

**“STUDIES ON FLOWERING AND FRUITING BEHAVIOUR OF  
DIFFERENT VARIETIES OF CASHEW (*Anacardium occidentale*  
Linn.) IN SOUTH GUJARAT.”**

**A**

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**BY**

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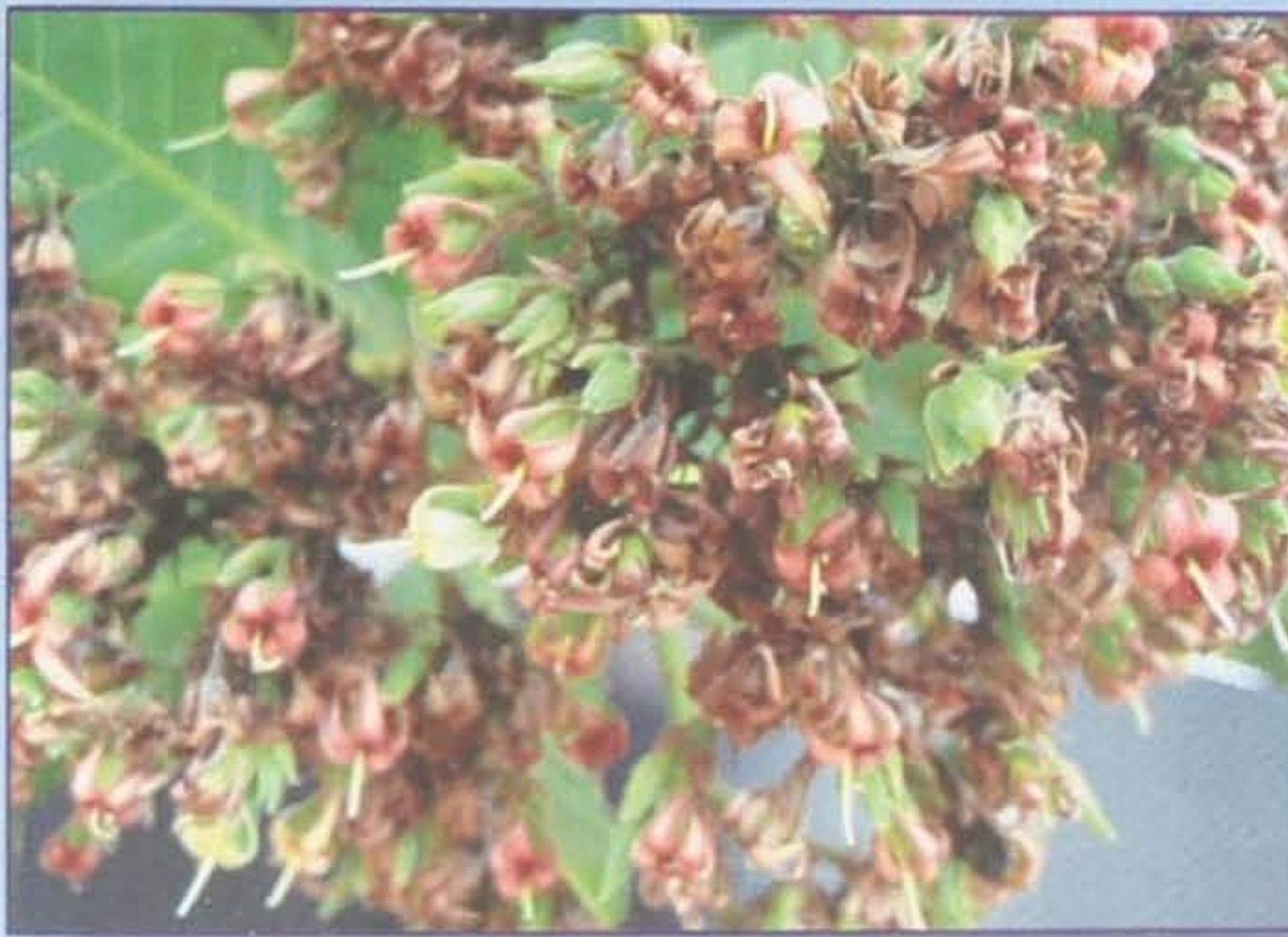
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**ABSTRACT**

**“STUDIES ON FLOWERING AND FRUITING BEHAVIOUR  
OF DIFFERENT VARIETIES OF CASHEW (*Anacardium  
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**ABSTRACT**

The present investigation entitled “Studies on flowering and fruiting behaviour of different varieties of Cashew (*Anacardium occidentale* Linn.) in South Gujarat.” was undertaken at Agriculture Experimental Station, Navsari Agriculture University, At & Po: Paria, Ta: Pardi, Dist. Valsad during the year 2010. This experiment consists of seven varieties released from Vengurla and planted at Paria farm i.e. Vengurla-1, Vengurla-2, Vengurla-3, Vengurla-4, Vengurla-5, Vengurla-6 and Vengurla-7 which are replicated four times with Randomized Block Design.

The highest total number of flowers, staminate flowers and percentage of staminate flowers were recorded under Vengurla-5, while highest percentage of hermaphrodite flowers and sex ratio were observed in Vengurla-7. However higher number of hermaphrodite flowers were recorded under Vengurla-4.

The Vengurla-5 had recorded highest number and percentage of fruit set with minimum days for period of harvest and

percentage of fruit drops at 15 days. Vengurla-2 had recorded minimum number of fruit drops at all periods with minimum percentage of fruit drops at 45 days. While minimum percentage of fruit drops at harvest stage was recorded under Vengurla-7 with minimum numbers of nuts per kilogram. However yield was highest recorded under Vengurla-4.

The highest weight and volume of apple with diameter of nut and length of apple was recorded under Vengurla-4. Highest diameter of Proximal, Middle, Distal end and average diameter of apple were recorded under Vengurla-3. However highest weight and volume of nut was recorded by Vengurla-7. Vengurla-6 had recorded highest length of nut. Yellow colour apple were observed under Vengurla-1, Vengurla-3, Vengurla-5, Vengurla-6 and Vengurla-7. Vengurla-2 and Vengurla-4 were observed with red colour.



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## C E R T I F I C A T E

This is to certify that the thesis entitled "STUDIES ON FLOWERING AND FRUITING BEHAVIOUR OF DIFFERENT VARIETIES OF CASHEW (*Anacardium occidentale* Linn.) IN SOUTH GUJARAT." submitted by SOLANKI PUSHPRAJSINH DOLATSINH in partial fulfillment of the requirement for the award of degree of MASTER OF SCIENCE (AGRICULTURE) in HORTICULTURE of Navsari Agricultural University is a record of bona fide research work carried out by him under my guidance and supervision and the thesis has not previously formed on the basis for the award of any degree, diploma or other similar title.

Place: Navsari

Major Advisor

(N. I. Shah)

Date: 23-5-11

## DECLARATION

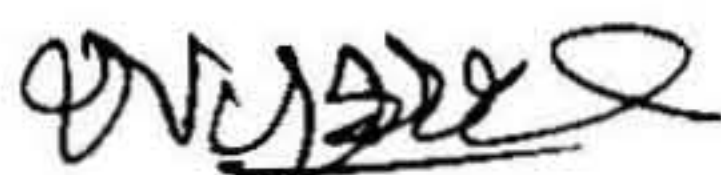
This is to declare that whole of the research work reported in the thesis is partial fulfillment of the requirement for the degree of **Master of Science (Agriculture) in Horticulture** by the undersigned is the results of investigation done by me under direct guidance and supervision of **Dr. N. I. Shah**, Associate Research Scientist, Agriculture Experimental Station, Navsari Agricultural University, Pariya farm, Ta. Pardi, Dist. Valsad and part of the work has been submitted for any other so far.

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## ABBREVIATIONS

SR. NO.	ABBREVIATION	MEANING
1	%	Per cent
2	/	Per
3	@	At the rate of
4	Anon	Anonymous
5	C.D.	Critical difference
6	C.V.	Co-efficient of variance
7	cm	Centimeter
8	cv.	Cultivar
9	<i>et al.</i>	<i>Et alii</i> (and others)
10	g	Gram(s)
11	<i>i. e.</i>	That is
12	Kg	Kilogram(s)
13	mg	Milligram
14	ml	Milliliter
15	No.	Number
16	°C	Degree Centigrade
17	S.Em.	Standard error of mean
18	Var.	Variety
19	<i>viz.</i>	Such as

## I. INTRODUCTION



# INTRODUCTION

## I. INTRODUCTION

---

Cashew (*Anacardium occidentale* L.) is one of the most important cash crops amongst the horticultural crops in the country. Cashew, a member of the family Anacardiaceae, is a native of South Eastern Brazil and in India, it is introduced in the first half of the sixteenth century by the Portuguese in Goa and Malabar hills and then it was spread slowly to other parts of the country. In the beginning it was mainly considered as a crop for afforestation and soil binding to check erosions. Because of its adaptive ability in wide range of agro climatic conditions with good production potential, it has become a crop of good economy and attained the status of an export oriented commodity bringing considerable foreign exchange to the country.

Now, India is the largest producer, processor and exporter of cashew kernel in the world (Nayar, 2000). Indian cashews are exported to more than 60 countries in the world and 60 per cent of cashew imported in USA is from India. Netherlands, UK, UAE and Japan are the other major countries importing cashew kernels from India (Wadkar *et al.*, 2007).

Cashew is mainly a crop of tropics. Its distribution extends up to 27°N and 28°S latitude and is restricted to altitude below 700 meter where average temperature does not fall below 20°C per annum but can withstand the rainfall from 30 to 40 centimeter.

It is now grown in the coastal areas of the most of the tropical countries between the Tropic of Cancer and Capricorn.

India is the largest area holder of this crop. Cultivation of cashew in India is confined mainly to the peninsular region. Presently the cashew cultivation in India is mainly confined to the coastal regions of Kerala, Maharashtra, Tamilnadu, Andhra Pradesh, Goa, Karnataka, Orissa and West Bengal. To a limited extent, it is being cultivated in Chhattisgarh, North Eastern States (Assam, Manipur, Tripura, Meghalaya and Nagaland), Andaman & Nicobar Islands and some part of Gujarat.

In India, the cashew is cultivated in an area of about 8,93,000 hectare with an annual production of 6,95,000 metric tones and productivity is 0.8 metric tones per hectare. In Gujarat, the cashew is cultivated in an area of about 6,000 hectare with a total production of 4,000 metric tones (Anon 2009).

Cashew tree is a hardy and drought resistant plant but very sensitive to frost. It can be cultivated in a wide range of soils. The cashew tree is andromonoecious (poly-gamomonoecious) with staminate (male) and hermaphrodite (bisexual) flowers appearing on the same panicle. Panicle called as inflorescence, where the secondary branches are racemes and the ultimate branchlets being cymes. Flowering period of cashew extends from September to March. The peak flowering period is December to February. It has two types of flower *viz.* staminate or male and hermaphrodite or bisexual or perfect. Flowers appearing on the same inflorescence are small in size, pentamerous, white or light greenish white in colour at the time of opening and later turning to pink. There is slight variation in size of flower of different varieties; usually the perfect flowers are bigger than the staminate flowers (Nair, 1980).

The cashew fruit consist of two parts, *viz.*, the apple or the false fruit and the nut or the true fruit. The growth rate of the nut was much faster than that of the apple in early stages of development (Augustin and Unnithan, 1982). The nut and apple do not grow at the same pace from set to maturity. The fruit is a kidney shaped nut containing single seed. The nut is born on a fleshy peduncle, which greatly enlarges and ripens into the cashew apple. The main by-product of cashew tree is cashew apple. The fully ripe cashew apple is full of juice with exotic flavor and fine pleasing aroma (Natarajan, 1979). Cashew apple can be utilized for preparation of fermented and non-fermented beverages, preserved products like jam, jelly, syrup, juice and soft drinks. Ripe cashew apple is also consumed as a delicious fruit by the rural people and its utilization can fetch additional income to the farming community. The kernels have high nutritive values which are rich in protein (21%), carbohydrates (22%), unsaturated fat (47%), minerals and vitamins (Rai, 1984).

The production of cashew in our country is not sufficient to meet the requirements of industry. The processing capacity of Indian cashew industry is 7 lakh metric tons per annum as against which only 4.7 lakh metric tons is provided by internal production. The deficit of which is met by import of raw cashew nut mainly from the African countries. This leads to drain of huge foreign exchange besides disturbing the market stability in the country leading to downfall of prices. Hence, there is an urgent need to increase the cashew production in our country.

The lower productivity in cashew may be due to exiting senile plantations on unfertile waste land with very poor genetic

stock, lack of nutritional management and adequate plant protection measures (Wadkar *et al.*, 2000). A high yielding variety is a most common way to increase the production. Till now more than 40 varieties of cashew have been developed in various parts of our country, which have contributed significantly for increasing its production. But successful cashew cultivation depends on the selection of the best varieties suited for the agroclimatic condition and adoption of right package of practices recommended for the region. Variety selection is the most critical decision in plantation management (Salam, 1999). The various research stations over all India have developed various varieties and hybrids of cashew for growing in different agroclimatic regions of our country.

In Gujarat the cashew is generally grown in the area of Dang, Valsad and Dahod districts. At present cashew variety release from Maharashtra, Vengurla-4 is performing well with production and very popular particularly in western part of South Gujarat. Processing industries are already established in this region of South Gujarat due to viable condition for cultivation of Cashew. The climatic condition of South Gujarat is similar to Cashew grown area of the Maharashtra. But there is lack of information about cultivation of other promising varieties release from Maharashtra of cashew in the agroclimatic condition of the South Gujarat. So the present investigation was carried out to find out the feasibility of other varieties released from Dapoli under South Gujarat condition. By evaluating different varieties of cashew, it will possible to provide wide scope for the processing industries for enhancing the income of the farmer and also promotes cashew cultivation.

The present investigation was therefore undertaken at Paria (Valsad District, South Gujarat region, nearer to coastal area of Daman and border of Maharashtra state) to study flowering and fruiting behaviour, physical changes during growth and development of cashew of some promising selections *viz.*, Vengurla-1, Vengurla-2 and hybrids *viz.*, Vengurla-3, Vengurla-4, Vengurla-5, Vengurla-6 and Vengurla-7 of cashew released from Vengurla, Dapoli with following objectives:

- To study the flowering and fruiting behaviour of different cashew cultivars under South Gujarat condition.
- To study the physiological parameters of cashew apple and nut at maturity.



REVIEW  
OF  
LITERATURE

## II REVIEW OF LITERATURE

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The research work done on flowering and fruiting behaviour, physical composition of cashew (*Anacardium occidentale* L.) was review under the following headings.

2.1 Flowering behaviour of cashew

2.2 Fruiting behaviour of cashew

2.3 The physiological parameters of cashew apple and nut at maturity.

### 2.1 Flowering behaviour of cultivars of cashew

Ashok and Thimmaraju (1983) reported that the panicles produced in the northern direction of the tree had significantly higher number and percentage of hermaphrodite flowers and the number of fruits set with the lower sex ratio as compared to the panicles produced in the other directions of the tree. The panicles produced in the lower position of the tree were found to have higher proportion of hermaphrodite flowers and lower sex ratio when compared to those produced in the middle position of the tree. The total number of flowers, number and percentage of hermaphrodite flowers and also the number of fruit set progressively increased from the base to the apex of the panicle indicating a positive relationship between the production of hermaphrodite flowers and fruit set at Bangalore condition.

Hallad and Sulikeri (1992) stated that the sex ratio was highest in 6/21 Moodabidri-Mysore (0.13), followed by 2/77 Tuni-Andhra and 2/61 Alangudi-Madras (0.11), while the least ratio was recorded in 8/46 Taliparamba-Kerala (0.06) at Dharwad condition.

Hanamashetti *et al.* (1986) revealed that the maximum and minimum number of flowers per panicle *i.e.* 837 and 165 were recorded under 3/67, 5/23 accession, respectively. The highest 61.1 number of hermaphrodite flowers per panicle was found in 9/86 followed by 52.2 (3/108) and the number was low in 2.5 (5/23) and 6.6 number (1/26). The ratio of male to bisexual flowers was least in 1/94 (4:1) followed by 9/86 (8:1), 1/40 (10:1), 3/108 (11:1), 3/67 (15:1) and 7/108 (15:1), whereas, it was highest in 1/26 (66:1) followed by 5/23 (54:1), 8/46 (44:1) and 9/66 (42:1) at Ullal condition.

Lenka *et al.* (1999) revealed that, flowering period continued up to 14<sup>th</sup> week in BPP 30/1 and H-303, while the peak staminate flower production was found from 3<sup>rd</sup> to 6<sup>th</sup> week and maximum perfect flowers produced up to 5<sup>th</sup> and 6<sup>th</sup> week. In case of the high sex ratio, was observed within the first three weeks of flower opening, but after 6<sup>th</sup> week the sex ratio declined at Bhubaneswar condition.

Murthi *et al.* (1974) studied the floral biology in cashew and concluded that the number of staminate flowers varied from 106 to 1380 and that of bisexual flower from 0 to 74 in panicles.

Narayana Reddy *et al.* (1989) observed that the maximum and minimum number of flowers *i.e.* 642.75 and 201.0 were reported under 3/108 Gubbi, 9/66 Chirala cultivars, respectively. The staminate flowers per panicle ranged between 63.25 (2/77 Tuni) and 463.50 (5/23 Coondapur) while the hermaphrodite flower per panicle ranged from 53 (1/63 Trumpet) and 212.75 (9/66 Chirala). The highest 74.18 percentage of

hermaphrodite flowers per panicle was found in 2/77 'Tuni at eastern dry zone of Karnataka condition.

Pavithran and Ravindranathan (1974) considered that the sexual phase specificity in anthesis in cashew inflorescence indicated three distinct phase: (1) the first male phase, (2) the mixed phase, and (3) the second male phase. The magnitude of pollen loss due to a prolonged first male phase has been indicated. A longer mixed phase with abundant flowering could ensure high sex ratio. An intrinsic balancing system controlling such a mixed phase would be of immense value for increasing yield in cashew. Genotypic selection for appropriate sexual phase specificity in anthesis may be possible in cashew and this may help in designing an ideal type for this crop plant at Kerala condition.

Samal *et al.* (2006) established the varietal evaluation of cashew varieties under Bhubaneswar condition and reported that the number of flowering per panicles were maximum in Vridhachalam-2 (24.88) closely followed by Vengurla-4 (23.42). The flowering duration varied from a maximum of 95 days in BPP-3 to a minimum of 40 days in Jhargram-1. The varieties Kanaka, Varidhachalam-2 Priyanka and NRCC-2 exhibited higher sex-ratio of more than 0.70.

Sena *et al.* (1995) reported that the sex ratio varied from 1.038 to 0.093 in various cashew types under study. Highest ratio was observed in BBSR cluster-1 (1.082) followed by H-1598 (0.817), Vengurla-3 (0.498) and it was minimum in H-1600 (0.093). The percentage of bisexual flowers under Bapatla condition extended 10.5% in Hyb-2/15 to 20.0 % in T-129. The percentage

of bisexual flower was maximum in cashew type Madakkathara condition.

Sheshagiri (1996) showed the flowering period and sex ratio in fifteen cashew varieties and reported more than 45 percent perfect flowers in 8/46-Taliparamba, Kerala (61.68%), 1/26-Nileshwar, Kerala (55.33%) 1/61-Alangudi, Madras (54.38%) and 2/97-Kottarakkara, Kerala (45.12%), while three selections (8/46-Taliparamba, Kerala (1.6:1), 1/26-Nileshwar, Kerala (1.24:1) and 1/61-Alangudi, Madras (1.18:1) had sex ratio more than one at Karnataka conditions.

Singh *et al.* (2008) studied on flowering behavior of the cashew cultivars *viz.* VTH-30/4, Kanaka (H-1598), H-2/15, Damodar (H-1610), VTH-12 and BLA-39-4 among them the ratio of perfect to staminate flowers was found to range from 0.07 (BLA-39-4) to 1.34 (Kanaka). While, in case of total number of flowers the variety BLA-39-4 (449.0) recorded significantly higher flowers as compared to other varieties. The variety VTH-30/4 (180.0) recorded the least number of flowers. The number of staminate flowers per panicle ranged between 104.25 (VTH-30/4) to 418.33 (BLA-39-4). The number of perfect flowers per panicle for above six varieties varied from 30.67 (BLA-39-4) to 114.98 Kanaka (H-1598) at West Bengal conditions.

The flower bud differentiation in cashew occurred between October-November and extended nearly 48 to 93 days. The duration of flowering ranged from 48 to 93 days. Hybrids 255, 30/1, 303 and 367 were produced higher number of hermaphrodite flowers with low Staminate: Hermaphrodite ratio having higher opportunities of fruit setting and production, even hybrid 3/28

and Vrindachalam-2 have produced high percentage of hermaphrodite flowers at Bastar region of Chhatisgarh (Sharma *et al.*, 2009).

## 2.2. Fruiting behaviour

### 2.2.1. Fruit set and fruit drop

Under Vengurla conditions, the fruit set in cashew was found to vary from 0.71 to 30.91 per cent and fruit drop varied from 8.19 to 96.84 per cent in different hybrid trees (Anonymous, 1973).

The first set in cashew under Vengurla conditions was observed to be 4.8 to 8.6 fruits per panicle and percentage of fruit set varied from 2.57 to 8.31 per cent in different hybrid trees (Anonymous, 1975).

Chattopadhyay and Ghosh (1993) discovered that highest percentage of fruit set with TN-16 (54.40 %) followed by BLA-39-4 (46.0 %), while it was found significantly lower in the Ansur No.-1 (28.60 %). The higher percentage of fruit retention was observed in Vector 56 (23.0%) followed by Red Hazari (15.0 %), while it was found significantly lower in the Ansur No.-1 (6.20 %) at Jhargram conditions.

Sapkal *et al.* (1994) determined the highest percentage of fruit set with 1/61 Alagudi Madras (21.83%), followed by 2/77 Tuni Andhra (20.69 %) while it was found significantly lower in the 6/21 Moodheri Mysore (8.51 %). The higher percentage of fruit retention was observed in 2/77 Tuni Andhra (18.22 %) at Dharwad conditions.

### 2.2.2. Yield and period of harvest

Krishnappa *et al.* (1989) observed that there was significant difference in nut yield amongst different selection during different years. Selection 8/46 Taliparamba recorded the highest mean yield (842.38 kg/ha) followed by 9/66 Chirala (678.18 kg/ha) at eastern dry zone of Karnataka.

Kumar *et al.* (1984) recorded that the yield of about 14.68 kg per plant and short duration of harvest varied from 50-60 days in cashew nut.

Lenka *et al.* (2003) revealed that nut yield and duration of nut collection ranged 1.88 to 8.79 per plant and 25-50 days, respectively in different varieties at Orissa condition.

Mahesha *et al.* (2005) established a trial on performance of Cashew varieties under hill zone of Karnataka and concluded that the nut yield per tree was found highest in varieties Vengurla-3 (4.60kg) followed by Vengurla-6 (4.25kg), Selection-2 (4.06kg) and Selection-1 (3.63kg) were performing better under hill zone of Karnataka. While the lowest yield was recorded in Vengurla-4 (2.00kg).

Nalini and Santhakumari (1991) had taken an experiment on ten promising varieties of cashew and resulted that the yield ranged 13.22 (K-16-1) to 29.29 (BLA-139-1) kg/tree/year, while the duration of harvest ranged 28 days (BLA-139-1) to 58 days (NLR-2-1) at Anakkayam, Kerala condition.

Nalini *et al.* (1994) had conducted an experiment on thirty-six high yielding cashew varieties and concluded that hybrids

H-1-1, H-3-4, H-7-6, H-8-8 and H-8-10 were the good yielders. Among these, H-8-10 produced maximum yield of about 12.43 kg/tree at Anakkayam, Kerala condition.

Reddy *et al.* (2002) showed that the nut yield ranged from 1.40 to 3.4 kg/tree at Bapatla condition.

Samal *et al.* (2006) worked on varietal evaluation of cashew varieties under Bhubaneswar condition and reported that the average nut yield varied from a minimum of 1.23 kg/plant (Jhargram-1) to a maximum of 11.60 kg/plant in BPP-8.

Sapkal *et al.* (1991) reported that the nut yield ranged from 1.360 Kg to 4.032 Kg per tree. The Selection 1/61 Alangudi Madras Registered highest yield (4.032 Kg/tree) followed by 2/77 Tuni Andhra (3.589 Kg/tree) and minimum in 4/43 Wyned Kerala (1.360 Kg/tree) at Karnataka condition.

### 2.2.3. Number of nut/kg

Nalini and santhakumari (1991) revolved that the variety K-16-1 had significantly minimum number of nut per kg i.e. 112, while significantly the maximum (325) number of nut per kg found with K-25-2 and K-26-1 (179) at Anakkayam, Kerala condition.

Narayana Reddy *et al.* (1986) recorded that significantly the minimum number of nut per kg with 6/21 Mudabidri i.e. 146, while significantly the maximum (325) number of nut per kg found with 1/61 Alangudi at Chintamani condition.

## 2.3 Physiological parameters of cashew apple and nut at maturity

### 2.3.1 Weight of Cashew nut and apple

Antarkar and Joshi (1986) observed that the apple increased throughout its growth and development irrespective of varieties at Dapoli condition.

Haldankar *et al.* (1986) discovered that the apple of variety Vengurla-3 exhibited maximum weight (75.22 g) followed by Vengurla-1 (56.81 g) at Dapoli condition.

Hallad *et al.* (1993) discovered that apple weight was maximum in 9/78 Ullal-Mysore (35.49 g) and it was least in 1/63 Chrompet-Madras (10.88 g) at Dharwad condition.

Kumar *et al.* (1984) established that the fresh weight of cashew nut increased throughout the first 50 days, thereafter drying and shrinking of nut at Dharwad condition.

Mahesha *et al.* (2005) recognized that the variety Selection-2 produced heaviest nut (9.76 g) followed by Vengurla-6 (8.57 g) and Selection-1 (8.48 g). The least weight of nut (4.69 g) was recorded in Vengurla-2 at hill zone of Karnataka.

Nalini and santhakumari (1991) revolved that the variety K-16-1 produced heaviest apple (80 g) and nut (8.9 g). The least weight of apple and nut was recorded with and K-28-1 (5.1 g) NLR-2-1 (27 g) respectively, at Anakkayam, Kerala condition.

Narayana Reddy *et al.* (1986) confirmed that the maximum apple weight (62.1 g) was recorded in 6/21 Mudabidri and minimum in 1/63 Chrompet (17.8 g), while maximum nut

weight (7.0 g) was recorded in 6/21 Mudabidri and minimum (2.5 g) in 9/62 Alangudi at Chintamani condition.

Renganayaki and Kavivaratharaju (1993) observed the maturity stages of nut and reported that the nuts attained the maturity within 40 days after fruit set.

Sapkal *et al.* (1991) recorded that the nut weight was maximum in 9/78 Ullal Mysore (6.52 g) followed by 6/21 Moodbedri Mysore (6.33 g) and minimum in 1/61 Alangudi Madras at Karnataka condition.

Sapkal *et al.* (1992) established that the variety 9/78 Ullal-Mysore produced apples of maximum weight (68.32 g) whereas the apple weight was the minimum in 1/61 Alangudi-Madras (26.82 g) at Dharwad condition.

Sena *et al.* (1995) established that apple weight was maximum in VTH 30/4 (87.28 g) and minimum in BBSR Cluster-1 (18.14 g) and rest of cultivars apple weight ranged from 25.75 g to 66.25 g at Dharwad condition.

Vilasachandran and Damodaran(1981) affirmed that the type K 10-2 ranked first in the mean weight of apple among the other sixteen high yielding types of cashew viz., Ansur 1-27, Vengurla 36-3, Sawantwadi, Vengurla 37-3, BLA-1, BLA-40, BLA-56, BLA-273, M 10/4, M 6/1, K 27-1, M 76-1, H 4-7, K 10-2, BLA 139-1, BLA 256-1, at Kerala condition.

### 2.3.2 Volume and specific gravity

Antarkar (1986) reported that the volume of cashew nut depicted a linear increase from fruit set till  $\frac{1}{4}$ <sup>th</sup> apple stage,

followed by a decline till full-grown apple stage. However, the specific gravity recorded an increasing trend from fruit set till maturity of nut at Dapoli condition.

Haldankar *et al.* (1986) exposed that the volume of cashew apple varied from 34.32 ml (Vengurla-5) to 88.49 ml (Vengurla-3). The apple of variety Vengurla-3 exhibited maximum volume (88.49 ml) followed by Vengurla-1 (57.26 ml), while the specific gravity varied from 0.764 (Vengurla-3) to 0.992 (Vengurla-1) at Dapoli condition.

Narayana Reddy *et al.* (1986) established that the highest volume of apple (65.6 ml) was found in 6/21 Mudabidri and it was lowest (16.0 ml) in 1/63 Chrompet, while the nut volume was highest (4.0 ml) in 2/97 Kottarakara and lowest (1.0 ml) in 1/64 Maduranthankam and 5/23 Coondapur at Chintamani condition.

Sena *et al.* (1995) established that the specific gravity of apple was highest in cashew types H-1608 (0.980) followed by H-1597 (0.976) and lowest in BBSR Cluster-1 (0.823) at Dharwad condition.

Thamburaj *et al.* (1980) concluded that the density of the nut increased in linear fashion up to harvest at Periakulam condition.

### 2.3.3 Size of nut and apple

Antarkar (1986) reported that the length of cashew increased gradually from fruit set till 1/4<sup>th</sup> grown apple stage followed a slight decline thereafter, the diameter of nut exhibited

an increasing trend from fruit set till 1/4<sup>th</sup> grown apple stage and then a slight decline upto full grown apple stage at Dapoli condition.

Arvindakshan *et al.* (1986) studied the thirteen cashew types for their physico-chemical attributes of apple and nut found that the length of apple and nut in different types differed significantly. Among these varieties H-3-13 has longest nut of 30.23 mm and shortest 2.91 in k-28-2. Out of thirteen cashew types in ten types, the average length of nut was more than 3 cm and breadth being ranged from 2.49 cm (H-3-17) to 2.11 cm (k-28-2).

Haldankar *et al.* (1986) declared that the Vengurla-3 had the biggest size of cashew apple while the smallest size was recorded in a variety Vengurla-5. The apple of variety Vengurla-3 exhibited maximum diameter at proximal end (5.53 cm), middle portion (6.73 cm) and distal end (7.11 cm) at Dapoli condition.

Sapkal *et al.* (1992) recognized that the length of apple was maximum in 1/64 Madhurandhkam-Madras (5.62 cm) and minimum in 8/46 Taliparamba-Kerala (3.78 cm). While the apple diameter was lowest in 1/64 Madhutandhkam-Madras (2.58 cm) whereas the diameter of apple was the maximum in 1/26 Nileswar-Kerala (3.63 cm) followed by 2/48 Taliparamba-Kerala (3.62 cm) at Dharwad condition.

Sena *et al.* (1995) established that the apple length was maximum in VTH-30/4 (7.85 cm) followed by Hyb-2/15 (7.23 cm) and minimum in BBSR Cluster-1 (4.04 cm) at Dharwad condition.

Thamburaj *et al.* (1980) revealed that growth of the nut was faster upto 14 days after fruit set followed by slow increase upto 35 days and afterwards, there was a steady decline upto harvest at Periakulam condition.

The growth patterns of cashew apple, pericarp and kernel showed different types. Initially, the nut grew much faster than the apple but in later stages, apple increased in size much more rapidly than the nut. Both pericarp and kernel reached their maximum size about 30 days after fruit set and thereafter the pericarp become hard and its growth decreased at Culcutta condition (Chattopadhyay *et al.* 1983).

#### 2.3.4 Colour

Antarkar and Joshi (1986) observed the colour of cashew nuts changed from brownish green at fruit set to gray at maturity at Dapoli condition.

Kumar and Aravinakshan(1985) confirmed that the colour of apple of different types could be classified under three categories viz; red, yellow, and mixed shades of these two. The colour of cashew apple was red under Ansur-1, BLA-1, BLA-139-1, BLA-256-1 and M-10-4, where as it was red under variety Sawantwadi. While the varieties Vengurla 36-3, M-6-1, K-27-1 and T-20 had mixed shades of these two at Kerala condition.

Haldankar *et al.* (1986) declared that the apple of Vengurla-1 was roundish, yellow and bigger than Vengurla-2 which produced conical apples with darker red colour. Vengurla-3 was characterized with big, cylindrical yellow coloured apple while Vegurla-4 had exceptionally conical and red coloured apple.

Vengurla-5 exhibited small roundish and golden yellow apples at Dapoli condition.

Hallad *et al.* (1993) revealed that the colour of apple varied with the cultivars and it was red in 2/48 Taliparamba-Kerala, 8/46 Taliparamba-Kerala, 1/61 Alangudi-Madras, 1/63 Chrompet-Madras, 1/64 Madhuranthakam-Madras, 2/64 Madhuranthakam-Madras, 1/26 Neeleshwar-Kerala. While, the yellow colour apples were found in 9/78 Ullal-Mysore, 6/21 Moodabidri-Mysore, 2/61 Alangudi-Madras and 2/77 Tuni-Andra at Dharwad condition.

Krishnappa *et al.* (1989) pragmated that the colour of cashew apple was red under 9/66 Chirala and 6/21 Mudabidri, where as it was yellow under varieties 5/23 Coondapur, 8/46 Taliparamba and 1/11 Ullal at eastern dry zone of Karnataka.

Nalini and Santhakumari (1991) revolved that the yellow coloured apples were observed in cultivar like K-10-1 and NLR-2-1, it was orange under K-25-2, K-10-2, K-28-2 and K-10-1, while it was red under K-19-1, K-22-1 and K-16-1 at Anakkayam, Kerala condition.

Narayana Reddy *et al.* (1986) observed the colour of fully matured apple varied with the selection and it ranged from brick red to red, light red, yellow, orange, yellow with green tinge, grey and light grey with yellow streaks at Chintamani condition.

Sena *et al.* (1995) established that the yellow coloured apples were observed in cultivar like H-1608, H-1610, Hyb-2/16, BPT-40, TN-129, M-26/2, M-44/3, V-3, BBSR Cluster-1, While orange red apple was observed in VTH-59/2 and pink coloured

apples in BBSR Cluster-2, V-4, V-2, VTH-30/4, H-1600 at Dharwad condition.

Vilasachandra and Damodaran (1984) reported that the colour of apple of different types could be classified under three categories *viz.* red, yellow, and mixed shades of these two.



# MATERIALS AND METHODS

### III MATERIALS AND METHODS

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The present investigation entitled, "Studies on flowering and fruiting behaviour of different varieties of Cashew (*Anacardium occidentale* Linn.) in South Gujarat." was undertaken at Agriculture Experimental Station, Navsari Agriculture University, At & Po: Paria, Ta: Pardi Dist. Valsad during the year 2010. The experimental material *i.e.* cashew apples and cashew nuts of was selected from different varieties *viz.* Vengurla-1, Vengurla-2, Vengurla-3, Vengurla-4, Vengurla-5, Vengurla-6 and Vengurla-7 were obtained from fifteen years old uniform trees of above varieties from Agriculture Experimental Station, Navsari agriculture university, At & Po. Paria, Dist. Valsad. The details of materials and method followed to carry out the said investigation are given below as per objectives of the study. During the course of investigation, flowering behaviour with respect total number of flowers, staminate flowers, hermaphrodite flowers and sex ratio, fruiting behaviour with respect to fruit set and fruit drop, physiological parameters of cashew apple and nut at maturity were studied.

#### 3.1 Location and climate

##### 3.1.1 Experimental site

The experiment was conducted at Agriculture Experiment Station, Navsari agricultural University, Paria, which is situated in Valsad district of Gujarat state at elevation of 10 meter above mean sea level latitude of 20<sup>0</sup>-57<sup>0</sup> N and east 72<sup>0</sup>-54<sup>0</sup> E longitude. Site is 10 kilometers away from seashore.

### **3.1.2 Climate and weather:**

The climate of this area is typically tropical, characterized by fairly hot and humid summer, warm monsoon with more humidity and moderately cold winter. The rainfall in this zone is heavy and normally received from southwest monsoon commences from second week of June up to end of September. The annual mean precipitation of this region is 1500 -2000 mm in 50 rainy days and grouped under south Gujarat heavy rainfall zone (I). July and August are month of heavy precipitation. Temperature ranges in rainy season is 20 to 30<sup>0</sup>c.

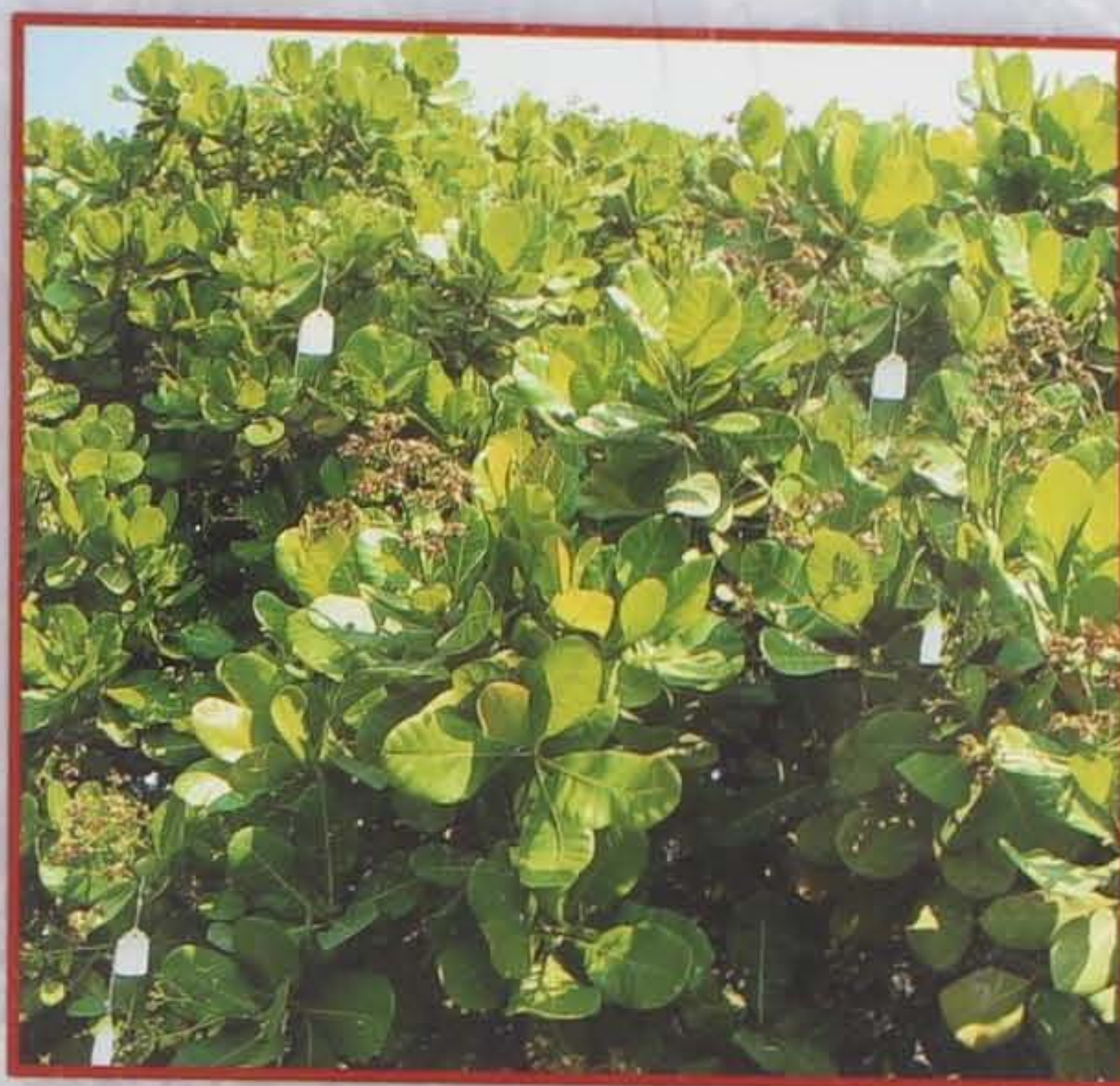
The winter season usually sets by end of October. The temperature starts declining in beginning of November and continues till the middle of February. The temperature becomes lowest in months of December and January. Frost is rarely occurrence in this area.

The summer commences from mid February and prolongs up to first fortnights of June the temperature rising from February onwards. April and May are the hottest months of the year. The metrological data in respect of maximum and minimum temperature, relative humidity and sunshine hours recorded at meteorological observatory of Agriculture Experimental Station, Paria during course of investigation from December to May 2009-10 presented in Appendix-I.

### **3.1.3 Soil**

Experimental site having a well drained alluvial to black soil. The soils in this agro-climatic zone are medium to deep with high clay content mainly belong to Entisols, Inceptisols

**Plate-1 : Method of tagging to panicle with muslin cloth bag**



and Vertisols. The permeability of the soils is low to very low. They are alkaline in nature and in the coastal area they are salt affected. They are low to medium in nitrogen, medium to high in phosphorus and sufficient in potash. The soil of the station contains 7.45 pH with 0.3 EC.

### **3.2 Experimental details**

#### **3.2.1 Experimental design**

The experiment was conducted under randomized block design (RBD) with four replications.

#### **3.2.2 Selection of trees**

For the experiment, a group of twenty eight trees having uniform size and canopy are selected for one replication. There were four replications so one hundred twelve trees used for present study from Block 6 plot 26 of the paria farm. The cashew orchard of experimental area were received the management practices of manures as well as recommended dose of fertilizers application, irrigation and cultural practices including plant protection measures.

#### **3.2.3 Treatment details**

**T<sub>1</sub> : Vengurla-1**

**T<sub>2</sub> : Vengurla-2**

**T<sub>3</sub> : Vengurla-3**

**T<sub>4</sub> : Vengurla-4**

**T<sub>5</sub> : Vengurla-5**

**T<sub>6</sub>** : Vengurla-6

**T<sub>7</sub>** : Vengurla-7

- 3.2.4**      **No. of trees per treatment**                      : 4 (Four)
- 3.2.5**      **No. of Replication**    : 4 (Four)
- 3.2.6**      **No. of trees in one replication** : 28 (Twenty eight)
- 3.2.7**      **Year and season**    : 2009- 2010

### **3.3**              **Procedure of tagging**

Selected 40 branches in one tree randomly with 10 branches in each direction and tagged it for recording different observations *viz.*, flowering and fruiting behaviour.

### **3.4**              **Observations recorded**

#### **3.4.1**            **Flowering behaviours**

1. Total number of flowers/Panicle
2. Staminate flowers/Panicle (Number and Percentage)
3. Hermaphrodite flowers/Panicle (Number and Percentage)
4. Sex ratio

#### **3.4.2**            **Fruiting behaviors**

1. Fruit set (Number and Percentage)
2. Number and Percentage of fruit drop (15 days interval)
3. Yield (Kg/tree)

4. No. of nuts per Kg
5. Period (Duration) of harvest

### **3.4.3 Physical parameter of cashew apple and nut at maturity**

1. Weight of Cashew nut and apple (gm)
2. Volume of fruit and nut (ml)
3. Specific gravity of nut and apple
4. Size of nut and apple
  - a) Length of nut (cm)
  - b) Length of apple (cm)
  - c) Diameter of nut (cm)
  - d) Diameter of apple (cm)
5. Colour

## **3.5 Detailed procedure of recording observations**

### **3.5.1 Flowering behaviour of different cashew cultivars**

Selected 40 branches in one tree randomly with 10 branches in each direction and tagged. Out of 40 branches 20 were used for recording flowering behaviour observation and remaining 20 were used for recording fruiting behaviour observation.

The five panicles were selected randomly from all direction on each tree and recorded different flowering behaviour at alternate days and at each counting the newly opened flowers are removed from each selected panicle by forceps.

### **3.5.1.1 Total number of flowers/panicle**

Total number of flowers were counted from the five panicle of each side *i.e.* 20 panicles and mean value of total number of flowers was recorded.

### **3.5.1.2 Staminate flowers/panicle (Number and Percentage of flowers)**

Total number of Staminate flowers were counted from the five panicle of each side *i.e.* 20 panicles and mean value of staminate flowers and percentage of staminate flowers on basis of total flowers was calculated.

### **3.5.1.4 Hermaphrodite flowers/panicle (Number and Percentage of flowers)**

Total number of Hermaphrodite flowers were counted from the five panicle of each side *i.e.* 20 panicles and mean of Hermaphrodite flowers and percentage of Hermaphrodite flowers on basis of total flowers was calculated.

### **3.5.1.5 Sex ratio**

The ratio of number of hermaphrodite flowers to the number of staminate flowers in the panicle was worked out and average of twenty panicles calculated.

### **3.5.2 Fruiting behaviour**

Among 40 tagged panicles, 20 panicles were selected for taking flowering behaviour and remaining 20 panicles were used for taking fruiting behaviour observations.

### **3.5.2.1 Fruit set (Number and Percentage)**

The drying of stigma and swelling of ovary are the indications of fruit set; such flowers were recorded as set fruits. The total numbers of hermaphrodite flowers were counted and using this data the percent fruit set per panicle was worked out.

### **3.5.2.2 Number and Percentage of fruit drop (15 days interval)**

For recording fruit drop, the muslin cloth bag was prepared and placed below the selected panicles, the fruits which dropped down were collected in that bag were counted and expressed as number of fruits dropped per panicle at 15 days interval the percent fruit set per panicle was worked out.

### **3.5.2.3 Yield (kg/tree)**

The average yield of nuts of four trees per replication was recorded during the season.

### **3.5.2.4 Number of nut per kg**

Among the total nuts produced on tree, one kg of nut was taken from each variety and number of nuts per Kg was counted.

### **3.5.2.5 Period (Duration) of harvest**

Harvesting of nuts was done at weekly interval. The period of harvest was computed from the date of initial harvesting to the date of final harvest.

### **3.5.3 Physical parameters of cashew apple and nut at maturity**

For this study, twenty fruits at maturity stage of fruit from each variety were randomly selected and brought into laboratory for recording different observations on the same day.

#### **3.5.3.1 Weight of cashew nut and apple**

Nut and apple of individual fruit were separated and weighed separately in grams on weighing balance. The average weight of twenty fruit was then calculated in grams.

#### **3.5.3.2 Volume of apple and nut**

Volume of apple and the nut was estimated separately by water displacement method using a measuring cylinder and recorded in milliliters by calculating the mean of twenty samples.

#### **3.5.3.3 Specific gravity of nut and apple**

The specific gravity of apple and nut was determined by dividing values of fresh weight by that of volume of apple and nut respectively.

#### **3.5.3.4 Size of nut and apple**

The size of cashew nut and apple was measured with the help of vernier calipers and expressed in centimeters.

##### **a) Length of nut**

The length of nut was calculated as linear distance between proximal and distal end of nut, which was measured with

the help of vernier calipers and recorded in centimeters. The mean length of twenty samples were calculated.

**b) Length of apple**

The length of apple was calculated as linear distance between proximal and distal end of apple measured with the help of vernier calipers and recorded in centimeters. The mean length of twenty samples were calculated.

**c) Diameter of nut**

The diameter of nut was recorded at middle having maximum size with the help of vernier calipers and recorded in centimeters. The mean length of twenty samples was recorded.

**d) Diameter of apple**

The diameter of apple was recorded at three point's *viz.* proximal, middle and distal ends with the help of vernier calipers and recorded in centimeters. The mean length of twenty samples was recorded.

**3.5.3.5 Colour**

Cashew apple and nut colour were determined by visual observation at maturity.

**3.6 Statistical analysis**

The data collected were analyzed statistically as per the procedure for Randomized block Design (RBD) (Panse and Sukhatme, 1967). The treatment means were compared by the value of critical differences at 5 per cent level of probability and

then analyzed statistically in the Department of Agricultural statistics, N.M. College of Agriculture, Navsari.



# EXPERIMENTAL RESULTS

## IV EXPERIMENTAL RESULTS

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In order to achieve a set of objectives, a field experiment entitled “Studies on flowering and fruiting behaviour of different varieties of Cashew (*Anacardium occidentale* L.) in South Gujarat” was carried out during the year 2009-2010 at Agriculture Experimental Station, Navsari Agricultural University, At & Po.Paria, Ta. Pardi, Dist. Valsad of Gujarat state. The results pertaining to flowering and fruiting behaviour have been presented in this chapter which recorded during the course of investigation and were subjected to statistical analysis.

### 4.1 Flowering behaviour

#### 4.1.1 Total no. of flowers/panicle

The data pertaining to total no. of flowers/panicle of different cashew varieties was presented in table 1. Significantly the highest total no. of flowers/panicle *i.e.* 524.86 was found with Vengurla-5 which was followed by Vengurla-1, while, total no. of flowers/panicle was found significantly the lowest 274.24 with Vengurla-6 which was statistically at par with Vengurla-7, Vengurla-3 and Vengurla-2. The total number of flowers/panicle was nearly double under Vengurla-5 than Vengurla-6 *i.e.* between highest and lowest.

#### 4.1.2 Staminate flowers/panicle

##### 4.1.2.1 Number of staminate flowers/ panicle

The data related to staminate flowers/panicle of different cashew varieties are presented in table 1. Vengurla-5 have recorded significantly the highest staminate flowers/panicle

flowers/panicle was found significantly the lowest with Vengurla-7 (186.85) which was at par with Vengurla-6 and Vengurla-3. The no. of staminate flowers/panicle was higher in Vengurla-5 differed by 250.62 than Vengurla-6 which was lowest one.

#### **4.1.2.2 Percentage of staminate flowers/ panicle**

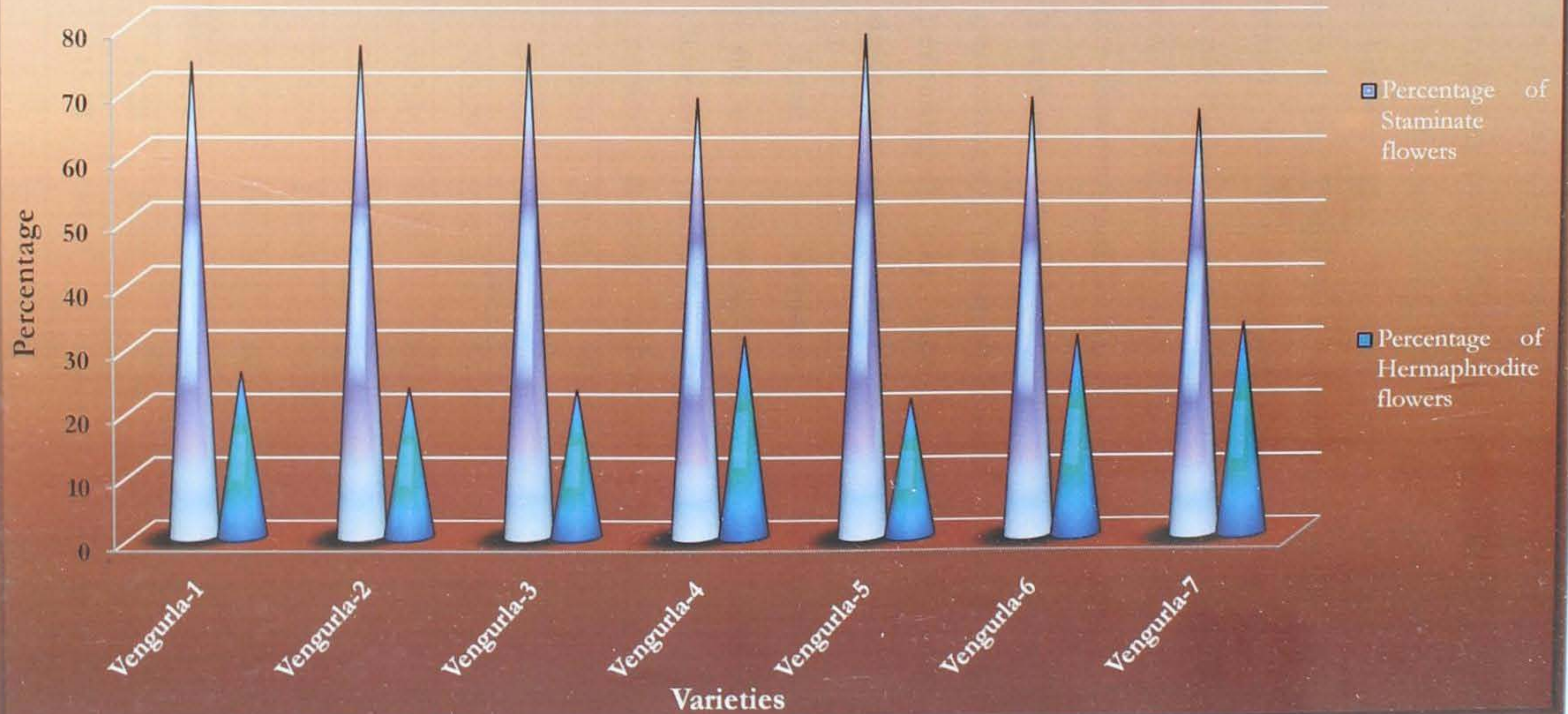
The data presented respect to percentage of staminate flowers/ panicle under table-1 and figure-1 indicated that percentage of staminate flowers/ panicles was differed significantly with in different varieties of cashew and significantly highest percentage of staminate flowers was found in Vengurla-5 (78.41%) which was at par with Vengurla-3, Vengurla-2, Vengurla-1, and Vengurla-6, However, Vengurla-7 registered the significantly minimum percentage of staminate flowers *i.e.* 66.69 % which was at par with Vengurla-4.

#### **4.1.3 Hermaphrodite flowers/panicle**

##### **4.1.3.1 Number of Hermaphrodite flowers/panicle**

The perusal of data presented in table 1 indicated that there were significant differences among different varieties of cashew in relation to hermaphrodite flowers/ panicle. Number of Hermaphrodite flowers/ panicle was observed significantly the highest *i.e.* 117.27 with Vengurla-4 which was at par with Vengurla-5 and Vengurla-1, while Vengurla-3 had significantly the lowest number of hermaphrodite flowers/ panicle *i.e.* 70.57 which was at par with Vengurla-2 and Vengurla-6. In relation to number of Hermaphrodite flowers/ panicle the variety Vengurla-4 and Vengurla-3 found highest and lowest respectively and difference among them were 46.70.

Fig. 1 Percentage Staminate flowers and Hermaphrodite flowers per panicle under different cashew varieties.



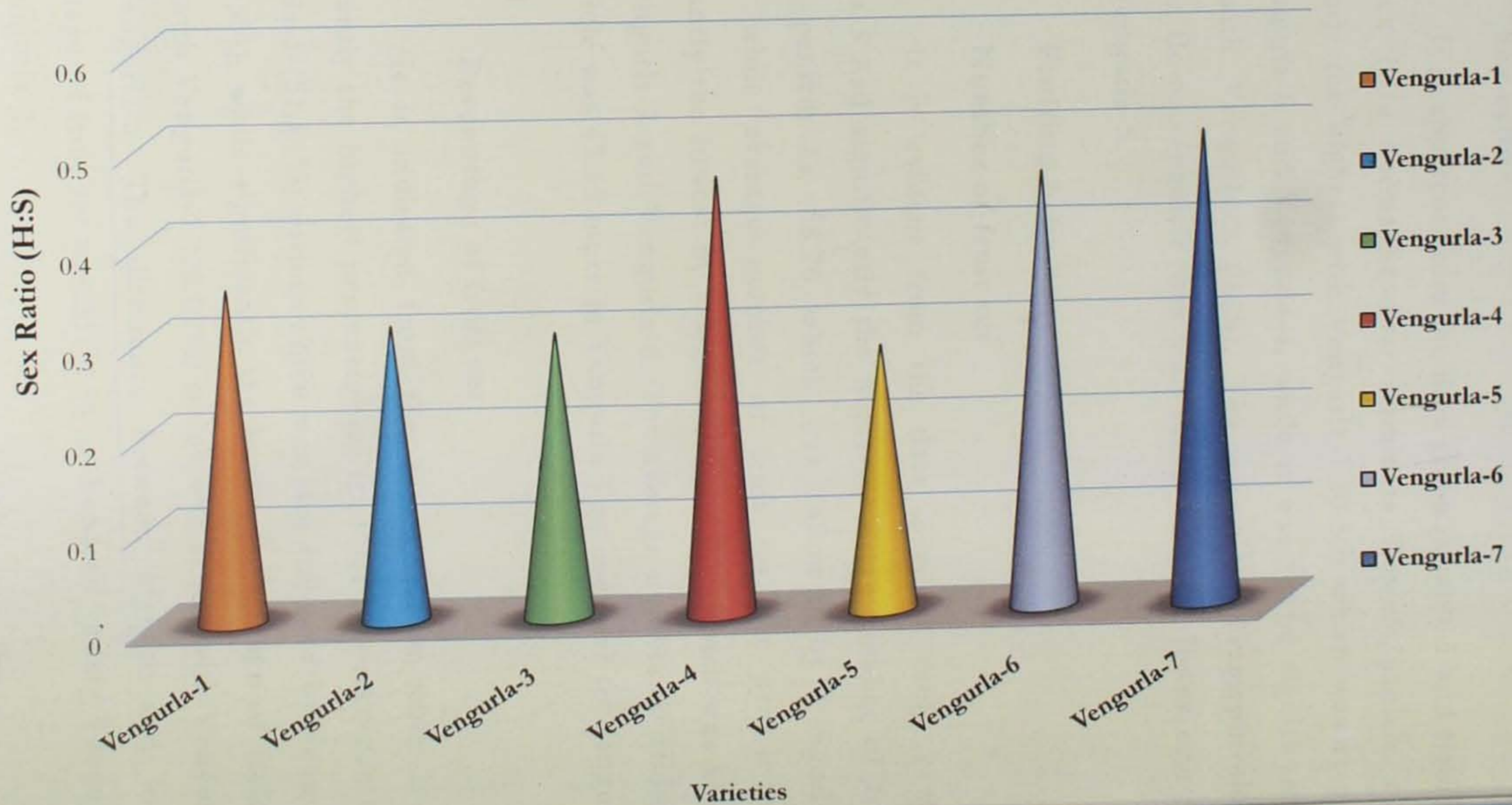
#### 4.1.3.2 Percentage of Hermaphrodite flowers/panicle

According to the data given in table- 1 and figure-1 the percentage of hermaphrodite flowers/panicle was recorded significantly highest (33.31 %) with Vengurla-7 which was at par with Vengurla-6 and Vengurla-4, while Vengurla-5 was observed with significantly lowest percentage of hermaphrodite flowers *i.e.* 21.59 % per panicle which was at par with Vengurla-2, Vengurla-3 and Vengurla-1. Vengurla-7 had 1.54 times more percentage hermaphrodite flowers/panicle than Vengurla-5.

**Table 1: Total no. of flowers, Staminate flowers (No and percentage), Hermaphrodite flowers (No and percentage) per panicle and Sex ratio under different cashew varieties.**

Varieties	Total no. of flowers/panicle	Staminate Flowers/panicle		Hermaphrodite flowers/panicle		Sex Ratio (H:S)
		No. of flowers	Percentage of flowers	No. of flowers	Percentage of flowers	
Vengurla-1	396.71	293.91	74.09	102.80	25.91	0.35
Vengurla-2	342.75	262.54	76.60	80.21	23.40	0.31
Vengurla-3	305.29	234.72	76.88	70.57	23.12	0.30
Vengurla-4	372.34	255.07	68.50	117.27	31.50	0.46
Vengurla-5	524.86	411.56	78.41	113.30	21.59	0.28
Vengurla-6	274.24	188.01	68.56	86.23	31.44	0.46
Vengurla-7	280.18	186.85	66.69	93.33	33.31	0.50
S.Em. ±	27.70	19.15	2.67	7.26	2.44	0.03
C.D.@ 5%	82.29	56.89	7.94	21.56	7.25	0.10
C.V.%	15.53	14.63	7.27	15.31	17.74	17.75

Fig. 2 Sex Ratio (H:S) of different cashew varieties



#### 4.1.4 Sex ratio

It is apparent from the data given in table 1 and figure-2 that sex ratio hermaphrodite: staminate flowers/panicle was significantly the highest with Vengurla-7 (0.50) which was at par with Vengurla-6 and Vengurla-4, while it was found significantly lowest with Vengurla-5 (0.28). The sex ratio hermaphrodite: staminate flowers/panicle was 0.22 more than the lower one *i.e.* variety Vengurla-5.

### 4.2 Fruiting behaviour

#### 4.2.1 Number of fruit set

It is evident from the data given in table 2 that Vengurla-5 had significantly the highest average number of fruit set per panicle *i.e.* 58.70 which was followed by Vengurla-4 (48.26), while average number of fruit set per panicle was significantly the lowest in Vengurla-3 *i.e.* 15.55 which was at par with Vengurla-2 and Vengurla-6. The average number of fruit set per panicle was 43.15 more in Vengurla-5 as compare to Vengurla-3.

##### 4.2.1.1 Percentage of fruit set

It is indicated from the data given in table 2 that significantly the highest percentage of fruit set was recorded with Vengurla-5 (51.81%) variety which was also followed by Vengurla-4 (41.15%), while significantly the lowest percentage of fruit set found with Vengurla-2 (20.07%) which was at par with Vengurla-3 and Vengurla-6. The difference between highest and lowest percentage of fruit set was 31.74 % *i.e.* between variety Vengurla-5 and Vengurla-2.

**Table 2: The number and percentage of fruit set per panicle of different cashew varieties.**

Varieties	Number hermaphrodite flowers/panicle	Number of fruit set per panicle	Percentage of fruit set
Vengurla-1	102.80	29.28	28.48
Vengurla-2	80.21	16.10	20.07
Vengurla-3	70.57	15.55	22.03
Vengurla-4	117.27	48.26	41.15
Vengurla-5	113.30	58.70	51.81
Vengurla-6	86.23	20.34	23.59
Vengurla-7	93.33	25.35	27.16
S.Em. $\pm$	7.26	1.67	1.92
C.D.@ 5%	21.56	4.97	5.71
C.V.%	15.31	10.96	12.56

#### 4.2.2 Average number and percentage of fruit drop at 15 day interval

##### 4.2.2.1 Average number of fruit drop at 15 days

The data presented in table 3 with respect to the average number of fruit drop at 15 days revealed that Vengurla-2 was noticed with significantly the lowest number of fruit drop *i.e.* 6.86, which was at par with Vengurla-7, Vengurla-3, Vengurla-6 and Vengurla-1, while significantly the highest average number of fruit drop *i.e.* 12.71 found with Vengurla-5 which was followed by Vengurla-4 (10.76) The difference between highest and lowest average number of fruit drop was 5.85 between variety Vengurla-5 and Vengurla-2 at 15 days.

#### 4.2.2.2 Average number of fruit drop at 30 days

It is apparent from the data given in table 3 that the Vengurla-2 (7.63) evaluated with significantly the lowest average number of fruit drop which was at par with Vengurla-3 and Vengurla-6, while significantly the highest average number of fruit drop was reported with Vengurla-5 (28.55) which was followed by Vengurla-4 (21.88). The Vengurla-2 had 3.74 times less average number of fruit drop as compared to Vengurla-5 at 30 days.

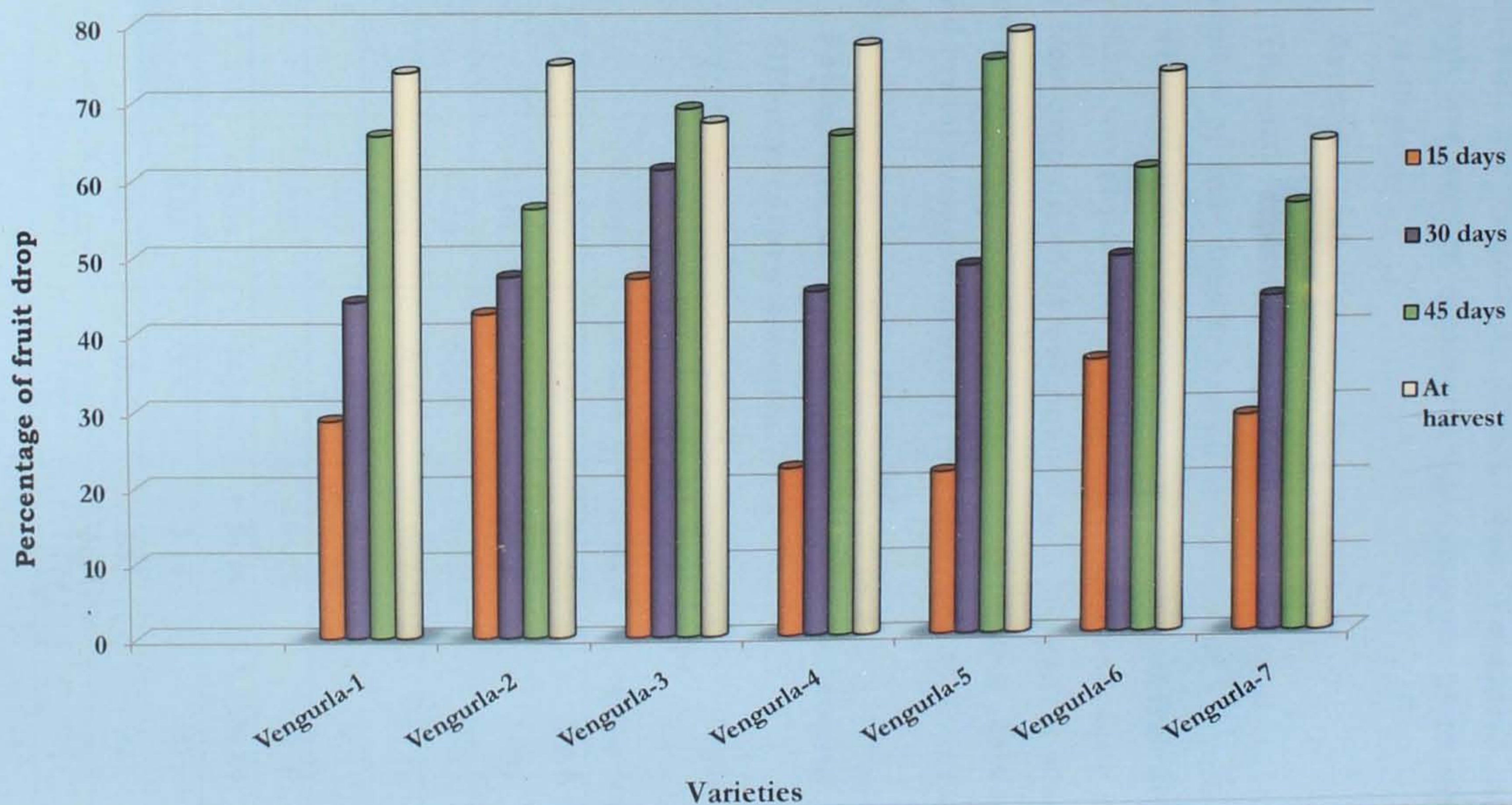
**Table 3: Number of fruit drops at 15 days interval of different cashew varieties.**

Varieties	Number of fruit drops				
	Initial	15 days	30 days	45 days	At harvest
Vengurla-1	29.28	8.42	12.95	19.24	21.62
Vengurla-2	16.10	6.86	7.63	9.05	10.47
Vengurla-3	15.55	7.33	9.52	10.75	12.05
Vengurla-4	48.26	10.76	21.88	31.67	37.31
Vengurla-5	58.70	12.71	28.55	44.24	46.34
Vengurla-6	20.34	7.37	10.12	12.45	14.99
Vengurla-7	25.35	7.26	11.25	14.32	16.40
S.Em. $\pm$	1.67	0.61	0.98	1.07	1.35
C.D.@ 5%	4.97	1.82	2.91	3.17	4.01
C.V.%	10.96	14.15	13.47	10.56	11.86

#### 4.2.2.3 Average number of fruit drop at 45 days

It is observed from the data given in table 3 that average number of fruit drop at 45 days was found significantly the lowest with Vengurla-2 (9.05) which was at par with Vengurla-3, while Vengurla-5 was found to have maximum fruit drop *i.e.*

Fig. 3 Percentage of fruit drops at 15 days interval of different cashew varieties



44.24 followed by Vengurla-4 (31.67). The Vengurla-2 had recorded with less average number of fruit drop *i.e.* 35.19 than Vengurla-5 at 45 days.

**4.2.2.4 Average number of fruit drop at harvest**

The data accessible in table 3 with respect to the average number of fruit drop at harvest revealed that Vengurla-2 was found with significantly the least average number of fruit drop *i.e.* 10.47 which was at par with Vengurla-3, while significantly the maximum fruit drop *i.e.* 46.34 was noticed with Vengurla-5 which was followed by Vengurla-4 (37.31). The difference between highest and lowest average number of fruit drop was 35.87 at final stage.

**Table 4: Percentage of fruit drops at 15 days interval of different cashew varieties**

Varieties	Percentage of fruit drops			
	15 days	30 days	45 days	At harvest
Vengurla-1	28.76	44.23	65.71	73.84
Vengurla-2	42.61	47.39	56.21	74.84
Vengurla-3	47.14	61.22	69.12	67.33
Vengurla-4	22.30	45.34	65.62	77.31
Vengurla-5	21.65	48.64	75.37	78.95
Vengurla-6	36.23	49.75	61.21	73.70
Vengurla-7	28.64	44.38	56.49	64.69
S.Em. $\pm$	3.03	3.37	3.14	3.11
C.D.@ 5%	9.01	10.02	9.32	9.23
C.V.%	18.68	13.85	9.76	8.52

#### 4.2.2.5 Percentage of fruit drop at 15 days

It is confirmed from the data given in table 4 and figure-3 that Vengurla-5 had shown the lowest percentage of fruit drop *i.e.* 21.65 % which was at par with Vengurla-4, Vengurla-7 and Vengurla-1, while significantly highest percentage of fruit drop was recorded with Vengurla-3 (47.14 %) which was at par with Vengurla-2. At 15 days variety Vengurla-3 had noticed with 25.49 % more fruit drop than Vengurla-5.

#### 4.2.2.6 Percentage of fruit drop at 30 days

It is cleared from the data given in table 4 and figure-3 that there were significant differences among the percentage of fruit drop at 30 days. Vengurla-1 was found with significantly the lowest percentage of fruit drop (44.23 %) which was at par with Vengurla-7, Vengurla-4, Vengurla-2, Vengurla-5 and Vengurla-6, while significantly the highest percentage of fruit drop *i.e.* 61.22 was recorded with Vengurla-3 which was followed by Vengurla-6. The Vengurla-3 had 16.99 percentages more fruit drop than Vengurla-1 at 30 days.

#### 4.2.2.7 Percentage of fruit drop at 45 days

The data presented in table 4 and figure-3 showed that the lowest percentage of fruit drop *i.e.* 56.21 % found with Vengurla-2 which was at par with Vengurla-7 and Vengurla-5 while Vengurla-5 was noticed with significantly the highest (75.37 %) percentage of fruit drop which was at par with Vengurla-3. The Vengurla-2 had 1.34 times less percentage of fruit drop than Vengurla-5 at 45 days.

#### 4.2.2.8 Percentage of fruit drop at harvest

The data regarding the percentage of fruit drop was summarized in table 4 and figure-3 showed that the fruit drop percentage was found significantly lowest with Vengurla-7 (64.69 %) which was at par with Vengurla-3, while the highest percentage of fruit drop was recorded with Vengurla-5 *i.e.* 78.95 % which was at par with Vengurla-4, Vengurla-2, Vengurla-6 and Vengurla-1. The Vengurla-5 was found with 14.26 % more fruit drop than Vengurla-7 at last stage of harvesting.

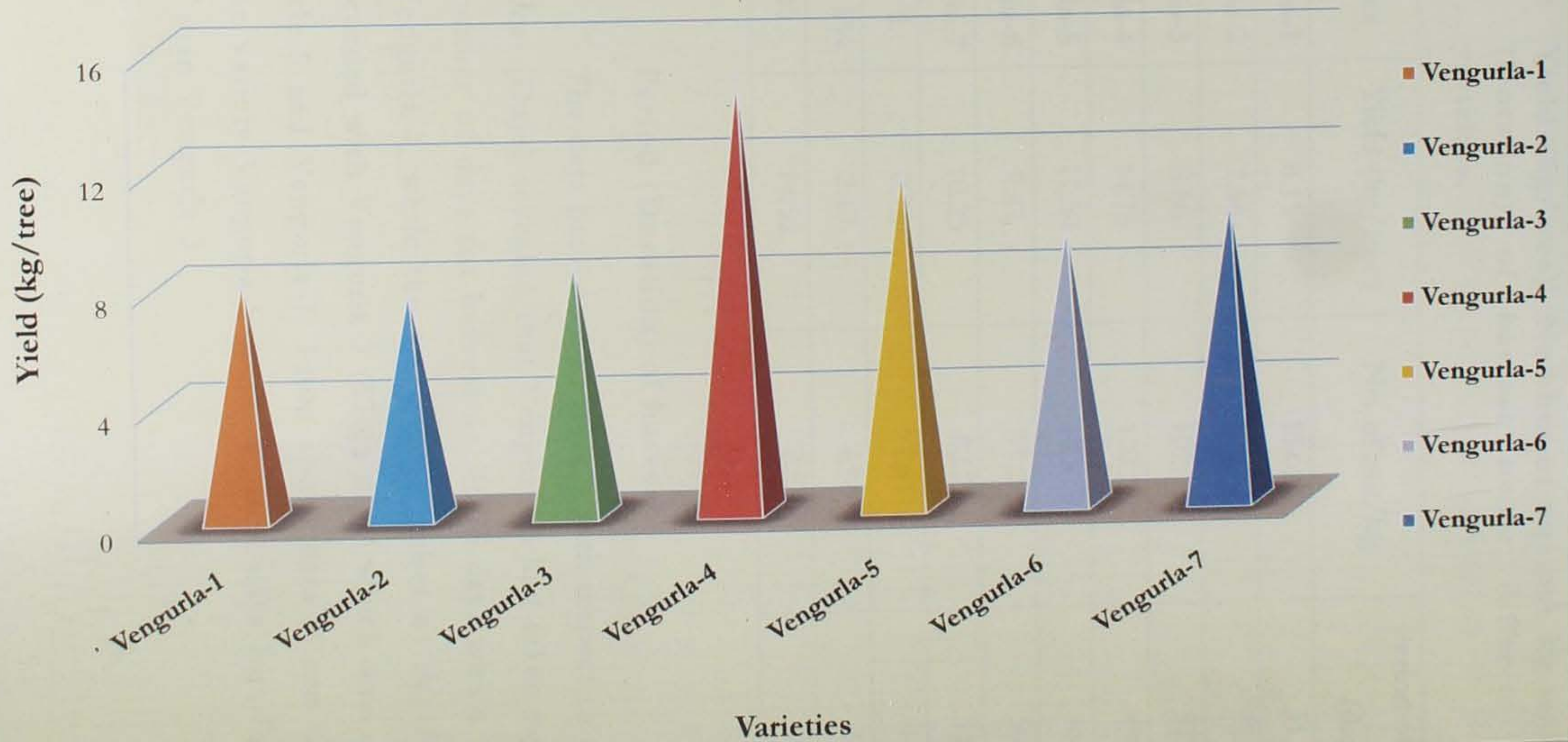
#### 4.2.3 Yield (Kg/tree)

The summarized data of Yield (kg/tree) presented in table 5 and figure-4 revealed that yield of cashew nut was recorded significantly highest (14.75 kg/tree) with Vengurla-4 followed by Vengurla-5 *i.e.* 11.50 kg/tree, while significantly least yield was obtained with Vengurla-2 (7.66 kg/tree) which was at par with Vengurla-1, Vengurla-3 and Vengurla-6. From data it was seen that the Vengurla-4 had 1.93 times more yield (kg/tree) as compared to Vengurla-2.

#### 4.2.4 Number of nuts/kg

The data presented in table 5 clearly indicate that there were significant differences in number of nut of different cashew varieties *i.e.* Vengurla-1 to Vengurla-7. Vengurla-7 reported with significantly least number of nut/ kg *i.e.* 82.25 which was followed by Vengurla-6, while Vengurla-5 found significantly highest in number of nut/kg (183.75) which was at par with Vengurla-2. According to the result Vengurla-5 had 101.50 more number of nuts/kg than Vengurla-7 indicates that Vengurla -5 was lighter in weight than other varieties.

**Fig. 4** Yield (kg/tree) of different cashew varieties.



**Table 5: Yield (kg/tree), Number of nut per kg and Period (Duration) of harvest under different cashew varieties.**

Varieties	Yield (kg/tree)	No. of nut/kg	Period of harvest (days)
Vengurla-1	8.15	154.25	51.75
Vengurla-2	7.66	180.75	53.50
Vengurla-3	8.56	102.75	57.25
Vengurla-4	14.75	107.25	49.50
Vengurla-5	11.50	183.75	46.75
Vengurla-6	9.47	99.25	56.75
Vengurla-7	10.25	82.25	56.50
S.Em. $\pm$	0.73	1.67	1.33
C.D.@ 5%	2.17	4.96	3.97
C.V.%	14.52	2.57	5.02

#### 4.2.5 Period (Duration) of harvest

The data presented in table 5 with respect to the Period of harvest (Days) revealed that Vengurla-5 had taken significantly least number of days for harvest *i.e.* 46.75 days which was at par with Vengurla-4, while the maximum number of day for harvest was recorded with Vengurla-3 (57.25 days) which was at par with Vengurla-6 and Vengurla-7. From above data it can be revealed that the variety Vengurla-5 requires 10.50 days less for maturity (Days) than Vengurla-3.

**4.3 Physical parameter of cashew apple and nut**

**4.3.1 Weight of cashew apple and nut (g)**

**4.3.1.1 Weight of cashew apple (g)**

It is apparent from table 6 that Vengurla-4 was found significantly the highest with respect to weight of apple *i.e.* 107.66 g which was found at par with Vengurla-3, while weight of apple was found significantly the lowest (42.26 g) with the Vengurla-5 which was at par with Vengurla-1. The weight of apple was found 65.40 g more with Vengurla-4 than the lowest. Vengurla-5 *i.e.* 2.55 times heavier.

**Table 6: Weight of apple and nut of different varieties.**

Varieties	Weight of Apple (g)	Weight of Nut (g)
Vengurla-1	54.47	6.49
Vengurla-2	71.28	5.53
Vengurla-3	95.99	9.73
Vengurla-4	107.66	9.33
Vengurla-5	42.26	5.44
Vengurla-6	71.07	10.09
Vengurla-7	86.74	12.14
S.Em. $\pm$	6.03	0.63
C.D.@ 5%	17.93	1.88
C.V.%	15.96	15.12

**4.3.1.2 Weight of cashew nut (g)**

The data regarding the nut weight (g) in table 6 revealed that Vengurla-7 (12.14 g) had maximum nut weight (g)

followed by Vengurla-6 *i.e.* 10.09 g. while nut weight (g) was noticed lowest *i.e.* 5.44 g with Vengurla-5 which was at par with Vengurla-2 and Vengurla-1. The nut weight of Vengurla-7 was 2.23 times more than the Vengurla-5 which had lowest nut weight.

#### 4.3.2 Volume of Cashew apple and nut (ml)

**Table 7: Volume of apple and nut of different cashew varieties.**

Varieties	Volume of Apple (ml)	Volume of Nut (ml)
Vengurla-1	57.05	4.60
Vengurla-2	76.30	3.15
Vengurla-3	103.50	6.45
Vengurla-4	112.10	5.60
Vengurla-5	45.80	3.55
Vengurla-6	74.05	7.50
Vengurla-7	90.20	9.45
S.Em. $\pm$	6.15	0.39
C.D.@ 5%	18.28	1.15
C.V.%	15.41	13.50

##### 4.3.2.1 Volume of cashew apple (ml)

It is marked from the data given in table 7 that Vengurla-4 was observed with significantly the highest volume of apple *i.e.* 112.10 ml which was at par with Vengurla-3. The least volume of apple *i.e.* 45.80 ml was found with Vengurla-5 which was at par with Vengurla-1. The volume of apple was 66.30 ml. more with Vengurla-4 than the Vengurla-5 which had lowest volume of apple.

#### 4.3.2.2 Volume of cashew nut (ml)

It is apparent from the data given in table 7 that the highest volume of nut (9.45 ml) was found with Vengurla-7 which was followed by Vengurla-6; however, the Vengurla-2 was observed with lowest volume of nut *i.e.* 3.15 ml which was at par with Vengurla-5. The difference between highest and lowest volume of nut was 6.30 ml *i.e.* between Vengurla-4 and Vengurla-2 respectively.

#### 4.3.3 Specific gravity of Cashew apple and nut

Table 8: Specific gravity of apple and nut with different cashew varieties.

Varieties	Specific gravity of Apple	Specific gravity of Nut
Vengurla-1	0.955	1.409
Vengurla-2	0.934	1.754
Vengurla-3	0.927	1.506
Vengurla-4	0.960	1.671
Vengurla-5	0.923	1.532
Vengurla-6	0.960	1.348
Vengurla-7	0.962	1.281
S.Em. $\pm$	0.008	0.084
C.D.@ 5%	0.025	0.248
C.V.%	1.766	11.145

#### 4.3.3.1 Specific gravity of Cashew apple

The inspection of data regarding specific gravity of cashew apple presented in table 8 clearly show that Vengurla-7 was having the highest specific gravity of cashew apple *i.e.* 0.962 which was at par with Vengurla-6, Vengurla-4 and Vengurla-1, while significantly least specific gravity of apple was observed with Vengurla-5 *i.e.* 0.923 which was at par with Vengurla-3 and Vengurla-2.

#### 4.3.3.2 Specific gravity of Cashew nut

The specific gravity of cashew nut was examined under table 8 show significantly the highest with Vengurla-2 (1.754) which was at par with Vengurla-4, Vengurla-5 and Vengurla-3, while Vengurla-7 was observed with significantly the least specific gravity of cashew nut *i.e.* 1.281 which was at par with Vengurla-6, Vengurla-1 and Vengurla-3.

#### 4.3.4. Size of nut and apple

##### 4.3.4.1 Length of Cashew apple and nut (cm)

##### 4.3.4.1.1 Length of Cashew apple (cm)

The data presented in table 9 with respect to the Length of cashew apple (cm) revealed that significantly highest length of apple *i.e.* 8.41 cm was obtained with Vengurla-4, which was followed by Vengurla-7, while Vengurla-5 was found with significantly the least length of apple (3.73 cm) which was followed by Vengurla-1 (5.25 cm). The Vengurla-4 had 2.25 times more longer cashew apple than the Vengurla-5.

**Table 9: Length of apple and nut of different cashew varieties.**

Varieties	Length of Apple (cm)	Length of Nut (cm)
Vengurla-1	5.25	2.98
Vengurla-2	6.56	3.21
Vengurla-3	5.98	3.59
Vengurla-4	8.41	3.85
Vengurla-5	3.73	2.85
Vengurla-6	6.42	4.25
Vengurla-7	7.08	4.00
S.Em. $\pm$	0.36	0.30
C.D.@ 5%	1.07	0.88
C.V.%	11.63	16.72

#### 4.3.4.1.2 Length of Cashew nut (cm)

It is clearly illustrated in table 9 that Vengurla-6 remained significantly highest with length of cashew nut (4.25 cm) which was at par with Vengurla-7, Vengurla-4 and Vengurla-3, while the Vengurla-5 was observed with significantly lowest length of cashew nut *i.e.* 2.85 cm which was at par with Vengurla-1, Vengurla-2 and Vengurla-3. The length of cashew nut was found 1.40 cm more long with Vengurla-6 than the Vengurla-5 which had lowest nut length.

4.3.4.2 Diameter of Cashew apple and nut (cm)

4.3.4.2.1 Diameter of Cashew apple (cm)

4.3.4.2.1.1 Diameter of Cashew apple at Proximal end (cm)

The data regarding diameter of proximal end of apple (cm) was summarized in table 10. The diameter of cashew apple at proximal end was recorded significantly highest with Vengurla-3 i.e. 4.07 cm, which was at par with Vengurla-7. In case of significantly least diameter of proximal end of apple (2.71 cm) was found with Vengurla-2 and Vengurla-6 which was at par with Vengurla-4, Vengurla-1 Vengurla-5, and Vengurla-7.

**Table 10: Diameter of Cashew apple (cm) at different end of different cashew varieties.**

Varieties	Proximal end of apple (cm)	Middle end of apple (cm)	Distal end of apple (cm)	Average diameter (cm)
Vengurla-1	2.95	3.35	4.03	3.44
Vengurla-2	2.71	3.70	4.13	3.51
Vengurla-3	4.07	5.01	5.87	4.98
Vengurla-4	2.92	3.93	4.91	3.92
Vengurla-5	3.03	4.04	3.86	3.64
Vengurla-6	2.71	3.63	4.49	3.61
Vengurla-7	3.48	4.85	5.00	4.44
S.Em. $\pm$	0.26	0.35	0.37	0.24
C.D.@ 5%	0.77	1.05	1.11	0.73
C.V.%	16.65	17.31	16.21	12.41

#### 4.3.4.2.1.2 Diameter of Cashew apple at Middle end (cm)

It is confirmed from the data given in table 10 that Vengurla-3 was recorded the significantly highest diameter of cashew apple *i.e.* 5.01 cm, which was at par with Vengurla-7 and Vengurla-5, while, the lowest diameter of cashew apple at middle end was found with Vengurla-1(3.35 cm) which was at par with Vengurla-6, Vengurla-2, Vengurla-4, and Vengurla-5.

#### 4.3.4.2.1.3 Diameter of Cashew apple at Distal end (cm)

The data presented in table 10 with respect to the diameter of cashew apple at distal end (cm) revealed that Vengurla-3 was found significantly the highest with diameter of distal end of apple *i.e.* 5.87 cm which was at par with Vengurla-7 and Vengurla-4, however, the lowest diameter of cashew apple at distal end was found with Vengurla-5 (3.86 cm) which was at par with Vengurla-1, Vengurla-2, Vengurla-6, and Vengurla-4.

#### 4.3.4.2.1.4 Average diameter of Cashew apple (cm)

The data given in table 10 indicate that the average diameter of cashew apple was reported significantly the highest with Vengurla-3 (4.98 cm) which was at par with Vengurla-7, however, the significantly lowest average diameter of cashew apple was found with Vengurla-1(3.44 cm) which was at par with Vengurla-2, Vengurla-6, Vengurla-5 and Vengurla-4.

#### 4.3.4.2.2 Diameter of Cashew nut (cm)

With regards to mean data given in table 11, Vengurla-4 was recorded with significantly the highest diameter of nut *i.e.* 2.45 cm which was at par with Vengurla-6, Vengurla-3 and

Vengurla-7, diameter of nut was found significantly the lowest *i.e.* 1.41 cm with Vengurla-2 which was at par with Vengurla-1 and Vengurla-5. The diameter of cashew nut *i.e.* Vengurla-4 was found 1.74 times thicker than the Vengurla-2.

**Table 11: Diameter of Cashew nut (cm) of different cashew varieties.**

Varieties	Diameter of Cashew nut (cm)
Vengurla-1	1.60
Vengurla-2	1.41
Vengurla-3	2.19
Vengurla-4	2.45
Vengurla-5	1.70
Vengurla-6	2.30
Vengurla-7	2.17
S.Em. $\pm$	0.15
C.D.@ 5%	0.45
C.V.%	15.20

#### 4.3.5 Colour of Cashew apple and nut at maturity

The visual observation regarding the colour of cashew apple and nut at maturity were indicated in table 12.

It is evident from table 12 that the yellow colour of cashew apple was observed with Vengurla-1, Vengurla-3, Vengurla-5, Vengurla-6 and Vengurla-7, while the red colour of cashew apple was found with Vengurla-2 and Vengurla-4.

It is seen from the table 12 that there were no difference in colour of cashew nut observed in different varieties

## Plate - 2 : Different varieties of cashew



Vengurla-1



Vengurla-2



Vengurla-3



Vengurla-4



Vengurla-5



Vengurla-6



Vengurla-7

of cashew at maturity. All the varieties *i.e.* Vengurla-1 to Vengurla-7 showed the grey colour of cashew nut at maturity.

**Table 12:** Effect of different cashew varieties on the colour of Cashew apple and nut at maturity.

Varieties	Colour of Cashew apple	Colour of Cashew nut
Vengurla-1	Yellow	Grey
Vengurla-2	Red	Grey
Vengurla-3	Yellow	Grey
Vengurla-4	Red	Grey
Vengurla-5	Yellow	Grey
Vengurla-6	Yellow	Grey
Vengurla-7	Yellow	Grey



## DISCUSSION

The experiment was carried out with the objective to study on flowering and fruiting behaviour of different varieties of cashew viz. Vengurla-1, Vengurla-2, Vengurla-3, Vengurla-4, Vengurla-5, Vengurla-6 and Vengurla-7 under South Gujarat condition and to study the physiological parameters of cashew apple and nut at maturity. The data pertaining to various observations viz., Flowering behaviour: Total number of flowers/panicle, Staminate flowers/panicle, Hermaphrodite flowers/panicle, Sex ratio, Fruiting Behaviour: Average fruit set (No. and percentage), Average number of fruit drop at 15 days interval, Yield (kg/tree), Number of nut per kg, Period (Duration) of harvest, Physiological parameter of cashew apple and nut at maturity: weight of cashew apple and nut (g), Volume of cashew apple and nut (ml), Specific gravity of cashew apple and nut, size of cashew apple and nut viz., Length of whole fruit (cm), Length of apple (cm), Length of nut (cm), Diameter of apple (cm), Diameter of apple (cm), Diameter of nut (cm), colour were recorded and statistically analyzed. The finding obtained in these experiments had been discussed in this chapter along with appropriate reasoning as well as supported earlier research workers.

### 5.1 Flowering behaviour

Experimental results evidently showed that the maximum total no. of flowers/panicle (524.86) was found with Vengurla-5 under South Gujarat condition. The similarly higher number of total flowers was obtained at Bhubaneswar condition in Vridhachalam-2 by Samal *et al.* (2006), at eastern dry zone of

Karnataka condition in 9/66 Chirala varieties of cashew by Narayana Reddy *et al.* (1989), while Bastar region of Chhatisgarh in H-30/1 by Sharma *et al.* (2009). It might be due to different types of soil and climatic condition at different research station during flowering period and all accession was behavior different at different situation.

Experimental results clearly showed that the highest number (411.56) and percentage (78.41%) of staminate flowers/panicle were recorded with Vengurla-5 under South Gujarat condition. The similarly H-30/1 in Chhatisgarh by Sharma *et al.* (2009), BLA-39/4 in West Bengal conditions by Singh *et al.* (2008) and Ullal Karnataka 9/2 in at Karnataka conditions Sheshagir (1996) reported higher percentage of staminate flowers under different research station.

The highest number (117.27) and percentage (33.31 %) of hermaphrodite flowers/panicle were recorded with Vengurla-4, Vengurla-7, respectively under South Gujarat condition. The similar observation was also made by Sharma *et al.* (2009) in H-255 at Bastar region of Chhatisgarh, Singh *et al.* (2008) in H-1598 (Kanaka) at West Bengal conditions, Sheshagir (1996) in 8/46 Taliparamba Kerala at Karnataka conditions, Narayana Reddy *et al.* (1989) in 1/61 Alangudi Madras at eastern dry zone of Karnataka condition. It might be due to dissimilarity of weather parameter during flowering period at different research station and it may be due to varietal difference also.

From the result of experiment it was cleared that the sex ratio was significantly the highest with Vengurla-7 (0.50) under South Gujarat condition. The similar finding was obtained in VTH-30/4 by Singh *et al.* (2008) at West Bengal conditions,

H-1598 (Kanaka) by Samal *et al.* (2006) at Bhubaneswar condition, M 44/3 by Lenka (1999) at Bhubaneswar condition, 9/66 Chirala Andhra by Sheshagir (1996) at Karnataka conditions, BBSR Cluster-1 by Sena *et al.* (1995) at Madakkathara condition during the studies regarding different accession of cashew at respected research station. It might be due to dissimilarity of weather parameter such as temperature, humidity, rainfall, coldness of winter etc. and elevation from sea level during flowering period at different research station.

## 5.2 Fruiting behaviour

Average number (58.70) and percentage (51.81 %) of fruit set found significantly the highest with Vengurla-5 under South Gujarat condition. Different scientist works at different research station and they all reported different accession or variety perform better with respect to fruit set under respective situation such as 1/61 Alangudi Madras at Dharwad conditions Sapkal *et al.* (1994), TN-16 at Jhargram conditions Chhatopadhyay and Ghosh (1993).

Significantly lowest fruit drops were recorded under Vengurla-2 during 15 days (6.86), 30 days (7.63), 45 days (9.05) and at harvest (10.47) days to fruit set. While with respect to percentage of fruit drops it was significantly lowest under Vengurla-1 during 30 days i.e. (44.23 %), and Vengurla-2 during 45(44.54 %) days after fruit set and variety Vengurla-5 (21.65 %) and Vengurla-6 (73.70 %) had reported lowest fruit drops during 15 days and at harvest respectively under South Gujarat condition. Similarly Sapkal *et al.* (1994) in 2/77 Tuni Andhra at Dharwad conditions, Chhatopadhyay and Ghosh (1993) in Vector-56 at Jhargram conditions reported lowest fruit drops. Fruit drops was

affected by numbers of aspect however weather and climate play important role for fruit drops and it's varies at station resulting discrepancy of performing of different variety at different climatic situation.

Significantly highest yield of cashew nut was recorded with Vengurla-4 (14.75 kg/tree) under South Gujarat condition. The likewise at Bhubaneswar condition in BPP-8 by Samal *et al.* (2006), at hill zone of Karnataka in Vengurla-3 by Mahesha *et al.* (2005), at Anakkayam, Kerala condition in H-8-10 by Nalini *et al.* (1994) and Anakkayam, Kerala condition in BLA-139-1 by Nalini and Santhakumari (1991) reported highest yield. It may be due to the age of tree and difference in agroclimatic conditions.

Vengurla-7 found significantly minimum in number of nut/kg (82.25) under South Gujarat condition. The parallel result was observed in 6/21 Mudabidri by Narayana Reddy *et al.* (1986) at Chintamani condition, K-16-1 by Nalini and Santhakumari (1991) at Anakkayam, Kerala condition.

Period of harvest (Days) revealed that significantly the lowest number of day for harvest was recorded with Vengurla-5 (46.75 days) under South Gujarat condition. The related finding was also reported by Lenka *et al.* (2003) at Orissa condition, Nalini and Santhakumari (1991) in NLR-2-1 at Anakkayam, Kerala condition.

### **5.3 Physiological parameter of cashew apple and nut at maturity**

Significantly the highest weight of apple (107.66 g) was reported with the Vengurla-4 under South Gujarat condition. Similarly result with highest weight of apple was discovered by

Sena *et al.* (1995) at Dharwad condition in VTH-30/4, by Nalini and Santhakumari (1991) at Anakkayam, Kerala condition in K-16-1, by Haldankar *et al.* (1986) at Dapoli condition in Vengurla-3, While Significantly the highest weight of nut was recorded with the Vengurla-7 (12.14 g) under South Gujarat condition. The similarly findings were also done by Nalini *et al.* (1994) in H-7-3 at Anakkayam, Kerala condition, by Mahesha *et al.* (2005) in Selection-2 at hill zone of Karnataka, by Nalini and Santhakumari (1991) in K-16-1 Anakkayam, Kerala condition and by Wadkar *et al.* (2007) in Vengurla-8 at Dapoli condition. The significant variation in apple and nut weight was noticed between the different varieties which may be due to varietal characteristics and agro-climatic condition.

Experimental results indicated that significantly the highest volume of apple (112.10 ml) was recorded with Vengurla-4 under South Gujarat condition. These similarly results were marked by Haldankar *et al.* (1986) in Vengurla-3 at Dapoli condition, Narayana Reddy *et al.* (1986) in 6/21 Mudabiri at Chintamani condition. It is conformed that significantly the highest volume of nut (ml) was recorded to Vengurla-7 (9.45 ml) under South Gujarat condition. These similarly higher volume were observed by Narayana Reddy *et al.* (1986) in 2/97 Kottarakara at Chintamani condition. It may be due to difference in agro-climatic condition and/or genetic factors

The inspection of data regarding specific gravity of cashew apple was found significantly the highest with Vengurla-7 (0.962) under South Gujarat condition. The similarly higher specific gravity was obtained by Narayana Reddy *et al.* (1986) in

Vengurla-1 at Chintamani condition, Sena *et al.* (1995) in H-1608 at Dharwad condition, Haldankar *et al.* (1986) in Vengurla-1 at Dapoli condition. The specific gravity of cashew nut was examined significantly the highest with Vengurla-2 (1.754) under South Gujarat condition. It may be due to genetic difference and agro-situation.

According to experimental result significantly the highest length of apple (8.41 cm) was obtained with Vengurla-4 under South Gujarat condition. These similarly result found by Haldankar *et al.* (1986) in Vengurla-4 at Dapoli condition, Sena *et al.* (1995) in VTH-30/4 at Dharwad condition, Sapkal *et al.* (1992) in 1/64 Madhurandhkam-Madras at Dharwad condition. It is clearly illustrated from the experimental result Vengurla-6 remained significantly highest with length of cashew nut *i.e.* 4.25 cm under South Gujarat condition. It may be due to performance of different varieties varies at different climatic situation.

The data summarized was gives the indication that the diameter of proximal (5.87 cm), middle (5.01 cm) and distal (4.07 cm) end of apple was found significantly the highest with Vengurla-3 under South Gujarat condition. The nearer to same result was reported in Vengurla-3 by Haldankar *et al.* (1986) at Dapoli condition. With regards to data significantly the highest diameter of nut was recorded with Vengurla-4 (2.45 cm) under South Gujarat condition. The similarly result observed in H-3-17 by Arvindakshan *et al.* (1986), Thamburaj *et al.* (1980) at Periakulam condition. It may be due to agroclimatic condition and varietal difference.

It is evident that the yellow colour of cashew apple was observed with Vengurla-1, Vengurla-3, Vengurla-5, Vengurla-6 and Vengurla-7, while the red colour of cashew apple was found with Vengurla-2 and Vengurla-4 under South Gujarat condition. The same result was recorded at Dapoli condition by Haldankar *et al.* (1986) and Wadkar *et al.* (2007). It may be due to genetic characteristic of varieties.

It is seen from experimental result that there were no difference in colour of cashew nut *i.e.* grey observed in different varieties of cashew at maturity under South Gujarat condition. The similarly result was recorded by Antarkar and Joshi (1986) with different varieties at Dapoli condition. All the varieties *i.e.* Vengurla-1 to Vengurla-7 showed the grey colour of cashew nut at maturity.

## VI SUMMARY AND CONCLUSION



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The present study was carried out at Agriculture Experimental Station, Navsari Agricultural University, At & Po.Paria, Ta. Pardi, Dist. Valsad, Gujarat, India during the year 2009-2010 with objective to study the flowering and fruiting behaviour of different varieties of Cashew (*Anacardium occidentale* L.) in South Gujarat.

The experiment was conducted in Randomized Block Design including seven varieties *viz.* T<sub>1</sub>: Vengurla-1, T<sub>2</sub>: Vengurla-2, T<sub>3</sub>: Vengurla-3, T<sub>4</sub>: Vengurla-4, T<sub>5</sub>: Vengurla-5, T<sub>6</sub>: Vengurla-6, T<sub>7</sub>: Vengurla-7 with four replications. The research results are summarized as under.

### 6.1 Flowering behaviour

1. The total no. of flowers/panicle of different cashew cultivars varied from 524.86 under Vengurla-5 to 274.24 under Vengurla-6.
2. The number and percentage of staminate flowers/panicle were significantly the highest *i.e.* 411.56, 78.49% with Vengurla-5 and lowest *i.e.* 186.85, 66.80 % with Vengurla-7 respectively.
3. The number and percentage of hermaphrodite flowers/panicle were significantly the highest *i.e.* 117.27, 33.62 % with Vengurla-4 and lowest 70.57, 21.73 % with Vengurla-3 respectively.
4. The sex ratio was varied between 0.28 under Vengurla-5 to 0.50 under Vengurla-7 among different cashew varieties.

## 6.2 Fruiting behaviour

1. Number and percentage of fruit set found significantly the highest with Vengurla-5 (58.70, 51.81 %) and lowest with Vengurla-3 (15.55, 22.03 %).
2. Significantly the lowest number of fruit drop was noticed at 15 days under Vengurla-3 (11.65), at 30 days under Vengurla-3 (10.30), at 45 days under Vengurla-3 (7.79) and at harvest it was noticed under Vengurla-2 (4.05) and highest at 15 days under Vengurla-5 (52.30), at 30 days under Vengurla-5 (35.56), at 45 days under Vengurla-5 (27.80) and at harvest it was noticed under Vengurla-5 (12.36).
3. Percentage of fruit drop was recorded significantly the lowest at 15 days with Vengurla-5 (21.65 %), at 30 days with Vengurla-1 (44.23 %), at 45 days with Vengurla-2 (56.21 %) and at harvest it was noticed with Vengurla-7 (64.69 %) and highest percentage of fruit drop was recorded at 15 days (47.14 %) and at 30 days (61.22 %) respectively, while at 45 days (75.37 %) and at harvest (78.95%) it was noticed with Vengurla-5.
4. Among different varieties available at Paria and varieties released from Vangurla, the significantly highest Yield was recorded under Vengurla-4 *i.e.* 14.75 kg/tree and lowest with Vengurla-2 *i.e.* 7.66 kg/tree.
5. The number of nuts per kg was higher under Vengurla-7 *i.e.* 82.25 and lowest under Vengurla-5 *i.e.* 183.75.

6. Vengurla-5 (46.75 days) required least number of days for harvest while highest number of days for harvest was required with Vengurla-3 (57.25 days).

### 6.3 Physiological parameter of cashew apple and nut at maturity

1. Significantly the highest weight of apple (107.66 g) was found with the Vengurla-4 while it was lowest with Vengurla-5 (42.26 g). The nut weight (g) was recorded significantly the highest with Vengurla-7 (12.14 g) while it was lowest with Vengurla-5 (5.44 g).
2. Volume of apple was recorded significantly the highest *i.e.* 116.45 ml with Vengurla-4 and least with Vengurla-5 *i.e.* 48.55 ml. Vengurla-7 was found with significantly the highest volume of nut *i.e.* 9.45 ml and lowest with Vengurla-2 (2.75 ml).
3. The specific gravity of cashew apple was found significantly the highest with Vengurla-1 (0.969) and lowest with Vengurla-5 (0.867). The specific gravity of cashew nut was significantly the highest *i.e.* 2.065 observed with Vengurla-2 and least with Vengurla-7 *i.e.* 1.287.
4. The Length of cashew apple was obtained significantly the highest with Vengurla-4 (8.41 cm) and least with Vengurla-5 *i.e.* 3.73 cm. While The Length of cashew nut remained significantly highest with Vengurla-6 *i.e.* 4.25 cm and lowest with Vengurla-5 *i.e.* 2.85 cm.

5. Vengurla-3 was found significantly the highest with diameter of proximal, middle and distal end of apple *i.e.* 4.07, 5.01 and 5.87 cm, respectively. In case of significantly least diameter of proximal end of apple (2.71 cm) was found with Vengurla-2 and Vengurla-5, with middle end of apple it was found with Vengurla-1(3.35) and at distal end of apple it was reported with Vengurla-1(4.03). Vengurla-4 (2.45 cm) was recorded significantly the highest with diameter of nut and lowest with Vengurla-2 *i.e.* 1.41 cm.
6. The yellow colour of cashew apple was observed with Vengurla-1, Vengurla-3, Vengurla-5, Vengurla-6 and Vengurla-7, while it was red colour in Vengurla-2 and Vengurla-4. All the cultivars *i.e.* Vengurla-1 to Vengurla-7 showed the grey colour of cashew nut at maturity.

## CONCLUSION:

Based on the results of the experiment entitled “Studies on flowering and fruiting behaviour of different varieties of Cashew (*Anacardium occidentale* L.) in South Gujarat” concluded that Vengurla-4 recorded higher production with superior physiological parameter and Vengurla-7 had higher sex ratio with minimum fruit drops and heavier row nut, while Vengurla-5 recorded highest total number of flowers, percentage of fruit set and minimum days require for harvest under South Gujarat condition.



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## VII REFERENCES

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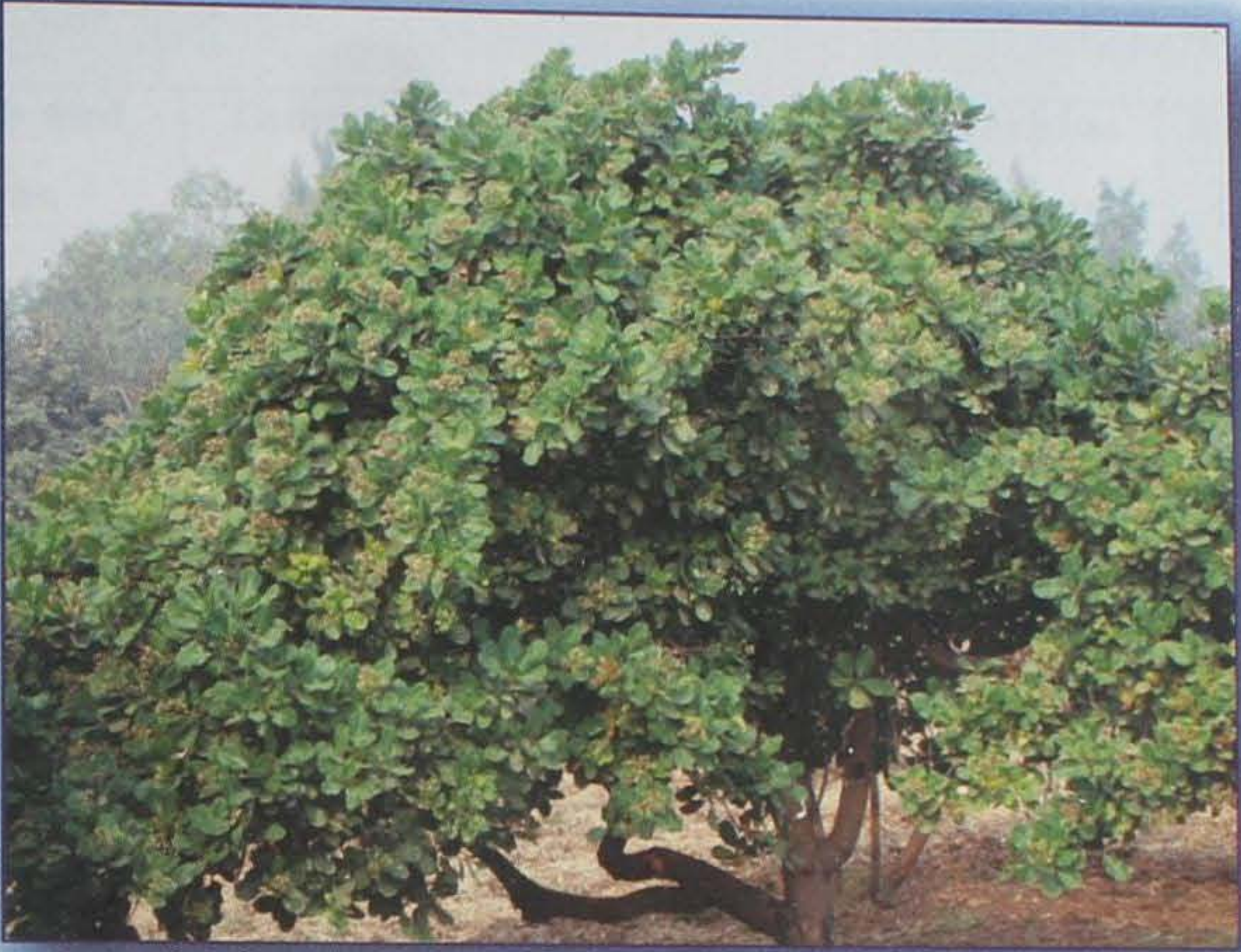
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# APPENDICES

**Appendix-I: Mean monthly meteorological data recorded at  
Meteorological observatory of AES, Paria.**

<b>Month and Year</b>	<b>Temperature °C</b>		<b>Mean Humidity (%)</b>	<b>Sunshine (Hours day<sup>-1</sup>)</b>	<b>Rainfall (mm)</b>
	<b>Max</b>	<b>Min</b>			
<b>December,09</b>	32.19	14.07	68.52	8.22	0.0
<b>January,10</b>	32.57	13.13	61.71	9.06	0.0
<b>February,10</b>	32.48	13.16	65.71	9.47	0.0
<b>March,10</b>	35.77	16.25	63.84	10.28	0.0
<b>April,10</b>	37.38	20.81	62.15	10.94	0.0
<b>May,10</b>	36.05	25.48	70.76	11.07	0.0
<b>June,10</b>	33.86	25.64	80.70	9.69	85.5

CERTIFICATE

*This is to certify that I have no objection to supply one copy of any part of this thesis at a time to any scientist through reprographic process if necessary for rendering reference service in a library or documentation centre.*

**Place: Navsari**

**Date: 23<sup>rd</sup> May, 2011**

  
**(Solanki P. D.)**