also recorded by Louis and Annappan (1980).

In the present study, maximum nut production was recorded during February to June for WCT and in Komadan during February to March. This may be due to the production of more number of bunches and nuts/bunch during this period. In both Komadan and WCT nut production was poor during October to December which was in conformity with the result of Radha et al. (1962). Bunch production was low during October to December months resulting in poor yield of nuts. Similar observations were made by Vijayaraghavan and Ramachandran (1989).

High setting mother palms are superior to the rest in respect of early germination (Patel, 1938 and Umali, 1940). There was no significant difference between Komadan and WCT with respect to percentage of fruitset. In the present study maximum button setting was observed during May to August with maximum value during June (54%) and lowest setting during September to February. Abeywardena (1971), reported similar results in which the highest fruitset was observed during May to June and lowest during January to February.

Annual nut yield per tree is one of the most important criteria for mother palm selection (Smith, 1933, Liyanage, 1962; Apacibla and Mendoza, 1968; Chadha and Rethinam, 1989 and Ramanathan, 1989b). Present study revealed superiority of Komadan with respect to three mother palm characters viz., number of spadices per palm per year, annual nut yield per palm and number of nuts per bunch. This is in conformity with the result of Manju _et al_., (1992a). Shylaraj _et al_., (1991) reported superiority of Komadan for number of bunches per palm, number of female flowers per spadix, percentage fruitset and annual nut yield per palm. Both varieties behaved in a similar manner with respect to all other mother palm characters indicating homogeneity of these characters in the two types. Komadan was found to have more nut production potential (119) per palm per year compared to WCT (89 nuts/palm/year). This is in agreement with the findings of Gopimony (1982) where more than 99% of Komadan palms gave more than 80 nuts per tree per year, while the average yield of WCT was comparatively less. This character is controlled by additive genetic variation (Nambiar and Nambiar, 1970) and that non additive gene action was low and selection practiced for this character might be indirectly based on component characters (Oheler, 1984).

Significant difference was observed between Komadan and WCT for number of spadix production with superior value for Komadan, but there was no significant difference for number of bunches between the varieties which indicated that barren bunch production was more in Komadan compared to WCT. But significant difference was seen between varieties with respect to annual nut yield per palm. This may be due to more number of nuts per bunch for Komadan.

In general, it can be observed that in both varieties during February to May (Hot weather period), there was higher production of bunches having proportionately more female flowers resulting in higher nut yields. Thus maximum production of nuts suited for seednut takes place during hot weather period (February to May). This may be due to higher temperature relative humidity and rainfall prevailing during this period which favours vigorous biochemical activities (Panda et al., 1985). Among seven mother palm characters studied, Komadan variety exhibited superiority over WCT in number of spadices per palm per year, number of nuts per bunch and annual nut yield per palm. Even though barren bunch production was found to be more in Komadan compared to WCT, more number of nuts per bunch in Komadan resulted in higher yield in this variety compared to WCT.

5.1.2 Correlation studies on mother palm characters

A knowledge of the association among floral characters, vegetative characters and yield of nuts is a pre-requisite for any selection programme (Satyabalan *et al*., 1969). Correlation provides information on the nature and extent of relationship among the various characters. Most of the correlations between floral and yield traits studied were found to be homogeneous during different seasons in both varieties with more homogenity in Komadan. This indicated that WCT is more sensitive to season compared to Komadan. Pieris (1934), Patel (1938) Narayana and John (1942), Menon and Pandalai (1958) and Nampoothiri *et al*. (1975) observed positive and significant correlation of number of female flowers with yield. Present study also observed such relation in WCT but not in Komadan. Nut yield was found to be positively and significantly correlated with number of spadices in WCT. Similar observations were made by Kalathiya and Sen (1991) in the coconut variety Dwarf Green. But this relation was not found in Komadan. In Komadan percentage fruitset was found to be positively and significantly correlated with yield. This is in conformity with the results of Menon and Pandalai (1958). Rate of fruitset varied inversely with number of female flowers per spadix and total number of female flowers in both the varieties. Similar observations were made by Balingasa and Carpio

(1983). This result points out that over production of female flowers is not a desirable character for mother palm selection. High correlation between number of spadices and number of bunches was observed in both varieties with perfect correlation in certain seasons. The correlations of number of spadices with number of nuts and number of female flowers and correlation between number of nuts per bunch and number of bunches showed high fluctuation during different seasons in WCT, indicating the high sensitiveness of these correlations to season. The variation in female flower production appeared to be related more to the number of female flowers per spadix than to the number of spadices as against the findings of Satyabalan etal (1969). In Komadan, number of spadices showed a negative association with fruitset as against the result of Kalathiya and Sen (1991) in coconut variety Dwarf Green. No significant relation was seen between these characters in WCT.

In general, in WCT, all the characters except percentage fruitset showed positive and significant correlation with nut yield, while in Komadan only three characters viz., number of nuts/bunch, number of bunches and percentage furitset showed positive and significant correlation with nut yield. This shows that the principal yield components in Komadan are number of nuts per bunch, number of bunches and percentage fruitset while in WCT high yields are the resultant effect of nuts per bunch, female flowers per spadix, number of bunches, total number of female flowers and number of spadices.

5.2.1 Seednut characters

The importance of seednut selection in coconut improvement was emphasised by Manthriratna (1970 b). Morphological characters of seednut were found to be related with the quality of planting material (Ghose and Debnath, 1987). Satyabalan (1985) pointed out that the quality of seednut at the time of harvest and weather conditions during germination and development of the seedlings rather than storage period largely account for the variation in germination, growth of seedling and recovery of seedlings with vigorous growth characters. Hence on the west coast of India seednuts harvested during the summer months may be stored and planted in the nursery during the onset of South West monsoon during June or July to obtain maximum germination and a high percentage of recovery of quality seedlings. In the present study, 16 seednut characters were considered to study the influence of different harvest times on seednut characters, of the two varieties viz., Komadan and WCT. All seednut characters studied differed significantly among harvests except thickness of meat. This is in agreement with the findings of Patel (1938), Pillai and Satyabalan (1960), Satyabalan and Mathew (1984) and Rao and Nair (1989). The coconut types Komadan and WCT did not show any significant difference in seednut characters (Shylaraj et al., 1991). In the present study Komadan was found to be superior to WCT for four characters viz., volume of nut water, weight of kernel, weight of embryo and copra content per nut. On the other hand Manju (1992) reported that Komadan was superior to WCT in all seednut characters except oil content, thickness of husk and husk/nut ratio. Variety x time of harvest interaction was significant for characters viz., equatorial diameter, weight of unhusked nut, weight of husk and husk/nut ratio.

Copra recovery differs between varieties, with Komadan showing superior value than WCT. This is in conformity with the reports of Manju (1992). Komadan and WCT recorded more or less similar values for equatorial diameter. No significant difference between varieties with regard to equatorial diameter was reported by Balakrishnan and Kannan (1991). Large sized nut and maximum copra content were abtained during hot weather period (February to May) for Komadan. Similar results were reported by Bhaskaran and Leela (1983). Percentage of oil was rather low in hot weather period when the production of copra was high. This is in conformity with the opinion of Patel (1938) and Nambiar and Rao (1991). This may be probably due to the effect of the higher maximum temperature which prevailed during the final stage of nut development (Nambiar and Rao, 1991). Patel (1938), Pillai and Satyabalan (1960) and Nambiar and Rao (1991) also reported large sized nut and maximum copra content during summer months (March - May). In WCT maximum nut size was exhibited by nuts harvested during winter periods (December - February) but maximum copra content during February to May itself as in the case of Komadan.

Umali (1940) reported high germination percentage and better quality seedlings from thin husked nuts than from the nuts with husk thickness of 3.0 cm or above. Similarly heavy nuts (1.85 - 2.45 kg) produced good quality seedlings. In the present study Komadan and WCT recorded similar values for thickness of husk and for weight of nut.. In both varieties thickness of husk was minimum during the month of June, but on par with that of February to March and August to September. In Komadan except during February and June during all other months the weight of nut was on par, with maximum value during May, while WCT recorded higher value for nut weight during August to December.

Weight of husked nut on an average was not significantly different between varieties. Similar observations were made by Ramanathan and Nallathambi (1988). In both varieties husked nut weight was at its maximum during summer months (March - May) and minimum during monsoon periods. This is in conformity with the findings of Vijayalakshmi et al., (1962).

Thickness of meat and split nut weight were not significantly different between Komadan and WCT, but Komadan was found to be significantly superior to WCT for kernel weight. This may be due to the significant difference among harvests for split nut weight and for kernel weight and may be due to the marginal superiority of Komadan for thickness of meat and split nut weight. Maximum quantity of kernel contained in the nut will have a direct bearing on the germination of the nut and growth of seedling. It was observed that the nuts harvested during summer months exhibited maximum value for splitnut weight and kernel. This is in general agreement with the findings of Aiyadurai (1962).

Komadan exhibited supeiority for embryo weight compared to WCT. Except in September, embryo weight was similar in all other times of harvest.

WCT exhibited more husk proportion among the two varieties studied which is in conformity with the result of Rao and Pillai (1982) and contrary to the report of Santos et al., (1981) who observed higher weight of fresh meat than husk in coconut population of Philippines. Husk weight was low during February and June in Komadan while during March and June in WCT.

Seednut quality index was more or less same for both varieties, but significant difference was observed during different times of harvest. The response of varieties with respect to this index was not consistent over harvests. In both the varieties nuts harvested during February and June to August exhibited maximum value for seednut quality index and minimum during October to December.

The variations in different nut characters during different seasons may be due to the influence of varying weather parameters during the process of nut development which extend to twelve months after fertilization (Nambiar and Rao, 1991). In the present study, the most important seednut characters like copra content per nut, Kernel weight, size of nut and husked nut weight were found to be maximum for nuts harvested during summer months in both the varieties. Hence summer months may be the best period for seednut collection for both WCT and Komadan in the west coast region. This is in conformity with the reports of Aiyadurai

(1954, 1962), Marar and Balakrishnan (1963), Thampan (1975) and Satyabalan (1983).

5.2.2 Correlations among seednut characters

Difference in the magnitude of association among seednut characters observed in the different months can be attributed to the effect of the seasons prevailing during development (Satyabalan and Mathew, 1984). In both Komadan and WCT most of the inter correlations among seednut characters were found to be homogeneous at different times of harvest. Correlations which were found heterogeneous in one variety were found to be homogeneous in the other variety. Varietal difference affected only a very limited number of correlations among seednut characters. The correlation of the most economically important seednut character copra content per nut with all other seednut characters was found to be homogeneous at different times of harvest in Komadan. In WCT correlation of copra content with weight of husked nut, weight of kernel and split nut weight were found to be heterogeneous at different times of harvest. In both Komadan and WCT copra content per nut was found to be positively and significantly correlated with equatorial diameter of nut, weight of unhusked nut and weight of opened nut, and in Komadan weight of husked nut also positively correlated with copra content per nut during the different times of harvest irrespective of seasonal effect. This is in conformity with the findings of Balakrishnan and Vijayakumar (1988) and Manju (1992). In WCT husked nut weight was positively and significantly correlated with copra content during all times of harvest except during December. In both Komadan and WCT, among the seednut characters, weight of kernel was found to be highly correlated with copra content. In Komadan equatorial diameter was positively and significantly correlated with copra content. This is in agreement with the findings of Balakrishnan and Vijayakumar (1988). But in WCT both polar diameter and equatorial diameter were found to be equally correlated with copra content per nut. From the farmers point of view size of nut and weight of unhusked nut are more important because, in the field they can not assess the weight of kernel or copra content which were believed to be most important seednut characters. Since in both varieties equatorial diameter and unhusked nut weight were positively and significantly correlated with copra content, these characters should be considered with due importance while selecting seednuts. The correlation between seednut quality index and copra content per nut was found to be positive and significant in both the varieties with highest correlation in WCT (r_p = 0.6432) compared to Komadan (r_p = 0.4310). Other seednut characters which were found positively and significantly correlated with copra content in both varieties were volume of nut water, weight of shell, diameter of eye and husk/nut ratio.

In Komadan oil content was significantly correlated with none of the seed nut characters, indicating the negligible effect of seednut characters on oil content in Komadan while in WCT it was found to be negatively correlated with weight of unhusked nut, weight of shell, weight of kernel weight of opened nut and weight of husk in all times of harvest. Similar results were reported by Manju (1992). Negative correlation between oil content and weight of husked nut during the months of December and May, negative correlation of oil content with volume of nut water during the months of October, December and May and its negative correlation with seed nut quality index during October and December was found in WCT. This indicates that in WCT the effect of season was not operating in the same way or to the same extent on oil content in different times of harvest.

Another most important seednut character, weight of kernel was found to be positively and significantly correlated with all seednut characters except thickness of husk, weight of embryo and oil content at all times of harvest in Komadan. In this variety polar diameter was found to be negatively related with kernel weight during December and August. In WCT weight of kernel showed positive and significant correlation with all seed nut characters except thickness of husk and thickness of meat. Weight of unhusked nut, weight of husked nut, weight of kernel and splitnut weight have shown intercorrelations among themselves. Similar correlations among seednut characters were reported earlier by Satyabalan and Mathew (1984), Balakrishnan and Vijayakumar (1988) and Manju (1992).

5.3.2.1 Direct and indirect effects of seednut characters on copra content per nut

Path coefficient analysis proposed by Wright (1923) is an effective means of examining the direct and indirect relationship among plant characters. The contribution of fifteen seednut characters on copra content per nut was high in WCT (88.9 per cent) compared to Komadan (60.7 per cent). This was attributed by the high correlation between seednut characters and copra content per nut in WCT compared to Komadan. In both the varieties, out of 15 seednut characters, five characters viz., equatorial diameter, weight of unhusked nut, weight of husked nut, weight of kernel and oil content were found to explain about 90 per cent of variation in copra content per nut that explained by 15 seednut characters. This suggested that irrespective of varieties the characters equatorial diameter, weight of unhusked nut, weight of husked nut, weight of kernel and oil content should be given emphasis while selecting seednuts. In Komadan weight of kernel had got maximum positive direct effect on copra content per nut. Correlation between these two characters was also found to be high in this variety. In WCT weight of husked nut followed by weight of kernel had maximum positive direct effects on copra content per nut and also exhibited high correlation with this character. Highest direct and positive effect of kernel content per nut on copra weight was observed by Louis and Chopra (1991). This revealed that kernel content per nut was the most important character determining copra content in Komadan, while in WCT copra content was mainly determined by both husked nut weight and kernel weight.

5.2.3.2 <u>Direct and indirect effects of seednut characters on oil content</u>

Only very limited amount of variability in oil content was explained by the seednut characters in both the varieties (13 per cent in Komadan and 25 per cent in WCT). This may be due to poor correlation between oil content and other seednut characters in both the varieties. This clearly indicates that oil content in coconut was mainly determined by some other characters other than the 15 seednut characters studied.

5.3 Correlation between mother palm characters and seednut characters

In both Komadan and WCT most of the correlations between mother palm characters and seednut characters were found to be homogeneous at different times of harvest. Homogeneity was more in Komadan than in WCT, indicating that relation between mother palm characters and seednut characters was more sensitive to seasonal fluctuation in WCT compared to Komadan. But only very limited number of correlations between mother palm characters and seednut characters in Komadan were found to be significant compared to WCT.

The most important economic character, yield of nuts per harvest was found to be negatively correlated with mean copra content per nut in WCT and in Komadan the oil content was found to be not significantly related with yield of nuts. Similar results were reported by Satyabalan (1982) and Bavappa and Sukumaran (1983) in WCT who opined that though mean copra content per nut was negatively correlated with yield, did not affect the annual out turn of copra per palm. In WCT oil content was positively correlated with yield of nuts. In this variety yield of nuts was also found to be negatively correlated with equatorial diameter, weight of unhusked and husked nuts, weight of splitnut and seednut quality index, while in Komadan yield of nuts was negatively correlated with equatorial diameter, weight of unhusked and husked nuts. In WCT negative correlation existed between the number of nuts in a bunch and most of the important seednut characters. This is in agreement with the finding of Mathew and Gopimony (1991b). But in Komadan nuts per bunch had correlation (negative) only with the seednut character equatorial diameter.

SUMMARY

SUMMARY

On the west coast of India which is the premier coconut growing tract, seednuts are being harvested during the summer months (February to May). Several studies were conducted earlier to understand the effect of harvesting time on seednut characters in WCT coconut variety. Similar studies in Komadan were not done so far. The present investigation was mainly to know whether the nuts harvested throughout the year can be used for seednut purpose in Komadan. An attempt was also made to find out the effect of season on various floral characters in the two varieties.

The investigation was conducted in the Department of Plant Breeding, College of Agriculture, Vellayani for a period of one year commencing from September 1991 to August 1992. The material consisted of two coconut varieties viz., Komadan and WCT of the same age group, ie., above 30 years old, growing in the Instructional Farm, Vellayani. Harvesting of nuts from the selected palms was conducted for a period of one year at intervals of 45 days. During each harvest, productivity attributes of the selected mother palms and seednut characters of both varieties were recorded. The data were subjected to statistical analysis. The results obtained were as follows.

1. In both Komadan and WCT, during February to May (Hot weather periods) there was higher production of bunches having proportionately more female flowers resulting in higher nut yields.

2. Komadan variety exhibited superiority over WCT in number of spadices per palm per year, number of nuts per bunch and annual nut yield per palm among seven mother palm charcters studied.

3. Correlation studies in mother palm characters revealed that the principal yield components in Komadan were number of nuts per bunch, number of bunches per season and percentage fruitset, while in WCT, high yields were the resultant effect of number of nuts per bunch, number of female flowers per spadix, number of bunches per season, total number of female flowers and number of spadices. It was also observed that in both varieties when the number of female flowers per spadix increases the retention percentage gets reduced.

4. Most of the correlations between floral and yield traits studied were found to be homogeneous at different times of harvest in both varieties, with more homogeneity in Komadan.

5. Important seednut characters like copra content per nut, kernel weight, size of nut, husked nut weight and seednut quality index were found to be at its maximum for nuts harvested during hot weather periods (February to May) in both WCT and Komadan, which reveals that hot weather periods are the best time for seedmut collection in Komadan and WCT.

6. The Komadan variety was found to be significantly superior to WCT in four seednut characters viz., weight of kernel, copra content per nut, weight of embryo and volume of nut water.

7. Most of the inter correlations among seednut characters were found to be homogeneous at different times of harvest in both Komadan and WCT. Correlations which were found heterogenous in one variety were found to be homogeneous in the other variety. Varietal difference affected only a very limited number of correlations among seed nut characters. Slight difference in the magnitude of association observed in the different months can be attributed to the effect of the season prevailing during development.

8. In both Komadan and WCT, among the seednut characters, weight of kernel was found to be highly correlated with copra content. When both equatorial diameter and polar diameter were found to be equally correlated with copra content in WCT, only equatorial diameter showed positive and significant correlation with copra content per nut in Komadan. The correlation between seednut quality index and copra content per nut was found to be positive and significant in both the varieties with highest correlation in WCT compared to Komadan. Oil content was not correlated with any of the seednut characters in Komadan. But in WCT, it was found to be negatively correlated with kernel weight.

9. Among the 15 seed nut characters studied, five characters viz., equatorial diameter, weight of unhusked nut, weight of husked nut, weight of kernel and oil content contributed 90 percent of the total variation explained by the 15 seednut characters on copra content per nut, in both komadan and WCT. Kernel weight was found to be the most important character determining copra content in Komadan, while in WCT, copra content was mainly determined by both husked nut weight and kernel weight.

10. The very limited variability for oil content was explained by the 15 seednut characters studied in both Komadan and WCT. This indicates that oil content in coconut was mainly determined by some characters other than the 15 seednut characters studied.

11. Most of the correlations between motherpalm characters and seednut characters were found to be homogeneous in different times of harvest. Homogeneity was more in Komadan than in WCT.

12. In Komadan, yield of nuts was negatively correlated with equatorial diameter, weight of unhusked nut and weight of husked nut. But in WCT yield of nuts was negatively correlated with almost all seednut characters.

Based on seednut qualities, hot weather period (February to May) was found to be the most suitable time for seednut collection in both Komadan and WCT.

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* - Original not seen

Appendix-i

Chi Square Values for homogeneity test within variety

Komadan

X1	7.89	4.68	11.23	14.39	8.20	10.37	16.88	7.83	10.43	8.97	11.27	2.26	15.21	7.29	5.39	2.97	5.76	13.90	8.06	9.05	6.64	13.59	12.52
X2	4.28	3.75	3.04	4.55	2.08	1.34	5.66	4.94	5.19	5.20	7.66	1.23	5.45	3.59	2.32	2.14	15.94	2.62	4.26	2.20	6.90	7.37	
X3	5.08	5.53	5.67	5.19	4.79	3.78	1.65	2.53	7.62	13.28	5.15	5.04	3.86	1.16	1.83	16.15	0.82	5.41	1.04	4.23	5.51		
X4	2.33	4.69	2.68	3.18	7.30	5.60	15.38	7.71	3.95	2.32	8.37	7.71	2.92	2.04	13.46	3.62	3.83	2.36	9.44	6.87			
X5	4.95	2.57	6.49	2.76	4.54	8.09	6.62	2.59	2.46	3.64	8.68	3.47	3.13	11.60	5.97	1.80	5.41	13.36	5.01				
X6	2.50	4.83	3.02	4.71	11.62	8.22	1.56	2.87	4.93	8.42	5.74	3.93	7.09	6.05	1.29	5.89	12.23	7.52					
X7	7.38	3.11	6.75	7.15	9.15	7.79	6.92	2.45	4.03	2.40	3.14	6.53	6.43	2.35	4.08	8.55	2.84						
X8	2.91	5.71	5.90	6.79	4.13	8.27	2.45	9.35	3.57	4.83	11.97	5.86	8.30	6.11	13.07	3.83							
X9	3.35	5.31	9.94	11.11	2.86	10.81	13.02	3.03	5.28	5.28	5.00	9.11	3.34	4.31	6.45								
X10	4.52	6.52	4.80	6.18	6.05	8.23	9.90	2.10	14.83	4.31	7.52	3.86	19.28	4.10									
X11	8.58	6.04	6.11	16.13	8.36	3.09	3.98	4.31	2.88	4.31	3.24	6.80	17.43										
X12	5.58	7.59	7.42	7.09	3.44	3.45	9.62	2.75	5.07	4.37	7.83	7.70											
X13	4.84	6.73	9.91	3.38	16.37	5.14	5.22	7.31	8.36	4.43	2.84												
X14	2.08	7.20	3.17	4.01	9.88	5.87	2.52	5.53	12.14	2.86													
X15	5.67	2.63	1.62	16.31	3.02	4.98	0.81	7.43	7.99														
X16	2.73	2.76	13.44	1.74	4.03	3.78	7.47	8.43															
X17	3.50	6.05	5.23	48.91	2.93	4.47	12.76																
X18	5.90	0.68	7.35	X11039.74	3.36	2.96																	
X19	11.18	6.27	5.41	X24690.4	3.05																		
X20	7.45	5.08	11.50	7.29																			
X21	8.23	7.36	2.05																				
X22	3.28	3.73																					
X23	2.99																						

WCT

X1	3.67	1.57	3.51	2.99	2.13	3.39	5.72	8.12	10.68	7.34	5.70	6.65	5.00	4.94	3.62	10.05	2.58	9.25	1.37	8.83	3.41	7.41	3.42
X2	5.44	4.92	2.63	3.58	1.92	1.68	5.49	6.84	1.34	2.18	7.66	1.81	1.43	1.70	4.95	7.65	4.35	5.70	4.15	5.57	1.05	11.41	
X3	8.26	4.28	3.04	3.66	5.23	5.75	11.71	1.98	5.95	2.84	4.66	9.83	7.65	5.93	5.19	5.10	9.43	2.64	2.14	3.99	9.23		
X4	8.90	6.99	11.23	8.33	8.35	10.07	7.93	8.64	13.80	9.64	7.06	3.34	2.35	2.03	11.57	4.65	3.23	2.54	2.93	7.19			
X5	10.46	8.35	6.49	9.17	3.98	5.93	19.63	14.70	4.93	7.88	1.88	3.66	4.18	26.28	5.05	3.18	2.86	5.26	6.42				
X6	4.25	4.90	5.77	7.87	6.42	8.47	21.39	4.07	7.32	3.84	4.84	4.69	33.64	6.63	5.02	3.57	6.53	5.53					
X7	7.69	12.48	5.12	6.17	6.82	13.13	8.59	8.06	1.34	3.22	3.19	18.72	4.00	3.50	2.90	4.78	8.60						
X8	11.37	2.04	5.32	24.6	13.26	5.17	7.37	1.63	3.37	3.19	20.86	5.11	2.54	2.15	4.05	7.21							
X9	9.83	1.97	10.80	6.97	11.83	6.15	4.87	4.56	2.92	4.00	6.81	4.39	3.41	5.08	11.14								
X10	6.68	0.73	12.42	2.51	13.04	6.50	9.11	5.90	5.20	2.54	9.94	6.38	3.70	10.88									
X11	4.09	6.46	5.57	7.11	3.83	1.24	5.50	5.29	3.50	5.48	4.20	3.71	7.72										
X12	11.14	19.92	5.15	2.33	5.82	5.63	23.84	2.73	4.59	4.05	4.37	8.57											
X13	13.62	12.09	10.18	3.69	18.18	6.25	17.31	3.18	19.75	4.08	14.13												
X14	7.78	1.17	3.27	3.49	20.94	4.57	2.66	2.51	4.32	7.86													
X15	4.28	3.73	3.99	4.93	7.84	3.22	5.72	3.25	3.18														
X16	7.23	2.74	7.53	8.84	1.87	3.01	9.17	2.66															
X17	11.31	16.79	8.24	X11022.39	11.62	5.38	9.32																
X18	4.56	4.48	8.84	X18841.80	0.98	3.58																	
X19	2.55	16.03	7.79	X26177.33	3.86																		
X20	8.03	7.80	X11951.	2.44																			
X21	8.45	X11647.	2.91																				
X22	X11612.66	3.00																					
X23	3.82																						

Appendix ii

Pooled Z values for homogeneity test between varieties

>1.96 Heterogeneous

X1	2.93	0.17	4.26	4.43	4.57	3.67	4.02	0.43	3.34	1.51	3.50	0.99	4.06	3.47	1.50	1.82	1.46	1.46	0.72	1.93	1.75	0.88	4.27
X2	0.40	0.00	1.25	0.97	0.42	1.41	2.53	1.74	1.93	0.00	0.16	1.22	0.79	1.06	1.18	2.77	0.36	2.46	0.78	2.63	0.15	0.20	
X3	0.73	1.30	1.40	0.83	1.56	1.62	0.64	1.67	0.67	1.04	1.35	0.67	1.21	0.11	0.81	0.31	1.12	0.08	0.80	0.00	0.52		
X4	0.00	0.40	1.19	0.12	1.62	1.01	0.68	1.84	1.50	0.39	0.59	0.54	1.24	2.39	0.73	1.96	0.79	2.39	0.21	1.80			
X5	2.59	2.44	2.40	1.05	0.59	1.12	0.06	1.10	3.61	0.24	0.49	0.99	1.62	0.38	1.46	0.36	1.47	0.10	0.42				
X6	2.61	2.93	0.26	1.17	0.74	4.17	1.55	3.02	0.31	0.59	0.38	1.46	0.34	1.76	0.19	1.37	0.00	0.12					
X7	1.67	1.35	0.99	1.85	3.68	0.60	1.82	0.86	0.36	0.71	1.43	0.00	1.48	0.28	1.42	0.05	0.95						
X8	2.15	0.31	1.12	4.06	1.08	0.00	0.29	0.58	1.39	1.61	0.43	1.35	0.73	1.38	0.36	0.34							
X9	1.28	0.67	2.47	0.05	1.91	1.67	0.26	0.06	0.83	1.24	1.42	0.22	0.98	0.26	2.04								
X10	0.34	0.07	0.43	0.52	1.23	0.05	1.87	2.53	0.01	1.83	1.24	2.43	0.21	1.51									
X11	0.63	0.62	1.38	0.47	0.95	0.73	0.57	0.05	0.00	0.57	0.72	0.21	0.99										
X12	0.90	4.64	1.42	0.29	1.73	2.07	0.83	1.30	1.24	1.53	0.83	1.54											
X13	0.98	1.53	0.52	0.77	0.11	0.26	0.78	0.66	0.05	0.10	1.51												
X14	0.44	0.51	1.22	1.58	0.27	1.42	0.57	1.46	0.26	0.00													
X15	0.85	1.36	2.80	0.71	2.31	0.98	2.94	0.37	0.89														
X16	0.31	0.86	0.83	0.88	0.46	0.88	0.47	0.22															
X17	2.84	1.35	2.26	219.26	3.41	1.60	0.88																
X18	0.79	0.65	2.77	0.00	0.36	0.97																	
X19	0.00	0.61	0.87	0.00	2.90																		
X20	2.47	1.13	228.70	0.36																			
X21	2.47	225.75	1.31																				
X22	224.34	2.28																					
X23	2.88																						

Direct and Indirect effects of 15 seed nut characters on copra content per nut

K1 - Komadan

0.0800	-0.0082	-0.0065	0.0200	0.2377	-0.0021	0.1155	0.4162	0.0361	-0.0114	-0.0346	0.0008	-0.7322	-0.1627	-0.1987
-0.0016	0.4104	-0.0167	0.7919	-0.5409	0.0036	-0.4235	-0.8464	0.0403	0.0341	-0.0566	-0.0129	1.7179	-0.6421	-0.0675
0.0248	0.3283	-0.0209	0.5312	-0.1475	0.0010	-0.0770	-0.1942	0.0170	0.0136	-0.0661	-0.0114	0.3661	-0.5651	-0.2099
0.0016	0.3242	-0.0111	1.0024	-0.6720	0.0045	-0.5390	-1.0406	0.0530	0.0522	0.0157	-0.0030	2.1403	-0.8133	-0.1050
-0.0232	0.2709	-0.0038	0.8219	-0.8195	0.0054	-0.6930	-1.3181	0.0467	0.0579	0.0220	-0.0106	2.7035	-0.5051	0.1349
-0.0280	0.2545	-0.0036	0.7718	-0.7539	0.0059	-0.5929	-1.0684	-0.0170	0.0409	0.0220	-0.0129	2.2248	-0.4794	0.1162
-0.0120	0.2257	-0.0021	0.7016	-0.7375	0.0045	-0.7699	-1.2071	0.0445	0.0443	-0.0189	-0.0129	2.6472	-0.4024	0.1349
-0.0240	0.2504	-0.0029	0.7518	-0.7785	0.0045	-0.6699	-1.3875	0.0976	0.0636	0.0220	-0.0083	2.7880	-0.4366	0.1499
0.0136	0.0780	-0.0017	0.2506	-0.1803	-0.0005	-0.1617	-0.6382	0.2121	0.0329	-0.0220	0.0045	1.0983	-0.1969	0.0112
-0.0080	0.1231	-0.0025	0.4611	-0.4179	0.0021	-0.3003	-0.7770	0.0615	0.1136	0.0850	-0.0129	1.4644	-0.2997	0.0375
-0.0088	-0.0739	0.0044	0.0501	-0.0574	0.0004	0.0462	-0.0971	-0.0148	0.0307	0.3147	-0.0068	0.0845	-0.0171	0.0150
0.0008	-0.0698	0.0031	-0.0401	0.1147	-0.0010	0.1309	0.1526	0.0127	-0.0193	-0.0283	0.0757	-0.3661	-0.0086	-0.0375
-0.0208	0.2504	-0.0027	0.7618	-0.7867	0.0046	-0.7238	-1.3736	0.0827	0.0591	0.0094	-0.0098	2.8162	-0.4366	0.1499
0.0152	0.3078	-0.0138	0.9522	-0.4835	0.0033	-0.3619	-0.7076	0.0488	0.0398	0.0063	0.0008	1.4362	-0.8562	-0.2174
0.0424	0.0739	-0.0117	0.2807	0.2950	-0.0018	0.2772	0.5550	-0.0064	-0.0114	-0.0126	0.0076	-1.1265	-0.4966	-0.3748

Residue = .3931

W1 - WCT

0.2417	0.2754	-0.0493	0.0569	-0.0397	-0.1897	-0.5189	-0.0627	-0.0039	-0.1538	0.0164	0.0092	0.9703	-0.0172	-0.1346
0.1209	0.5509	-0.1117	0.0652	-0.0389	-0.1937	-0.4986	-0.0584	0.0045	-0.1754	0.0173	0.0102	0.8894	-0.0199	-0.1717
0.0822	0.4242	-0.1451	0.0346	0.0055	0.0395	0.0611	0.0228	0.0036	-0.0738	0.0100	-0.0025	-0.2628	-0.0142	-0.3249
0.1668	0.4352	-0.0610	0.0825	-0.0639	-0.3162	-0.8140	-0.1082	0.0009	-0.1846	0.0164	0.0163	1.5969	-0.0236	-0.0835
0.1233	0.2754	0.0102	0.0676	-0.0779	-0.3834	-0.9768	-0.1395	-0.0003	-0.1815	0.0255	0.0173	2.0012	-0.0152	0.2042
0.1160	0.2699	0.0145	0.0660	-0.0756	-0.3953	-0.9259	-0.1310	0.0005	-0.1661	0.0191	0.0224	1.8799	-0.0147	0.1903
0.1233	0.2699	0.0087	0.0660	-0.0748	-0.3597	-1.0175	-0.1324	0.0008	-0.1661	0.0264	0.0143	1.9607	-0.0145	0.1949
0.1064	0.2259	0.0232	0.0627	-0.0763	-0.3637	-0.9463	-0.1424	-0.0012	-0.1846	0.0255	0.0158	2.0012	-0.0135	0.2274
0.0604	-0.1598	0.0334	-0.0049	-0.0016	0.0119	0.0509	-0.0114	-0.0156	-0.0154	0.0055	-0.0036	0.0809	0.0022	0.0371
0.1209	0.3140	-0.0348	0.0495	-0.0460	-0.2135	-0.5495	-0.0854	-0.0008	-0.3076	0.0301	0.0127	1.1926	-0.0132	0.0511
0.0435	0.1047	-0.0160	0.0148	-0.0218	-0.0830	-0.2951	-0.0399	-0.0009	-0.1015	0.0911	-0.0015	0.5862	-0.0027	0.1021
-0.0435	-0.1102	-0.0073	-0.0264	0.0265	0.1739	0.2849	0.0441	-0.0011	0.0769	0.0027	-0.0509	-0.6266	0.0069	0.0000
0.1160	0.2424	0.0189	0.0652	-0.0771	-0.3676	-0.9870	-0.1410	-0.0006	-0.1815	0.0264	0.0158	2.0214	-0.0140	0.2228
0.1692	0.4462	-0.0842	0.0792	-0.0483	-0.2372	-0.6003	-0.0783	0.0014	-0.1661	0.0100	0.0143	1.1522	-0.0245	-0.2135
0.0701	0.2038	-0.1016	0.0148	0.0343	0.1621	0.4274	0.0698	0.0012	0.0338	-0.0200	0.0000	-0.9703	-0.0113	-0.4641

Residue = 0.1109

Direct and Indirect effects of 15 seed nut characters on oil content

K2 - Komadan

0.0921	0.0010	-0.2037	-0.0265	-0.6110	0.3335	0.0550	-0.6904	-0.0877	0.0359	0.0418	-0.0928	0.5519	0.1468	0.4640
-0.0018	-0.0486	-0.5258	-1.0454	1.3906	-0.5908	-0.2016	1.4038	-0.0980	-0.1078	0.0685	0.1447	-1.2948	0.5795	0.1576
0.0286	-0.0389	-0.6572	-0.7014	0.3793	-0.1620	-0.0367	0.3222	-0.0413	-0.0431	0.0799	-0.0037	-0.2759	0.5100	0.4903
0.0018	-0.0384	-0.3483	-1.3233	1.7277	-0.7338	-0.2566	1.7260	-0.1290	-0.1653	-0.0190	0.1521	-1.6132	0.7341	0.2452
-0.0267	-0.0321	-0.1183	-1.0851	2.1070	-0.8767	-0.3299	2.1862	-0.1135	-0.1833	-0.0266	0.2560	-2.0377	0.4559	-0.3152
-0.0322	-0.0301	-0.1117	-1.0190	1.9384	-0.9529	-0.2823	1.7720	0.0413	-0.1294	-0.0266	0.1781	-1.6769	0.4327	-0.2714
-0.0138	-0.0267	-0.0657	-0.9263	1.8963	-0.7338	-0.3666	2.0021	-0.1084	-0.1401	0.0228	0.2375	-1.9953	0.3632	-0.3152
-0.0276	-0.0296	-0.0920	-0.9925	2.0016	-0.7338	-0.3189	2.3013	-0.2374	-0.2012	-0.0266	0.3043	-2.1014	0.3941	-0.3502
0.0157	-0.0092	-0.0526	-0.3308	0.4635	0.0762	-0.0770	1.0586	-0.5160	-0.1042	0.0266	0.1855	-0.8278	0.1777	-0.0263
-0.0092	-0.0146	-0.0789	-0.6087	1.0745	-0.3431	-0.1430	1.2887	-0.1496	-0.3593	-0.1027	0.1967	-1.1038	0.2705	-0.0876
-0.0101	0.0087	0.1380	-0.0662	0.1475	-0.0667	0.0220	0.1611	0.0361	-0.0970	-0.3804	0.1002	-0.0637	0.0155	-0.0350
-0.0230	-0.0189	0.0066	-0.5426	1.4538	-0.4574	-0.2346	1.8871	-0.2580	-0.1904	-0.1027	0.3711	-1.6556	0.1314	-0.4465
-0.0239	-0.0296	-0.0854	-1.0057	2.0227	-0.7528	-0.3446	2.2783	-0.2012	-0.1869	-0.0114	0.2894	-2.1226	0.3941	-0.3502
0.0175	-0.0364	-0.4338	-1.2572	1.2431	-0.5336	-0.1723	1.1737	-0.1187	-0.1258	-0.0076	0.0631	-1.0825	0.7727	0.5078
0.0488	-0.0087	-0.3681	-0.3705	-0.7585	0.2954	0.1320	-0.9205	0.0155	0.0359	0.0152	-0.1892	0.8490	0.4482	0.8755

Residue = 0.8702

W2 - WCT

0.3830	0.6870	-0.0992	-1.4960	1.9788	-1.4583	-0.9854	-0.7704	0.0274	-0.4042	0.0312	-0.9314	2.1472	1.0239	-0.3135
0.1915	1.3740	-0.2247	-1.7128	1.9400	-1.4887	-0.9468	-0.7179	-0.0317	-0.4608	0.0330	-0.9081	1.9682	1.1848	-0.4000
0.1302	1.0580	-0.2919	-0.9106	-0.2716	0.3038	0.1159	0.2801	-0.0252	-0.1940	0.0191	0.3260	-0.5815	0.8484	-0.7568
0.2643	1.0855	-0.1226	-2.1681	3.1817	-2.4306	-1.5458	-1.3307	-0.0066	-0.4851	0.0312	-1.5368	3.5339	1.4042	-0.1946
0.1953	0.6870	0.0204	-1.7779	3.8801	-2.9471	-1.8550	-1.7159	0.0022	-0.4770	0.0486	-2.2121	4.4285	0.9069	0.4757
0.1839	0.6733	0.0292	-1.7345	3.7637	-3.0382	-1.7583	-1.6108	-0.0033	-0.4365	0.0365	-2.0258	4.1601	0.8776	0.4433
0.1953	0.6733	0.0175	-1.7345	3.7249	-2.7648	-1.9322	-1.6284	-0.0055	-0.4365	0.0503	-2.0957	4.3391	0.8630	0.4541
0.1685	0.5634	0.0467	-1.6478	3.8025	-2.7951	-1.7970	-1.7509	0.0088	-0.4851	0.0486	-2.2354	4.4285	0.8045	0.5298
0.0958	-0.3985	0.0671	0.1301	0.0776	0.0911	0.0966	-0.1401	0.1094	-0.0404	0.0104	-0.1630	0.1789	-0.1316	0.0865
0.1915	0.7832	-0.0700	-1.3009	2.2893	-1.6406	-1.0434	-1.0505	0.0055	-0.8084	0.0573	-1.2108	2.6392	0.7899	0.1189
0.0689	0.2611	-0.0321	-0.3903	1.0864	-0.6380	-0.5604	-0.4903	0.0066	-0.2668	0.1736	-0.8848	1.2972	0.1609	0.2379
0.1532	0.5359	0.0409	-1.4310	3.6861	-2.6432	-1.7390	-1.6809	0.0077	-0.4204	0.0660	-2.3285	4.2943	0.6143	0.5947
0.1839	0.6046	0.0379	-1.7128	3.8413	-2.8255	-1.8743	-1.7334	0.0044	-0.4770	0.0503	-2.2354	4.4733	0.8338	0.5190
0.2681	1.1130	-0.1693	-2.0814	2.4057	-1.8229	-1.1400	-0.9630	-0.0098	-0.4365	0.0191	-0.9780	2.5498	1.4627	-0.4973
0.1111	0.5084	-0.2043	-0.3903	-1.7072	1.2457	0.8115	0.8579	-0.0088	0.0889	-0.0382	1.2807	-2.1472	0.6729	-1.0812

Residue = 0.7499

Appendix-v

Seed nut quality index values

II 1									
26.76594	29.7859	28.5539	28.35412	28.22692	26.97815	22.99292	22.78733	31.33446	23.15919
25.88451	22.62191	26.32797	23.90182	30.51775	25.60491	33.10334	21.86357	31.77797	26.77059
II 2									
17.09469	20.75505	16.01676	17.17063	17.85449	17.92871	15.8154	13.75575	21.65332	17.47826
20.69701	17.06939	16.87189	15.82705	20.18227	14.76356	24.95053	14.96146	17.61949	15.91685
II 3									
13.66603	15.59453	14.0798	14.46561	15.15789	14.60362	13.16792	11.84344	14.54778	15.96401
16.13414	12.51203	15.37029	13.2243	16.47907	13.12398	22.02193	12.10673	14.95921	14.40136
II 4									
26.55793	34.92757	28.98297	30.12643	31.3814	28.54618	27.89127	24.08071	32.77251	27.23524
34.0021	27.84728	31.57721	28.05417	33.29138	27.91248	41.07054	26.35865	35.56968	30.1615
II 5									
23.47569	32.04727	22.04224	26.74551	23.82969	23.70517	23.20913	21.93778	24.86276	23.62512
22.29124	19.53409	21.12246	20.49355	25.60465	19.65934	22.90142	20.09574	21.92525	21.06562
II 6									
21.64352	30.6471	23.01974	25.418	24.13547	21.73533	24.06202	20.58701	24.49021	27.74769
24.42018	21.74025	22.87249	20.46181	24.03596	20.89277	25.94702	19.60534	22.71335	21.70597
II 7									
28.41978	37.00405	33.21847	31.9626	27.83317	27.68397	29.7568	28.71957	30.03433	28.67015
30.5253	27.86767	29.18632	22.91128	28.12655	25.75434	37.53845	25.52924	29.05829	26.51918
II 8									
27.35803	30.74674	29.21862	28.00794	32.65333	26.84927	27.8777	28.18309	28.09571	29.0111
35.33461	30.23283	30.1725	28.23786	27.431	27.06648	31.84301	25.64441	28.23861	27.58303

EFFECT OF HARVESTING TIME ON SEEDNUT CHARACTERS IN COCONUT

BY

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ABSTRACT OF A THESIS
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ABSTRACT

On the west coast of India, seednuts are being harvested during the summer months (February to May). The present investigation was mainly to know whether the nuts harvested through out the year can be used for seednut purpose in Komadan. An attempt was also made to find out the effect of season on the floral characters in the two varieties.

Study on the effect of season on the manifestation of the various floral characters revealed that, in both Komadan and WCT, during February to May there was higher production of bunches having proportionately more female flowers resulting in higher nut yields.

The study on mother palm characters revealed that the Komadan variety exhibited superiority over WCT in number of spadices per palm per year, number of nuts per bunch and annual nut yield per palm.

Correlation studies in mother palm characters revealed that the principal yield components in Komadan were number of nuts per bunch, number of bunches per season and percentage fruitset, while in WCT, high yields were

the resultant effect of number of nuts per bunch, number of female flowers per spadix, number of bunches per season, total number of female flowers and number of spadices. It was also observed that in both varieties when the number of female flowers per spadix increases the retention percentage gets reduced.

Most of the correlations between floral and yield traits studied were found to be homogeneous at different times of harvest in both varieties, with more homogeneity in Komadan.

Study on the effect of harvesting time on seednut characters revealed that February to May (hot weather periods) is the best period for seednut collection in both WCT and Komadan. This is based on the fact that the important seednut characters like copra content per nut, kernal weight, size of nut, husked nut weight and seednut quality index were found to be at its maximum for nuts harvested during summer months in both WCT and Komadan.

The Komadan variety was found to be significantly superior to WCT in four seednut characters viz., weight of kernel, copra content per nut, weight of embryo and volume of nut water.

Varietal difference affected only a very limited number of correlations among seednut characters. Most of the inter correlations among seednut characters were found to be homogeneous at different times of harvest in both Komadan and WCT.

In both Komadan and WCT, among the seednut characters, weight of kernel was found to be highly correlated with copra content. Oil content was not correlated with any of the seednut characters in Komadan. But in WCT, it was found to be negatively correlated with kernel weight.

Among the 15 seednut characters studied, five characters viz., equatorial diameter, weight of unhusked nut, weight of husked nut, weight of kernel and oil content contributed 90 per cent of the total variation explained by the 15 seednut characters on copra content per nut, in both Komadan and WCT.

In both Komadan and WCT, the very limited variability for oil content was explained by the 15 seednut characters studied.

In Komadan, yield of nuts was negatively correlated with equatorial diameter of nut, weight of unhusked nut and weight of husked nut. But in WCT, yield of nuts was negatively correlated with almost all seednut characters.

Based on seednut qualities, hot weather periods (February to May) were found to be the most suitable time for seednut collection in both Komadan and WCT.