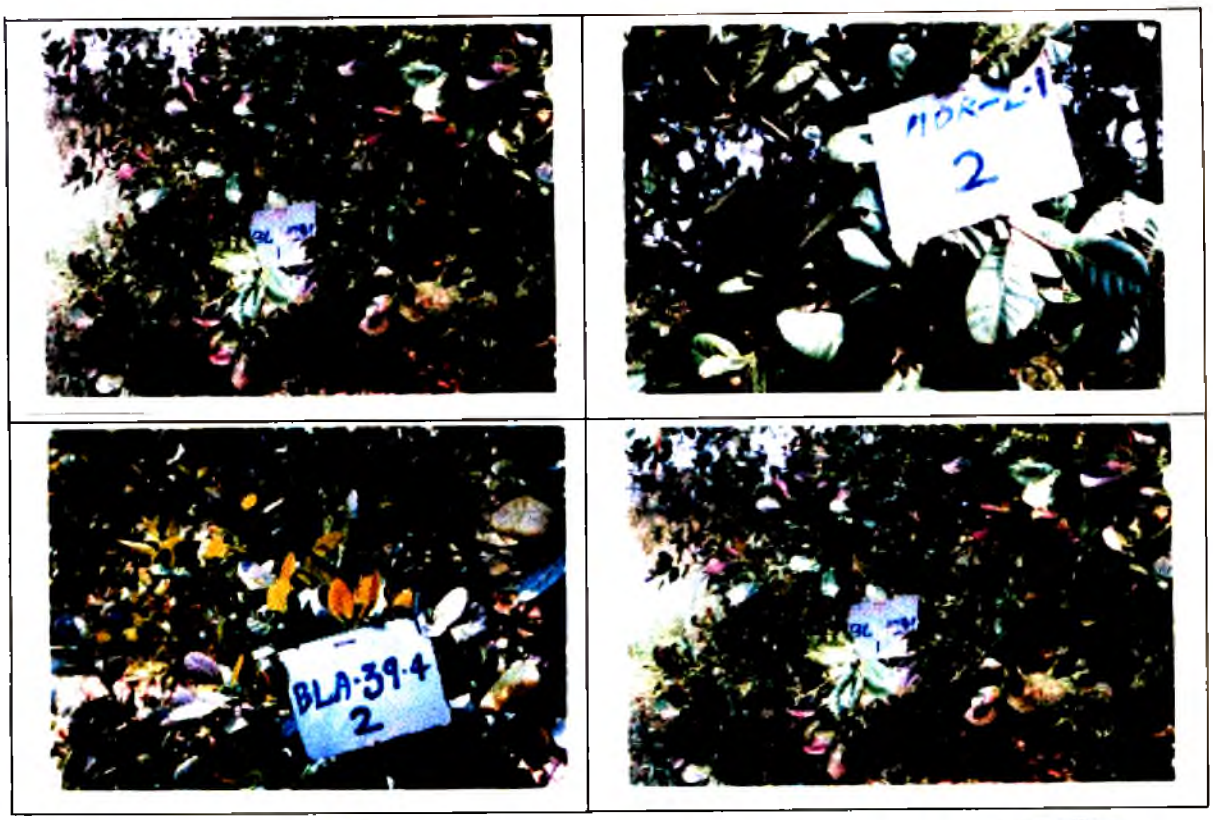
ICAR *ad hoc* scheme
on
Influence of weather and soil factors on growth, yield, nut weight and nut quality of cashew in West and East coasts of India



Final Report

(01.04.1995 to 31.03.1999)

Kerala Agricultural University
Regional Agricultural Research Station
Pilicode – 671 353, Kasaragod Dist., Kerala
1999

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F.No. 15-18/93- Hort. I dt. 23.12.94 (ICAR)
R2/66255/93 dt. 03.02.1995 (KAU)

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Preface

The reproductive phase of cashew is the one which is very sensitive to weather aberrations. There is a belief that the behaviour of the reproductive phase of cashew depends on rainfall distribution and it requires long dry spell for better yield. The pest complex of cashew across the west coast is another menace, which affects cashew production as it coincides with flushing/flowering phase of cashew. The weather factors, which are conducive for better flowering, sometimes trigger the pest build up also across the west coast. Whereas, it is the surface air temperature (both high maximum and low minimum) during the reproductive phase across the east coast, which decides the cashew production and its quality. Due to streak of weather events that took place since the last four years, not much progress is made in improvement of cashew production of Kerala despite sound technology is available. To understand the effect of weather elements on biotic events of cashew and its yield, no systematic study was conducted in India as well outside before the year 1990. For the first time, an ICAR *ad hoc* scheme was taken up in Kerala Agricultural University at RARS, Pilicode on "Crop weather models of cashew" for a period of three years starting from 06.05.1992 to 05.05.1995 to understand the crop weather interactions of cashew. In continuation of the above project, the ICAR had sanctioned another *ad hoc* scheme entitled "Influence of weather and soil factors on growth, yield, nut weight and quality of cashew across the west and east coasts of India" for a period of four years starting from 01.04.1995 to 31.03.1999.

Out of the huge and rich data bank generated on different biotic events of cashew and meteorological variables across the west and east coasts of India, several inferences could be drawn from crop weather interactions of cashew. The results are quite interesting and thought provoking. For example, it was not the rainy season, a dry spell in continuous wet spell may be critical to break the bud in cashew along with the dry spell that occurs after the prolonged wet spell. The delay in flowering of cashew was explained not only with rainfall distribution and surface air temperature but also with soil nutrients as the delay in bud break was noticed between better and poor crop management conditions. The biotic events of cashew also delayed with latitude and altitude irrespective of the variety. It is also proved that the "Hopkins' Bio climatic law" holds good in biotic events of cashew, provided the genotype and the distribution of rainfall are same. The role of dry spell and mild winter on the reproductive phase of cashew was also highlighted. The effect of phototropism on biotic events of cashew and its yield was also brought out clearly for the first time. The effect of weather on nut characteristics was also studied. The crop weather diagrams were prepared to give insight for the better crop management of cashew. The cashew production and nut characteristics were compared across the west and east coasts of India and suggested measures for improvement based on agroclimatic zones delineated for the purpose. It is understood that cashew enamoured with dry spell/drought and yields relatively better.

The Principal Investigator is of the opinion that the results emanated out of the project need to be published in an abridged form for the benefit of the concerned who involved in cashew improvement and production. It is felt that the joint efforts made by the Kerala Agricultural University and the Indian Council of Agricultural Research paid rich dividends in understanding crop weather interactions of cashew to a considerable extent in different agro-climatic situations which prevail across the west and east coasts of India. Finally, but not the least, the Principal Investigator is grateful to the ICAR for funding the project of this nature.

Principal Investigator

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FINAL REPORT OF RESEARCH SCHEME
(01.04.1995 to 31.03.1999)

1. Project Title : Influence of weather and soil factors on growth, yield, nut weight and nut quality of cashew in West and East coasts of India

2. Sanction No. : F. No. 15-18/93-Hort.I dt.23.12.94 (ICAR) R2/66255/93 dt.3.2.1995 of KAU

3. Date of Start : 01.04.1995

4. Date of termination : 31.03.1999

5. (a) Name of Institute : Kerala Agricultural University
Regional Agricultural Research Station
Pilicode – 671 353, Kasaragod District

(b) Division/Department/Section : Department of Agricultural Meteorology

(c) Location of work : Regional Agricultural Research Station
Kerala Agricultural University
Pilicode – 671 353, Kasaragod District
Kerala

6. Technical personnel employed :

a. Research Associate employed at the Project site

Name with designation	Date of joining	Date of leaving	Total no. of man months spent
Mr.C.S. Gopakumar Research Associate (Meteorology)	01.08.95	31.03.99	44

b. Technical personnel involved at different locations

Mrs. B. Suma
Asst. Professor (Hort)
CRS, Madakkathara
Pin: 680 656

Sri. M.C. Narayanan Kutty
Asst. Professor (Hort)
CRS, Anakkayam
Malappuram Dist

Dr. K.C. Aipe
Associate Professor & Head
RARS, Ambalavayal
Wynad Dist, Pin: 673 593

Dr. B.B. Sapkal &
Dr. S.B. Desh Pande
RFRS, Vengurla P.O
Maharashtra- 416 516

Dr.H.B. Lingaiah &
Dr. Thirumala Raju, G.T
AICCP (Cashew), Chintamani
Kolar Dist, Karnataka

Dr. Lakshmi Narayana Reddy
Head & Horticulturist
CRS, Bapatla – 522 101
Guntur Dist, A.P

Dr. P.C. Lenka
Horticulturist
OUAT, Bhubaneswar
Pin: 751 003, Orissa

Dr. S.N. Ghosh
Reader
RRS, Jhargram
Pin: 721 507, Midnapur, W.B

Dr. M.Selvarajan
RRS, Vriddhachalam
Vallalar Dist, South Arcot
Pin: 606 001, Tamil Nadu

Dr.M.P.Giridharan
Asst. Professor (Horti)
RARS, Pilicode
Kasaragod Dist
Pin: 671 353

Dr.B.Jayaprakash Naik
Asst. Professor (Pl. Breed.)
RARS, Pilicode
Kasaragod Dist
Pin: 671 353

Dr.P.R.Suresh
Asst. Professor
(SS&Ag.Chemistry)
COA, Padnekkad
Kasaragod Dist

7. Total outlay : Rs. 4.60660 /- lakhs

Share of ICAR	Share of Participating Agency
100%	Nil

8. Total amount spent : Rs. 3.17026/- lakhs

Share of ICAR	Share of Participating Agency
100%	Nil

9. Objectives and how far these have been achieved

a) To understand the effect of latitude and altitude on different phenophases of cashew.

b) To study the environment and varietal interactions on cashew yield.

c) To study the effect of weather on cashew yield and nut weight and to compare nut weight of cashew between West and East coasts of India.

All the above objectives have been achieved

10. Approved Technical Programme :

(i) Locations :- Figs. 1 & 2

West coast	:	Kottarakkara, Madakkathara, Anakkayam, Ambalavayal Chintamani, Pilicode and Vengurla
East coast	:	Vriddhachalam, Bapatla, Bhubaneswar and Jhargram

(ii) Varieties:-

Anakkayam-1 (BLA-139-1), Madakkathara-1 (BLA-39-4), Kanaka (H-1598) and Madakkathara-2 (NDR-2-1)

(iii) Data:-

The past climatological data viz., rainfall, maximum and minimum surface air temperatures will be collected along with the available data on cashew yield from different cashew stations.

The daily weather data on rainfall, pan evaporation, maximum and minimum surface air temperatures, bright sunshine, relative humidity and dew fall will be collected from different cashew stations during the project period along with the phenological data viz., date of bud break, flushing, flowering, nut setting and harvest.

The available information on soil fertility status will be collected from all the centres. As suggested by the ICAR, the maps available from the NBSS and LUP will be utilised for information on soils. Soil samples also will be collected from different locations for soil nutrient analysis.

a. Remarks of scientific panel on cashew reports.

i) Comments on the Annual Report 1996-97

One of the main objectives of the Project is to find out the influence on weather and soil factors on the nut quality, especially on the kernel weight. The data so far collected only pertains to bud break and the yield. It could have been more appropriate if the differences in soil nutrient status and other soil characteristics are correlated with growth of the plants. The soil moisture is an important factor which needs to be assessed especially with reference to the nut size and kernel size. The principal Investigator may be advised to collect the data from all centres on these aspects. The phenological data from all the centres identified is also yet to be collected.

ii) Comments on the Annual Report 1997-98

One of the main problems noticed in the yield of cashew is, in general, the yields in East Coast are less compared to West Coast regions. Further the same variety when tested in both the locations, the nut size differed and it invariably was low in East Coast compared to the values obtained for nut weight and kernel weight for the same variety in the West Coast.

The primary objectives of the Project is to investigate the effect of soil and weather parameters on phenology, nut weight and kernel weight. The Project also envisages to study the effect of water stress on the nut and kernel development. The investigators have compiled the data available at Research Centres located at Chintamani and Vengurla in the West Coast & Vriddhachalam and Bapatla in the East Coast under AICRP on Cashew, in addition to the data from Research Stations at Kottarakkara, Pilicode and Ambalavayal under Kerala Agricultural University. However, most of the data collected from the AICRP on Cashew Centres does not pertain to the Scheme period and in most of the cases, the data compiled is up to 1995-96 season only, while the Project has commenced only from April 1995. Further, during the current year, the data presented in the report is confined to only Kottarakkara, Pilicode and Ambalavayal. The conclusions drawn is based on the data collected from Kerala State and does not fulfil the objective of the Project. Some of the conclusions like ".....low surface air temperature that exist at high altitude which may prolong nut development period" are not supported by the data compiled during the season. The Project also envisages to workout the water stress/water deficit using Thornthwaite's water balance procedure. But so far, no data has been reported on this aspect in the reports presented. The data pertaining to the years 1996 and 1997 for the rainfall pattern during November and December as compared to the data of 1995 would have given a very valuable information on this subject. The Principal Investigator may be asked to collect the information from all the Centres proposed originally in the Project properly and draw the conclusions instead of basing on the data from a single location namely Pilicode under KAU. It may also be noted that the differences in the soil characteristic were also to be correlated with the nut weight and kernel development for which a post of Research Associate (Soil Sci.) was sanctioned. Even after three years of implementation of the Project, the post has not been filled up which obviously resulted in default in collection of data on soil aspects. Before the Project is concluded, the PI may be asked to complete the gaps in data collection and interpret the data accordingly, instead of drawing the conclusions based on data collected from Kerala State alone.

11. Detailed report

11.1 Methodology

The effect of latitude and altitude on different phenophases of cashew, in particular, on cashew flowering will be studied across West and East coasts of India.

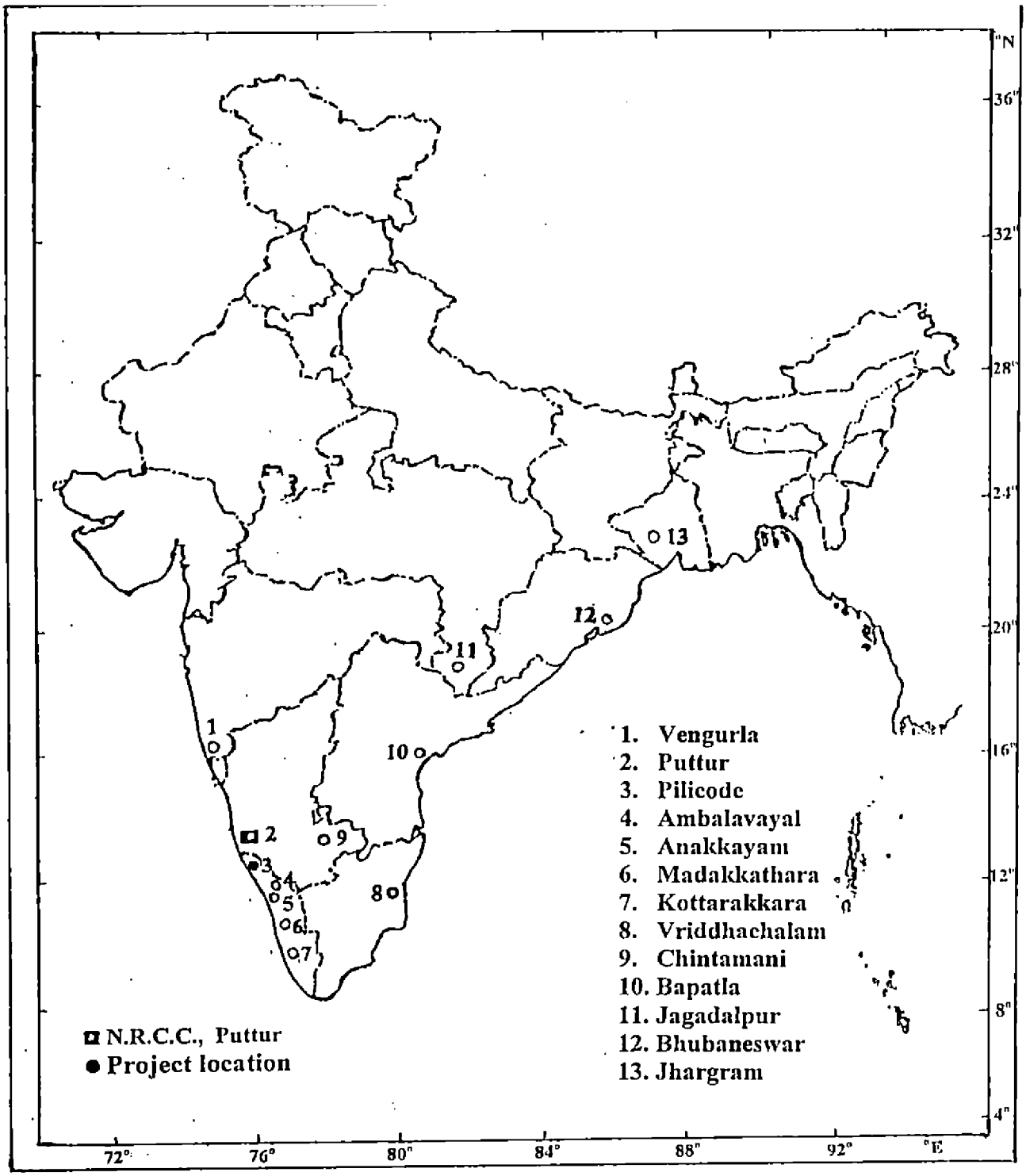

Fig 1. Cashew Research Stations in India

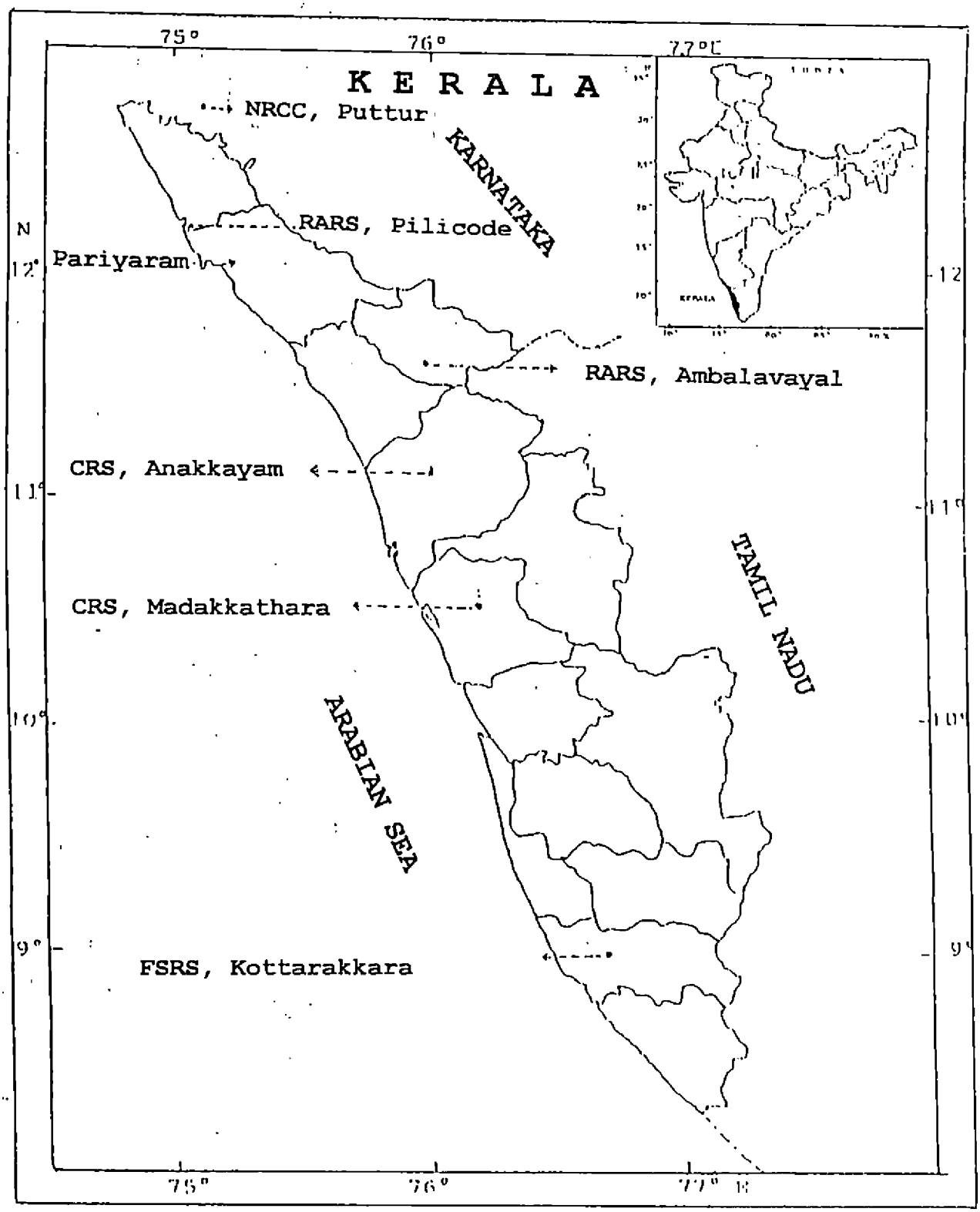

Fig 2. Cashew Research Stations in Kerala

The effect of rainfall and water stress on cashew yield will be attempted at individual stations based on past climatological and cashew yield data. This study will be taken up wherever the above data are available. The water stress/water deficit will be worked out using Thornthwaite's water balance (1955) procedure.

The length of weekly water availability periods (Cocheme and Franquine, 1967) will be worked out using daily rainfall and pan evaporation and its impact on cashew phenology and yields will be studied through graphical technique.

Reaction of cashew varieties to different environments will also be studied.

Different soil and weather elements will be compared from one location to another and their impact on cashew phenology, nut weight and cashew nuts will be studied through crop weather calendars.

11.2 DATA COLLECTED

11.2.1 Climatological Data

11.2.1.1 Monthly rainfall at RRS, Vriddhachalam

Monthly rainfall (mm) and no. of rainy days from 1973 to 1998

Year	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Jan	0.0	0.0	3.0	0.0	3.5	3.4	0.0	0.0	19.8	0.0	0.0	18.2	158.4
	(0)	(0)	(1)	(0)	(1)	(0)	(0)	(0)	(2)	(0)	(0)	(2)	(5)
Feb	0.0	3.9	0.0	0.0	10.0	0.0	31.2	0.0	0.0	0.0	0.0	182.4	0.0
	(0)	(1)	(0)	(0)	(1)	(0)	(1)	(0)	(0)	(0)	(0)	(7)	(0)
Mar	0.0	13.6	46.6	0.0	0.0	0.0	2.1	0.0	15.8	0.0	0.0	97.4	0.0
	(0)	(1)	(2)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(5)	(0)
Apr	8.9	0.0	0.0	5.4	38.0	61.8	0.0	0.0	0.0	6.6	0.0	14.0	0.0
	(1)	(0)	(0)	(1)	(2)	(1)	(0)	(0)	(0)	(1)	(0)	(1)	(0)
May	7.4	89.2	24.2	11.3	15.2	2.2	26.5	0.0	187.4	0.0	87.6	27.8	49.6
	(2)	(3)	(2)	(1)	(3)	(0)	(3)	(0)	(6)	(0)	(5)	(1)	(3)
Jun	93.8	75.5	17.5	48.6	36.5	19.4	78.4	12.0	36.8	21.2	48.8	3.8	116.0
	(8)	(5)	(3)	(3)	(1)	(3)	(5)	(1)	(2)	(4)	(3)	(1)	(3)
Jul	68.6	90.6	237.1	151.0	15.2	66.7	27.2	133.4	236.0	39.8	49.2	175.0	62.8
	(7)	(6)	(11)	(8)	(1)	(6)	(20)	(8)	(10)	(3)	(5)	(9)	(6)
Aug	133.3	111.0	162.6	103.6	172.6	78.1	131.4	59.8	164.8	26.8	286.2	55.4	139.6
	(8)	(7)	(10)	(9)	(12)	(7)	(6)	(6)	(7)	(2)	(10)	(6)	(6)
Sep	177.4	159.4	157.0	77.4	78.3	305.3	255.6	84.4	249.8	88.4	160.9	283.0	223.5
	(9)	(11)	(6)	(6)	(8)	(13)	(11)	(5)	(10)	(6)	(7)	(9)	(6)
Oct	213.3	142.2	228.0	139.1	38.9	212.8	100.8	35.6	182.8	71.0	129.8	46.4	110.0
	(11)	(9)	(13)	(5)	(2)	(11)	(8)	(7)	(9)	(7)	(7)	(3)	(4)
Nov.	211.0	28.6	220.0	211.5	678.2	248.3	615.6	140.7	143.8	280.9	96.2	151.6	336.0
	(9)	(2)	(10)	(13)	(16)	(8)	(19)	(7)	(9)	(8)	(9)	(5)	(8)
Dec	89.1	22.0	43.0	102.7	14.2	188.3	63.4	40.6	45.9	27.4	360.2	78.8	127.0
	(7)	(2)	(3)	(9)	(3)	(16)	(5)	(2)	(4)	(2)	(13)	(3)	(5)
Total	1002.8	736.0	1139.0	816.6	1100.6	1186.3	1332.2	506.5	1282.9	562.1	1218.9	1133.8	1322.9
	(62)	(47)	(61)	(55)	(50)	(65)	(78)	(36)	(60)	(33)	(59)	(52)	(46)

Contd.....

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Jan	118.3	3.2	0.0	5.0	59.8	1.5	0.0	0.0	0.0	10.4	0.0	5.4	0.0
Feb	43.7	0.0	2.0	0.0	61.0	0.0	0.0	17.0	26.4	0.0	0.0	0.0	0.0
Mar	55.0	0.0	29.6	0.0	55.2	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0
Apr	19.6	0.0	45.8	28.5	25.0	0.0	0.0	0.0	0.0	1.5	146.5	0.0	0.0
May	48.2	0.0	16.0	3.0	24.8	0.0	10.9	20.0	21.2	170.4	60.4	0.0	48.5
Jun	77.4	93.3	22.4	26.4	11.6	75.7	38.8	62.2	29.0	49.5	213.9	34.7	-
Jul	34.4	23.9	78.8	255.0	61.5	14.9	43.1	89.6	81.0	42.7	6.0	13.8	-
Aug	100.5	69.1	155.4	52.5	181.8	109.5	84.7	79.2	154.7	36.5	160.3	74.2	-
Sep	155.1	319.1	212.1	18.4	102.2	112.0	118.4	140.8	90.1	212.4	160.4	56.4	-
Oct	156.9	116.4	38.4	132.5	150.8	255.2	117.2	189.3	181.4	255.5	123.4	155.5	-
Nov	162.0	183.0	118.0	217.5	84.0	616.8	296.5	311.3	304.3	104.3	264.6	386.3	-
Dec	146.2	240.5	0.0	35.0	30.0	23.0	81.5	410.0	55.3	0.0	826.9	367.3	-
Total	1117.3	1048.5	718.5	773.8	847.7	1208.6	791.1	1319.4	943.4	890.7	1962.4	1093.6	

( ) - indicates the no. of rainy days

Mean annual rainfall : 1042.2 mm
No. of rainy days : 54

11.2.1.2 Monthly surface air temperature (°C)

Month		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Jan	Max	32.6	35.1	34.0	-	31.9	30.5	-	-	30.6	30.4
	Min	-	23.2	-	23.4	25.0	25.2	-	-	21.6	-
	Mean	-	29.2	-	-	28.5	27.9	-	-	26.1	-
Feb	Max	32.6	34.1	34.5	-	33.8	32.6	-	-	35.2	32.4
	Min	20.8	25.0	-	25.6	26.7	24.2	-	-	22.5	-
	Mean	26.7	30.0	-	-	30.3	28.4	-	-	28.9	-
Mar	Max	36.5	37.7	34.1	-	37.2	37.1	-	-	38.1	37.0
	Min	24.3	29.7	-	30.6	29.1	24.2	-	-	24.9	-
	Mean	30.4	33.7	-	-	33.2	30.7	-	-	31. 5	-
Apr	Max	40.5	40.0	39.8	-	43.0	40.5	-	35.9	39.7	37.0
	Min	29.3	29.9	-	31.9	33.1	25.6	-	29.0	-	-
	Mean	34.9	35.0	-	-	38.1	33.1	-	32.5	-	-
May	Max	41.7	41.3	44.8	-	37.9	40.2	-	38.3	42.1	39.4
	Min	30.6	31.4	31.0	33.2	32.5	28.4	-	28.1	-	-
	Mean	36.2	36.4	37.9	-	35.2	34.3	-	33.2	-	-
Jun	Max	41.2	41.3	42.9	-	34.8	40.2	-	37.4	42.1	40.2
	Min	29.6	31.6	32.2	31.5	28.7	27.5	-	29.0	-	-
	Mean	35.4	36.5	37.6	-	31.8	33.9	-	33.2	-	-
Jul	Max	38.5	39.9	40.8	-	38.5	36.7	-	35.4	39.0	36.0
	Min	28.6	29.2	29.9	31.6	29.7	27.5	-	26.8	-	-
	Mean	33.6	34.6	35.4	-	34.1	32.1	-	31.1	-	-
Aug	Max	37.5	39.9	38.0	-	33.7	38.3	-	34.8	39.2	34.6
	Min	27.4	28.6	29.2	28.2	26.3	25.3	-	28.4	-	-
	Mean	32.5	34.3	33.6	-	30.0	31.8	-	31.6	-	-
Sep	Max	36.1	36.7	39.7	-	35.6	34.0	-	35.1	37.9	35.8
	Min	27.8	29.6	28.8	25.2	27.5	24.9	-	27.6	-	-
	Mean	32.0	33.2	34.3	-	31.6	29.5	-	31.4	-	-
Oct	Max	36.0	36.2	-	-	34.6	34.9	-	32.2	35.5	34.5
	Min	26.6	-	28.4	28.7	26.4	25.2	-	25.8	-	-
	Mean	31.3	-	-	-	30.5	30.0	-	29.0	-	-
Nov	Max	36.1	36.3	-	-	32.6	34.1	-	29.3	33.5	-
	Min	26.5	-	25.2	28.3	26.8	24.4	-	23.7	-	-
	Mean	31.3	-	-	-	29.7	29.3	-	26.5	-	-
Dec	Max	35.6	34.1	-	-	30.2	34.0	-	29.4	30.0	-
	Min	25.0	-	23.9	26.4	22.3	23.0	-	20.9	-	-
	Mean	30.3	-	-	-	26.3	28.5	-	25.2	-	-

11.2.1.2a Monthly rainfall (mm) and surface air temperature (°C) at CRS, Bhubaneswar from 1982 to 1998

Year	Rainfall (mm)												
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Total
1982	1.8	48.8	23.3	35.9	61.6	294.0	214.0	442.0	219.0	39.6	19.6	0.0	1398.0
1983	0.0	109.0	10.7	44.4	45.3	200.0	369.0	557.0	299.0	174.0	3.3	11.4	1822.9
1984	0.0	26.1	0.0	17.4	23.9	23.4	508.0	557.0	216.0	55.7	0.0	0.0	1637.9
1985	10.0	33.5	2.8	7.2	28.3	148.0	400.0	403.0	383.0	221.0	0.0	0.0	1636.6
1986	32.0	27.5	6.6	55.7	67.7	268.0	393.0	289.0	274.0	188.0	174.0	8.4	1782.8
1987	5.4	0.0	10.2	19.4	56.6	91.7	292.0	256.0	111.0	125.0	106.0	3.8	1076.3
1988	0.0	7.4	6.2	34.2	84.3	196.0	381.0	143.0	271.0	89.0	0.0	0.0	1212.4
1989	0.0	0.0	4.2	4.7	157.0	231.0	130.0	365.0	163.0	41.2	0.0	0.0	1094.8
1990	59.8	120.0	131.0	125.0	217.0	290.0	469.0	238.0	165.0	247.0	92.0	0.0	2151.4
1991	69.9	0.6	39.1	16.5	13.6	161.0	501.0	307.0	127.0	105.0	79.9	3.0	1423.0
1992	20.5	54.9	0.0	11.0	251.00	138.0	354.0	356.0	226.0	164.0	1.3	0.0	1577.4
1993	0.0	0.0	9.7	90.6	55.7	285.0	241.0	457.0	195.0	79.3	48.2	0.0	1427.7
1994	0.0	33.6	8.0	21.9	17.9	169.0	238.0	489.0	252.0	149.0	5.6	0.0	1384.2
1995	32.0	52.5	21.6	11.4	704.0	132.0	176.0	195.0	240.0	335.0	184.0	0.0	2083.8
1996	83.5	4.6	0.0	17.2	41.1	135.0	142.0	228.0	67.0	109.0	16.3	0.0	842.8
1997	67.5	8.0	54.6	136.0	16.4	84.0	192.0	53.5	349.00	32.3	9.4	27.7	1510.5
1998	26.4	20.9	67.3	77.8	40.5	164.0	342.0	164.0	239.0	307.0	93.5	0.0	1541.5

Year	Maximum temperature (°C)												
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1982	29.7	31.0	33.3	36.6	38.5	34.6	34.4	31.2	32.9	33.6	31.1	29.9	33.1
1983	29.2	29.2	33.5	36.0	37.2	36.8	32.7	31.9	31.9	31.5	30.1	28.8	32.4
1984	28.0	29.7	35.2	37.0	37.0	33.8	32.2	31.6	32.5	32.6	30.3	29.4	32.4
1985	28.7	31.1	35.5	37.6	37.0	36.1	31.7	31.3	31.4	31.3	30.7	29.8	32.7
1986	27.7	32.2	35.4	35.9	35.3	34.4	32.4	32.3	32.8	31.5	29.8	28.6	32.4
1987	28.3	31.5	34.1	36.2	37.2	37.3	33.2	32.8	33.4	32.9	29.5	28.2	32.9
1988	29.4	32.8	35.8	37.3	36.4	34.4	37.7	32.1	32.6	32.5	30.8	29.6	33.5
1989	28.4	32.8	35.3	38.1	37.0	33.7	32.2	32.1	32.4	33.0	31.9	25.8	32.7
1990	30.7	31.5	31.6	34.5	34.8	34.2	31.8	32.9	32.6	31.5	30.7	29.2	32.2
1991	27.6	33.8	35.5	37.8	38.3	35.2	32.2	31.2	31.9	30.6	27.9	26.9	32.4
1992	26.5	29.0	39.6	36.7	36.3	35.4	32.4	32.1	32.9	32.7	30.9	29.2	32.8
1993	30.5	32.6	35.1	36.8	37.6	34.5	33.5	33.1	32.2	33.2	31.4	27.6	33.2
1994	29.3	29.8	35.0	36.4	39.1	33.5	31.3	31.0	31.9	31.6	29.7	29.1	32.3
1995	26.8	31.8	34.8	37.4	34.5	34.2	31.8	32.4	31.9	30.5	29.2	28.9	32.0
1996	29.1	30.9	35.0	36.9	37.5	34.1	32.8	30.9	33.1	31.9	30.2	28.0	32.5
1997	27.3	31.1	34.7	34.1	36.7	36.1	33.3	32.0	32.3	32.9	32.1	28.4	32.6
1998	28.8	31.0	33.5	36.2	38.8	36.8	32.9	32.6	32.2	31.6	30.6	28.6	32.8

Year	Minimum temperature (°C)												
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1982	18.1	20.7	22.6	25.3	26.6	26.3	26.3	25.7	25.2	23.5	19.7	16.2	23.0
1983	17.6	20.2	23.8	24.9	26.3	26.6	26.1	25.9	25.9	23.2	18.8	14.3	22.8
1984	17.4	18.4	21.7	25.1	27.3	26.1	25.2	25.4	24.7	23.0	16.2	15.1	22.1
1985	17.4	18.5	23.1	25.4	26.6	26.4	25.2	25.4	25.2	21.7	17.9	15.2	22.3
1986	15.3	19.2	22.0	24.8	25.3	26.0	28.4	25.7	25.0	22.6	19.4	17.0	22.6
1987	15.3	17.5	21.2	24.9	26.2	26.8	25.9	26.6	25.9	23.3	20.0	15.8	22.5
1988	16.3	18.8	22.8	24.9	27.2	25.6	25.9	25.8	25.2	22.2	18.1	16.1	22.4
1989	15.1	17.5	21.2	25.2	26.7	25.4	25.8	25.3	25.2	23.1	17.7	14.6	21.9
1990	15.5	19.5	21.5	24.8	25.6	25.7	25.3	26.0	25.5	22.9	20.5	15.6	22.4
1991	16.7	19.8	23.2	25.7	28.0	26.9	26.0	25.6	25.5	23.2	17.7	14.2	21.7
1992	13.8	18.3	21.8	23.7	25.5	26.4	25.2	24.1	24.5	22.5	19.7	13.6	21.6
1993	15.6	17.8	21.6	24.4	26.6	26.3	25.1	24.8	24.5	23.8	17.8	13.8	21.8
1994	14.6	18.6	22.6	24.7	26.9	26.0	25.1	25.0	24.6	22.9	18.7	13.5	21.9
1995	18.4	18.7	21.8	24.9	26.3	26.7	25.8	25.7	25.5	23.5	19.0	14.7	22.6
1996	16.9	18.3	22.6	24.5	26.8	25.4	25.3	25.0	25.3	23.1	17.4	12.9	21.9
1997	13.6	17.1	22.1	21.9	25.6	25.9	25.6	24.8	24.8	22.4	20.9	17.4	21.8
1998	16.5	19.0	22.1	24.4	27.1	27.2	25.5	25.9	25.3	24.2	20.7	17.2	22.9

11.2.1.3 Monthly rainfall and no. of rainy days at ARS, Chintamani

Rainfall (mm) and no. of rainy days from 1983 to 1998

Month	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Jan	0.0 (0)	0.0 (0)	8.5 (2)	20.0 (2)	0.0 (0)	0.0 (0)	0.0 (0)	0.8 (0)	18.4 (2)	13.6 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	5.0 (1)	0.0 (0)
Feb	0.0 (0)	44.6 (3)	0.0 (0)	15.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	13.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
Mar	12.4 (1)	75.7 (2)	10.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	9.2 (1)	14.4 (3)	0.0 (0)	0.0 (0)	14.5 (1)	0.0 (0)	8.4 (1)	0.0 (0)	33.0 (2)	7.0
Apr	0.0 (0)	8.1 (1)	21.2 (3)	3.0 (1)	5.0 (1)	57.8 (2)	11.2 (1)	5.4 (1)	5.2 (1)	34.8 (2)	3.4 (1)	14.6 (2)	0.0 (0)	71.8 (3)	79.6 (4)	19.6
May	97.1 (4)	27.5 (3)	17.6 (1)	22.8 (3)	12.6 (2)	74.6 (4)	17.2 (4)	193.0 (7)	112.4 (8)	43.8 (4)	32.3 (2)	51.4 (7)	163.3 (8)	50.0 (3)	9.7 (1)	72.4
Jun	109.7 (6)	34.0 (3)	67.1 (3)	80.1 (4)	72.0 (7)	0.0 (0)	21.0 (4)	13.6 (1)	122.2 (10)	112.2 (8)	139.1 (3)	46.4 (4)	85.8 (8)	197.5 (11)	119.2 (8)	-
Jul	48.4 (5)	94.6 (7)	86.1 (6)	56.8 (6)	38.6 (4)	90.4 (10)	311.2 (11)	15.4 (2)	56.0 (8)	30.8 (3)	92.7 (3)	64.4 (6)	122.6 (9)	20.6 (4)	46.9 (5)	-
Aug	128.2 (11)	23.4 (2)	16.8 (3)	19.2 (3)	39.4 (4)	215.2 (10)	22.6 (4)	150.2 (7)	47.6 (6)	97.0 (4)	139.6 (7)	58.9 (7)	194.8 (8)	62.8 (6)	27.7 (3)	-
Sep	134.9 (10)	144.4 (8)	177.0 (11)	157.2 (12)	211.8 (7)	181.6 (10)	187.0 (5)	160.4 (9)	220.6 (8)	56.6 (3)	141.8 (7)	38.8 (3)	103.8 (5)	170.5 (13)	193.8 (10)	-
Oct	34.2 (5)	90.0 (8)	60.2 (5)	81.6 (4)	211.1 (11)	31.8 (2)	43.2 (4)	101.0 (7)	362.2 (9)	118.2 (10)	194.3 (13)	150.0 (14)	133.5 (9)	75.4 (6)	85.9 (5)	-
Nov	10.7 (2)	34.8 (4)	63.6 (5)	61.0 (5)	31.1 (4)	11.0 (2)	7.4 (2)	44.4 (5)	92.8 (6)	56.6 (7)	82.8 (6)	9.3 (1)	22.2 (3)	10.2 (2)	68.7 (6)	-
Dec	40.1 (5)	15.0 (2)	13.2 (1)	19.2 (2)	36.9 (4)	26.4 (2)	4.6 (2)	4.2 (1)	0.0 (0)	0.0 (0)	63.2 (1)	2.8 (1)	0.0 (0)	39.8 (5)	10.1 (1)	-
Total (mm)	615.7 (49)	592.1 (43)	541.1 (41)	635.9 (43)	658.5 (44)	689.4 (42)	655.8 (37)	715.8 (44)	1037.4 (58)	563.6 (42)	903.7 (44)	436.6 (45)	834.4 (50)	689.4 (52)	680.0 (46)	-

( )- indicates the no. of rainy days

11.2.1.4 Monthly surface air temperature (°C)

Year		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Jan	Max	27.3	26.2	26.2	26.6	27.0	26.4	26.2	26.2	27.2	28.5	27.4	27.4	27.4	27.6	26.2
	Min	13.1	17.4	20.3	17.2	17.4	13.5	14.0	13.4	16.6	12.0	14.1	14.0	15.3	12.2	-
	Mean	20.2	21.8	23.3	21.9	22.2	20.0	20.1	19.8	21.9	20.3	20.8	20.7	21.4	19.9	-
Feb	Max	31.8	26.7	30.0	28.7	28.1	29.5	26.9	28.9	28.3	29.0	30.8	30.0	31.0	25.9	29.9
	Min	17.9	18.2	18.5	20.1	18.1	15.8	13.6	15.7	17.2	17.3	18.3	16.0	15.5	12.1	-
	Mean	24.9	22.5	24.3	24.4	23.1	22.7	20.3	22.3	22.8	23.2	24.6	23.0	23.3	19.0	-
Mar	Max	34.0	30.7	3.3.3	31.5	32.2	33.8	31.2	32.0	32.2	30.5	32.0	33.2	32.9	33.8	32.6
	Min	18.9	19.6	19.9	21.7	21.5	19.1	17.5	20.3	20.0	18.6	22.7	16.2	16.8	15.3	-
	Mean	26.5	25.2	26.6	26.6	26.8	26.5	24.4	26.2	26.1	24.6	27.4	24.7	24.9	24.6	-
Apr	Max	-	33.6	33.2	34.8	35.2	33.9	33.9	34.7	34.0	-	35.6	35.0	33.8	34.4	34.1
	Min	-	23.0	21.1	24.1	24.0	21.9	21.9	22.9	22.0	-	24.2	20.2	21.3	-	-
	Mean	-	28.3	27.2	29.5	29.6	27.9	27.9	28.8	28.0	-	29.6	27.0	28.9	-	-
May	Max	-	35.6	29.2	34.8	34.5	34.0	34.6	31.7	34.0	35.9	35.9	34.3	33.3	30.0	32.9
	Min	-	24.6	23.9	24.3	25.4	22.8	22.5	21.4	22.7	-	24.9	22.1	21.2	-	21.4
	Mean	-	30.1	26.6	29.6	30.0	28.4	28.6	26.6	28.4	-	30.4	28.2	27.3	-	27.2
Jun	Max	-	30.7	29.6	31.8	31.9	32.6	31.1	30.2	29.5	31.7	32.2	30.7	32.5	32.4	31.9
	Min		22.1	23.0	23.1	23.8	20.5	21.1	21.0	21.1	-	23.5	20.5	20.0	-	21.7
	Mean	-	26.4	26.3	27.5	27.9	26.6	26.1	25.6	25.3	-	27.9	25.6	26.3	-	26.8
Jul	Max	-	28.4	28.4	29.9	31.2	28.1	28.1	28.1	28.4	30.6	30.5	29.1	30.6	30.8	31.1
	Min	-	21.3	21.6	22.6	22.8	20.5	20.3	20.3	19.9	-	21.7	20.2	20.6	-	21.4
	Mean	-	24.9	25.0	26.3	27.0	24.3	24.2	24.2	24.2	-	26.1	24.7	25.6	-	26.3
Aug	Max	-	29.1	28.9	28.7	30.7	28.4	28.4	27.5	28.2	30.2	28.9	28.9	29.1	2.9.0	30.7
	Min	-	20.1	22.0	22.8	22.4	22.0	20.1	20.2	19.8	19.6	21.4	19.9	19.4	-	21.1
	Mean	-	24.6	25.5	25.8	26.6	25.2	24.3	23.9	24.0	24.9	25.2	24.4	24.3	-	25.9
Sep	Max	27.7	28.5	28.5	29.1	30.5	27.6	28.6	27.7	28.2	30.6	28.3	-	29.4	29.2	32.1
	Min	21.3	20.4	22.3	22.8	23.4	20.1	20.0	20.0	20.0	19.6	21.3	-	19.8	-	20.5
	Mean	24.5	24.5	25.4	25.9	27.0	23.9	24.3	23.9	24.1	25.1	24.8	-	24.6	-	26.3
Oct	Max	27.8	27.7	28.5	28.8	28.1	28.6	27.9	27.2	28.4	29.5	28.1	28.2	29.5	27.1	31.5
	Min	21.8	19.5	21.7	22.3	22.5	18.7	19.4	19.7	19.8	18.4	21.6	19.1	19.3	-	20.1
	Mean	24.8	23.6	25.1	25.6	25.3	23.7	23.7	23.5	24.1	24.0	24.9	23.7	24.4	-	25.8
Nov	Max	27.5	26.2	25.7	27.2	28.2	27.2	27.3	26.3	26.2	28.3	27.1	25.4	29.1	27.0	30.6
	Min	18.2	17.8	20.2	21.4	17.4	15.9	16.4	17.5	17.7	16.6	17.9	15.3	16.4	-	18.8
	Mean	22.9	22.0	23.0	24.3	22.8	21.6	21.9	21.9	22.0	22.5	22.5	20.4	22.8	-	24.7
Dec	Max	25.9	26.7	26.4	27.1	23.8	25.7	25.9	25.9	26.3	28.0	26.0	26.0	27.1	25.3	26.7
	Min	18.8	16.7	18.7	19.5	16.7	14.7	15.4	14.6	13.9	11.9	15.0	13.7	11.5	-	15.3
	Mean	22.4	21.7	22.6	23.3	20.3	20.2	20.7	20.3	20.1	20.0	20.5	19.9	19.3	-	21.0

11.2.1.5 Relative humidity (%)

Year		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Jan	Max	91	84	89	87	87	75	78	64	76	79	-	76	78	71	74
	Min	32	48	73	50	68	49	67	37	50	43	-	57	50	34	48
	Mean	62	66	81	69	78	67	73	51	63	61	-	67	64	53	61
Feb	Max	84	85	66	79	79	75	73	71	71	74	-	74	76	62	66
	Min	33	50	45	48	56	42	46	40	38	42	-	52	46	30	32
	Mean	59	68	56	64	68	59	60	56	55	58	-	63	61	46	49
Mar	Max	75	71	55	82	82	73	65	72	70	64	-	69	61	53	54
	Min	29	31	34	41	45	39	44	40	35	35	-	40	40	24	29
	Mean	52	51	45	62	64	56	55	56	53	50	-	55	51	39	42
Apr	Max	-	75	62	70	82	73	74	70	72	74	-	69	61	70	62
	Min	-	36	35	47	41	44	33	43	41	45	30	37	38	40	31
	Mean	-	56	49	59	62	59	54	57	57	60	-	53	50	55	47
May	Max	-	73	68	71	83	67	66	78	77	73	76	43	73	56	64
	Min	-	34	45	57	45	45	38	54	47	44	53	26	44	32	30
	Mean	-	54	57	64	64	56	52	66	62	59	65	35	59	44	47
Jun	Max	-	86	86	83	95	72	76	75	81	73	81	39	74	74	77
	Min	-	51	59	59	51	50	45	53	70	61	64	35	50	49	41
	Mean	-	69	73	71	73	61	61	64	76	67	73	37	62	62	59
Jul	Max	-	89	88	81	92	87	85	77	79	77	85	78	80	76	72
	Min	-	61	62	49	48	65	65	58	70	59	69	58	60	53	48
	Mean	-	75	75	65	70	76	75	68	75	68	77	68	70	65	60
Aug	Max	-	87	85	76	91	84	77	81	79	80	89	80	82	76	73
	Min	-	57	61	63	59	79	54	60	62	64	69	58	63	59	47
	Mean	-	72	73	70	75	82	66	71	71	72	79	69	73	68	60
Sep	Max	86	88	82	83	89	78	80	79	76	79	87	72	78	82	76
	Min	66	66	65	65	53	72	55	57	62	58	70	55	59	65	57
	Mean	76	77	74	74	71	75	67	68	69	69	79	64	69	74	67
Oct	Max	83	74	81	84	88	-	76	81	81	78	85	82	74	81	73
	Min	58	49	59	66	72	-	56	60	74	64	77	66	62	67	55
	Mean	71	67	70	75	80	-	66	71	78	71	81	74	68	74	64
Nov	Max	76	89	80	85	82	75	71	78	84	80	85	86	75	72	82
	Min	52	77	60	69	67	52	51	69	74	65	67	63	58	63	61
	Mean	64	83	70	77	75	64	61	74	79	73	76	75	67	68	72
Dec	Max	87	85	81	85	85	-	78	80	74	75	80	76	64	77	74
	Min	61	71	57	68	68	-	52	55	58	53	70	54	51	50	57
	Mean	74	78	69	77	77	-	65	68	66	64	75	65	58	64	66

11.2.1.6 Monthly rainfall at CRS, Bapatla

Monthly rainfall (mm) from 1960 to 1998

Year/ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1960	7.6	0.0	0.0	17.2	50.4	18.4	148.0	9.0	31.4	108.2	87.8	17.2	495.2
1961	0.0	6.9	0.0	0.0	5.8	201.9	114.7	233.9	98.4	348.8	81.2	0.0	1091.6
1962	0.0	0.0	0.0	43.4	24.8	41.0	69.1	174.6	269.8	153.8	42.8	14.0	833.3
1963	0.0	0.0	24.0	25.4	17.4	91.6	184.1	274.6	115.6	348.4	0.0	0.0	1081.1
1964	0.0	0.0	0.0	0.0	0.0	182.7	100.2	168.0	535.2	60.0	106.9	1.4	1154.4
1965	2.0	0.0	0.0	16.5	25.8	83.9	91.6	118.7	72.2	0.0	10.8	0.0	421.5
1966	8.5	0.0	0.0	0.3	31.3	76.6	213.7	143.3	147.5	81.0	223.4	19.6	945.2
1967	0.0	0.0	27.2	0.0	2.2	67.1	109.1	93.7	70.8	19.9	0.4	109.8	550.2
1968	12.2	2.0	0.0	57.8	0.0	31.3	77.3	44.1	207.3	100.4	161.8	0.8	695.0
1969	0.0	0.0	0.0	2.4	336.9	74.0	231.5	65.4	75.0	270.7	206.4	106.7	1368.7
1970	0.0	0.0	14.8	0.0	75.9	121.1	109.9	307.5	117.2	233.3	4.1	0.0	983.8
1971	3.8	3.4	7.4	86.8	116.1	45.9	99.9	142.9	170.8	107.3	0.0	0.0	784.3
1972	0.0	0.8	0.0	0.0	90.0	97.8	128.2	53.6	40.3	332.8	162.0	42.8	948.3
1973	0.0	0.0	0.0	0.0	0.0	26.8	25.0	187.9	76.0	192.4	65.2	3.0	576.3
1974	0.0	1.0	0.0	0.0	2.8	71.0	13.2	29.4	114.5	227.6	20.6	0.0	480.1
1975	0.0	27.0	0.0	0.0	4.4	92.0	88.5	164.5	193.5	219.2	46.4	1.4	836.9
1976	0.0	0.0	0.0	0.5	5.0	29.6	198.4	174.8	49.4	118.4	456.6	0.5	1033.2
1977	0.0	0.0	0.0	43.6	80.2	177.8	154.9	81.4	89.7	291.7	606.2	0.0	1525.5
1978	0.0	0.0	0.0	34.8	72.1	42.2	105.4	256.4	182.4	43.7	87.7	0.0	832.2
1979	0.5	26.1	0.0	28.7	71.9	14.5	56.3	63.5	140.3	34.1	0.0	7.5	435.9
1980	0.0	0.0	0.0	0.0	0.0	0.0	154.2	96.7	36.5	142.3	118.8	0.0	548.5
1981	0.0	0.0	0.0	0.0	28.1	59.2	90.0	31.9	220.2	136.7	36.8	0.0	602.6
1982	1.6	0.0	0.0	0.0	0.0	121.7	83.3	655.9	221.4	50.7	167.4	0.0	1302.0
1983	0.0	1.3	0.0	0.0	5.4	138.5	270.7	235.8	291.6	136.1	1.4	0.1	1097.3
1984	0.0	64.1	0.0	1.3	1.9	15.1	203.7	20.1	98.2	191.2	24.4	16.5	628.5
1985	51.3	0.0	0.6	0.0	0.0	144.2	103.8	129.3	59.4	121.1	62.6	8.7	811.4
1986	44.0	66.9	0.0	0.0	3.8	30.6	187.6	159.6	93.5	90.9	94.0	139.1	771.9
1987	12.0	0.0	7.9	25.0	12.2	17.8	81.6	137.4	46.6	213.6	313.7	1.0	952.0
1988	0.0	0.0	0.0	4.4	23.6	27.1	137.2	323.0	221.7	61.5	2.7	24.2	919.6
1989	0.0	0.0	84.4	0.0	32.0	55.0	416.0	65.3	163.9	72.1	246.5	118.4	1150.0
1990	14.4	125.1	6.2	0.0	614.9	80.7	32.0	229.1	146.6	162.6	161.2	14.8	1579.0
1991	11.2	0.0	0.0	0.0	8.4	284.9	48.1	117.2	313.7	76.3	294.2	6.2	1172.8
1992	8.0	0.0	0.0	2.2	18.2	83.0	64.9	125.7	202.8	51.4	225.7	18.8	781.9
1993	0.0	0.0	0.0	0.0	86.7	73.7	111.2	57.5	331.1	211.9	47.3	107.9	1027.3
1994	0.5	18.9	0.0	0.0	0.6	37.3	118.7	89.5	78.0	360.7	430.7	0.2	1134.4
1995	138.3	0.0	0.2	0.0	192.3	26.7	130.8	265.1	89.8	239.2	11.3	0.0	1093.7
1996	0.0	0.0	0.0	9.8	4.6	67.9	74.8	373.1	203.5	410.2	70.6	19.4	1233.9
1997	22.3	0.0	0.0	104.6	9.8	26.7	57.8	216.4	362.5	112.4	88.0	118.3	1118.8
1998	3.0	0.0	0.8	24.1	27.6	54.6	136.7	149.7	348.2	432.7	73.3	0.0	1250.7

Climatic mean (mean of 38 years) = 920.99 mm

11.2.1.7 Monthly surface air temperature (°C)

Year		1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Jan	Max	27.9	28.1	28.4	20.0	28.5	29.9	29.7	-	27.8	29.2	29.6	29.4	27.9
	Min	18.9	17.0	17.5	16.9	16.8	20.9	17.7	-	17.8	17.5	16.8	19.3	18.3
	Mean	23.4	22.6	22.9	18.5	22.7	25.4	23.7	-	22.8	23.4	23.2	24.4	23.1
Feb	Max	30.0	30.6	29.5	29.6	29.4	31.8	30.5	-	31.5	30.5	30.8	30.6	31.0
	Min	20.4	18.4	20.7	16.9	20.0	21.5	21.3	-	18.2	19.8	22.0	22.1	19.9
	Mean	25.2	24.5	25.1	23.3	24.7	26.7	25.9	-	28.9	25.2	26.4	26.4	25.5
Mar	Max	31.5	32.0	32.0	31.9	31.0	33.7	32.5	-	32.3	32.1	32.6	32.3	32.5
	Min	22.5	21.4	23.2	19.5	23.1	23.5	21.1	-	21.6	23.5	23.6	21.7	22.7
	Mean	27.0	26.7	27.6	25.7	27.1	28.6	26.8	-	26.9	27.8	28.1	27.0	27.6
Apr	Max	33.1	33.4	32.9	33.6	32.1	34.1	34.3	-	34.0	34.5	34.0	34.8	36.9
	Min	26.9	26.4	26.4	19.8	26.7	26.4	25.5	-	25.6	26.3	25.8	25.2	26.6
	Mean	30.0	29.9	29.7	26.7	29.4	30.3	29.9	-	29.8	30.4	29.9	30.0	31.8
May	Max	38.2	35.6	39.4	39.8	35.7	38.5	36.7	-	38.6	36.8	38.0	36.8	37.2
	Min	28.7	27.5	28.2	27.3	27.5	27.5	26.9	-	25.8	27.4	28.0	28.4	27.9
	Mean	33.5	31.6	33.8	33.6	31.6	33.0	31.8	-	32.2	32.1	33.0	32.6	32.6
Jun	Max	36.7	37.5	36.1	37.8	36.5	36.4	37.3	-	38.0	36.3	36.6	36.9	35.2
	Min	27.6	27.0	26.9	27.2	27.5	25.8	27.6	-	27.9	25.9	27.0	27.1	26.1
	Mean	32.2	32.3	31.5	32.5	32.0	31.1	32.5	-	32.9	31.1	31.8	32.0	30.7
Jul	Max	35.4	35.4	33.7	33.5	35.0	33.7	36.1	34.5	32.4	35.0	33.7	33.3	33.0
	Min	26.3	26.1	25.6	25.3	28.2	25.1	27.0	26.0	25.7	25.4	26.3	25.3	24.9
	Mean	30.9	30.8	29.7	29.4	31.6	29.4	31.6	30.3	29.1	30.2	30.0	29.3	28.9
Aug	Max	32.5	34.3	33.7	32.3	32.1	31.8	34.5	33.9	33.0	33.7	32.7	35.0	33.2
	Min	25.0	26.4	26.4	24.8	25.1	24.4	26.0	25.1	26.9	25.9	25.0	26.5	25.2
	Mean	28.8	30.4	30.1	28.6	28.6	28.1	30.3	29.5	29.9	29.8	28.9	30.8	29.2
Sep	Max	33.6	32.2	30.8	33.9	34.9	32.9	32.0	33.6	31.0	32.7	31.4	33.0	33.2
	Min	25.7	24.9	25.0	25.4	25.2	24.8	25.2	25.6	24.3	24.4	25.0	25.2	25.1
	Mean	29.7	28.6	27.9	29.7	29.6	28.8	28.6	29.6	27.7	28.6	28.2	29.1	29.2
Oct	Max	30.7	31.3	30.2	32.9	30.3	32.5	32.4	32.4	31.9	32.3	31.2	31.4	31.0
	Min	24.0	24.2	24.2	24.2	24.4	24.2	23.4	23.3	23.9	24.0	24.4	23.2	22.2
	Mean	27.4	27.6	27.2	28.6	27.4	28.4	27.9	27.9	27.9	28.2	27.8	27.3	26.6
Nov	Max	29.9	30.5	30.2	29.9	29.3	30.8	-	30.5	30.1	30.1	29.9	29.8	29.7
	Min	20.2	20.0	20.8	23.1	21.8	22.4	-	20.3	19.4	21.1	19.1	19.5	19.2
	Mean	25.1	25.3	25.5	26.5	25.6	26.6	-	25.4	24.8	25.6	24.5	24.7	24.5
Dec	Max	28.7	28.6	28.8	29.4	29.5	29.5	-	29.8	27.9	29.8	29.2	30.2	29.1
	Min	18.3	17.4	17.1	19.6	19.7	19.4	-	18.7	17.9	17.4	18.3	17.8	18.4
	Mean	23.5	23.0	22.9	24.5	24.6	24.5	-	24.3	22.9	23.6	23.8	24.0	23.8

Contd.....

Year		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Jan	Max	28.2	29.7	29.7	29.3	30.3	29.4	28.3	29.6	29.6	27.9	29.9	28.3
	Min	17.1	17.6	16.9	16.8	16.8	18.8	15.8	16.8	17.5	18.1	17.1	16.4
	Mean	22.7	23.7	23.3	23.1	23.6	24.1	22.1	23.2	23.6	23.0	23.5	23.4
Feb	Max	29.9	29.3	30.8	30.9	30.9	31.3	29.7	30.7	30.4	29.8	30.5	30.2
	Min	18.7	16.6	20.7	17.0	19.8	18.3	20.0	17.9	19.5	19.7	18.8	18.3
	Mean	24.3	23.0	25.8	24.0	25.4	24.8	24.9	24.3	25.0	24.8	24.7	24.3
Mar	Max	32.1	32.0	32.9	31.9	32.2	35.5	33.6	32.6	32.6	32.4	32.7	32.7
	Min	22.1	21.0	24.1	20.2	24.0	22.2	19.7	22.4	21.5	21.3	21.1	21.2
	Mean	27.1	26.5	28.5	26.1	28.1	28.9	26.7	27.5	27.1	26.9	26.9	27.0
Apr	Max	33.4	35.3	34.5	34.0	34.5	34.6	33.7	33.7	32.6	33.7	33.5	32.2
	Min	26.1	25.9	25.1	24.8	26.1	26.0	24.8	25.1	25.5	24.6	26.0	23.7
	Mean	29.8	30.6	29.8	29.4	30.3	30.3	29.3	29.4	29.1	29.2	29.8	28.0
May	Max	39.2	36.3	39.3	38.1	33.4	36.3	36.8	36.1	37.9	34.3	39.8	37.7
	Min	28.1	27.1	28.3	27.5	25.6	28.2	27.5	26.9	28.2	25.0	27.2	26.8
	Mean	33.7	31.7	33.8	32.8	29.5	32.3	32.2	31.5	33.1	29.7	33.5	32.3
Jun	Max	37.5	38.8	38.4	33.8	34.6	34.3	36.5	38.0	37.7	38.7	35.8	39.4
	Min	21.3	27.5	27.3	27.5	25.1	26.3	23.2	27.1	27.6	27.9	27.2	27.6
	Mean	29.4	33.2	32.9	30.7	29.9	30.3	29.9	32.6	32.7	33.3	31.5	33.5
Jul	Max	35.3	35.3	33.2	33.3	34.2	33.7	35.6	34.0	34.2	33.2	32.7	36.8
	Min	25.7	26.0	25.6	25.2	25.9	26.3	26.1	25.9	25.5	25.1.	25.7	26.7
	Mean	30.5	30.7	29.4	29.3	30.1	30.0	30.9	30.0	29.9	29.2	29.2	31.8
Aug	Max	33.2	33.7	32.3	31.9	32.7	33.4	33.6	34.6	33.2	34.0	33.0	35.8
	Min	25.3	23.2	25.0	25.2	25.1	25.4	25.1	25.8	25.3	25.7	25.5	25.8
	Mean	29.3	28.5	28.7	28.6	28.9	29.4	29.4	30.2	29.3	29.9	29.3	30.8
Sep	Max	33.5	34.6	31.3	31.9	32.9	32.7	32.7	33.3	34.3	33.0	32.8	33.0
	Min	25.3	26.2	25.0	24.7	24.9	25.2	24.7	25.3	25.4	25.5	24.9	25.4
	Mean	29.4	30.4	28.2	28.3	28.9	29.0	29.2	29.3	29.9	29.3	28.9	29.2
Oct	Max	31.2	31.6	32.5	32.6	30.5	31.5	32.7	31.3	30.5	31.0	30.5	31.8
	Min	23.4	24.1	23.2	23.4.	23.9	23.9	23.8	23.9	24.0	24.9	24.2	23.4
	Mean	27.3	27.9	27.9	28.0	27.2	27.7	28.3	27.6	27.3	28.0	27.4	27.6
Nov	Max	30.4	29.9	31.0	30.2	30.8	28.1	29.7	30.3	28.3	31.5	30.5	30.3
	Min	20.3	21.7	18.9	19.8	22.5	20.9	21.9	20.6	20.9	21.7	21.0	23.0
	Mean	25.4	25.8	25.0	25.0	26.7	24.5	25.8	25.5	24.6	26.6	25.8	26.7
Dec	Max	30.0	29.2	29.3	29.2	29.5	27.9	29.1	28.4	29.3	30.0	28.6	29.4
	Min	17.9	19.3	18.5	18.0	18.9	18.1	16.8	18.1	17.2	17.8	18.1	21.6
	Mean	24.0	24.3	23.9	23.6	24.2	23.0	23.0	23.3	23.3	23.9	23.4	25.5

11.2.1.8 Monthly rainfall at RFRS, Vengurla

Monthly rainfall (mm) from 1976 to 1996

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976	0.0	0.0	22.9	0.0	0.9	761.7	1020.5	581.3	239.2	27.9	117.2	0.0	2771.6
1977	0.0	0.0	0.0	2.7	12.8	760.8	1312.4	440.0	232.4	60.2	99.5	0.0	2920.8
1978	0.0	0.0	0.0	0.0	264.0	1292.1	1036.0	494.7	261.0	84.6	27.0	11.7	3471.1
1979	0.0	0.0	0.0	0.0	0.0	628.8	590.8	417.6	150.1	27.1	61.3	0.0	1929.4
1980	0.0	0.0	0.0	0.0	0.0	1065.7	602.3	744.7	211.5	40.0	26.2	0.0	2690.0
1981	0.0	0.0	0.0	1.2	5.0	1417.0	1140.6	808.9	409.5	80.6	7.4	4.8	3875.0
1982	0.0	0.0	0.0	0.0	8.4	851.3	1066.2	829.9	224.4	30.8	83.3	0.0	3094.3
1983	0.0	0.0	0.0	0.0	0.0	599.0	1125.0	1173.0	692.0	86.0	31.0	7.0	3713.0
1984	0.0	0.0	0.0	0.0	0.0	849.0	910.0	368.0	162.0	182.0	1.0	1.0	2419.0
1985	0.0	0.0	0.0	0.0	49.0	1685.0	1660.0	638.0	95.0	387.0	0.0	0.0	3914.0
1986	0.0	0.0	0.0	0.0	0.0	777.0	552.0	527.0	32.0	19.0	85.0	0.0	1992.0
1987	0.0	0.0	0.0	0.0	0.0	1029.0	671.0	625.0	113.0	283.0	75.0	0.0	2796.0
1988	0.0	0.0	0.0	0.0	4.0	649.0	1144.0	630.0	522.0	25.0	0.0	0.0	2974.0
1989	0.0	0.0	0.0	0.0	10.0	874.0	742.0	469.0	272.0	73.0	0.0	0.0	2440.0
1990	0.0	0.0	0.0	0.0	314.0	736.0	580.0	686.0	368.0	84.0	58.0	0.0	2826.0
1991	0.0	0.0	0.0	9.0	19.0	659.0	1373.0	478.0	45.0	42.0	0.0	0.0	2625.0
1992	0.0	0.0	0.0	0.0	49.0	889.0	733.0	684.0	160.0	37.0	27.0	0.0	2579.0
1993	0.0	0.0	0.0	0.6	70.4	510.6	1288.8	417.5	387.2	89.4	0.0	22.0	2816.0
1994	0.0	0.0	0.0	53.0	0.0	814.4	746.6	406.6	198.4	204.4	1.0	0.0	2434.4
1995	1.0	0.0	0.0	3.0	13.0	746.8	1476.0	290.0	49.6	102.8	0.0	0.0	2682.6
1996	0.0	0.0	0.0	0.0	1.0	837.8	1045.6	403.6	94.8	382.6	3.6	0.0	2769.0
Mean	0.0	0.0	1.0	3.3	39.1	838.0	946.0	551.0	223.6	110.5	33.5	2.2	2715.0

11.2.1.9 Monthly surface air temperature (°C)

Year		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Jan	Max	31.1	31.9	31.5	31.6	31.7	32.4	31.2	31.5	32.1	32.3
	Min	17.3	18.7	-	21.4	17.5	15.1	17.4	17.6	16.9	17.6
	Mean	24.2	25.3	-	26.5	24.6	23.8	24.3	24.6	24.5	25.0
Feb	Max	30.4	30.4	31.4	32.7	31.3	30.8	33.5	30.9	30.0	32.1
	Min	17.6	17.9	-	16.2	18.2	15.3	19.2	18.0	18.7	17.3
	Mean	24.0	24.2	-	24.5	24.8	23.1	26.4	24.5	24.4	24.7
Mar	Max	31.4	33.1	32.1	32.7	31.2	30.9	33.7	32.2	31.9	31.3
	Min	19.4	19.4	-	21.2	19.9	18.2	22.2	22.0	20.0	20.4
	Mean	25.4	26.3	-	27.0	25.6	24.6	28.0	27.1	26.0	25.9
Apr	Max	32.8	32.8	33.4	32.7	31.1	31.7	33.9	33.0	32.4	32.8
	Min	23.7	23.7	-	23.4	22.1	20.2	24.9	23.4	23.7	23.5
	Mean	28.3	28.3	-	28.6	26.6	26.9	29.4	28.2	28.1	28.2
May	Max	33.7	34.0	34.6	33.9	33.3	34.1	33.8	33.1	33.1	34.3
	Min	25.4	24.4	-	25.9	24.2	26.0	25.8	25.0	25.6	25.3
	Mean	29.6	29.2	-	29.9	28.8	30.1	29.8	29.1	29.4	29.8
Jun	Max	29.6	31.0	30.6	29.7	31.2	32.3	30.8	29.6	31.2	30.9
	Min	24.3	25.2	24.3	24.6	24.2	25.2	24.5	24.0	25.2	25.4
	Mean	27.0	28.1	27.5	27.2	27.2	28.8	27.7	26.8	28.2	28.2
Jul	Max	29.0	29.9	29.7	29.3	29.6	30.0	28.9	28.9	29.7	29.8
	Min	23.6	24.6	24.6	24.7	23.3	24.6	24.2	24.4	24.7	25.3
	Mean	26.3	27.3	27.2	27.0	26.5	27.3	26.6	26.7	27.2	27.6
Aug	Max	28.9	28.3	29.1	28.7	29.1	29.2	28.9	28.9	28.4	29.2
	Min	24.1	23.9	24.0	24.0	23.6	24.4	23.9	23.9	23.3	24.2
	Mean	26.5	26.1	26.6	26.4	26.4	26.8	26.4	26.4	25.9	26.7
Sep	Max	29.1	30.3	30.0	30.1	29.5	29.3	29.6	30.0	30.3	30.8
	Min	22.9	23.8	23.2	23.7	22.7	23.8	23.2	23.2	23.4	24.1
	Mean	26.0	27.1	26.6	26.9	26.1	26.6	26.4	26.6	26.9	27.5
Oct	Max	32.2	32.3	32.4	32.6	32.5	31.4	30.6	30.7	32.3	32.2
	Min	22.4	25.8	22.4	22.6	22.2	22.4	24.5	21.6	22.9	22.9
	Mean	27.3	29.1	27.4	27.6	27.4	26.9	27.6	26.2	27.6	27.6
Nov	Max	33.0	32.5	34.0	33.0	33.2	32.5	33.1	31.4	32.4	33.1
	Min	22.0	-	20.1	19.2	17.1	17.8	18.2	18.1	21.4	20.9
	Mean	27.5	-	27.1	26.1	25.2	25.1	25.7	24.8	26.9	27.0
Dec	Max	33.4	34.0	32.7	32.9	33.2	32.6	33.2	-	32.3	33.5
	Min	19.5	27.0	21.9	17.3	17.1	19.2	17.6	18.4	18.6	18.2
	Mean	26.5	25.5	27.3	25.1	25.2	25.9	25.4	-	25.5	25.9

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Year		1988	1989	1990	1991	1992	1993	1994
Jan	Max	32.4	32.8	33.3	31.2	32.4	31.8	32.4
	Min	16.9	16.9	17.1	16.8	14.7	20.7	17.3
	Mean	24.7	24.9	25.2	24.0	23.6	26.2	24.9
Feb	Max	32.1	33.3	32.0	32.0	30.9	32.5	31.2
	Min	18.5	15.9	17.7	16.8	16.6	21.4	16.6
	Mean	20.3	24.6	24.9	24.4	23.8	26.9	23.9
Mar	Max	31.3	32.2	31.5	31.6	31.7	31.4	31.0
	Min	19.5	20.8	20.0	20.3	20.0	24.8	21.3
	Mean	20.4	26.5	25.8	25.9	25.9	27.6	26.2
Apr	Max	33.0	32.9	32.1	33.1	32.5	30.8	31.0
	Min	29.5	23.8	22.3	24.7	22.5	26.6	24.0
	Mean	31.3	28.4	27.2	28.9	27.5	28.7	27.5
May	Max	33.9	32.7	31.9	32.4	33.6	32.9	32.8
	Min	26.0	25.7	24.9	25.6	25.5	29.0	25.5
	Mean	30.0	29.2	28.4	29.0	29.6	30.9	29.2
Jun	Max	31.1	29.3	30.1	31.4	31.5	31.1	29.5
	Min	25.0	24.4	24.6	25.3	25.0	28.8	24.9
	Mean	28.1	26.9	27.4	28.4	28.3	29.9	27.2
Jul	Max	29.1	28.8	29.5	21.6	29.4	29.4	29.0
	Min	24.6	24.3	24.6	24.4	24.5	27.8	23.6
	Mean	26.9	26.6	27.4	23.0	27.0	28.6	26.3
Aug	Max	28.9	28.7	28.5	28.6	27.9	30.3	28.9
	Min	24.4	23.9	24.1	24.2	24.1	24.5	25.5
	Mean	26.7	26.3	26.3	26.4	26.0	27.4	27.2
Sep	Max	29.8	29.7	29.7	30.2	30.1	30.2	28.6
	Min	24.0	23.5	23.5	23.9	23.7	24.1	23.9
	Mean	26.9	26.6	26.6	27.1	26.9	27.2	26.3
Oct	Max	31.4	31.1	32.1	32.0	31.2	31.1	29.5
	Min	21.8	23.1	22.6	22.8	23.0	24.1	23.4
	Mean	26.6	27.1	27.4	27.4	27.1	27.6	26.5
Nov	Max	33.7	34.2	32.5	32.7	33.7	33.9	31.8
	Min	28.1	19.9	21.5	20.8	22.3	21.2	19.2
	Mean	30.9	27.2	27.0	26.8	28.0	27.6	25.5
Dec	Max	33.2	32.9	33.2	31.8	32.9	32.8	31.9
	Min	23.2	18.7	18.8	16.7	20.0	17.0	16.6
	Mean	28.2	25.8	26.0	29.3	26.5	24.9	24.3

11.2.2 Weekly and monthly weather data at selected stations from 1995 to 1998

11.2.2.1 Weekly weather at RARS, Pilicode during 1995

Week No	Temperature (°C)			Rainfall (mm)	Sunshine (h/day)	Evaporation (mm)	Relative humidity (%)		
	Max	Min	Mean				RHM	RHE	Mean
1	30.9	18.2	24.6	0.0	7.7	30.9	91	56	74
2	30.8	20.8	25.8	0.0	10.5	36.1	90	56	73
3	31.9	21.3	26.6	0.0	10.1	34.2	92	56	74
4	31.8	18.8	25.3	0.0	10.7	33.9	96	54	75
5	32.2	21.2	26.7	0.0	10.4	31.7	92	55	74
6	32.3	20.9	26.6	0.0	10.7	32.6	91	57	74
7	31.9	22.7	27.3	0.0	10.6	38.6	94	63	79
8	31.7	22.8	27.3	0.0	10.5	35.0	94	63	79
9	31.9	23.4	27.7	0.0	9.9	38.0	88	54	71
10	31.9	22.6	27.3	0.0	10.1	38.5	92	61	77
11	32.8	23.7	28.3	0.0	10.2	38.6	88	58	73
12	32.8	23.7	28.3	0.0	10.1	40.0	90	64	77
13	32.7	24.1	28.4	0.0	10.9	39.0	84	59	72
14	32.7	25.7	29.2	0.0	10.2	42.9	85	63	74
15	33.4	24.7	29.1	3.2	10.7	44.0	83	55	69
16	33.7	25.8	29.8	0.0	10.5	46.9	82	57	70
17	33.6	26.1	29.9	29.0	9.8	43.5	76	65	71
18	32.8	24.8	28.8	43.0	6.3	31.6	91	71	81
19	32.9	25.4	29.2	81.2	5.3	30.9	88	75	82
20	32.1	25.2	28.7	25.8	8.5	40.0	88	64	76
21	33.2	25.5	29.4	0.0	11.3	42.7	84	65	75
22	33.5	26.6	30.1	0.0	9.5	42.4	85	64	75
23	32.9	25.5	29.2	159.0	6.8	33.9	91	68	80
24	27.7	24.4	26.1	393.2	0.8	10.6	97	91	94
25	28.2	23.7	26.0	99.4	3.0	17.5	98	84	91
26	29.8	24.2	27.0	257.6	2.3	18.9	97	87	92
27	29.3	23.7	26.5	283.8	3.3	22.1	98	82	90
28	26.5	23.2	24.9	412.2	0.8	13.5	100	97	99
29	27.3	23.6	25.5	285.4	0.8	18.0	100	94	97
30	28.0	23.8	25.9	120.4	1.9	18.2	99	91	95
31	28.4	24.1	26.3	124.6	3.5	12.4	100	87	94
32	29.3	24.5	26.9	84.5	4.8	20.3	99	84	92
33	29.2	24.0	26.6	122.2	3.9	24.1	97	84	91
34	29.5	24.8	27.2	80.4	5.1	23.5	97	82	90
35	27.1	23.3	25.2	287.2	1.5	9.2	100	95	98
36	29.3	24.1	26.7	75.0	7.5	20.2	97	81	89
37	29.9	23.8	26.9	33.0	6.6	22.7	97	79	88
38	29.4	23.9	26.7	6.5	7.3	21.5	97	76	87
39	30.3	23.5	26.9	0.6	7.6	23.0	96	76	86
40	30.6	24.2	27.4	0.2	7.9	22.1	90	71	81
41	30.1	23.6	26.9	102.8	5.4	25.2	99	76	88
42	30.8	23.4	27.1	0.0	8.5	29.4	94	69	82
43	31.2	23.8	27.5	71.8	8.6	24.9	96	71	84
44	30.6	24.2	27.4	41.3	7.8	24.5	96	78	87
45	30.5	23.3	26.9	27.4	6.9	25.1	94	72	83
46	31.2	21.4	26.3	0.0	9.9	25.4	91	69	80
47	31.1	23.1	27.1	0.0	8.8	26.3	93	70	82
48	31.4	22.2	26.8	0.0	10.4	25.3	92	59	76
49	32.2	19.5	25.9	0.0	10.8	29.8	90	50	70
50	31.3	18.5	24.9	0.0	10.5	28.1	93	49	71
51	30.6	17.0	23.8	0.0	10.3	30.8	91	48	70
52	30.8	19.3	25.1	0.0	9.6	36.0	95	54	75

11.2.2.2 Weekly weather at RARS, Pilicode during 1996

Week No	Temperature (°C)			Rainfall (mm)	Sunshine (h/day)	Evaporation (mm)	Relative humidity (%)		
	Max	Min	Mean				RHM	RHE	Mean
1	30.8	21.5	26.2	0.0	9.0	27.2	97	57	77
2	31.6	19.2	25.4	0.0	10.3	28.8	95	54	75
3	31.3	22.2	26.8	0.0	8.4	27.0	91	55	73
4	31.5	18.3	24.9	0.0	10.6	28.9	90	44	67
5	32.1	17.6	24.9	0.0	10.5	32.5	90	43	67
6	32.1	19.5	25.8	0.0	10.6	32.7	85	48	67
7	31.9	22.2	27.1	0.0	9.1	34.7	92	55	74
8	32.5	21.0	26.8	0.0	10.3	34.0	88	53	71
9	32.5	22.1	27.3	0.0	10.2	43.1	94	59	77
10	32.5	22.9	27.7	0.0	10.1	36.3	94	64	79
11	33.3	24.4	28.9	0.0	9.7	42.1	88	65	77
12	33.1	25.3	29.2	0.0	9.1	39.7	91	65	78
13	33.0	25.8	29.4	0.0	7.0	40.2	89	63	76
14	32.8	25.2	29.0	9.6	8.5	38.6	86	67	77
15	32.6	24.2	28.4	18.5	8.8	36.4	93	63	78
16	32.4	24.8	28.6	17.8	9.4	36.3	92	66	79
17	33.6	26.5	30.1	0.0	10.8	45.9	83	62	73
18	32.7	26.3	29.5	0.0	8.1	41.1	86	67	77
19	33.1	25.4	29.3	0.0	10.7	45.8	81	59	70
20	32.8	26.2	29.5	0.0	10.0	42.8	80	63	72
21	33.6	26.8	30.2	0.0	8.4	44.5	86	64	75
22	34.0	25.6	29.8	40.0	9.5	35.9	87	64	76
23	31.6	24.7	28.2	176.7	7.0	26.8	95	80	88
24	26.8	22.7	24.8	835.6	1.0	7.8	98	98	98
25	26.9	23.7	25.3	238.7	2.9	21.4	99	92	96
26	30.8	24.0	27.4	0.0	9.1	29.8	94	76	85
27	30.7	24.0	27.4	149.4	7.8	24.2	94	75	85
28	28.4	23.1	25.8	314.2	2.0	18.4	100	91	96
29	26.7	23.2	25.0	401.8	0.4	10.7	100	96	98
30	27.7	23.6	25.7	263.4	1.8	16.3	100	92	96
31	29.4	23.4	26.4	95.9	6.4	23.0	99	83	91
32	28.3	23.6	26.0	145.8	2.9	23.5	99	85	92
33	27.8	23.6	25.7	145.4	1.5	18.8	99	89	94
34	28.3	23.8	26.1	63.0	3.4	21.1	100	89	95
35	29.1	24.2	26.7	18.4	6.6	26.6	98	83	91
36	29.6	24.5	27.1	1.2	5.0	23.2	99	84	92
37	29.4	24.1	26.8	79.4	5.1	24.2	97	80	89
38	29.7	23.9	26.8	21.1	7.1	30.2	98	80	89
39	28.9	23.9	26.4	94.0	5.2	29.4	97	84	91
40	29.0	23.0	26.0	78.8	7.2	28.4	95	81	88
41	30.2	23.7	27.0	110.0	6.9	26.9	96	76	86
42	29.6	23.3	26.5	43.6	5.3	22.2	98	78	88
43	29.5	22.3	25.9	7.2	7.9	23.8	96	73	85
44	30.3	22.8	26.6	20.6	8.4	26.1	97	71	84
45	30.8	21.8	26.3	2.2	8.6	24.4	95	68	82
46	31.6	23.2	27.4	2.2	8.2	24.7	97	66	82
47	31.9	23.8	27.9	48.6	7.1	25.3	96	69	83
48	31.3	22.0	26.7	12.4	9.8	25.5	97	63	80
49	30.5	18.8	24.7	26.6	8.4	23.7	95	55	75
50	30.7	23.3	27.0	12.0	5.1	18.2	99	70	85
51	30.5	20.8	25.7	7.0	7.8	22.6	94	61	78
52	31.0	18.8	24.9	0.0	10.2	27.6	96	54	75

11.2.2.3 Weekly weather at RARS, Pilicode during 1997

Week No	Temperature (°C) Max	Min	Mean	Rainfall (mm)	Sunshine (h/day)	Evaporation (mm)	Relative humidity (%) RHM	RHE	Mean
1	30.8	18.7	24.8	0.0	9.9	25.4	95	54	75
2	31.9	20.6	26.3	0.0	9.6	28.4	96	58	77
3	31.1	21.1	26.1	0.0	10.2	31.6	88	59	74
4	30.9	19.4	25.2	0.0	10.4	28.1	90	59	75
5	30.9	20.1	25.5	0.0	10.1	33.3	84	61	73
6	30.8	19.8	25.3	0.0	9.9	30.9	87	62	75
7	31.0	20.1	25.6	0.0	10.0	31.0	89	63	76
8	31.6	21.0	26.3	0.0	10.3	37.3	82	58	70
9	31.8	20.6	26.2	0.0	10.1	33.4	91	64	78
10	31.9	21.6	26.8	0.0	10.0	34.8	88	64	76
11	32.7	24.4	28.6	0.0	9.1	36.5	89	66	78
12	32.9	25.2	29.1	0.0	8.3	35.4	84	64	74
13	33.2	24.5	28.9	0.0	10.0	39.4	86	61	74
14	33.6	23.9	28.8	0.0	10.5	45.0	82	57	70
15	33.1	24.7	28.9	0.0	11.1	47.6	75	51	63
16	33.2	24.6	28.9	0.0	10.7	45.9	78	55	67
17	33.7	25.6	29.7	0.0	10.0	43.1	78	57	68
18	34.2	25.2	29.7	3.4	10.3	46.9	80	57	69
19	33.9	26.0	30.0	1.0	9.4	48.3	78	60	69
20	33.3	25.2	29.3	0.6	7.4	42.7	80	60	70
21	33.7	26.2	30.0	6.5	8.6	42.1	80	59	70
22	33.4	24.7	29.1	0.0	11.5	46.5	78	60	69
23	33.9	25.3	29.6	15.8	8.0	38.1	79	59	69
24	30.2	23.0	26.6	221.2	5.2	24.5	94	87	91
25	30.3	23.1	26.7	166.3	4.5	22.8	93	82	88
26	27.1	22.5	24.8	727.4	0.2	5.2	100	96	98
27	26.8	22.4	24.6	359.5	0.4	4.6	100	98	99
28	27.3	22.1	24.7	532.6	1.9	9.2	100	93	97
29	30.2	24.7	27.5	88.7	4.1	21.4	96	78	87
30	27.1	23.1	25.1	452.1	0.1	12.5	99	95	97
31	29.2	23.1	26.2	180.4	2.5	20.2	98	85	92
32	27.9	22.7	25.3	251.9	1.5	11.8	99	88	94
33	29.8	23.2	26.5	34.7	6.5	22.0	94	77	86
34	28.7	23.4	26.1	239.7	4.3	20.8	99	86	93
35	29.1	23.2	26.2	97.6	4.8	23.1	97	87	92
36	30.2	23.9	27.1	5.5	5.7	24.9	93	77	85
37	30.8	23.9	27.4	8.1	5.8	25.3	95	71	83
38	30.3	23.4	26.9	114.7	6.7	25.5	92	75	84
39	30.5	23.3	26.9	39.6	7.7	29.2	92	71	82
40	31.2	23.4	27.3	20.2	9.3	31.0	90	71	81
41	31.7	24.0	27.9	10.7	7.2	25.4	92	70	81
42	32.0	24.3	28.2	0.1	7.0	25.1	94	66	80
43	30.8	23.7	27.3	27.5	5.8	19.1	92	71	82
44	31.3	23.3	27.3	40.5	7.7	25.2	93	73	83
45	31.8	23.7	27.8	18.4	6.5	23.3	92	71	82
46	32.1	23.5	27.8	15.5	6.9	23.3	93	70	82
47	30.9	23.2	27.1	63.4	6.1	21.0	95	69	82
48	32.1	23.2	27.7	1.0	8.4	24.2	92	66	79
49	31.6	22.9	27.3	19.1	5.9	19.2	95	68	82
50	32.2	23.7	28.0	27.0	9.6	26.7	93	68	81
51	31.7	23.7	27.7	11.6	7.0	22.2	95	71	83
52	31.4	22.1	26.8	1.6	8.7	27.8	94	63	79

11.2.2.4 Weekly weather at RARS, Pilicode during 1998

Week No	Temperature (°C) Max	Min	Mean	Rainfall (mm)	Sunshine (h/day)	Evaporation (mm)	Relative humidity (%) RHM	RHE	Mean
1	32.7	20.2	26.5	0.0	10.2	25.5	95	59	77
2	32.4	20.3	26.4	0.0	9.7	27.1	93	55	74
3	32.4	21.6	27.0	0.0	9.7	29.4	90	63	77
4	32.3	23.1	27.7	0.0	9.4	31.7	84	61	73
5	33.7	20.9	27.3	0.0	10.5	32.9	94	58	76
6	32.6	20.7	26.7	0.0	10.0	32.3	92	56	74
7	32.4	21.6	27.0	2.8	10.2	33.8	90	56	73
8	32.1	21.8	27.0	0.0	9.9	37.7	85	58	72
9	32.6	23.3	28.0	0.0	9.8	38.9	85	61	73
10	32.3	22.3	27.3	0.0	10.0	40.3	85	62	74
11	32.6	22.5	27.6	0.0	10.5	41.4	83	63	73
12	33.1	23.8	28.5	0.0	9.5	41.2	86	63	75
13	34.0	26.3	30.2	1.4	9.1	43.9	84	62	73
14	34.1	26.3	30.2	0.0	9.2	44.8	82	66	74
15	34.9	26.5	30.7	0.0	10.0	45.3	81	60	71
16	34.5	26.3	30.4	12.2	9.0	45.0	83	62	73
17	35.3	26.8	31.1	0.0	11.0	48.2	80	59	70
18	35.1	27.1	31.1	0.4	10.4	50.6	80	61	71
19	35.0	26.8	30.9	4.0	7.2	48.0	86	65	76
20	33.7	25.0	29.4	72.8	6.9	37.1	89	67	78
21	33.9	26.3	30.1	7.6	9.2	45.8	79	64	72
22	33.9	25.4	29.7	18.8	9.5	45.2	86	62	74
23	32.3	25.1	28.7	96.8	7.0	34.7	90	68	79
24	30.5	23.5	27.0	200.8	1.5	16.5	98	84	91
25	29.0	23.0	26.0	459.3	1.3	8.4	97	91	94
26	28.0	22.8	25.4	376.0	0.4	9.6	98	94	96
27	28.4	22.6	25.5	310.8	1.4	12.6	98	92	95
28	29.9	23.3	26.6	228.8	4.0	20.9	96	84	90
29	29.7	24.0	26.9	82.0	5.0	27.0	96	81	89
30	27.9	23.4	25.7	254.6	1.0	12.7	97	90	94
31	29.8	23.6	26.7	54.6	4.7	16.7	96	90	93
32	28.8	23.8	26.3	85.3	3.2	18.8	98	89	94
33	29.9	23.5	26.7	71.4	3.7	21.5	95	85	90
34	28.4	23.2	25.8	212.7	1.8	18.1	98	94	96
35	29.0	22.6	25.8	259.3	4.8	23.0	98	82	90
36	28.9	23.9	26.4	130.4	3.8	20.4	98	83	91
37	28.8	22.9	25.9	238.9	3.1	20.5	98	89	94
38	30.0	22.9	26.5	51.2	7.5	25.8	95	76	86
39	28.8	22.6	25.7	122.8	2.5	19.6	99	81	90
40	28.6	23.0	25.8	117.8	3.2	18.3	97	81	89
41	28.8	23.5	26.2	225.7	1.6	21.9	98	84	91
42	29.7	22.1	25.9	33.3	6.3	27.1	95	77	86
43	30.3	22.3	26.3	12.2	8.9	30.1	93	76	85
44	30.5	22.6	26.6	15.8	5.8	24.0	92	75	84
45	31.1	23.2	27.2	34.4	6.6	22.8	96	71	84
46	31.5	22.2	26.9	8.7	9.0	31.8	93	76	85
47	31.0	22.4	26.7	2.0	7.8	28.4	93	71	82
48	31.3	21.4	26.4	14.0	9.5	26.2	91	62	77
49	31.6	21.6	26.6	0.0	7.0	26.0	96	59	78
50	31.2	23.3	27.3	46.6	4.1	24.9	94	64	79
51	30.8	19.7	25.3	0.0	10.1	24.1	96	56	76
52	31.1	19.6	25.4	0.0	9.6	23.3	95	58	77

11.2.2.5 Monthly rainfall (mm) and no. of rainy days at FSRS, Kottarakkara

Year/ Month	1995	1996	1997	1998
Jan	0.0	0.0	0.0	39.6
	(0)	(0)	(0)	(2)
Feb	7.9	0.0	0.0	0.0
	(2)	(0)	(0)	(0)
Mar	43.8	2.5	78.4	11.6
	(5)	(0)	(3)	(1)
Apr	246.0	89.0	151.3	95.5
	(13)	(7)	(7)	(8)
May	454.4	46.4	242.4	264.0
	(12)	(4)	(11)	(9)
Jun	404.7	387.0	304.2	210.3
	(16)	(15)	(10)	(6)
Jul	331.3	694.5	402.6	153.0
	(13)	(18)	(27)	(14)
Aug	385.9	163.4	337.8	96.8
	(15)	(8)	(16)	(6)
Sep	219.4	199.1	432.2	-
	(12)	(14)	(15)	-
Oct	112.4	338.5	391.7	-
	(9)	(12)	(13)	-
Nov	127.9	220.6	149.6	-
	(6)	(10)	(11)	-
Dec	0.0	100.1	43.0	-
	(0)	(4)	(3)	-
Total	2333.7	2240.9	2533.2	870.8
	(103)	(92)	(116)	(46)

11.2.2.6 Monthly rainfall (mm) and no. of rainy days at Madakkathara

Year/ Month	1995	1996	1997	1998
Jan	0.0	0.0	0.0	0.0
	(0)	(0)	(0)	(0)
Feb	0.5	0.0	0.0	0.0
	(0)	(0)	(0)	(0)
Mar	2.8	0.0	0.0	11.0
	(0)	(0)	(0)	(1)
Apr	118.7	152.0	8.2	61.4
	(5)	(7)	(1)	(4)
May	370.5	95.6	63.0	203.0
	(13)	(4)	(4)	(9)
Jun	500.4	400.3	720.5	809.3
	(19)	(16)	(18)	(24)
Jul	884.7	588.7	979.2	752.9
	(26)	(25)	(28)	(28)
Aug	448.7	310.0	636.8	433.6
	(22)	(20)	(23)	(18)
Sep	282.5	391.6	164.0	571.3
	(13)	(17)	(13)	(24)
Oct	110.4	219.3	194.7	452.8
	(8)	(12)	(12)	(18)
Nov	88.4	23.1	211.3	-
	(5)	(2)	(7)	
Dec	0.0	60.8	66.7	-
	(0)	(2)	(2)	
Total	2807.6	2241.4	3044.4	3295.3
	(111)	(105)	(108)	(126)

11.2.2.7 Monthly rainfall (mm) and no. of rainy days at Anakkayam

Year/ Month	1995	1996	1997	1998
Jan	3.1	0.0	0.0	0.0
	(0)	(0)	(0)	(0)
Feb	0.0	0.0	0.0	0.0
	(0)	(0)	(0)	(0)
Mar	0.0	63.2	24.1	0.0
	(0)	(1)	(3)	(0)
Apr	73.8	146.6	9.4	36.0
	(3)	(3)	(1)	(3)
May	357.2	166.0	69.2	75.0
	(11)	(4)	(7)	(4)
Jun	729.4	401.3	684.0	1027.0
	(20)	(12)	(15)	(25)
Jul	612.5	503.8	1565.1	756.8
	(27)	(19)	(28)	(29)
Aug	456.6	173.4	523.3	520.3
	(18)	(14)	(19)	(23)
Sep	294.7	263.2	199.2	472.2
	(13)	(10)	(10)	(26)
Oct	198.6	291.9	223.6	185.7
	(10)	(16)	(11)	(13)
Nov	170.6	27.2	426.8	-
	(8)	(4)	(11)	-
Dec	0.0	30.2	15.0	-
	(0)	(3)	(1)	
Total	2896.5	2066.8	3739.7	3073.0
	(110)	(86)	(106)	(123)

11.2.2.8 Monthly rainfall (mm) and no. of rainy days at Ambalavayal

Year/ Month	1995	1996	1997	1998
Jan	2.6	19.2	21.0	0.0
	(0)	(1)	(1)	(0)
Feb	20.6	0.0	21.8	0.0
	(2)	(0)	(1)	(0)
Mar	2.6	0.0	53.8	38.8
	(0)	(0)	(7)	(4)
Apr	261.2	131.6	138.6	83.8
	(10)	(12)	(5)	(9)
May	253.4	121.8	101.8	96.8
	(10)	(3)	(7)	(7)
Jun	253.6	446.4	305.0	323.8
	(16)	(12)	(14)	(18)
Jul	513.6	408.8	527.4	524.6
	(24)	(20)	(25)	(27)
Aug	442.0	251.4	379.8	198.0
	(17)	(18)	(20)	(18)
Sep	199.8	252.8	164	130.8
	(13)	(11)	(11)	(14)
Oct	222.6	368.4	237.0	200.0
	(11)	(11)	(13)	(14)
Nov	116.0	49.8	166.6	-
	(8)	(5)	(12)	
Dec	0.0	130.6	40.0	-
	(0)	(6)	(4)	
Total	2288.0	2180.8	2156.8	1596.6
	(111)	(99)	(120)	(111)

11.2.2.9 Monthly rainfall (mm) and no. of rainy days at Pilicode

Year/ Month	1995	1996	1997	1998
Jan	0.0	0.0	0.0	0.0
	(0)	(0)	(0)	(0)
Feb	0.0	0.0	0.0	2.8
	(0)	(0)	(0)	(1)
Mar	0.0	0.0	0.0	1.4
	(0)	(0)	(0)	(0)
Apr	32.5	45.9	0.0	12.2
	(3)	(5)	(0)	(1)
May	150.0	36.6	11.5	84.8
	(8)	(1)	(2)	(4)
June	907.2	1254.4	1029.3	1108.5
	(23)	(18)	(21)	(27)
July	1172.8	1173.8	1569.5	944.6
	(30)	(27)	(27)	(24)
Aug	543.9	423.5	760.7	611.0
	(23)	(25)	(25)	(23)
Sept	202.1	259.7	176.3	589.6
	(9)	(9)	(11)	(23)
Oct	174.8	260.2	82.0	389.0
	(7)	(16)	(5)	(17)
Nov	68.7	65.4	115.3	60.9
	(4)	(2)	(9)	(7)
Dec	0.0	45.6	59.3	60.4
	(0)	(3)	(5)	(2)
Total	3252.0	3565.1	3803.9	3865.2
	(107)	(106)	(105)	(129)

11.2.2.10 Monthly rainfall (mm) and no. of rainy days at Vriddhachalam

Year/ Month	1995	1996	1997	1998
Jan	10.4	0.0	5.4	0.0
	(1)	(0)	(1)	(0)
Feb	0.0	0.0	0.0	0.0
	(0)	(0)	(0)	(0)
Mar	7.5	0.0	0.0	0.0
	(1)	(0)	(0)	(0)
Apr	1.5	146.5	0.0	0.0
	(0)	(3)	(0)	(0)
May	170.4	60.4	0.0	48.5
	(4)	(2)	(0)	(2)
Jun	49.5	213.9	34.7	-
	(3)	(10)	(4)	
Jul	42.7	6.0	13.8	-
	(4)	(1)	(2)	
Aug	36.5	160.3	74.2	-
	(3)	(7)	(4)	
Sep	212.4	160.4	56.3	-
	(7)	(11)	(3)	
Oct	255.5	123.4	155.5	-
	(10)	(4)	(8)	
Nov	104.3	264.6	386.3	-
	(5)	(13)	(17)	
Dec	0.0	826.9	367.3	-
	(0)	(10)	(10)	
Total	890.7	1962.4	1093.5	48.5
	(38)	(61)	(51)	(2)

11.2.2.11 Monthly rainfall (mm) and no. of rainy days at Chintamani

Year/ Month	1995	1996	1997	1998
Jan	0.0	0.0	5.0	0.0
	(1)	(0)	(1)	(0)
Feb	0.0	0.0	0.0	0.0
	(0)	(0)	(0)	(0)
Mar	8.4	0.0	33.0	7.0
	(1)	(0)	(2)	(2)
Apr	0.0	71.8	79.6	19.6
	(0)	(3)	(4)	-
May	163.3	50.0	9.7	72.4
	(8)	(3)	(1)	
Jun	85.8	197.7	119.2	-
	(8)	(11)	(8)	
Jul	122.6	20.6	46.9	-
	(9)	(4)	(5)	
Aug	194.8	62.8	27.7	-
	(8)	(6)	(3)	
Sep	103.8	170.5	193.8	-
	(5)	(13)	(10)	
Oct	133.5	75.4	85.9	-
	(9)	(6)	(5)	
Nov	22.2	10.2	68.7	-
	(3)	(2)	(6)	
Dec	0.0	39.8	10.1	-
	(0)	(5)	(1)	
Total	436.6	834.4	689.4	-
	(50)	(52)	(46)	

11.2.2.12 Monthly rainfall (mm) and no. of rainy days at Bapatla

Year/ Month	1994	1995	1996	1997	1998
Jan	1.0	138.3	0.0	22.3	3.0
	(0)	(4)	(0)	(2)	(0)
Feb	18.9	0.0	0.0	0.0	0.0
	(1)	(0)	(0)	(0)	(0)
Mar	0.0	0.2	0.0	0.0	0.8
	(0)	(0)	(0)	(0)	(0)
Apr	0.0	0.0	9.8	104.6	24.1
	(0)	(0)	(1)	(2)	(1)
May	1.2	192.3	4.6	9.8	27.6
	(0)	(5)	(1)	(1)	(1)
Jun	57.3	26.7	67.9	26.7	54.6
	(4)	(6)	(4)	(2)	(3)
Jul	118.6	120.8	74.8	57.8	136.7
	(9)	(11)	(8)	(6)	(8)
Aug	89.5	265.1	373.1	216.4	149.7
	(9)	(12)	(15)	(9)	(8)
Sep	78.0	89.8	203.5	367.5	348.2
	(2)	(8)	(11)	(10)	(12)
Oct	365.5	195.5	410.2	112.4	432.7
	(15)	(11)	(12)	(8)	(16)
Nov	430.7	11.3	70.6	88.0	73.3
	(10)	(6)	(4)	(7)	(6)
Dec	0.2	0.0	19.4	118.3	0.0
	(0)	(0)	(3)	(9)	(0)
Total	1160.9	1040.0	1233.9	1123.8	1250.7
	(50)	(63)	(59)	(56)	(55)

11.2.2.13 Monthly rainfall (mm) and no. of rainy days at Vengurla

Year/ Month	1994	1995	1996	1997	1998
Jan	0.0	1.0	0.0	11.2	0.0
	(0)	(0)	(0)	(1)	(0)
Feb	0.0	0.0	0.0	0.0	0.0
	(0)	(0)	(0)	(0)	(0)
Mar	0.0	0.0	0.0	0.0	0.0
	(0)	(0)	(0)	(0)	(0)
Apr	53.0	3.0	0.0	0.0	0.0
	(2)	(1)	(0)	(0)	(0)
May	0.0	13.0	1.0	0.0	52.0
	(0)	(2)	(0)	(0)	(2)
Jun	814.4	746.8	837.8	981.4	1014.2
	(26)	(20)	(17)	(20)	(22)
Jul	754.4	1476.4	1045.6	1003.0	908.0
	(29)	(30)	(28)	(28)	(24)
Aug	428.0	1026.4	403.6	828.8	499.8
	(24)	(22)	(23)	(30)	(25)
Sep	198.4	312.6	94.8	51.8	312.6
	(14)	(11)	(7)	(5)	(20)
Oct	180.0	172.8	382.6	27.4	291.4
	(13)	(8)	(7)	(3)	(16)
Nov	1.0	0.0	3.6	65.0	60.4
	(0)	(0)	(1)	(3)	(2)
Dec	0.0	0.0	0.0	84.2	0.0
	(0)	(0)	(0)	(2)	(0)
Total	2434.4	3752.0	2769.0	3041.6	3138.4
	(108)	(94)	(83)	(92)	(111)

11.2.2.14 Monthly rainfall (mm) and no. of rainy days at Bhubaneswar

Year/ Month	1994	1995	1996	1997	1998
Jan	0.0	32.0	83.5	67.5	26.4
	(0)	(5)	(2)	(3)	(2)
Feb	33.6	52.5	4.6	8.0	20.9
	(6)	(4)	(1)	(3)	(5)
Mar	0.8	21.6	0.0	54.6	67.3
	(0)	(2)	(0)	(4)	(8)
Apr	219.0	11.4	17.2	135.5	77.8
	(7)	(2)	(4)	(10)	(5)
May	179.0	703.9	41.1	16.3	40.5
	(4)	(9)	(5)	(3)	(5)
Jun	168.9	132.2	134.5	84.0	164.4
	(15)	(13)	(14)	(13)	(12)
Jul	238.0	176.4	141.5	191.9	341.5
	(27)	(16)	(16)	(16)	(20)
Aug	489.3	195.1	227.9	534.7	163.5
	(20)	(22)	(25)	(21)	(17)
Sep	251.7	240.2	67.0	348.6	239.1
	(16)	(17)	(8)	(17)	(22)
Oct	149.3	335.0	109.2	32.3	306.6
	(10)	(19)	(9)	(4)	(15)
Nov	5.6	183.5	16.3	9.4	93.5
	(2)	(7)	(5)	(1)	(6)
Dec	0.0	0.0	0.0	27.7	0.0
	(0)	(0)	(0)	(4)	(0)
Total	1735.2	2083.8	842.8	1610.5	1541.5
	(107)	(116)	(88)	(99)	(117)

11.2.2.15 Monthly rainfall (mm) and no. of rainy days at Jhargram

Year/ Month	1994	1995	1996	1997
Jan	9.6	28.0	-	0.0
	(1)	(4)		(0)
Feb	35.0	2.2	-	12.0
	(2)	(0)		(2)
Mar	0.0	1.4	-	15.8
	(0)	(0)		(4)
Apr	115.8	100.4	64.4	49.3
	(8)	(6)	(6)	(6)
May	93.4	112.5	31.6	20.0
	(7)	(9)	(8)	(5)
Jun	362.2	337.9	155.4	178.4
	(20)	(15)	(11)	(10)
Jul	519.4	380.1	286.0	256.0
	(25)	(19)	(16)	(15)
Aug	340.6	361.6	310.2	280.2
	(26)	(22)	(19)	(19)
Sep	252.0	267.9	222.4	218.6
	(15)	(16)	(18)	(13)
Oct	68.6	117.0	172.6	156.4
	(5)	(6)	(8)	(11)
Nov	2.2	14.2	19.2	38.2
	(0)	(2)	(5)	(6)
Dec	0.0	9.7	21.6	28.0
	(0)	(2)	(3)	(4)
Total	1798.8	1734.9	1283.4	1252.9
	(109)	(101)	(94)	(95)

11.2.2.16 Monthly surface air temperature (°C) at FSRS, Kottarakkara

Year/ Month		1995	1996	1997	1998
Jan	Max	32.4	33.6	33.9	34.5
	Min	15.6	22.7	22.4	23.0
	Mean	24.0	28.2	28.2	28.8
Feb	Max	33.9	34.2	35.4	36.3
	Min	15.2	21.8	22.5	23.2
	Mean	24.6	28.0	29.0	29.8
Mar	Max	34.4	35.5	36.2	38.4
	Min	14.3	22.1	23.3	25.7
	Mean	24.4	28.8	29.8	32.0
Apr	Max	32.2	32.6	35.1	38.2
	Min	14.8	21.9	24.0	25.1
	Mean	23.5	27.3	29.6	31.7
May	Max	31.2	32.2	34.0	34.0
	Min	15.2	23.3	23.4	23.3
	Mean	23.2	27.8	28.7	28.7
Jun	Max	28.7	30.0	32.8	31.6
	Min	14.5	20.7	23.0	22.0
	Mean	21.6	25.4	27.9	26.8
Jul	Max	28.7	28.1	30.0	29.5
	Min	13.3	22.1	22.8	21.5
	Mean	21.0	25.1	26.4	25.5
Aug	Max	29.8	29.2	30.4	32.2
	Min	13.6	21.9	23.1	21.0
	Mean	21.7	25.6	26.8	26.6
Sep	Max	27.8	29.6	31.1	29.5
	Min	13.6	21.8	23.1	23.3
	Mean	20.7	25.7	27.1	26.4
Oct	Max	25.1	31.5	32.8	-
	Min	14.3	22.0	23.1	
	Mean	19.7	26.8	28.0	
Nov	Max	24.4	30.8	32.6	-
	Min	12.8	22.6	23.3	
	Mean	18.6	26.7	29.0	
Dec	Max	-	31.7	33.0	-
	Min	-	21.6	23.3	
	Mean		26.7	28.2	
	Max	29.9	29.2	33.1	33.8
	Min	14.3	22.0	23.1	23.1
	Mean	22.1	25.6	28.1	28.5

11.2.2.17 Monthly surface air temperature (°C) at Vellanikkara

Year/ Month		1995	1996	1997	1998
Jan	Max	32.9	33.1	32.0	33.1
	Min	22.4	22.4	22.9	22.8
	Mean	27.7	27.8	27.5	28.0
Feb	Max	35.4	34.7	33.9	34.4
	Min	23.4	23.4	21.8	23.6
	Mean	29.4	29.1	27.9	29.0
Mar	Max	37.6	36.4	35.7	36.2
	Min	23.8	24.3	24.0	23.6
	Mean	30.7	30.4	29.9	29.9
Apr	Max	36.6	34.6	35.2	36.5
	Min	24.9	25.0	24.5	25.6
	Mean	30.8	29.8	29.9	31.0
May	Max	33.5	32.8	34.4	34.1
	Min	23.9	25.2	24.5	25.2
	Mean	28.7	29.0	29.5	29.7
Jun	Max	31.6	30.5	31.2	30.2
	Min	23.1	23.8	23.0	25.5
	Mean	27.4	27.2	27.1	27.9
Jul	Max	29.9	28.8	28.6	29.2
	Min	23.2	23.1	21.8	23.6
	Mean	26.6	26.0	25.2	26.4
Aug	Max	30.6	29.1	29.0	29.8
	Min	23.7	23.6	22.8	23.9
	Mean	27.2	26.4	25.9	26.9
Sep	Max	30.1	29.2	30.6	30.2
	Min	23.5	23.7	23.4	23.3
	Mean	26.8	26.4	27.0	26.8
Oct	Max	33.2	30.1	32.2	28.0
	Min	23.2	22.9	23.6	22.8
	Mean	28.2	26.5	27.9	25.4
Nov	Max	31.3	31.5	31.6	-
	Min	22.5	23.6	23.2	
	Mean	26.9	27.6	27.4	
Dec	Max	32.5	30.5	31.7	-
	Min	21.3	21.8	23.8	
	Mean	26.9	26.2	27.8	
	Max	32.9	31.8	32.2	32.2
	Min	23.2	23.6	23.3	24.0
	Mean	28.1	27.7	27.8	28.1

11.2.2.18 Monthly surface air temperature (°C) at Anakkayam

Year/ Month		1995	1996	1997	1998
Jan	Max	33.2	31.4	32.8	34.9
	Min	20.2	19.8	18.4	22.1
	Mean	26.7	25.6	25.6	28.5
Feb	Max	34.7	32.6	34.3	34.1
	Min	22.5	20.5	20.8	22.2
	Mean	28.6	26.7	27.6	26.7
Mar	Max	36.3	34.2	36.2	35.8
	Min	23.5	23.4	22.8	24.8
	Mean	29.9	28.8	29.5	30.3
Apr	Max	36.1	33.4	36.1	36.5
	Min	24.9	23.0	23.1	26.3
	Mean	30.5	28.2	29.6	3.14
May	Max	32.9	33.9	35.2	35.0
	Min	23.8	24.2	24.0	26.2
	Mean	23.4	29.1	29.6	30.1
Jun	Max	30.2	30.9	32.7	32.7
	Min	24.1	23.4	23.4	25.0
	Mean	29.2	27.2	28.1	28.9
Jul	Max	28.7	28.7	28.1	29.2
	Min	23.3	22.9	23.1	22.2
	Mean	26.0	25.8	25.6	25.7
Aug	Max	29.7	29.1	28.3	29.2
	Min	23.6	23.9	23.1	24.9
	Mean	26.7	26.5	25.7	27.1
Sep	Max	30.5	30.9	30.9	31.2
	Min	23.0	23.7	23.6	24.4
	Mean	26.8	27.3	27.3	27.8
Oct	Max	34.0	32.2	32.3	30.3
	Min	21.1	22.9	23.4	24.2
	Mean	27.6	27.6	27.9	27.3
Nov	Max	33.5	31.8	30.8	-
	Min	21.5	22.3	23.5	
	Mean	27.5	27.1	27.2	
Dec	Max	33.0	31.4	32.8	-
	Min	17.5	20.6	24.6	
	Mean	25.3	26.0	28.7	
	Max	32.7	31.7	32.5	32.9
	Min	22.4	22.6	22.8	24.2
	Mean	27.6	27.2	27.7	28.6

11.2.2.19 Monthly surface air temperature (°C) at Ambalavayal

Year/ Month		1995	1996	1997	1998
Jan	Max	27.7	28.2	26.4	28.2
	Min	13.5	12.1	15.9	16.9
	Mean	20.6	20 .2	21.2	22.6
Feb	Max	25.9	29.5	28.5	28.9
	Min	15.6	14.8	16.6	18.4
	Mean	20.8	22.2	22.6	23.7
Mar	Max	31.5	32.3	30.0	31.4
	Min	16.7	17.8	17.9	19.2
	Mean	24.1	25.1	24.3	26.3
Apr	Max	30.4	30.6	29.5	31.8
	Min	17.4	19.5	19.0	20.8
	Mean	22.8	24.8	24.9	25.7
May	Max	28.3	29.5	29.6	30.5
	Min	17.3	20.0	20.2	20.8
	Mean	21.6	22.8	24.9	25.7
Jun	Max	26.3	26.6	26.9	25.5
	Min	16.9	19.0	19.9	19.7
	Mean	24.6	22.8	23.4	22.6
Jul	Max	24.3	24.4	24.7	24.8
	Min	16.5	18.6	19.3	19.2
	Mean	20.4	21.5	22.0	22.0
Aug	Max	25.4	25.1	24.7	25.7
	Min	16.6	18.6	18.8	18.9
	Mean	21.0	21.9	21.8	22.3
Sep	Max	26.3	26.0	26.3	26.2
	Min	15.6	18.7	18.3	19.4
	Mean	26.0	22.4	22.3	22.8
Oct	Max	27.1	26.3	28.1	25.6
	Min	15.8	17.7	18.7	18.5
	Mean	21.5	22.0	23.4	22.1
Nov	Max	26.5	26.3	26.6	-
	Min	14.8	17.7	19.0	
	Mean	20.7	22.0	22.8	
Dec	Max	27.2	25.1	26.8	-
	Min	11.0	15.7	18.2	
	Mean	19.1	20.4	22.5	
	Max	27.6	27.5	27.3	27.9
	Min	15.6	17.5	18.5	19.2
	Mean	21.6	22.5	22.9	23.6

11.2.2.20 Monthly surface air temperature (°C) at Pilicode

Year/ Month		1995	1996	1997	1998
Jan	Max	31.4	31.3	31.2	32.5
	Min	19.8	18.7	19.8	21.3
	Mean	25.6	25.0	25.5	26.9
Feb	Max	32.0	32.2	31.1	32.6
	Min	22.3	20.8	20.3	21.6
	Mean	27.2	26.5	25.7	27.1
Mar	Max	32.5	33.0	32.5	32.9
	Min	23.4	24.1	23.6	23.5
	Mean	28.0	28.6	28.1	28.2
Apr	Max	33.4	32.9	33.4	34.7
	Min	25.6	25.3	24.8	26.5
	Mean	29.4	29.1	29.1	30.6
May	Max	32.8	33.2	33.7	34.4
	Min	25.4	26.0	25.5	26.2
	Mean	29.1	29.6	29.6	30.3
Jun	Max	30.1	29.5	30.8	30.3
	Min	26.9	24.0	23.6	23.7
	Mean	28.5	26.8	27.2	27.0
Jul	Max	27.8	28.5	27.9	29.0
	Min	23.5	23.4	23.1	23.3
	Mean	25.7	26.0	25.5	26.2
Aug	Max	28.9	28.5	28.8	29.2
	Min	24.8	23.8	23.1	23.4
	Mean	26.9	26.2	26.0	26.3
Sep	Max	29.5	29.4	30.4	29.2
	Min	24.5	24.1	23.6	23.1
	Mean	27.0	26.8	27.0	26.2
Oct	Max	30.7	29.6	31.4	29.5
	Min	23.8	23.0	23.8	23.8
	Mean	27.3	26.3	27.6	26.7
Nov	Max	31.0	31.3	31.6	31.1
	Min	22.8	23.0	23.4	22.3
	Mean	26.9	27.2	27.5	26.7
Dec	Max	31.3	30.7	31.8	31.2
	Min	18.7	20.3	23.1	21.1
	Mean	25.0	25.5	27.5	26.2
	Max	31.0	31.7	31.2	31.4
	Min	24.5	23.0	23.1	23.3
	Mean	27.8	27.4	27.2	27.4

11.2.2.21 Monthly surface air temperature (°C) at Vengurla

Year/ Month		1995	1996	1997	1998
Jan	Max	31.5	31.6	31.0	31.9
	Min	-	16.6	16.2	18.4
	Mean	-	24.1	23.6	25.2
Feb	Max	31.7	32.0	30.4	31.8
	Min	-	17.6	14.7	17.5
	Mean	-	24.8	22.6	24.7
Mar	Max	31.8	32.0	31.6	31.0
	Min	-	21.4	20.5	19.8
	Mean	-	26.7	26.1	25.4
Apr	Max	33.6	31.3	31.0	33.1
	Min	23.1	23.1	21.9	23.7
	Mean	28.4	27.2	26.5	28.4
May	Max	33.7	33.1	32.0	33.9
	Min	25.7	24.4	24.0	26.7
	Mean	29.7	28.8	28.0	30.1
Jun	Max	31.7	31.1	30.9	31.5
	Min	25.2	25.1	24.0	25.7
	Mean	28.5	28.1	27.5	28.6
Jul	Max	29.2	29.1	30.0	-
	Min	24.3	24.4	25.1	
	Mean	26.8	26.8	27.6	
Aug	Max	30.6	29.0	29.5	-
	Min	24.2	24.1	24.2	
	Mean	27.4	26.6	26.9	
Sep	Max	30.3	30.4	31.0	-
	Min	23.9	23.6	24.0	
	Mean	27.1	27.0	27.5	
Oct	Max	32.9	32.0	33.0	-
	Min	23.4	22.0	23.6	
	Mean	28.2	27.0	28.3	
Nov	Max	32.8	32.9	32.7	-
	Min	19.2	19.3	22.7	
	Mean	26.0	26.1	27.7	
Dec	Max	32.5	30.3	31.7	-
	Min	16.7	17.2	20.7	
	Mean	24.6	23.4	26.2	
	Max	31.9	31.2	31.2	32.1
	Min	22.9	21.6	21.8	22.0
	Mean	27.4	26.4	26.5	27.1

11.2.2.22 Monthly surface air temperature (°C) at Chintamani

Year/ Month		1995	1996	1997
Jan	Max	27.4	27.6	26.2
	Min	15.3	12.2	-
	Mean	21.4	19.9	-
Feb	Max	31.0	25.9	29.9
	Min	15.5	12.1	-
	Mean	23.3	19.0	-
Mar	Max	32.9	33.8	32.6
	Min	16.8	15.3	-
	Mean	24.9	24.6	-
Apr	Max	34.4	34.1	32.8
	Min	21.3	-	-
	Mean	27.9	-	-
May	Max	33.3	30.0	32.9
	Min	21.2	-	21.4
	Mean	27.3	-	27.9
Jun	Max	32.5	32.4	31.9
	Min	20.0	-	21.7
	Mean	26.3	-	26.8
Jul	Max	30.6	30.8	31.1
	Min	20.6	-	21.4
	Mean	25.6	-	26.3
Aug	Max	29.1	29.0	30.7
	Min	19.4	-	21.1
	Mean	24.3	-	25.9
Sep	Max	29.4	29.2	32.1
	Min	19.8	-	20.5
	Mean	24.6	-	26.3
Oct	Max	29.5	27.1	31.5
	Min	19.3	-	20.1
	Mean	22.8	-	25.8
Nov	Max	29.1	27.0	30.6
	Min	16.4	-	18.8
	Mean	22.8	-	24.7
Dec	Max	27.1	25.3	26.7
	Min	11.5	-	15.3
	Mean	19.3	-	21.0
	Max	30.5	29.4	30.8
	Min	18.1	13.2	20.0
	Mean	24.3	21.3	25.4

11.2.2.23 Monthly surface air temperature (°C) at Vriddhachalam

Year/ Month		1995	1996	1997
Jan	Max	30.6	30.4	-
	Min	21.6	-	-
	Mean	26.1	-	-
Feb	Max	35.2	32.4	30.8
	Min	22.5	-	-
	Mean	28.9	-	-
Mar	Max	38.1	37.0	34.4
	Min	24.9	-	-
	Mean	31.5	-	-
Apr	Max	39.7	37.0	-
	Min	-	-	-
	Mean	-	-	-
May	Max	42.1	39.4	-
	Min	-	-	-
	Mean	-	-	-
Jun	Max	42.1	40.2	-
	Min	-	-	-
	Mean	-	-	-
Jul	Max	39.0	36.0	-
	Min	-	-	-
	Mean	-	-	-
Aug	Max	39.2	34.6	-
	Min	-	-	-
	Mean	-	-	-
Sep	Max	37.9	35.8	-
	Min	-	-	-
	Mean	-	-	-
Oct	Max	35.5	34.5	-
	Min	-	-	-
	Mean	-	-	-
Nov	Max	33.5	-	-
	M in	-	-	-
	Mean	-	-	-
Dec	Max	30.0	-	-
	Min	-	-	-
	Mean	-	-	-
	Max	36.9	35.7	32.6
	Min	23.0	-	-
	Mean	29.9	-	-

11.2.2.24 Monthly surface air temperature (°C) at Bapatla

Year/ Month		1994	1995	1996	1997	1998
Jan	Max	29.6	27.9	29.9	28.3	29.7
	Min	17.5	18.1	17.1	16.4	19.3
	Mean	23.6	23.0	23.5	22.4	24.5
Feb	Max	30.4	29.8	30.5	30.2	31.0
	Min	19.5	19.7	18.8	18.3	21.7
	Mean	25.0	24.8	24.7	24.3	26.4
Mar	Max	32.6	32.4	32.7	32.7	32.2
	Min	21.5	21.3	21.1	21.2	20.8
	Mean	27.1	26.9	26.9	27.0	26.5
Apr	Max	32.6	33.7	33.5	32.2	33.3
	Min	25.5	24.6	26.0	23.7	25.2
	Mean	29.1	29.2	29.8	28.0	30.4
May	Max	37.9	34.3	39.8	37.7	38.0
	Min	28.2	25.0	27.2	26.8	27.4
	Mean	33.1	29.7	33.5	32.3	32.7
Jun	Max	37.7	38.7	35.8	39.4	38.4
	Min	27.6	27.9	27.2	27.6	28.3
	Mean	32.7	33.3	31.5	33.5	33.4
Jul	Max	34.2	33.2	32.7	36.8	34.0
	Min	25.5	25.1	25.7	26.7	26.0
	Mean	30.0	29.2	29.2	31.8	30.0
Aug	Max	33.2	34.0	33.0	35.8	33.0
	Min	25.3	25.7	25.5	25.8	25.6
	Mean	29.3	29.9	29.3	30.8	29.3
Sep	Max	34.3	33.0	32.8	33.0	32.4
	Min	25.4	25.5	24.9	25.4	25.4
	Mean	30.3	29.3	28.9	29.2	28.9
Oct	Max	30.5	31.0	30.5	31.8	30.5
	Min	24.0	24.9	24.2	23.4	24.2
	Mean	27.3	28.0	27.4	27.6	27.4
Nov	Max	28.3	31.5	30.5	30.3	30.3
	Min	20.3	21.7	21.0	23.0	22.3
	Mean	24.3	26.6	25.8	26.7	26.3
Dec	Max	29.3	30.0	28.6	29.4	-
	Min	17.2	17.8	18.1	21.6	
	Mean	23.3	23.9	23.4	25.5	
	Max	32.5	32.5	32.5	33.1	33.0
	Min	23.1	23.1	23.1	23.3	24.2
	Mean	27.8	27.8	27.8	28.2	28.6

11.2.2.25 Monthly surface air temperature (°C) at Bhubaneswar

Year/ Month		1994	1995	1996	1997	1998
Jan	Max	29.3	26.8	29.1	27.3	28.8
	Min	14.6	18.4	16.9	13.6	16.5
	Mean	22.0	20.6	23.0	20.5	22.7
Feb	Max	29.8	31.8	30.9	31.1	31.0
	Min	18.6	18.7	18.3	17.1	19.0
	Mean	24.2	25.3	24.5	24.1	25.0
Mar	Max	35.0	34.8	35.0	34.7	33.5
	Min	23.0	21.8	22.6	22.1	22.1
	Mean	29.0	28.3	28.8	28.4	27.8
Apr	Max	36.4	37.4	36.9	34.1	36.2
	Min	24.7	24.9	24.5	21.9	24.4
	Mean	30.3	31.2	30.7	28.0	30.3
May	Max	39.1	34.5	37.5	36.7	38.8
	Min	26.9	26.3	26.8	25.6	27.1
	Mean	33.0	30.4	32.2	31.2	32.9
Jun	Max	33.5	34.2	34.1	36.1	36.8
	Min	26.0	26.7	25.4	25.9	27.2
	Mean	29.7	30.4	30.0	31.0	32.0
Jul	Max	31.3	31.8	32.8	33.3	32.9
	Min	25.1	25.8	25.3	25.6	25.5
	Mean	28.2	28.8	29.1	29.5	29.2
Aug	Max	31.0	32.4	30.9	32.0	32.6
	Min	25.0	25.7	25.0	24.8	25.9
	Mean	28.0	29.0	28.0	28.4	29.3
Sep	Max	31.9	31.9	33.1	32.3	32.2
	Min	24.6	25.5	25.1	24.8	25.3
	Mean	28.3	28.7	29.1	28.4	28.8
Oct	Max	31.6	30.5	31.9	32.9	31.6
	Min	22.9	23.5	23.1	22.4	24.2
	Mean	27.3	27.0	27.7	27.7	27.9
Nov	Max	29.7	29.2	30.2	32.1	30.6
	Min	18.7	19.0	17.4	20.9	20.7
	Mean	24.2	24.2	23.8	26.5	25.7
Dec	Max	29.1	28.9	28.0	28.4	28.6
	Min	13.5	14.7	12.9	17.4	17.2
	Mean	21.3	21.0	20.5	23.0	22.9
	Max	32.3	32.0	32.5	32.6	32.8
	Min	22.0	22.6	21.9	21.8	22.9
	Mean	27.2	27.3	27.2	27.2	27.9

11.2.2.26 Monthly surface air temperature (°C) at Jhargram

Year/ Month		1994	1995	1996	1997
Jan	Max	26.4	26.5	-	26.0
	Min	12.0	7.5	-	11.0
	Mean	19.2	18.5	-	18.5
Feb	Max	26.7	31.5	-	28.8
	Min	16.0	19.0	-	15.4
	Mean	21.4	25.3	-	22.1
Mar	Max	34.2	39.0	-	34.0
	Min	20.5	16.5	-	20.4
	Mean	27.4	27.8	-	27.2
Apr	Max	38.0	38.1	37.5	37.0
	Min	18.5	21.4	18.6	24.1
	Mean	30.8	29.8	28.1	30.6
May	Max	39.0	39.4	39.4	38.9
	Min	23.5	23.9	21.0	23.3
	Mean	31.3	31.7	30.2	31.1
Jun	Max	39.5	37.5	38.8	38.4
	Min	22.5	23.4	22.0	22.8
	Mean	31.0	30.5	30.4	30.6
Jul	Max	33.5	34.8	35.4	34.7
	Min	24.0	24.5	23.5	23.0
	Mean	28.8	29.7	29.5	28.9
Aug	Max	33.0	33.9	35.0	35.2
	Min	23.0	24.3	23.0	22.6
	Mean	28.0	29.1	29.0	28.9
Sep	Max	34.5	34.6	35.6	34.8
	Min	21.0	23.8	22.8	21.8
	Mean	26.8	29.2	29.2	28.3
Oct	Max	34.5	33.5	30.0	30.2
	Min	19.0	22.1	22.8	22.0
	Mean	26.8	27.8	26.4	26.1
Nov	Max	31.5	30.7	29.0	28.8
	Min	13.0	15.8	14.6	14.4
	Mean	22.3	23.3	21.8	21.6
Dec	Max	26.8	26.9	25.5	25.1
	Min	9.6	10.7	11.5	12.7
	Mean	18.2	18.8	18.5	18.9
	Max	33.1	34.7	34.0	32.5
	Min	18.6	19.4	20.0	19.5
	Mean	25.8	27.1	27.0	26.0

11.2.2.27 Mean monthly bright sunshine hours (h/day) at FSRS, Kottarakkara

Year/ Month	1995	1996	1997	1998
Jan	7.1	NR	9.3	9.3
Feb	8.9	NR	8.8	9.8
Mar	9.6	NR	9.1	9.7
Apr	7.3	NR	8.2	7.7
May	6.1	NR	7.2	NA
Jun	2.9	NR	4.4	
Jul	2.9	NR	3.1	
Aug	5.0	4.4	4.8	
Sep	6.0	3.4	6.2	
Oct	6.1	6.7	6.6	
Nov	5.8	6.2	5.8	
Dec	8.4	6.6	7.1	
Mean	6.3	5.5	6.7	9.1

NR – Not recorded ; NA – Not available

11.2.2.28 Mean monthly bright sunshine hours (h/day) at Madakkathara

Year/ Month	1995	1996	1997	1998
Jan	9.6	9.4	9.6	9.3
Feb	10.0	9.9	9.3	9.6
Mar	9.3	9.1	9.6	10.0
Apr	9.1	8.3	9.4	9.0
May	6.5	7.7	6.7	7.6
Jun	3.7	4.7	5.9	3.4
Jul	2.1	2.7	1.9	3.3
Aug	3.7	3.7	3.4	3.6
Sep	6.1	4.3	6.8	4.1
Oct	8.3	6.0	7.3	4.8
Nov	6.5	7.1	5.3	-
Dec	10.3	6.8	7.5	-
Mean	7.1	6.5	6.9	6.5

11.2.2.29 Mean monthly bright sunshine hours (h/day) at Anakkayam

Year/ Month	1995	1996	1997	1998
Jan	8.6	9.1	9.1	6.3
Feb	9.3	9.3	9.3	7.3
Mar	9.5	8.9	8.8	8.2
Apr	8.9	8.2	7.0	8.0
May	6.5	7.7	7.5	7.2
Jun	4.1	5.5	5.6	6.2
Jul	2.2	3.2	2.9	7.2
Aug	3.8	4.0	3.2	-
Sep	5.2	4.0	6.1	-
Oct	6.8	6.0	6.2	-
Nov	6.0	7.0	6.7	-
Dec	10.0	7.5	7.1	-
Mean	6.7	6.7	6.6	7.2

11.2.2.30 Mean monthly bright sunshine hours (h/day) at Ambalavayal

Year/ Month	1995	1996	1997	1998
Jan	7.5	8.5	7.8	8.5
Feb	8.6	4.0	9.1	8.9
Mar	8.4	8.3	8.4	8.4
Apr	7.7	6.4	8.1	7.8
May	-	6.6	6.4	6.8
Jun	-	4.1	4.3	3.0
Jul	1.5	1.9	1.3	1.2
Aug	2.7	1.3	1.6	1.6
Sep	3.9	2.1	3.5	2.6
Oct	4.9	4.2	3.4	3.8
Nov	5.1	6.0	3.9	-
Dec	8.4	5.8	4.4	-
Mean	5.9	4.9	5.2	5.3

11.2.2.31 Mean monthly bright sunshine hours (h/day) at Pilicode

Year/ Month	1995	1996	1997	1998
Jan	9.8	9.6	10.1	9.8
Feb	10.5	10.1	10.1	10.1
Mar	10.3	9.2	9.4	9.8
Apr	10.1	9.2	9.6	9.8
May	8.2	9.5	9.2	8.6
Jun	3.8	5.2	5.3	3.2
Jul	1.5	3.4	1.5	2.9
Aug	4.0	4.2	3.8	3.3
Sep	7.0	5.5	6.3	4.4
Oct	7.6	7.0	7.4	5.4
Nov	8.7	8.3	6.8	7.5
Dec	10.3	8.1	8.0	7.9
Mean	7.7	7.4	7.3	6.9

11.2.2.32 Mean monthly bright sunshine hours (h/day) at Vengurla

Year/ Month	1995	1996	1997
Jan	9.1	9.7	9.4
Feb	9.9	9.7	10.2
Mar	9.0	8.7	9.2
Apr	6.6	10.3	10.3
May	7.9	9.7	10.3
Jun	-	5.6	4.3
Jul	-	2.2	2.8
Aug	-	2.6	2.2
Sep	5.1	5.0	7.3
Oct	6.7	8.4	8.7
Nov	8.8	8.7	6.2
Dec	9.3	7.8	8.5
Mean	8.0	7.4	7.5

11.2.2.33 Mean monthly bright sunshine hours (h/day) at Chintamani

Year/ Month	1995	1996	1997	1998
Jan	7.7	-	-	9.2
Feb	10.0	-	-	9.0
Mar	9.0	-	-	-
Apr	11.5	-	-	-
May	8.2	-	-	-
Jun	8.5	-	6.5	-
Jul	3.2	-	4.5	-
Aug	5.1	-	4.2	-
Sep	-	-	4.7	-
Oct	-	-	6.4	-
Nov	-	-	2.1	-
Dec	-	-	4.4	-
Mean	7.9	-	4.7	9.1

- Not available

11.2.2.34 Mean monthly bright sunshine hours (h/day) at Vriddhachalam

Year/ Month	1995	1996	1997	1998
Jan	5.2	8.2	-	-
Feb	8.1	10.0	-	-
Mar	9.3	7.8	-	-
Apr	9.6	9.9	-	-
May	7.5	-	-	-
Jun	7.5	-	-	-
Jul	7.0	-	-	-
Aug	7.1	-	-	-
Sep	6.3	-	-	-
Oct	6.5	-	-	-
Nov	6.0	-	-	-
Dec	6.4	-	-	-
Mean	7.2	9.0	-	-

- Not available

11.2.2.35 Mean monthly bright sunshine hours (h/day) at Bhubaneswar

Year/ Month	1994	1995	1996	1997	1998
Jan	8.7	7.4	8.1	7.6	7.5
Feb	8.3	8.9	9.4	9.1	7.7
Mar	9.0	8.8	8.1	7.7	8.0
Apr	7.6	8.0	8.6	8.4	8.8
May	9.7	7.2	8.4	8.4	8.9
Jun	3.1	4.1	8.2	5.4	4.4
Jul	3.6	3.7	5.4	3.2	4.6
Aug	4.2	4.8	4.3	4.5	4.1
Sep	5.6	4.8	7.5	5.0	5.3
Oct	7.2	6.2	7.6	8.2	5.6
Nov	6.9	7.8	8.8	7.8	7.2
Dec	9.0	9.0	8.0	6.8	8.4
Mean	6.9	6.7	7.7	6.8	6.7

11.2.2.36 Monthly pan evaporation (mm) at Vellanikkara

Year/ Month	1995	1996	1997	1998
Jan	179	209	175	168
Feb	172	201	159	167
Mar	190	219	203	190
Apr	164	157	191	242
May	129	135	157	121
Jun	104	103	128	87
Jul	89	89	92	102
Aug	96	100	109	88
Sep	98	95	112	86
Oct	114	93	125	89
Nov	89	119	90	-
Dec	196	113	135	-
Total	1620	1633	1676	1340

11:2.2.37 Monthly pan evaporation (mm) at Anakkkayam

Year/ Month	1995	1996	1997	1998
Jan	109	103	85	112
Feb	116	115	74	109
Mar	158	180	106	114
Apr	140	136	118	199
May	112	129	-	194
Jun	98	141	-	133
Jul	100	156	-	-
Aug	119	169	-	-
Sep	141	95	-	-
Oct	159	146	-	-
Nov	138	107	-	-
Dec	128	57	-	-
Total	1518	1534	383	861

- data not available

11.2.2.38 Monthly pan evaporation (mm) at Ambalavayal

Year/ Month	1995	1996	1997	1998
Jan	115	133	97	123
Feb	116	132	116	125
Mar	154	166	141	144
Apr	134	115	123	126
May	100	126	105	111
Jun	60	75	76	57
Jul	36	43	32	32
Aug	52	42	38	35
Sep	72	63	73	53
Oct	89	75	77	59
Nov	75	97	76	-
Dec	160	81	76	-
Total	1163	1148	1030	865

11.2.2.39 Monthly pan evaporation (mm) at Pilicode

Year/ Month	1995	1996	1997	1998
Jan	146	124	128	127
Feb	141	142	132	141
Mar	172	175	160	181
Apr	186	168	194	197
May	171	189	200	200
Jun	97	97	110	88
Jul	78	81	54	80
Aug	84	100	85	83
Sep	91	114	113	94
Oct	112	113	111	110
Nov	111	107	99	112
Dec	133	99	103	-
Total	1522	1509	1489	1413

11.2.2.40 Monthly pan evaporation (mm) at Vengurla

Year/ Month	1995	1996	1997
Jan	89	123	119
Feb	125	133	115
Mar	160	145	144
Apr	169	174	178
May	164	206	195
Jun	129	144	129
Jul	105	111	119
Aug	108	104	125
Sep	115	104	116
Oct	126	99	104
Nov	116	93	93
Dec	125	92	75
Total	1531	1528	1512

11.2.2.41 Monthly pan evaporation (m at Chintamani

Year/ Month	1995	1996	1997	1998
Jan	140	233	155	195
Feb	199	190	157	-
Mar	273	304	254	310
Apr	309	267	198	300
May	236	273	288	248
Jun	219	204	273	-
Jul	124	195	205	-
Aug	158	192	189	-
Sep	192	207	108	-
Oct	198	136	195	-
Nov	153	126	111	-
Dec	158	96	140	-
Total	2359	2423	2273	1053

- data not available

11.2.2.42 Monthly pan evaporation (m at Vriddhachalam

Year/ Month	1995	1996	1997	1998
Jan	273	167	136	116
Feb	182	168	157	104
Mar	198	217	179	130
Apr	186	162	184	183
May	171	183	230	266
Jun	177	189	242	306
Jul	161	184	209	121
Aug	129	213	173	111
Sep	141	107	146	105
Oct	167	90	95	105
Nov	129	72	64	108
Dec	189	57	86	105
Total	2103	1809	1901	1760

11.2.3 Soil characteristics

11.2.3.1 Soil description and taxonomy of the selected stations
(Source : NBSS and LUP, (ICAR), Nagpur)

1. Kottarakkara (Mapping Unit No. 12)

Soil type : Very deep, well drained, gravelly clay soils with moderate surface gravelliness on gently sloping midland laterites with valleys of southern Kerala, with moderate erosion, associated with very deep, well drained, clay soils.

Taxonomy: Clayey-skeletal, kaolintic, Ustic kanhaplohumults

2. Madakkathara (Mapping Unit No.7)

Soil type : Very deep, well drained, gravelly clay soils on gently sloping coastal laterites, with moderate erosion; associated with very deep, well drained, gravelly clay soils with moderate surface gravelliness.

Taxonomy: Clayey-skeletal, kaolinitic, Typic kandiusbelts/ Typic kanhaplustults

3. Anakkayam (Mapping Unit No.11)

Soil type : Very deep, well drained, gravelly clayey soils on gently sloping midland laterites with valleys of central Kerala, with moderate erosion, associated with deep, well drained, clay soils with coherent material at 100 to 150 cm on gentle slopes.

Taxonomy: Clayey, kaolinitic ustic kandihumults

4. Ambalavayal (Mapping Unit No.18)

Soil type : Very deep, well drained, clayey soils on gently sloping lands of Wayanad plateau, with moderate erosion, associated with very deep, well drained, clayey soils.

Taxonomy: Clayey, mixed, Ustic Palehumults

5. Pilicode (Mapping Unit No. 10)

Soil type : Very deep, well drained, gravelly clay soils on gently sloping midland laterites with valleys of northern Kerala, with moderate erosion associated with deep, well drained, gravelly clay soils with moderate surface gravelliness and ironstone layer at 100 to 150 cm on nearly level lands, slightly eroded.

Taxonomy: Clayey, kaolinitic, Ustic kandihkumults

6. Vengurla

Soil type : Shallow to moderately deep, well drained, loamy soils on undulating moderate to steep sloppy with moderate to severe erosion, associated with low available water and non calcareous soil with moderate to strong surface stoniness

Taxonomy: Inceptisol, Alfisol Lithic Rhodustalfs

7. Vriddhachalam

Soil type : Moderate to very deep, well drained, loamy soil with laterite and underlying sandstone rocks, associated with low to medium available moisture and acidic non calcareous soil with slight to moderate erosion.

Taxonomy: Inceptisols, halaquepts, Ustropepts and Rhodustalfs

8. Bapatla

Soil type : Shallow to moderately deep, excessively drained gravelly clayey and gravelly loam soils on gentle to moderate sloppy land, associated with rock out crops of non calcareous neutral to alkaline soil with moderate to severe erosion and low available water.

Taxonomy: Ustropepts, Rhodustalfs Vertisols, Inceptisols

9. Bhubaneswar

Soil type : Shallow to moderately deep, well drained loamy soils on gently sloppy lands with slight erosion associated with low available water and neutral soil reaction.

Taxonomy: Typic Ustropepts, Typic Ustorthents

10. Jhargram

Soil type : Deep, coarse to fine loamy soils with moderate to well drained, neutral to slightly alkaline and strongly saline with high base saturation associated with moderate to severe erosion and disseminated ferruginous concretions in the sub soils

Taxonomy : Ustifluvents

11.2.3.2 Nutrient status of soils

11.2.3.2.1 Nutrient status of soils at FSRS, Kottarakkara (Laterite in origin-oxisol)

Parameter	Period	Lowland	Area 1	Area 2
p^H	1986-87	4.03	4.39	4.44
	1990-91	4.21	4.70	4.68
EC (mmhos/cm)	1986-87	0.05	0.07	0.04
	1990-91	0.05	0.04	0.05
Organic Carbon (%)	1986-87	0.50	1.60	1.42
	1990-91	0.51	3.19	3.91
Available N (Kg/ha)	1986-87	111.0	360.0	31.90
	1990-91	112.0	716.0	880.0
Available P_2O_5 (Kg/ha)	1986-87	14.30	5.40	4.00
	1990-91	16.30	5.49	16.12
Available K_2O (Kg/ha)	1986-87	93.30	111.7	122.9
	1990-91	102.3	158.59	123.6

11.2.3.2.2 Nutrient status of soils at CRS, Madakkathara (Laterite)

Chemical composition :
Organic Carbon : 0.72 to 1.01 % Available P_2O_5 : 6 to 12.6 kg/ha
Available K_2O : 186 to 345 kg/ha

11.2.3.2.3 Nutrient status of soils at RFRS, Vengurla (Laterite)

Plot	p^H 1:2:5	EC mmhos/cm	Organic carbon %	Available N	Available P_2O_5 (kg/ha)	Available K_2O
Cashew A	5.30	0.068	1.03	156.0	0.72	208.5
Cashew 1	5.25	0.122	1.00	252.0	0.97	192.1
Coconut Cashew B	5.33	0.070	0.96	278.2	0.85	179.3
Cashew hill	6.03	0.130	0.98	280.8	1.05	178.7
Cashew D	5.80	0.140	0.87	299.2	0.97	170.6
Cashew E	5.44	0.067	0.84	479.2	2.12	206.7

11.2.3.2.4 Nutrient status of soils at CRS, Vriddhachalam

Type of soil	: Red laterite	Soil texture	: Sandy loam
Field capacity	: 31.46%	Bulk density	: 1.54 g/cc
p^H	: 5.5 to 6.5	Wilting point	: 8.6%
Infilitration rate	: 7.2 cm/hr	Available N	: 332.44 kg
Available P_2O_5	: 6.97 kg	Available K_2O	: 123.2 kg
OC	: 0.5%	EC	: 0.05 mmhos/cm

11.2.3.2.5 Nutrient status of soil at Chintamani

Soil type	: Red sandy loam	p^H	: 5.1 - 6.4
OC	: 0.1 - 0.15 (0.35 - 0.55%)	EC	: 0.1 - 0.15 mmhos/cm
P_2O_5	: 28 kg/acre (12.5 - 22 kg/ha)	K_2O	: 80 kg/acre (>200 kg/ha)

11.2.3.2.6 Nutrient status of soil at CRS, Bapatla

Depth cm	Organic Carbon	Total N	Available nutrients kg/ha			CEC	ne/100g soil	Exchangeable cations me/100g soil				Base Saturation
			N	P_2O_5	K_2O			Ca++	Mg++	K++	Na++	
0-15	0.194	0.018	78	4	-	2.0	2.0	1.0	0.27	-	0.43	85.0
15-30	0.094	0.016	59	4	-	1.4	1.4	0.6	0.16	-	0.32	77.6
30-60	0.086	0.016	39	3	-	1.4	1.4	0.6	0.13	-	0.32	75.2
60-90	0.086	0.011	39	4	-	1.4	1.4	0.6	0.14	-	0.32	75.7
Range	0.086-0.194	0.011-0.018	39-78	3-4	-	1.4-2.0	1.4-2.0	0.6-1.0	0.13-0.27	-	0.32-0.43	75.2-85.3
Mean	0.103	0.015	54	4	-	1.6	1.6	0.7	0.17	-	0.35	78.3

11.2.3.2.7 Available (DTPA extractable) micro-nutrients status of soils of Cashew Research Station, Bapatla

Depth cm	Available nutrients (ppm)			
	Zn	Fe	Mn	Cu
0-15	0.76	9.07	0.80	0.37
15-30	0.67	6.57	1.30	0.18
30-60	0.25	5.98	2.65	0.09
60-90	0.77	5.59	1.95	0.14
Range	0.25-0.77	5.59-9.07	0.80-2.65	0.09-0.37
Mean	0.61	6.80	1.68	0.20

11.2.3.2.8 Soil characteristics at selected stations during 1998-99

Sample No	Location	Organic Carbon (%)	Available Nitrogen (%)	K_2O (kg/ha)	P^H	EC mmhos/cm
1	VT4 (30) – D PLOT	1.19	0.14	209.40	5.26	0.119
2	VT1 (30) - D PLOT	1.63	0.20	182.92	5.84	0.136
3	VT2 (30) - D PLOT	0.95	0.04	326.46	5.90	0.108
4	VT5 (30) - D PLOT	1.37	0.01	123.11	4.88	0.099
5	VT3 (30) - D PLOT	1.16	0.01	182.92	5.80	0.095
6	PT1 (30) – BLA-39-4	2.58	0.12	238.70	5.36	0.152
7	PT2 (30) – BLA-39-4	1.95	0.03	290.57	5.43	0.137
8	PT1 (60) – BLA-39-4	1.49	0.18	234.80	5.27	0.154
9	PT1 (60) – NDR-2-1	1.74	0.42	234.80	5.40	0.140
10	PT2 (60) – BLA-39-4	1.40	0.14	326.46	5.14	0.150
11	PT1 (30) – NDR-2-1	2.67	0.34	266.65	5.43	0.137
12	PT3 (30) – BLA-39-4	2.65	0.24	250.66	5.30	0.154
13	PT3 (60) – BLA-39-4	1.28	Nil	154.96	5.40	0.101
14	PT2 (60) – NDR-2-1	1.28	0.23	322.43	4.29	0.092
15	PT2 (30) – NDR-2-1	2.47	0.32	326.46	5.39	0.125
16	PT3 (30) – NDR-2-1	1.56	0.57	202.81	5.40	0.100
17	PT3 (60) – NDR-2-1	1.40	0.32	162.89	5.65	0.147
18	PT1 (30) – BLA–139-1	2.81	0.49	226.73	5.65	0.142
19	PT1 (60) – BLA-139-1	1.95	0.16	138.97	5.18	0.112
20	PT2 (30) – BLA-139-1	2.21	0.17	111.15	5.47	0.148
21	PT3 (30) – BLA-139-1	1.35	0.25	138.97	5.01	0.068
22	PT2 (60) – BLA-139-1	2.37	0.16	83.19	5.03	0.111
23	PT3 (60) – BLA-139-1	1.74	0.04	170.96	4.99	0.064
24	PAT1 (60) – BLA-39-4	1.49	0.18	131.04	5.44	0.147
25	PAT1 (60) – NDR-2-1	1.26	0.18	115.05	5.06	0.089
26	PAT2 (30) – BLA-39-4	2.42	0.27	87.23	5.34	0.144
27	PAT1 (60) – BLA-139-1	1.63	0.17	91.12	5.26	0.120
28	PAT3 (30) – BLA-39-4	2.14	0.27	190.85	5.36	0.154
29	PAT2 (60) – BLA-139-1	1.40	0.15	91.12	5.07	0.105
30	PAT2 (30) – BLA-139-1	2.28	0.25	71.23	5.27	0.147
31	PAT1 (30) – BLA-139-1	2.56	0.22	31.32	5.26	0.093
32	PAT1 (30) – NDR-2-1	2.49	0.29	91.12	5.44	0.070
33	PAT1 (30) – BLA-39-4	2.60	0.31	119.08	5.51	0.137
34	PAT3 (60) – BLA-139-1	1.47	0.02	131.04	5.01	0.116
35	PAT2 (60) – BLA-39-4	1.33	0.03	95.16	5.39	0.125
36	PAT3 (30) – BLA-139-1	2.51	0.10	91.12	5.35	0.092
37	PAT3 (60) - BLA-39-4	1.60	0.15	123.11	5.30	0.145
38	BA (30S) – BLA-39-4	0.23	0.21	27.42	5.37	0.059
39	BA (60S) – BLA-39-4	0.21	0.02	3.49	6.16	0.142
40	BA (30E) – BLA-39-4	0.02	0.14	79.16	5.96	0.146
41	BA (60E) – BLA-39-4	0.02	0.04	19.35	6.38	0.146
42	BA (30W) – BLA-39-4	0.02	0.10	51.34	6.40	0.147
43	BA (60W) – BLA-39-4	0.44	0.05	27.42	7.10	0.093
44	BA (30N) – BLA-39-4	0.21	0.06	71.23	6.06	0.157
45	BA (60N) – BLA-39-4	0.44	0.02	75.26	6.91	0.100
46	BH (30S) – BLA-39-4	0.21	0.10	31.31	4.93	0.141
47	BH (60S) – BLA-39-4	0.14	0.08	35.34	4.90	0.100
48	BH (30N) – BLA-39-4	0.23	0.10	15.46	5.40	0.099
49	BH (60N) – BLA-39-4	0.21	0.08	19.35	5.40	0.101
50	J (30) – BLA-39-4	0.19	0.28	135.07	5.85	0.054
51	J (30) – NDR-2-1	0.09	0.04	170.96	5.34	0.087
52	J (30) – II-1598	0.16	0.10	182.92	5.57	0.150
53	J (30) – BLA-139-1 (PM)	0.19	0.05	270.68	5.63	0.098

V-Vengurla; P-Pilicode; PA- Pariyaram; BA- Bapatla; BH- Bhubaneswar; J- Jhargram ; Figures in parenthesis indicate soil depth in cm and direction; T- Tree number; PM – Poor management ; S-South; N- North; W- West and E- East

11.2.3.2.9 Soil characteristics at selected stations during 1998-1999*

Name of Station	Organic Carbon (%)	pH	EC mmhos/cm	Available Nitrogen (%)	K_2O (kg/ha)
Pilicode	1.94	5.27	0.124	0.23	215.68
Pariyaram	1.94	5.29	0.120	0.19	104.26
Vengurla	1.26	5.54	0.111	0.08	204.96
Bapatla	0.20	6.29	0.124	0.08	44.33
Bubaneshwar	0.20	5.16	0.110	0.09	25.36
Jhargram	0.15	5.58	0.097	0.14	162.98

*Soil samples were collected at the time of bud break and flushing (November/January)

11.2.4 Varietal characteristics

11.2.4.1 Name of variety : **Anakkayam - 1 (BLA-139-1)**

Apple colour : Pinkish Yellow
Nut weight : 5.95 g
Kernel weight : 1.67 g
Shelling percentage : 27.99
Export grade : W 280
Mean nut yield per tree : 12.0 Kg

Source of planting material : Cashew Research Station
Kerala Agricultural University
Madakkathara – 680656, Thrissur
&
Cashew Research Station
Kerala Agricultural University
Anakkayam, Malappuram Dt.

Recommended regions for cultivation : Kerala, Manipur, Tripura and Andaman & Nicobar islands

Recognition : Kerala Agricultural University

N.B: *The nut size of the variety is found to be small and hence not recommended for large scale adoption, as per the recommendation of National Workshop on Cashew of 1987*

11.2.4.2 Name of variety : **Madakkathara – 1 (BLA-39-4)**

Apple colour	: Yellow
Nut weight	: 6.2 g
Kernel weight	: 1.64 g
Shelling percentage	: 26.8
Export grade	: W 280
Mean nut yield per tree	: 13.8 Kg
Source of planting material	: Cashew Research Station Kerala Agricultural University Madakkathara – 680656, Thrissur & Cashew Research Station Kerala Agricultural University Anakkayam, Malappuram Dt.
Recommended regions for cultivation	: Kerala, West Bengal, Manipur and Andaman & Nicobar islands
Recognition	: National Workshop on Cashew 1987

11.2.4.3 Name of Variety : **Madakkathara – 2 (NDR-2-1)**

Apple colour	: Red
Nut weight	: 6.0 g
Kernel weight	: 2.80 g
Shelling percentage	: 28
Export grade	: W 210
Mean nut yield per tree	: 17.0 Kg
Source of planting material	: Cashew Research Station, Kerala Agricultural University, Madakkathara – 680656, Thrissur & Cashew Research Station Kerala Agricultural University Anakkayam, Malappuram Dt.
Recommended regions for cultivation	: Kerala
Recognition	: National Workshop on Cashew 1987

11.2.4.4 Name of Variety : **Kanaka (H-1598)**

Apple colour	: Yellow
Nut weight	: 6.80 g
Kernel weight	: 2.08 g
Shelling percentage	: 30.58
Export grade	: W 280
Mean nut yield per tree	: 12.8 Kg
Source of planting material	: Cashew Research Station, Kerala Agricultural University, Madakkathara – 680656, Thrissur & Cashew Research Station Kerala Agricultural University Anakkayam, Malappuram Dt.
Recommended regions for cultivation	: Kerala
Recognition	: State Variety Release Committee

N.B: *The size of the variety is found to be small and hence not recommended for large scale adoption as per the recommendation of National Workshop on Cashew of 1993*

11.2.5 Cashew Phenology

11.2.5.1 Bud break of Ank-1 (BLA-139-1)

1a. Mean bud break (<25%) of Ank-1 at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	22.09.92	09.09.93	-	-	25.09.96	20.09.97	06.10.98	22nd Sept
2	Madakkathara	29.09.92	03.10.93	-	-	17.10.96	08.09.97	20.10.98	3rd Oct
3	Anakkayam	20.09.92	22.09.93	-	-	01.09.96	15.09.97	28.10.98	23rd Sept
4	Ambalavayal	-	15.10.93	-	-	28.10.96	04.10.97	18.10.98	16th Oct
5	Pilicode	17.09.92	27.08.93	13.09.94	18.09.95	20.10.96	15.10.97	28.10.98	28th Sept
6	Pariyaram	01.10.92	18.10.93	27.09.94	-	14.11.96	24.10.97	12.11.98	21st Oct
7	Puttur	01.11.92	17.10.93	24.10.94	-	-	-	-	24th Oct
8	Vengurla	-	-	-	-	07.10.96	08.10.97	-	8th Oct
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	18.11.96	17.11.97	-	18th Nov
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	08.01.99	8th Jan

1b. Mean bud break (25%) of Ank-1 at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	02.10.92	12.09.93	-	-	02.10.96	26.09.97	11.10.98	29th Sept
2	Madakkathara	03.10.92	08.10.93	-	-	22.10.96	14.09.97	26.10.98	9th Oct
3	Anakkayam	25.09.92	25.09.93	-	-	17.09.96	15.10.97	06.11.98	6th Oct
4	Ambalavayal	-	21.10.93	-	-	01.11.96	14.10.97	21.10.98	22nd Oct
5	Pilicode	26.09.92	02.09.93	19.09.94	26.09.95	30.10.96	23.10.97	03.11.98	6th Oct
6	Pariyaram	03.10.92	22.10.93	30.09.94	-	20.11.96	31.10.97	18.11.98	26th Oct
7	Puttur	04.11.92	23.10.93	29.10.94	-	-	-	-	29th Oct
8	Vengurla	-	-	-	-	10.10.96	14.10.97		12th Oct
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	20.11.96	23.11.97	-	22nd Nov
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

1c. Mean bud break (50%) of Ank-1 at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	15.10.92	16.09.93	-	-	07.10.96	03.10.97	18.10.98	6th Oct
2	Madakkathara	07.10.92	13.10.93	-	-	24.10.96	18.09.97	31.10.98	13th Oct
3	Anakkayam	30.09.92	02.10.93	-	-	30.09.96	15.10.97	13.11.98	12th Oct
4	Ambalavayal	-	27.10.93	-	-	05.11.96	25.10.97	25.10.98	28th Oct
5	Pilicode	03.10.92	14.09.93	22.09.94	14.10.95	04.11.96	02.11.97	08.11.98	14th Oct
6	Pariyaram	05.10.92	27.10.93	03.10.94	-	23.11.96	07.11.97	21.11.98	30th Oct
7	Puttur	05.11.92	27.10.93	05.11.94	-	-	-	-	2nd Nov
8	Vengurla	-	-	-	-	16.10.96	20.10.97	-	18th Oct
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	23.11.96	25.11.97	-	24th Nov
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

1d. Mean bud break (75%) of Ank-1 at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	21.10.92	18.09.93	-	-	14.10.96	15.10.97	23.10.98	12th Oct
2	Madakkathara	12.10.92	17.10.93	-	-	26.10.96	23.10.97	04.11.98	23rd Oct
3	Anakkayam	09.10.92	08.10.93	-	-	10.10.96	21.11.97	19.11.98	26th Oct
4	Ambalavayal	-	01.11.93	-	-	07.11.96	27.10.97	08.11.98	3rd Nov
5	Pilicode	15.10.92	22.09.93	26.09.94	22.10.95	07.11.96	09.11.97	13.11.98	21st Oct
6	Pariyaram	11.10.92	31.10.93	05.10.94	-	26.11.96	12.11.97	25.11.98	3rd Nov
7	Puttur	09.11.92	31.10.93	10.11.94	-	-	-	-	6th Nov
8	Vengurla	-	-	-	-	22.10.96	06.11.97	-	30th Oct
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	13.12.96	16.12.97	-	15th Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

1e. Mean bud break (100%) of Ank-1 at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	01.11.92	20.9.93	-	-	28.10.96	25.10.97	28.10.98	21st Oct
2	Madakkathara	17.10.92	25.10.93	-	-	28.10.96	29.10.97	09.11.98	28th Oct
3	Anakkayam	14.10.92	12.10.93	-	-	15.10.96	26.11.97	24.11.98	31st Oct
4	Ambalavayal	-	06.11.93	-	-	09.11.97	29.10.97	20.11.98	8th Nov.
5	Pilicode	21.10.92	30.09.93	29.09.94	26.10.95	11.11.96	14.11.97	15.11.98	26th Oct
6	Pariyaram	18.10.92	04.11.93	07.10.94	-	29.11.96	17.11.97	29.11.98	7th Nov
7	Puttur	11.11.92	02.11.93	16.11.94	-	-	-	-	10th Nov
8	Vengurla	-	-	-	-	27.10.96	10.11.97	-	3rd Nov
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	02.01.97	04.01.98	-	3rd Jan
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

11.2.5.2 Flushing of Ank-1 (BLA-139-1)

2a. Mean flushing (<25%) of Ank-1 at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	08.10.92	15.09.93	-	-	07.10.96	02.10.97	17.10.98	4th Oct
2	Madakkathara	04.10.92	09.10.93	-	-	24.10.96	15.09.97	03.11.98	11th Oct
3	Anakkayam	26.09.92	25.09.93	-	-	03.10.96	12.10.97	18.11.98	11th Oct
4	Ambalavayal	-	31.10.93	-	-	07.11.96	26.10.97	04.11.98	2nd Nov
5	Pilicode	30.09.92	22.09.93	26.09.94	28.09.95	02.11.96	28.10.97	05.11.98	12th Oct
6	Pariyaram	18.10.92	30.10.93	09.10.94	-	25.11.96	15.11.97	17.11.98	4th Nov
7	Puttur	19.11.92	25.10.93	05.11.94	-	-	-	-	6th Nov
8	Vengurla	-	-	-	-	17.10.96	29.10.97	-	23rd Oct
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	26.11.96	25.11.97	-	26th Nov
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

2b. Mean flushing (25%) of Ank-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	15.10.92	19.09.93	-	-	10.10.96	06.10.97	22.10.98	8th Oct
2	Madakkathara	07.10.92	14.10.93	-	-	26.10.96	24.09.97	08.11.98	16th Oct
3	Anakkayam	31.09.92	30.09.93	-	-	10.10.96	06.11.97	25.11.98	21st Oct
4	Ambalavayal	-	29.11.93	-	-	09.11.96	28.10.97	13.11.98	12th Nov
5	Pilicode	07.10.92	25.09.93	08.10.94	06.10.95	07.11.96	07.11.97	08.11.98	19th Oct
6	Pariyaram	23.10.92	04.11.93	16.10.94	-	01.12.96	18.11.97	19.11.98	8th Nov
7	Puttur	21.11.92	28.10.93	10.11.94	-	-	-	-	9th Nov
8	Vengurla	-	-	-	-	21.10.96	03.11.97	-	28th Oct
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	30.11.96	02.12.97	-	1st Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

2c. Mean flushing (50%) of Ank-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	25.10.92	22.9.93	-	-	16.10.96	10.10.97	31.10.98	15th Oct
2	Madakkathara	11.10.92	19.10.93	-	-	29.10.96	30.09.97	12.11.98	20th Oct
3	Anakkayam	14.10.92	12.10.93	-	-	16.10.96	19.11.97	30.11.98	31st Oct
4	Ambalavayal	-	6.12.93	-	-	13.11.96	01.11.97	18.11.98	17th Nov
5	Pilicode	12.10.92	29.9.93	16.10.94	18.10.95	13.11.96	14.11.97	11.11.98	25th Oct
6	Pariyaram	31.10.92	9.11.93	21.10.94		08.12.96	21.11.97	27.11.98	14th Nov
7	Puttur	25.11.92	31.10.93	17.11.94	-	-	-	-	14th Nov
8	Vengurla	-	-	-	-	28.10.96	07.11.98	-	2nd Nov
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	3.12.96	06.12.97	-	5th Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

2d. Mean flushing (75%) of Ank-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	03.11.92	25.09.93	-	-	22.10.96	18.10.97	08.11.98	22nd Oct
2	Madakkathara	18.10.92	26.10.93	-	-	31.10.96	18.10.97	20.11.98	29th Oct
3	Anakkayam	26.10.92	17.10.93	-	-	22.10.96	27.11.97	06.12.98	7th Nov
4	Ambalavayal	-	04.01.94	-	-	18.11.96	07.11.97	22.11.98	28th Nov
5	Pilicode	18.10.92	02.10.93	28.10.94	26.10.95	19.11.96	21.11.97	16.11.98	1st Nov
6	Pariyaram	06.11.92	12.11.93	26.10.94	-	13.12.96	26.11.97	04.12.98	19th Nov
7	Puttur	27.11.92	06.11.93	21.11.94	-	-	-	-	18th Nov
8	Vengurla	-	-	-	-	06.11.96	14.11.97	-	10th Nov
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	18.12.96	20.12.97	-	19th Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

2e. Mean flushing (100%) of Ank-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	12.11.92	28.09.93	-	-	06.11.96	28.10.97	14.11.98	30th Oct
2	Madakkathara	17.11.92	01.11.93	-	-	10.11.96	13.11.97	28.11.98	14th Nov
3	Anakkayam	08.11.92	22.10.93	-	-	30.10.96	14.12.97	13.12.98	17th Nov
4	Ambalavayal	-	16.01.94	-	-	27.11.96	15.11.97	07.12.98	9th Dec
5	Pilicode	28.10.92	07.10.93	05.11.94	09.11.95	23.11.96	28.11.97	19.11.98	8th Nov
6	Pariyaram	18.11.92	15.11.93	02.11.94	-	18.12.96	01.12.97	08.12.98	25th Nov
7	Puttur	30.11.92	10.11.93	27.11.94	-	-	-	-	22nd Nov
8	Vengurla	-	-	-	-	20.11.96	29.11.97	-	25th Nov
9	Vriddhachalam	-	-	-	-	-	-	-	
10	Chintamani	-	-	-	-	06.01.97	09.01.98	-	8th Jan
11	Bhubaneswar	-	-	-	-	-	-	-	
12	Bapatla	-	-	-	-	-	-	-	
13	Jhargram	-	-	-	-	-	-	-	

11.2.5.3 Flowering of Ank-1 (BLA-139-1)

3a. Mean flowering (<25%) of Ank-1at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	07.11.92	22.09.93	-	-	22.10.96	16.10.97	08.11.98	21st Oct
2	Madakkathara	11.10.92	13.10.93	-	-	26.10.96	24.09.97	22.11.98	19th Oct
3	Anakkayam	19.10.92	12.10.93	-	-	05.11.96	06.11.97	11.12.98	4th Nov
4	Ambalavayal	-	02.12.93	-	-	22.11.96	06.11.97	18.11.98	20th Nov
5	Pilicode	22.11.92	31.10.93	29.10.94	22.10.95	21.11.96	03.11.97	11.11.98	7th Nov
6	Pariyaram	23.11.92	22.11.93	12.11.94	-	14.12.96	22.11.97	30.11.98	26th Nov
7	Puttur	08.12.92	05.11.93	17.11.94	-	-	-	-	20th Nov
8	Vengurla	-	-	-	-	28.10.96	01.11.97	-	30th Oct
9	Vriddhachalam	-	-	-	-	-	-	-	
10	Chintamani	-	-	-	-	15.12.96	17.12.97	-	16th Dec
11	Bhubaneswar	-	-	-	-	-	-	-	
12	Bapatla	-	-	-	-	-	-	-	
13	Jhargram	-	-	-	-	-	-	-	

3b. Mean flowering (25%) of Ank-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	14.11.92	05.10.93	-	-	30.10.96	26.10.97	15.11.98	30th Oct
2	Madakkathara	10.10.92	17.10.93	-	-	28.10.96	30.09.97	28.11.98	23rd Oct
3	Anakkayam	28.10.92	22.11.93	-	-	11.11.96	15.11.97	17.12.98	18th Nov
4	Ambalavayal	-	20.12.93	-	-	06.12.96	26.11.97	25.11.98	4th Dec
5	Pilicode	30.11.92	16.11.93	12.11.94	08.11.95	28.11.96	18.11.97	27.11.98	20th Nov
6	Pariyaram	08.12.92	29.11.93	19.11.94	-	28.12.96	04.12.97	07.12.98	6th Dec
7	Puttur	13.12.92	16.11.93	22.11.94	-	-	-	-	27th Nov
8	Vengurla	-	-	-	-	01.11.96	04.11.97	-	3rd Nov
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	17.12.96	18.12.97	-	18th Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

3c. Mean flowering (50%) of Ank-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	21.11.92	11.10.93	-	-	07.11.96	05.11.97	27.11.98	8th Nov
2	Madakkathara	30.10.92	31.10.93	-	-	11.11.96	16.11.97	04.12.98	12th Nov
3	Anakkayam	11.11.92	28.10.93	-	-	21.11.96	19.11.97	28.12.98	21st Nov
4	Ambalavayal	-	27.12.93	-	-	20.12.96	20.12.97	30.11.98	17th Dec
5	Pilicode	20.11.92	24.11.93	24.11.94	29.11.95	04.12.96	02.12.97	07.12.98	29th Nov
6	Pariyaram	22.12.92	04.12.93	08.12.94	-	03.01.97	16.12.97	14.12.98	16th Dec
7	Puttur	15.12.92	23.11.93	29.11.94	-	-	-	-	2nd Dec
8	Vengurla	-	-	-	-	04.11.96	14.11.97	20.11.98	13th Nov
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	23.12.96	25.12.97	30.12.98	26th Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

3d. Mean flowering (75%) of Ank-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	28.11.92	15.10.93	-	-	14.11.96	20.11.97	06.12.98	16th Nov
2	Madakkathara	28.10.92	28.10.93	-	-	04.11.96	28.11.97	10.12.98	13th Nov
3	Anakkayam	20.11.92	09.11.93	-	-	27.11.96	07.01.98	04.01.99	8th Dec
4	Ambalavayal	-	08.01.94	-	-	08.01.97	25.12.97	08.12.98	28th Dec
5	Pilicode	10.01.93	03.12.93	12.12.94	08.12.95	14.12.96	20.12.97	11.12.98	16th Dec
6	Pariyaram	20.01.93	09.12.93	18.12.94	-	10.01.97	28.12.97	18.12.98	28th Dec
7	Puttur	20.12.92	30.11.93	06.12.94	-	-	-	-	9th Dec
8	Vengurla	-	-	-	-	28.11.96	24.11.97	-	26th Nov
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	10.01.97	13.01.98	-	12th Jan
11	Bhubaneswar	-	-	-	-	-	--	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

3e. Mean flowering (100%) of Ank-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	05.12.92	18.10.93	-	-	24.11.96	06.12.97	13.12.98	25th Nov
2	Madakkathara	30.11.92	06.11.93	-	-	07.12.96	05.12.97	17.12.99	1st Dec
3	Anakkayam	24.11.92	22.11.93	-	-	05.12.96	15.01.98	08.01.99	15th Dec
4	Ambalavayal	-	21.01.94	-	-	27.01.97	30.12.97	14.12.98	8th Jan
5	Pilicode	20.01.93	13.12.93	19.12.94	28.12.95	20.12.96	17.01.98	15.12.98	28th Dec
6	Pariyaram	05.02.93	16.12.93	01.01.95	-	18.01.97	09.01.98	25.12.98	7th Jan
7	Puttur	23.12.92	07.12.93	10.12.94	-	-	-	-	13th Dec
8	Vengurla	-	-	-	-	04.12.96	05.12.97	-	5th Dec
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	28.01.97	31.01.98	-	30th Jan
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

11.2.5.4 Harvest of Ank-1 (BLA-139-1)

4a. Mean harvest (<25%) of Ank-1 at different locations across West and East coasts of Ir

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	22.11.92	10.11.93	-	-	12.01.97	26.12.97	28.12.98	14th Dec
2	Madakkathara	03.01.93	24.12.93	-	-	04.12.96	30.11.97	16.01.99	22nd Dec
3	Anakkayam	18.01.93	22.12.93	-	-	08.01.97	29.12.97	28.01.99	9th Jan
4	Ambalavayal	-	09.02.94	-	-	02.03.97	26.02.98	-	22nd Feb
5	Pilicode	02.01.93	01.01.94	13.12.94	20.12.96	28.01.97	15.01.97	21.01.99	5th Jan
6	Pariyaram	08.01.93	29.01.94	13.01.95	-	18.02.97	17.01.98	22.01.99	23rd Jan
7	Puttur	29.01.93	15.01.94	08.02.95	-	-	-	-	28th Jan
8	Vengurla	-	-	-	-	05.02.97	24.01.98	-	30th Jan
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	18.02.97	20.02.98	-	19th Feb
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

4b. Mean harvest (25%) of Ank-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	28.11.92	28.11.93	-	-	20.01.97	05.01.98	20.01.99	27th Dec
2	Madakkathara	09.01.93	31.12.93	-	-	20.12.96	24.12.97	22.01.99	3rd Jan
3	Anakkayam	25.01.93	15.01.94	-	-	25.01.97	16.01.98	05.02.99	23rd Jan
4	Ambalavayal	-	24.02.94	-	-	09.03.97	28.02.98	05.03.99	3rd Mar
5	Pilicode	13.01.93	06.01.94	27.12.94	10.01.96	06.02.97	23.01.98	03.02.99	17th Jan
6	Pariyaram	17.01.93	08.02.94	18.01.95	-	22.02.97	27.01.98	31.01.99	31st Jan
7	Puttur	12.02.93	10.02.94	28.02.95	-	-	-	-	17th Feb
8	Vengurla	-	-	-	-	10.02.97	02.02.98	-	6th Feb
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	28.03.97	30.03.98	-	29th Mar
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

4c. Mean harvest (50%) of Ank-1 at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	14.12.92	12.12.93	-	-	27.01.97	16.01.98	31.01.99	8th Jan
2	Madakkathara	14.01.93	08.01.94	-	-	30.12.96	30.12.97	28.01.99	10th Jan
3	Anakkayam	18.02.93	14.02.94	-	-	16.02.97	25.01.98	11.02.99	11th Feb
4	Ambalavayal	-	10.03.94	-	-	18.03.97	13.03.98	12.03.99	13th Mar
5	Pilicode	25.01.93	10.01.94	05.01.95	25.01.96	13.02.97	04.02.98	07.02.99	26th Jan
6	Pariyaram	25.01.93	15.02.94	25.01.95	-	27.02.97	06.02.98	18.02.99	9th Feb
7	Puttur	24.02.93	28.02.94	07.03.95	-	-	-	-	1st Mar
8	Vengurla	-	-	-	-	19.02.97	23.02.98	-	21st Feb
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	25.05.97	27.05.98	-	26th May
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

4d. Mean harvest (75%) of Ank-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	30.12.92	28.12.93	-	-	04.02.97	21.01.98	10.02.99	19th Jan
2	Madakkathara	18.01.93	25.01.94	-	-	25.01.97	10.02.98	06.02.99	29th Jan
3	Anakkayam	28.02.93	21.02.94	-	-	28.02.97	10.02.98	23.02.99	22nd Feb
4	Ambalavayal	-	28.03.94	-	-	26.03.97	23.03.98	18.03.98	24th Mar
5	Pilicode	10.02.93	15.01.94	15.01.95	15.02.96	22.02.97	15.02.98	16.02.99	7th Feb
6	Pariyaram	08.02.93	22.02.94	31.01.95	-	10.03.97	18.02.98	28.02.99	19th Feb
7	Puttur	18.03.93	10.03.94	18.03.95	-	-	-	-	15th Mar
8	Vengurla	-	-	-	-	28.02.97	28.02.98	-	28th Feb
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	30.05.97	03.06.98	-	1st June
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

4e. Mean harvest (100%) of Ank-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	02.01.93	20.01.94	-	-	09.02.97	26.01.98	18.02.99	27th Jan
2	Madakkathara	21.01.93	06.02.94	-	-	28.02.97	28.01.98	21.02.99	8th Feb
3	Anakkayam	03.03.93	26.02.94	-	-	12.03.97	20.02.98	02.03.99	1st Mar
4	Ambalavayal	-	12.04.94	-	-	02.04.97	03.04.98	10.04.99	7th Apr
5	Pilicode	18.02.93	20.01.94	25.01.95	08.03.96	05.03.97	23.02.98	24.02.99	17th Feb
6	Pariyaram	25.02.93	28.02.94	06.02.95	-	20.03.97	02.03.98	06.03.99	1st Mar
7	Puttur	26.03.93	09.04.94	02.04.95	-	-	-	-	2nd Apr
8	Vengurla	-	-	-	-	12.03.97	02.03.98		7th Mar
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	10.06.97	12.06.98	-	11th June
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

11.2.5.5 Bud break of Mdk-1 (BLA-39-4)

5a. Mean bud break (<25%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	20.09.92	02.10.93	-	-	24.09.96	26.09.97	04.10.98	27th Sep
2	Madakkathara	02.10.92	06.10.93	-	-	30.10.96	20.09.97	26.10.98	11th Oct
3	Anakkayam	08.11.92	24.09.93	-	-	03.10.96	07.11.97	10.11.98	23rd Oct
4	Ambalavayal	-	04.10.93	-	-	10.10.96	20.10.97	26.10.98	15th Oct
5	Pilicode	24.09.92	02.09.93	28.09.94	16.09.95	28.10.96	19.09.97	29.10.98	29th Sep
6	Pariyaram	28.09.92	10.11.93	16.10.94	-	28.11.96	20.11.97	26.11.98	6th Nov
7	Puttur	01.11.92	17.10.93	24.10.94	-	-	-	-	24th Oct
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	24.10.96	07.01.98	18.12.98	6th Dec
12	Bapatla	-	-	-	-	22.12.96	09.01.98	26.12.98	29th Dec
13	Jhargram	-	-	-	-	-	-	02.01.99	2nd Jan

5b. Mean bud break (25%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	30.09.92	06.10.93	-	-	30.09.96	30.09.97	09.10.98	3rd Oct
2	Madakkathara	07.10.92	09.10.93	-	-	08.11.96	28.09.97	31.10.98	17th Oct
3	Anakkayam	16.11.92	30.09.93	-	-	16.10.96	10.11.97	16.11.98	30th Oct
4	Ambalavayal	-	10.10.93	-	-	15.10.96	23.10.97	04.11.98	21st Oct
5	Pilicode	30.09.92	11.09.93	07.10.94	22.09.95	02.11.96	03.10.97	03.11.98	7th Oct
6	Pariyaram	03.10.92	13.11.93	20.10.94	-	03.12.96	27.11.97	30.11.98	11th Nov
7	Puttur	06.11.92	22.10.93	30.10.94	-	-	-	-	30th Oct
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	19.11.96	20.01.98	24.12.98	21st Dec
12	Bapatla	-	-	-	-	24.12.96	13.01.98	01.01.99	2nd Jan
13	Jhargram	-	-	-	-	-	-	16.01.99	16th Jan

5c. Mean bud break (50%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	09.10.92	09.10.93	-	-	07.10.96	02.10.97	13.10.98	8th Oct
2	Madakkathara	12.10.92	13.10.93	-	-	14.11.96	19.10.97	04.11.98	25th Oct
3	Anakkayam	20.11.92	09.10.93	-	-	21.11.96	14.11.97	22.11.98	11th Nov
4	Ambalavayal	-	16.10.93	-	-	20.10.96	26.10.97	11.11.98	26th Oct
5	Pilicode	05.10.92	20.09.93	14.10.94	28.09.95	05.11.96	17.10.97	10.11.98	14th Oct
6	Pariyaram	07.10.92	17.11.93	28.10.94	-	07.12.96	04.12.97	04.12.98	16th Nov
7	Puttur	10.11.92	25.10.93	06.11.94	-	-	-	-	3rd Nov
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	19.01.97	03.02.98	28.12.98	17th Jan
12	Bapatla	-	-	-	-	29.12.96	22.01.98	03.01.99	8th Jan
13	Jhargram	-	-	-	-	-	-	23.01.99	23rd Jan

5d. Mean bud break (75%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	18.10.92	12.10.93	-	-	14.10.96	10.10.97	19.10.98	15th Oct
2	Madakkathara	16.10.92	18.10.93	-	-	19.11.96	26.10.97	08.11.98	30th Oct
3	Anakkayam	24.11.92	25.10.93	-	-	27.11.96	17.11.97	26.11.98	18th Nov
4	Ambalavayal	-	21.10.93	-	-	24.10.96	29.10.97	17.11.98	31st Oct
5	Pilicode	17.10.92	27.09.93	19.10.94	18.10.95	09.11.96	21.10.97	14.11.98	22nd Oct
6	Pariyaram	28.10.92	19.11.93	02.11.94	-	11.12.96	09.12.97	06.12.98	22nd Nov
7	Puttur	13.11.92	28.10.93	11.11.94	-	-	-	-	7th Nov
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	28.01.97	18.02.98	31.12.98	26th Jan
12	Bapatla	-	-	-	-	02.01.97	26.01.98	06.01.99	11th Jan
13	Jhargram	-	-	-	-	-	-	05.02.99	5th Feb

5e. Mean bud break (100%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	30.10.92	14.10.93	-	-	21.10.96	16.10.97	24.10.98	21st Oct
2	Madakkathara	19.10.92	23.10.93	-	-	22.11.96	30.10.97	12.11.98	3rd Nov
3	Anakkayam	28.11.92	31.10.93	-	-	01.12.96	20.11.97	30.11.98	22nd Nov
4	Ambalavayal	-	28.10.93	-	-	28.10.96	03.11.97	25.11.98	6th Nov
5	Pilicode	19.10.92	03.10.93	23.10.94	28.10.95	13.11.96	28.10.97	18.11.98	28th Oct
6	Pariyaram	13.11.92	23.11.93	06.11.94	-	16.12.96	15.12.97	08.12.98	29th Nov
7	Puttur	15.11.92	31.10.93	15.11.94	-	-	-	-	10th Nov
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	05.02.97	20.02.98	03.01.99	30th Jan
12	Bapatla	-	-	-	-	09.01.97	03.02.98	08.01.99	17th Jan
13	Jhargram	-	-	-	-	-	-	14.02.99	14th Feb

11.2.5.6 Flushing of Mdk-1 (BLA-39-4)

6a. Mean flushing (<25%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	04.10.92	08.10.93	-	-	30.09.96	04.10.97	16.10.98	6th Oct
2	Madakkathara	07.10.92	11.10.93	-	-	04.11.96	06.10.97	06.11.98	19th Oct
3	Anakkayam	15.11.92	30.09.93	-	-	18.11.96	22.11.97	26.11.98	10th Nov
4	Ambalavayal	-	23.10 93	-	-	21.10.96	30.10.97	20.11.98	31st Oct
5	Pilicode	06.10.92	24.09.93	18.10.94	25.09.95	04.11.96	03.10.97	11.11.98	13th Oct
6	Pariyaram	04.11.92	15.11.93	04.11.94	-	10.12.96	11.12.97	07.12.98	24th Nov
7	Puttur	14.11.92	25.10.93	01.11.94	-	-	-	-	3rd Nov.
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	29.10.96	27.01.98	27.12.98	18th Dec
12	Bapatla	-	-	-	-	04.01.97	19.01.98	04.01.99	9th Jan
13	Jhargram	-	-	-	-	-	-	09.01.99	9th Jan

6b. Mean flushing (25%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	11.10.92	10.10.93	-	-	06.10.96	07.10.97	20.10.98	11th Oct
2	Madakkathara	17.10.92	15.10.93	-	-	08.11.96	08.10.97	09.11.98	24th Oct
3	Anakkayam	20.11.92	09.10.93	-	-	30.11.96	25.11.97	05.12.98	18th Nov
4	Ambalavayal	-	28.10.93	-	-	27.10.96	04.11.97	25.11.98	6th Nov
5	Pilicode	14.10.92	29.09.93	25.10.94	08.10.95	07.11.96	10.10.97	14.11.98	20th Oct
6	Pariyaram	07.11.92	21.11.93	09.11.94	-	13.12.96	19.12.97	10.12.98	28th Nov
7	Puttur	18.11.92	28.10.93	06.11.94	-	-	-	-	7th Nov
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	26.11.96	18.02.98	30.12.98	4th Jan
12	Bapatla	-	-	-	-	08.01.97	23.01.98	08.01.99	13th Jan
13	Jhargram	-	-	-	-	-	-	21.01.99	21st Jan

6c. Mean flushing (50%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	21.10.92	13.10.93	-	-	13.10.96	10.10.97	27.10.98	17th Oct
2	Madakkathara	25.10.92	21.10.93	-	-	14.11.96	10.10.97	12.11.98	29th Oct
3	Anakkayam	26.11.92	23.10.93	-	-	12.12.96	01.12.97	12.12.98	27th Nov
4	Ambalavayal	-	1.11.93	-	-	06.11.96	08.11.97	29.11.98	11th Nov
5	Pilicode	21.10.92	4.10.93	31.10.94	18.10.95	11.11.96	18.10.97	18.11.98	26th Oct
6	Pariyaram	12.11.92	27.11.93	16.10.94	-	16.12.96	28.12.97	16.12.98	29th Nov
7	Puttur	24.11.92	29.10.93	12.11.94	-	-	-	-	11th Nov
8	Vengurla		-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	28.01.97	08.02.98	-	3rd Feb
12	Bapatla	-	-	-	-	12.1.97	30.1.98	11.01.99	18th Jan
13	Jhargram	-	-	-	-	-	-	28.01.99	28th Jan

6d. Mean flushing (75%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	29.10.92	17.10.93	-	-	18.10.96	16.10.97	05.11.98	23rd Oct
2	Madakkathara	04.11.92	04.11.93	-	-	19.11.96	14.10.97	18.11.98	6th Nov
3	Anakkayam	02.12.93	01.11.93	-	-	19.12.96	05.12.97	20.12.98	3rd Dec
4	Ambalavayal	-	05.11.93	-	-	15.11.96	14.11.97	03.12.98	17th Nov
5	Pilicode	26.10.92	08.10.93	18.11.94	29.10.95	17.11.96	30.10.97	20.11.98	3rd Nov
6	Pariyaram	18.11.92	01.12.93	20.11.94	-	20.12.96	03.01.98	19.12.98	9th Dec
7	Puttur	27.11.92	06.11.93	16.11.94	-	-	-	-	16th Nov
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	10.02.97	14.02.98	06.01.99	31st Jan
12	Bapatla	-	-	-	-	17.01.97	05.02.98	14.01.99	22nd Jan
13	Jhargram	-	-	-	-	-	-	08.02.99	8th Feb

6e. Mean flushing (100%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	06.11.92	20.10.93	-	-	25.10.96	23.10.97	12.11.98	30th Oct
2	Madakkathara	10.12.92	10.11.93	-	-	22.11.96	02.11.97	24.11.98	20th Nov
3	Anakkayam	07.12.92	10.11.93	-	-	24.12.96	13.12.97	28.12.98	10th Dec
4	Ambalavayal	-	10.11.93	-	-	24.11.96	22.11.97	07.12.98	23rd Nov
5	Pilicode	02.11.92	14.10.93	05.12.94	12.11.95	22.11.96	13.11.97	28.11.98	14th Nov
6	Pariyaram	20.11.92	07.12.93	25.11.94	-	25.12.96	12.01.98	22.12.98	14th Dec
7	Puttur	30.10.92	08.11.93	22.11.94	-	-	-	-	10th Nov
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	15.02.97	20.02.98	14.01.99	6th Feb
12	Bapatla	-	-	-	-	20.01.97	10.02.98	17.01.99	26th Jan
13	Jhargram	-	-	-	-	-	-	14.02.99	14th Feb

11.2.5.7 Flowering of Mdk-1 (BLA-39-4)

7a. Mean flowering (<25%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	23.10.92	22.10.93	-	-	25.10.96	20.10.97	03.11.98	25th Oct
2	Madakkathara	16.10.92	28.10.93	-	-	14.11.96	18.10.97	20.11.98	1st Nov
3	Anakkayam	24.11.92	01.11.93	-	-	05.12.96	02.12.97	16.12.98	28th Nov
4	Ambalavayal	-	23.11.93	-	-	20.11.96	13.01.98	02.12.98	7th Dec
5	Pilicode	20.10.92	02.11.93	09.11.94	16.10.95	21.11.96	02.11.97	20.11.98	4th Nov
6	Pariyaram	09.12.92	12.12.93	26.11.94	-	25.12.96	03.01.98	17.12.98	16th Dec
7	Puttur	26.11.92	01.11.93	08.11.94	-	-	-	-	12th Nov
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	08.11.96	07.03.98	06.01.99	6th Jan
12	Bapatla	-	-	-	-	16.01.97	02.02.98	22.01.99	24th Jan
13	Jhargram	-	-	-	-	-	-	09.02.99	9th Feb

7b. Mean flowering (25%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	30.10.92	26.10.93	-	-	30.10.96	04.11.97	12.11.98	2nd Nov
2	Madakkathara	25.10.92	10.11.93	-	-	19.11.96	28.10.97	25.11.98	9th Nov
3	Anakkayam	29.11.92	06.11.93	-	-	08.12.96	05.12.97	21.12.98	2nd Dec
4	Ambalavayal	-	04.12.93	-	-	05.02.97	22.01.98	07.12.98	2nd Jan
5	Pilicode	30.10.92	16.11.93	26.11.94	22.10.95	29.11.96	17.11.97	07.12.98	16th Nov
6	Pariyaram	16.12.92	18.12.93	18.12.94	-	31.12.96	11.01.98	24.12.98	25th Dec
7	Puttur	30.11.92	06.11.93	15.11.94	-	-	-	-	17th Nov
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	26.11.96	15.03.98	-	20th Jan
12	Bapatla	-	-	-	-	21.01.97	08.02.98	30.01.99	30th Jan
13	Jhargram	-	-	-	-	-	-	02.03.99	2nd Mar

7c. Mean flowering (50%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	07.11.92	31.10.93	-	-	10.11.96	18.11.97	26.11.98	12th Nov
2	Madakkathara	01.11.92	20.11.93	-	-	30.11.96	25.11.97	30.11.98	21st Nov
3	Anakkayam	03.12.92	08.11.93	-	-	10.12.96	09.12.97	02.01.99	7th Dec
4	Ambalavayal	-	28.12.94	-	-	20.12.96	29.01.98	21.12.98	1st Jan
5	Pilicode	20.11.92	28.11.93	20.12.94	25.11.95	06.12.96	05.12.97	12.12.98	4th Dec
6	Pariyaram	31.12.92	25.12.93	01.01.95	-	04.01.97	16.01.98	27.12.98	2nd Jan
7	Puttur	06.12.92	13.11.93	20.11.94	-	05.12.96	-	-	26th Nov
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	11.02.97	18.03.98	25.02.99	27th Feb
12	Bapatla	-	-	-	-	24.01.97	13.02.98	06.02.99	4th Feb
13	Jhargram	-	-	-	-	-	-	09.03.99	9th Mar

7d. Mean flowering (75%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	14.11.92	05.11.93	-	-	16.11.96	27.11.97	08.12.98	20th Nov
2	Madakkathara	26.11.92	30.11.93	-	-	05.12.96	29.11.97	14.12.98	3rd Dec
3	Anakkayam	26.12.92	21.11.93	-	-	24.12.96	23.12.97	09.01.99	21st Dec
4	Ambalavayal	-	11.01.94	-	-	15.01.97	03.03.98	30.12.98	22nd Jan
5	Pilicode	04.12.92	13.12.93	06.01.95	06.12.95	10.12.96	26.12.97	19.12.98	16th Dec
6	Pariyaram	25.01.93	02.01.94	28.01.95	-	18.01.97	31.01.98	30.12.98	17th Jan
7	Puttur	11.12.92	18.11.93	26.11.94	-	-	-	-	28th Nov
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	15.02.97	22.03.98	-	5th Mar
12	Bapatla	-	-	-	-	26.01.97	22.02.98	12.02.99	10th Feb
13	Jhargram	-	-	-	-	-	-	19.03.99	19th Mar

7e. Mean flowering (100%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	22.11.92	09.11.93	-	-	24.11.96	06.12.97	16.12.98	27th Nov
2	Madakkathara	22.12.92	11.12.93	-	-	13.12.96	18.12.97	28.12.98	18th Dec
3	Anakkayam	16.01.93	07.12.93	-	-	02.01.97	02.01.98	16.01.99	2nd Jan
4	Ambalavayal	-	29.01.94	-	-	30.01.97	28.03.98	10.01.99	8th Feb
5	Pilicode	19.12.92	22.12.93	29.01.95	26.12.95	15.12.96	31.01.98	26.12.98	2nd Jan
6	Pariyaram	19.02.93	07.01.94	08.02.95	-	10.02.97	15.02.98	31.01.99	5th Feb
7	Puttur	19.12.92	25.11.93	01.12.94	-	-	-	-	5th Dec
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	28.02.97	28.03.98	-	14th Mar
12	Bapatla	-	-	-	-	29.01.97	28.02.98	17.02.99	14th Feb
13	Jhargram	-	-	-	-	-	-	28.03.99	28th Mar

11.2.5.8 Harvest of Mdk-1 (BLA-39-4)

8a. Mean harvest (<25%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	21.11.92	06.01.94	-	-	10.01.97	26.12.97	06.01.99	26th Dec
2	Madakkathara	09.01.93	02.01.94	-	-	20.01.97	28.12.97	14.01.99	8th Jan
3	Anakkayam	14.03.93	30.12.93	-	-	11.03.97	16.03.98	28.02.99	24th Feb
4	Ambalavayal	-	03.03.94	-	-	14.03.97	26.03.98	18.03.99	15th Mar
5	Pilicode	11.12.92	30.12.93	03.01.95	24.12.95	23.01.97	30.12.97	28.01.99	4th Jan
6	Pariyaram	20.01.93	07.02.94	28.01.95	-	28.02.97	04.02.98	26.01.99	3rd Feb
7	Puttur	19.01.93	06.01.94	20.01.95	-	-	-	-	15th Feb
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	08.02.97	18.03.98	-	27th Feb
12	Bapatla	-	-	-	-	06.04.97	28.03.98	26.03.99	30th Mar
13	Jhargram	-	-	-	-	-	-	10.04.99	10th Apr

8b. Mean harvest (25%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	28.11.92	14.01.94	-	-	16.01.97	07.01.98	25.01.99	6th Jan
2	Madakkathara	16.01.93	18.01.94	-	-	26.01.97	02.01.98	21.01.99	17th Jan
3	Anakkayam	20.03.93	20.01.94	-	-	28.03.97	30.03.98	04.03.99	9th Mar
4	Ambalavayal	-	18.03.94	-	-	22.03.97	24.03.98	26.03.99	23rd Mar
5	Pilicode	19.12.92	17.01.94	20.01.95	16.01.96	12.02.97	28.01.98	04.02.99	21st Jan
6	Pariyaram	26.01.93	23.02.94	06.02.95	-	08.03.97	14.02.98	02.02.98	13th Feb
7	Puttur	29.01.93	30.01.94	18.02.95	-	-	-	-	5th Feb
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	18.03.97	18.04.98	-	3rd Apr
12	Bapatla	-	-	-	-	12.04.97	15.04.98	10.04.99	12th Apr
13	Jhargram	-	-	-	-	-	-	20.04.99	20th Apr

8c. Mean harvest (50%) of Mdk-1 at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	14.12.92	20.01.94	-	-	22.01.97	18.01.98	03.02.99	15th Jan
2	Madakkathara	25.01.93	31.01.94	-	-	04.02.97	16.01.98	30.01.99	27th Jan
3	Anakkayam	10.04.93	28.02.94	-	-	12.04.97	02.04.98	23.03.99	28th Mar
4	Ambalavayal	-	23.03.94	-	-	31.03.97	28.03.98	02.04.99	29th Mar
5	Pilicode	25.12.92	28.01.94	31.01.95	05.02.96	26.02.97	20.02.98	14.02.99	4th Feb
6	Pariyaram	30.01.93	01.03.94	27.02.95	-	16.03.97	24.02.98	23.02.99	24th Feb
7	Puttur	12.02.93	25.02.94	13.03.95	-	-	-	-	26th Feb
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	10.04.97	06.05.98	-	23rd Apr
12	Bapatla	-	-	-	-	18.04.97	04.05.98	18.04.99	23rd Apr
13	Jhargram	-	-	-	-	-	-	02.05.99	2nd May

8d. Mean harvest (75%) of Mdk-1 at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	30.12.92	28.02.94	-	-	29.01.97	23.01.98	08.02.99	30th Jan
2	Madakkathara	12.02.93	08.02.94	-	-	28.02.97	24.01.98	08.02.99	10th Feb
3	Anakkayam	20.04.93	28.02.94	-	-	22.04.97	28.04.98	08.04.99	9th Apr
4	Ambalavayal	-	29.03.94	-	-	06.04.97	12.04.98	28.04.99	11th Apr
5	Pilicode	30.12.92	13.02.94	16.02.95	28.02.96	18.03.97	15.03.98	22.02.99	19th Feb
6	Pariyaram	21.02.93	17.03.94	04.03.95	-	24.03.97	10.03.98	08.03.99	9th Mar
7	Puttur	20.02.93	12.12.93	28.03.95	-	-	-	-	9th Feb
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	26.04.97	02.05.98	06.05.99*	1st May
12	Bapatla	-	-	-	-	22.04.97	07.05.98	06.05.99*	2nd May
13	Jhargram	-	-	-	-	-	-	16.05.99*	16th May

* Estimated based on time of flowering

8e. Mean harvest (100%) of Mdk-1 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	07.01.93	06.02.94	-	-	07.02.97	28.01.98	20.02.99	1st Feb
2	Madakkathara	23.02.93	15.02.94	-	-	12.03.97	30.01.98	16.02.99	19th Feb
3	Anakkayam	28.04.93	18.03.94	-	-	05.05.97	16.05.98	18.05.99	29th Apr
4	Ambalavayal	-	11.04.94	-	-	12.04.97	26.04.98	16.05.99	24th Apr
5	Pilicode	06.01.93	22.02.94	28.02.95	26.03.96	25.03.97	06.04.98	28.02.99	4th Mar
6	Pariyaram	07.03.93	26.03.94	28.03.95	-	30.03.97	20.03.98	22.03.99	22nd Mar
7	Puttur	09.03.93	15.04.94	13.04.95	-	-	-	-	2nd Apr
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	-	-	-	-
11	Bhubaneswar	-	-	-	-	10.05.97	26.05.98	24.05.99*	22nd May
12	Bapatla	-	-	-	-	30.04.97	11.05.98	10.05.99*	7th May
13	Jhargram	-	-	-	-	-	-	23.05.99*	23rd May

* Estimated based on flowering

11.2.5.9 Bud break of Mdk-2 (NDR-2-1)

9a. Mean bud break (<25%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	07.11.96	06.11.97	10.11.98	8th Nov
2	Madakkathara	04.11.92	13.10.93	-	-	11.11.96	31.10.97	18.11.98	3rd Nov
3	Anakkayam	06.11.92	20.12.93	-	-	-	-	-	28th Nov
4	Ambalavayal	-	01.11.93	-	-	10.11.96	18.12.97	25.11.98	21st Nov
5	Pilicode	16.09.92	04.09.93	21.10.94	18.10.95	13.11.96	10.12.97	13.11.98	23rd Oct
6	Pariyaram	07.12.92	29.12.93	09.12.94	-	16.12.96	-	-	15th Dec
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	15.12.96	-	-	15th Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

9b. Mean bud break (25%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	14.11.96	14.11.97	16.11.98	15th Nov
2	Madakkathara	09.11.92	18.10.93	-	-	16.11.96	06.11.97	23.11.98	8th Nov
3	Anakkayam	20.11.92	28.12.93	-	-	-	-	-	4th Dec
4	Ambalavayal	-	06.11.93	-	-	15.11.96	24.12.97	30.11.98	26th Nov
5	Pilicode	26.09.92	09.09.93	25.10.94	28.10.95	19.11.96	16.12.97	17.11.98	29th Oct
6	Pariyaram	20.12.92	05.01.94	17.12.94	-	21.12.96	-	-	24th Dec
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	20.12.96	-	-	20th Dec
11	Bhubaneswar	-	-	-	-		-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

9c. Mean bud break (50%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	22.11.96	17.11.97	22.11.98	20th Nov
2	Madakkathara	14.11.92	25.10.93	-	-	22.11.96	10.11.97	29.11.98	14th Nov
3	Anakkayam	12.11.92	10.01.94	-	-	-	-	-	12th Dec
4	Ambalavayal	-	11.11.93	-	-	22.11.96	28.12.97	07.12.98	2nd Dec
5	Pilicode	06.10.92	14.09.93	29.10.94	20.11.95	25.11.96	27.12.97	20.11.98	7th Nov
6	Pariyaram	30.12.92	12.01.94	22.12.94	-	25.12.96	-	-	30th Dec
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	30.12.96	-	-	30th Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

9d. Mean bud break (75%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara			-	-	28.11.96	20.11.97	26.11.98	25th Nov
2	Madakkathara	18.11.92	02.11.93	-	-	26.11.96	15.11.97	06.12.98	19th Nov
3	Anakkayam	18.11.92	15.01.94	-	-	-	-	-	17th Dec
4	Ambalavayal	-	15.11.93	-	-	26.11.96	05.01.98	16.12.98	8th Dec
5	Pilicode	15.10.92	18.09.93	01.11.94	06.12.95	29.11.96	03.01.98	26.11.98	14th Nov
6	Pariyaram	11.01.93	18.01.94	28.12.94	-	02.01.97	-	-	7th Jan
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	10.01.97	-	-	10th Jan
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

9e. Mean bud break (100%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	06.12.96	25.11.97	30.11.98	30th Nov
2	Madakkathara	21.11.92	07.11.93	-	-	06.12.96	01.12.97	10.12.98	27th Nov
3	Anakkayam	22.11.92	18.01.94	-	-	-	-	-	21st Dec
4	Ambalavayal	-	20.11.93	-	-	30.11.96	13.01.98	21.12.98	14th Dec
5	Pilicode	21.10.92	24.09.93	04.11.94	18.12.95	02.12.96	09.01.98	08.12.98	21st Nov
6	Pariyaram	23.01.93	25.01.94	04.01.95	-	09.01.97	-	-	15th Jan
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	15.01.97	-	-	15th Jan
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

11.2.5.10 Flushing of Mdk-2 (NDR-2-1)

10a. Mean flushing (<25%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	16.11.96	14.11.97	25.11.98	18th Nov
2	Madakkathara	08.11.92	25.10.93	-	-	16.11.96	13.11.97	28.11.98	12th Nov
3	Anakkayam	12.11.92	08.01.94	-	-	-	-	-	11th Dec
4	Ambalavayal	-	17.11.93	-	-	23.11.96	28.12.97	16.12.98	6th Dec
5	Pilicode	14.10.92	25.09.93	27.10.94	30.10.95	23.11.96	26.12.97	26.11.98	7th Nov
6	Pariyaram	04.01.93	27.01.94	16.12.94	-	28.12.96	-	-	3rd Jan
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	19.12.96	-	-	19th Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

10b. Mean flushing (25%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-		-	-	27.11.96	18.11.97	28.11.98	24th Nov
2	Madakkathara	15.12.92	28.10.93	-	-	22.11.96	20.11.97	06.12.98	24th Nov
3	Anakkayam	18.11.92	16.01.94	-	-	-	-	-	18th Dec
4	Ambalavayal	-	28.11.93	-	-	08.12.96	04.01.98	27.12.99	17th Dec
5	Pilicode	21.10.92	03.10.93	31.10.94	12.11.95	30.11.96	02.01.98	29.11.98	14th Nov
6	Pariyaram	09.01.93	31.01.94	22.12.94	-	04.01.97	-	-	9th Jan
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	25.12.96	-	-	25th Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

10c. Mean flushing (50%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	30.11.96	21.11.97	04.12.98	28th Nov
2	Madakkathara	23.12.92	8.12.93	-	-	30.11.96	28.11.97	14.12.98	9th Dec
3	Anakkayam	28.11.92	20.01.94	-	-	-	-	-	25th Dec
4	Ambalavayal	-	5.12.93	-	-	23.12.96	13.01.98	07.01.99	28th Dec
5	Pilicode	10.11.92	9.10.93	5.11.94	28.11.95	05.12.96	08.01.97	05.12.98	23rd Nov
6	Pariyaram	18.01.93	6.2.94	31.12.94	-	09.01.97	-	-	16th Jan
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	31.12.96	-	-	31st Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

10d. Mean flushing (75%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	11.12.96	09.12.97	10.12.98	10th Dec
2	Madakkathara	16.01.93	18.12.93	-	-	08.12.96	05.12.97	23.12.98	20th Dec
3	Anakkayam	04.12.92	24.01.94	-	-	-	-	-	30th Dec
4	Ambalavayal	-	18.12.93	-	-	08.01.97	25.01.98	21.01.99	10th Jan
5	Pilicode	18.11.92	14.10.93	08.11.94	08.12.95	08.12.96	12.01.98	08.12.98	28th Nov
6	Pariyaram	24.01.93	09.02.94	07.01.95	-	18.01.97	-	-	22nd Jan
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	18.01.97	-	-	18th Jan
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

10e. Mean flushing (100%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	22.12.96	18.12.97	17.12.98	19th Dec
2	Madakkathara	27.01.93	30.12.93	-	-	15.12.96	11.12.97	06.01.99	30th Dec
3	Anakkayam	10.12.92	28.01.94	-	-	-	-	-	4th Jan
4	Ambalavayal	-	03.01.94	-	-	23.01.97	06.02.98	28.01.99	23rd Jan
5	Pilicode	29.11.92	19.10.93	10.11.94	26.12.95	10.12.96	17.01.98	13.12.98	5th Dec
6	Pariyaram	31.01.93	12.02.94	14.01.95	-	28.01.97	-	-	29th Jan
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	25.01.97	-	-	25th Jan
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

11.2.5.11 Flowering of Mdk-2 (NDR-2-1)

11a. Mean flowering (<25%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	20.11.96	16.11.97	14.12.98	27th Nov
2	Madakkathara	23.11.92	07.12.93	-	-	12.12.96	23.12.97	26.12.98	12th Dec
3	Anakkayam	28.12.92	20.01.94	-	-	-	-	-	9th Jan
4	Ambalavayal	-	04.01.94	-	-	21.01.97	29.01.98	29.12.98	13th Jan
5	Pilicode	10.01.93	11.11.93	11.11.94	12.11.95	02.12.96	07.01.98	03.12.98	4th Dec
6	Pariyaram	20.01.93	12.02.94	07.01.95	-	22.01.97	-	-	23rd Jan
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	28.12.96	-	-	28th Dec
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

11b. Mean flowering (25%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara			-	-	28.11.96	20.11.97	20.12.98	3rd Dec
2	Madakkathara	29.11.92	25.12.93	-	-	16.12.96	28.12.97	08.01.99	21st Dec
3	Anakkayam	04.01.93	28.01.94	-	-	-	-	-	16th Jan
4	Ambalavayal	-	22.01.94	-	-	29.01.97	08.02.98	08.01.99	25th Jan
5	Pilicode	21.01.93	19.11.93	25.12.94	26.11.95	13.12.96	23.01.98	15.12.98	21st Dec
6	Pariyaram	26.01.93	21.02.94	15.02.94	-	04.02.97	-	-	9th Feb
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	12.01.97	-	-	12th Jan
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

11c. Mean flowering (50%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	12.12.96	27.11.97	30.12.98	13th Dec
2	Madakkathara	07.01.93	02.01.94	-	-	20.12.96	03.01.98	18.01.99	4th Jan
3	Anakkayam	08.01.93	31.01.94	-	-	-	-	-	20th Jan
4	Ambalavayal	-	08.02.94	-	-	07.02.97	16.02.98	16.01.99	4th Feb
5	Pilicode	04.02.93	30.11.93	05.01.95	22.12.95	25.12.96	02.02.98	21.12.98	2nd Jan
6	Pariyaram	02.02.93	02.03.94	06.02.95	-	19.02.97	-	-	14th Feb
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	27.01.97	29.01.98	28.01.99	28th Jan
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

11d. Mean flowering (75%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	18.12.96	19.12.97	06.01.99	25th Dec
2	Madakkathara	26.01.93	15.01.94	-	-	30.12.96	10.01.98	24.01.99	15th Jan
3	Anakkayam	20.01.93	08.02.94	-	-	-	-	-	30th Jan
4	Ambalavayal	-	02.03.94	-	-	28.02.97	28.02.98	28.01.99	21st Feb
5	Pilicode	18.02.93	17.12.93	20.01.95	10.01.96	08.01.97	28.02.98	13.01.99	21st Jan
6	Pariyaram	15.03.93	16.03.94	18.02.95	-	22.02.97	-	-	4th Mar
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	16.02.97	-	-	16th Feb
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

11e. Mean flowering (100%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	28.12.96	25.12.97	18.01.99	3rd Jan
2	Madakkathara	09.02.93	22.01.94	-	-	11.01.97	18.01.98	30.01.99	24th Jan
3	Anakkayam	28.01.93	14.02.94	-	-	-	-	-	6th Feb
4	Ambalavayal	-	21.03.94	-	-	22.03.97	18.03.98	31.01.99	8th Mar
5	Pilicode	24.02.93	28.12.93	09.02.95	16.02.96	14.01.97	23.03.98	26.01.99	6th Feb
6	Pariyaram	06.04.93	23.03.94	05.03.95	-	26.02.97	-	-	16th Mar
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	28.02.97	-	-	28th Feb
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

11.2.5.12 Harvest of Mdk-2 (NDR-2-1)

12a. Mean harvest (<25%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	16.01.97	20.01.98	04.02.99	24th Jan
2	Madakkathara	14.03.93	20.02.94	-	-	20.03.97	02.02.98	16.02.99	26th Feb
3	Anakkayam	28.03.93	02.04.94	-	-	-	-	-	31st Mar
4	Ambalavayal	-	30.04.94	-	-	18.05.97	10.05.98	16.05.99	11th May
5	Pilicode	08.02.93	10.02.94	20.01.95	12.02.96	01.03.97	24.03.98	22.02.99	17th Feb
6	Pariyaram	07.04.93	27.04.94	07.04.95	-	08.04.97	-	-	12th Apr
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	20.04.97	-	-	20th Apr
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	08.01.99	8th Jan

12b. Mean harvest (25%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	18.02.97	10.02.98	18.02.99	15th Feb
2	Madakkathara	28.03.93	27.02.94	-	-	10.04.97	28.04.98	16.03.99	29th Mar
3	Anakkayam	05.04.93	18.04.94	-	-	-	-	-	12th Apr
4	Ambalavayal	-	12.05.94	-	-	28.05.97	28.05.98	26.05.99	24th May
5	Pilicode	20.02.93	16.02.94	20.02.95	18.03.96	12.03.97	08.04.98	02.03.99	6th Mar
6	Pariyaram	16.04.93	03.05.94	12.04.95	-	12.04.97	-	-	18th Apr
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	30.04.97	-	-	30th Apr
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

12c. Mean harvest (50%) of Mdk-2 at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	22.03.97	18.02.98	10.03.99	7th Mar
2	Madakkathara	09.04.93	03.03.94	-	-	26.04.97	12.05.98	28.03.99	9th Apr
3	Anakkayam	19.04.93	28.04.94	-	-	-	-	-	24th Apr
4	Ambalavayal	-	25.05.94	-	-	10.06.97	05.06.98	03.06.99	3rd June
5	Pilicode	05.03.93	22.02.94	13.03.95	08.04.96	19.03.97	20.04.98	19.03.99	20th Mar
6	Pariyaram	22.04.93	15.05.94	19.04.95	-	16.04.97	-	-	26th Apr
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	20.05.97	-	-	20th May
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

12d. Mean harvest (75%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	30.03.97	15.03.98	19.03.99	21st Mar
2	Madakkathara	19.04.93	13.03.94	-	-	30.04.97	19.05.98	12.04.99	18th Apr
3	Anakkayam	29.04.93	02.05.94	-	-	-	-	-	1st May
4	Ambalavayal	-	04.06.94	-	-	18.06.97	10.06.98	11.06.99	11th June
5	Pilicode	18.03.93	18.03.94	18.04.95	28.04.96	06.04.97	28.04.98	25.03.99	7th Apr
6	Pariyaram	28.04.93	21.05.94	24.04.95	-	28.04.97	-	-	3rd May
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	31.05.97	-	-	31st May
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

12e. Mean harvest (100%) of Mdk-2 at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	16.04.97	06.04.98	04.04.99	9th Apr
2	Madakkathara	02.05.93	20.03.94	-	-	05.05.97	28.05.98	06.05.99	30th Apr
3	Anakkayam	05.05.93	18.05.94	-	-	-	-	-	12th May
4	Ambalavayal	-	17.06.94	-		25.06.97	18.06.98	20.06.99	20th June
5	Pilicode	25.03.93	12.04.94	03.05.95	02.05.96	17.04.97	18.05.98	31.03.99	19th Apr
6	Pariyaram	07.05.93	02.06.94	29.04.95	-	02.05.97	-	-	10th May
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	-	-	-	-
10	Chintamani	-	-	-	-	18.06.97	-	-	18th June
11	Bhubaneswar	-	-	-	-	-	-	-	-
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	-	-

11.2.5.13 Bud break of Kanaka (H-1598)

13a. Mean bud break (<25%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	-	07.10.97	10.10.98	9th Oct
2	Madakkathara	-	-	-	-	30.10.96	24.09.97	29.10.98	18th Oct
3	Anakkayam	-	-	-	-	25.09.96	15.09.97	06.11.98	6th Oct
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	11.11.96	20.10.97	11.11.98	4th Nov
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	18.12.96	20.12.97	-	19th Dec
10	Chintamani	-	-	-	-	29.11.96	-	-	29th Nov
11	Bhubaneswar	-	-	-	-	03.11.96	05.12.97	16.12.98	28th Nov
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	25.12.98	25th Dec

13b. Mean bud break (25%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	-	10.10.97	15.10.99	13th Oct
2	Madakkathara	-	-	-	-	02.11.96	02.10.97	06.11.98	24th Oct
3	Anakkayam	-	-	-	-	10.10.96	02.10.97	13.11.98	19th Oct
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	14.11.96	30.10.97	15.11.98	9th Nov
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	28.12.96	29.12.97	-	29th Dec
10	Chintamani	-	-	-	-	06.12.96	-	-	6th Dec
11	Bhubaneswar	-	-	-	-	08.11.96	14.12.97	23.12.98	5th Dec
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	13.01.99	13th Jan

13c. Mean bud break (50%) of Kanaka at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	-	15.10.97	-	15th Oct
2	Madakkathara	-	-	-	-	05.11.96	10.10.97	13.11.98	30th Oct
3	Anakkayam	-	-	-	-	28.11.96	18.10.97	19.11.98	11th Nov
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	17.11.96	10.11.97	19.11.98	15th Nov
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	20.01.97	25.01.98	-	23rd Jan
10	Chintamani	-	-	-	-	12.12.96	-	-	12th Dec
11	Bhubaneswar	-	-	-	-	30.12.96	28.02.98	-	29th Jan
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-		-	28.01.99	28th Jan

13d. Mean bud break (75%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	-	25.10.97	28.10.98	27th Oct
2	Madakkathara	-	-	-	-	08.11.96	14.10.97	19.11.98	3rd Nov
3	Anakkayam	-	-	-	-	06.12.96	24.10.97	28.11.98	19th Nov
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	21.11.96	18.11.97	22.11.98	20th Nov
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	02.02.97	06.02.98	-	4th Feb
10	Chintamani	-	-	-	-	20.12.96	-	-	20th Dec
11	Bhubaneswar	-	-	-	-	20.01.97	08.02.98	06.01.99	22nd Jan
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	02.02.99	2nd Feb

13e. Mean bud break (100%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	-	03.11.97	06.11.98	5th Nov
2	Madakkathara	-	-	-	-	19.11.97	22.10.97	24.11.98	11th Nov
3	Anakkayam	-	-	-	-	12.12.96	06.11.97	06.1298	28th Nov
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	25.11.96	29.11.97	26.11.98	27th Nov
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	15.02.97	17.02.98	-	16th Feb
10	Chintamani	-	-	-	-	29.12.96	-	-	29th Dec
11	Bhubaneswar	-	-	-	-	10.02.97	15.02.98	12.01.99	2nd Feb
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	16.02.99	16th Feb

11.2.5.14 Flushing of Kanaka (H-1598)

14a. Mean flushing (<25%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	-	31.10.97	26.10.98	29th Oct
2	Madakkathara	-	-	-	-	05.11.96	12.10.97	16.11.98	1st Nov
3	Anakkayam	-	-	-	-	05.12.96	27.09.97	03.12.98	11th Nov
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	19.11.96	23.11.97	16.11.98	19th Nov
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	22.12.96	31.12.97	-	27th Dec
10	Chintamani	-	-	-	-	02.12.96	-	-	2nd Dec
11	Bhubaneswar	-	-	-	-	09.11.96	12.12.97	27.12.98	6th Dec
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	08.01.99	8th Jan

14b. Mean flushing (25%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	-	05.11.97	08.11.98	7th Nov
2	Madakkathara	-	-	-	-	08.11.96	16.10.97	20.11.98	4th Nov
3	Anakkayam	-	-	-	-	11.12.96	22.10.97	10.12.98	24th Nov
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	22.11.96	26.11.97	18.11.98	22nd Nov
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	20.01.97	20.02.98	-	5th Feb
10	Chintamani	-	-	-	-	09.12.96	-	-	9th Dec
11	Bhubaneswar	-	-	-	-	19.11.96	20.12.97	06.01.99	15th Dec
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	19.01.99	19th Jan

14c. Mean flushing (50%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	-	10.11.97	13.11.98	12th Nov
2	Madakkathara	-	-	-	-	16.11.96	25.10.97	29.11.98	13th Nov
3	Anakkayam	-	-	-	-	22.12.96	06.11.97	18.12.98	5th Dec
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	26.11.96	28.11.97	20.01.99	15th Dec
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	01.02.97	03.03.98	-	16th Feb
10	Chintamani	-	-	-	-	18.12.96	-	-	18th Dec
11	Bhubaneswar	-	-	-	-	19.01.97	18.01.98	-	19th Jan
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	28.01.99	28th Jan

14d. Mean flushing (75%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	-	17.11.97	20.11.98	19th Nov
2	Madakkathara	-	-	-	-	19.11.96	29.10.97	04.12.98	17th Nov
3	Anakkayam	-	-	-	-	30.12.96	11.11.97	26.12.98	12th Dec
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	29.11.96	07.12.97	24.11.98	30th Nov
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	18.02.97	26.03.98	-	8th Mar
10	Chintamani	-	-	-	-	20.01.97	-	-	20th Jan
11	Bhubaneswar	-	-	-	-	28.01.97	26.01.98	19.01.99	24th Jan
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	02.02.99	2nd Feb

14e. Mean flushing (100%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	-	25.11.97	26.11.98	26th Nov
2	Madakkathara	-	-	-	-	23.11.96	06.11.97	10.12.98	23rd Nov
3	Anakkayam	-	-	-	-	16.01.97	17.11.97	08.01.99	24th Dec
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	02.12.96	14.12.97	02.12.98	6th Dec
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	01.03.97	05.04.98	-	19th Mar
10	Chintamani	-	-	-	-	29.01.97	-	-	29th Jan
11	Bhubaneswar	-	-	-	-	20.02.97	23.02.98	23.01.99	12th Feb
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	16.02.99	16th Feb

11.2.5.15 Flowering of Kanaka (H-1598)

15a. Mean flowering (<25%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	16.10.96	20.11.97	26.11.98	10th Nov
2	Madakkathara	-	-	-	-	14.11.96	16.11.97	30.11.98	20th Nov
3	Anakkayam	-	-	-	-	26.12.96	06.11.97	20.12.98	7th Dec
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	26.11.96	13.12.97	20.11.98	30th Nov
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	20.01.97	24.01.98	-	22nd Jan
10	Chintamani	-	-	-	-	02.01.97	-	-	2nd Jan
11	Bhubaneswar	-	-	-	-	14.11.96	26.12.97	06.01.99	16th Dec
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	05.02.99	5th Feb

15b. Mean flowering (25%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	30.10.96	24.11.97	27.11.98	17th Nov
2	Madakkathara	-	-	-	-	28.11.96	21.11.97	08.12.98	29th Nov
3	Anakkayam	-	-	-	-	02.01.97	10.12.97	02.01.99	25th Dec
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	08.12.96	28.12.97	11.12.98	16th Dec
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	30.01.97	10.02.98	-	5th Feb
10	Chintamani	-	-	-	-	18.01.97	-	-	18th Jan
11	Bhubaneswar	-	-	-	-	04.01.97	06.01.98	18.01.99	9th Jan
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	20.02.99	20th Feb

15c. Mean flowering (50%) of Kanaka at different locations across West and East coasts of India

Sl No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	07.11.96	28.11.97	01.12.98	22nd Nov
2	Madakkathara	-	-	-	-	05.12.96	29.11.97	18.12.98	7th Dec
3	Anakkayam	-	-	-	-	21.01.96	22.12.97	22.01.99	11th Jan
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	15.12.96	13.01.98	26.12.98	28th Dec
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	17.02.97	18.03.98	10.03.99	6th Mar
10	Chintamani	-	-	-	-	11.02.97	11.02.98	-	11th Feb
11	Bhubaneswar	-	-	-	-	28.01.97	21.01.98	-	25th Jan
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	18.03.99	18th Mar

15d. Mean flowering (75%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	20.11.96	14.12.97	17.12.98	7th Dec
2	Madakkathara	-	-	-	-	12.12.96	02.12.97	26.12.98	13th Dec
3	Anakkayam	-	-	-	-	10.02.97	31.12.97	28.01.99	23rd Jan
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	25.12.96	28.01.98	02.01.99	8th jan
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	02.03.97	06.04.98	-	20th Mar
10	Chintamani	-	-	-	-	11.03.97	-	-	11th mar
11	Bhubaneswar	-	-	-	-	17.02.97	20.02.98	08.02.99	15th Feb
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	26.03.99	26th Mar

15e. Mean flowering (100%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	15.12.96	26.12.97	31.12.98	24th Dec
2	Madakkathara	-	-	-	-	20.12.96	13.12.97	06.01.99	23rd Dec
3	Anakkayam	-	-	-	-	27.02.97	07.01.98	05.02.99	3rd Feb
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	01.01.97	07.02.98	13.01.99	17th Jan
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	20.03.97	24.04.98	-	7th Apr
10	Chintamani	-	-	-	-	06.04.97	-	-	6th Apr
11	Bhubaneswar	-	-	-	-	10.03.97	14.03.98	-	12th Mar
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	08.04.99*	8th Apr

* Estimated based on bud break

11.2.5.16 Harvest of Kanaka (H-1598)

16a. Mean harvest (<25%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	30.01.97	08.01.98	10.01.99	16th Jan
2	Madakkathara	-	-	-	-	28.01.97	16.02.98	10.02.99	8th Feb
3	Anakkayam	-	-	-	-	17.02.97	19.02.98	22.02.99	19th Feb
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	04.02.97	17.02.98	08.02.99	10th Feb
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	10.04.97	08.04.98		9th Apr
10	Chintamani	-	-	-	-	21.02.97	-	-	21st Feb
11	Bhubaneswar	-	-	-	-	13.03.97	06.03.98	-	10th Mar
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	18.04.99*	18th Apr

* Estimated based on time of flowering

16b. Mean harvest (25%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	04.02.97	23.01.98	23.01.99	27th Jan
2	Madakkathara	-	-	-	-	16.02.97	28.03.98	16.02.99	1st Mar
3	Anakkayam	-	-	-	-	24.02.97	25.02.98	28.02.99	26th Feb
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	13.02.97	27.02.98	17.02.99	19th Feb
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	28.04.97	22.04.98	-	25th Apr
10	Chintamani	-	-	-	-	18.03.97	-	-	18th Mar
11	Bhubaneswar	-	-	-	-	18.03.97	28.03.98	-	23rd Mar
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	27.04.99*	27th Apr

* Estimated based on time of flowering

16c. Mean harvest (50%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	09.02.97	10.02.98	16.02.99	12th Feb
2	Madakkathara	-	-	-	-	28.02.97	02.05.98	28.03.99	30th Mar
3	Anakkayam	-	-	-	-	05.03.97	06.03.98	10.03.99	7th Mar
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	24.02.97	11.03.98	20.02.99	28th Feb
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	11.05.97	10.05.98	-	11th May
10	Chintamani	-	-	-	-	17.04.97	-	-	17th Apr
11	Bhubaneswar	-	-	-	-	23.03.97	06.04.98	-	30th Mar
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	02.05.99*	2nd May

* Estimated based on time of flowering

16d. Mean harvest (75%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	16.02.97	28.02.98	27.02.99	24th Feb
2	Madakkathara	-	-	-	-	10.04.97	13.05.98	16.04.99	23rd Apr
3	Anakkayam	-	-	-	-	18.03.97	10.03.98	26.03.99	18th Mar
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	18.03.97	11.04.98	03.03.99	21st Mar
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	22.05.97	28.05.98	-	25th May
10	Chintamani	-	-	-	-	26.04.97	-	-	26th Apr
11	Bhubaneswar	-	-	-	-	29.04.97	25.04.98		27th Apr
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	15.05.99*	15th May

* Estimated based on flowering

16e. Mean harvest (100%) of Kanaka at different locations across West and East coasts of India

Sl. No	Location	Year							Mean
		1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	
1	Kottarakkara	-	-	-	-	20.02.97	20.03.98	28.03.99	13th Mar
2	Madakkathara	-	-	-	-	02.05.97	22.05.98	30.04.99	8th May
3	Anakkayam	-	-	-	-	25.03.97	28.03.98	18.04.99	3rd Apr
4	Ambalavayal	-	-	-	-	-	-	-	-
5	Pilicode	-	-	-	-	27.03.97	14.05.98	11.03.99	7th Apr
6	Pariyaram	-	-	-	-	-	-	-	-
7	Puttur	-	-	-	-	-	-	-	-
8	Vengurla	-	-	-	-	-	-	-	-
9	Vriddhachalam	-	-	-	-	05.06.97	10.06.98	-	8th June
10	Chintamani	-	-	-	-	03.05.97	-	-	3rd May
11	Bhubaneswar	-	-	-	-	05.05.97	13.05.98	-	9th May
12	Bapatla	-	-	-	-	-	-	-	-
13	Jhargram	-	-	-	-	-	-	28.05.99*	28th May

* Estimated based on time of flowering

11.2.6 Cashew Yield

11.2.6.1 Cashew yield at CRS, Madakkathara

a. Mean tree yield of 16 varieties for 7 years from 1982 to 1988 at CRS, Madakkathara

Sl. No.	Variety	Years							Cumulative mean yield for 7 years
		1982	1983	1984	1985	1986	1987	1988	
1.	ANSUR-1	3.183	4.793	1.67	3.397	5.578	5.319	4.327	28.267
2.	VENGURLA 36-3	3.232	3.385	1.02	4.152	5.770	5.678	4.335	27.572
3.	SWANTWADI	3.953	3.324	1.34	3.697	4.029	4.668	5.205	26.216
4.	VENGURLA 37-3	2.838	4.600	2.42	3.037	4.430	3.496	2.871	23.692
5.	BLA (TREE NO.1)	3.289	2.947	1.55	3.215	4.158	4.443	6.229	25.831
6.	TREE NO. 40 BLA	2.031	3.926	0.77	2.726	3.471	2.586	5.792	21.302
7.	TREE NO. 56 BLA	3.429	3.765	1.21	3.952	3.820	3.640	4.915	24.731
8.	TREE NO. 273 BLA	2.75	2.993	0.66	3.444	4.462	3.214	5.318	22.841
9.	M-10/4	3.280	5.533	2.18	3.527	3.734	3.960	4.572	26.786
10.	M-6/1	4.121	5.891	2.58	3.810	5.152	3.516	5.521	30.691
11.	K-27/1	4.282	6.446	0.64	2.954	6.558	5.789	2.720	29.389
12.	M-76/1	4.456	7.067	3.97	4.966	4.620	5.052	5.900	36.031
13.	H-4-7	4.060	4.904	3.78	5.061	5.345	4.100	3.855	31.105
14.	K-10-2	5.406	5.367	3.73	6.537	10.138	5.661	2.471	39.310
15.	BLA-139-1	4.704	4.119	1.39	4.213	5.140	6.161	6.864	32.591
16.	BLA-259-1	1.537	5.469	0.73	4.795	3.270	4.129	5.081	25.011
Mean		3.534	4.658	1.85	3.968	4.980	4.463	4.749	28.210

b. Mean cashew yield (kg/tree) data of MLT varieties at CRS, Madakkathara

Sl. No.	Variety	3rd year 1990-91	4th year 1991-92	5th year 1992-93	6th year 1993-94	7th year 1994-95
1.	H-1598	4.642	3.630	11.670	12.170	11.04
2.	H-1600	2.592	4.960	11.330	8.200	6.800
3.	H-1608	2.975	2.683	11.970	9.330	7.770
4.	H-1610	0.558	1.775	8.167	8.130	2.200
5.	T-30/4	2.025	3.275	9.833	7.600	9.730
6.	T-59/2	1.842	3.583	9.170	5.270	5.570
7.	T-129	0.870	1.790	5.900	3.030	3.460
8.	T-40	0.908	3.167	5.230	4.500	4.670
9.	H-2/15	1.470	1.842	6.470	7.330	8.030
10.	H-2/16	1.496	1.708	7.867	4.800	4.810
11.	V2	1.275	2.833	7.267	4.270	5.260
12.	V3	1.658	3.000	11.520	8.730	7.090
13.	V4	1.312	2.575	11.830	7.530	6.910
14.	V5	1.458	3.177	9.000	12.100	13.89
15.	M-33/3	1.900	3.670	11.150	7.300	5.410
16.	M-44/3	5.475	6.808	10.700	11.20	10.17
17.	M-26/2	3.379	6.583	14.470	10.00	10.22
18.	AKM-1	2.695	2.117	11.000	10.87	9.64
Mean		2.028	3.288	9.696	7.908	7.385

11.2.6.2 Cashew yield at RRS, Vriddhachalam

a. Cashew yield (Kg/tree) of Vriddhachalam varieties (planted in 1964) from 1967 to 1993

Year	Yield of nuts (Kg/tree)		
	VRI-1	VRI-2	VRI-3
1967	1.05	1.05	0.10
1968	7.18	4.00	0.57
1969	7.07	5.52	5.86
1970	3.76	5.69	5.79
1971	9.20	7.06	7.15
1972	8.50	6.80	3.10
1973	5.35	0.38	6.55
1974	6.44	7.32	9.46
1975	0.50	7.15	1.60
1976	10.10	6.99	10.17
1977	3.70	6.90	14.20
1978	7.94	7.30	16.83
1979	5.94	8.30	14.65
1980	10.20	5.40	11.26
1981	16.60	11.92	8.35
1982	11.45	7.00	22.58
1983	12.65	-	19.80
1984	-	-	-
1985	7.75	6.90	22.18
1986	5.70	7.30	11.35
1987	11.25	8.30	19.05
1988	5.70	5.40	4.90
1989	12.25	11.92	7.16
1990	8.85	7.00	12.20
1991	2.49	10.66	4.45
1992	4.53	22.01	10.25
1993	1.27	-	-
Mean yield	7.21	7.43	9.98

11.2.6.3 Cashew yield at ARS, Chintamani

a. Cashew yields (Kg/tree) at Cashew Research Station, Chintamani (Planted in 1986)

Entries	89-90	90-91	91-92	92-93	93-94	94-95
1. H-1610	1.42	1.78	2.77	5.39	4.04	8.18
2. H-1600	1.48	3.05	3.73	6.10	4.02	5.45
3. H-1608	1.59	2.03	2.13	5.79	6.25	10.32
4. H-1598	0.66	1.85	2.30	5.67	3.70	8.00
5. TN-129	2.19	1.51	1.63	5.13	3.21	6.17
6. TN-40	1.09	2.00	2.27	7.29	2.48	2.71
7. Hyb 2/15	1.73	2.18	2.70	4.19	2.69	6.78
8. Hyb 2/16	1.36	1.88	4.10	3.13	2.55	6.17
9. M 44/3 VRI	2.07	2.37	3.70	8.05	6.24	11.14
10. M 44/3 (Vengurla)	1.05	2.20	1.77	2.84	0.90	5.38
11. H-24	1.57	2.21	3.43	5.21	4.21	6.65
12. M 44/3 (VTH-12)	1.09	2.19	2.40	5.09	2.26	7.71
13. M 30/3 (VTH-12)	1.26	1.38	1.63	3.65	2.96	4.87
14. 59/2 (VTH-59)	1.13	2.32	1.87	5.45	4.23	7.93
Mean yield	1.41	2.07	2.60	5.21	3.55	6.96

b. Cashew yields (Kg/tree) of different varieties of Bapatla and Vengurla at ARS, Chintamani (Planted in 1986)

Varieties	1989-90	90-91	91-92	92-93	93-94	94-95
1. Vengurla-1	1.24	1.03	2.50	6.74	3.21	9.65
2. Vengurla-2	1.20	1.51	4.53	7.31	5.44	9.21
3. Vengurla-3	0.82	0.84	2.37	8.32	6.46	10.54
4. Vengurla-4	0.97	0.76	3.17	2.15	3.38	6.12
5. Vengurla-5	2.33	3.92	6.83	6.72	4.05	13.04
6. Bapatla-1	2.11	1.68	2.50	3.25	2.22	6.42
7. Bapatla-2	2.15	1.77	4.83	8.99	4.60	10.48
8. Bapatla-3	1.79	1.14	2.83	4.68	4.50	6.62
9. Bapatla-4	1.78	1.43	3.53	5.58	4.23	7.73
10.Bapatla-5	2.60	2.12	4.00	5.71	3.42	7.77
Mean yield	1.699	1.62	5.32	5.94	4.15	8.76

c. Mean cashew yield of CIN-1 (Kg/tree) at Chintamani (Planted in 1982)

Year	Mean yield (Kg/tree)
1984-85	1.96
1985-86	4.50
1987-88	5.85
1988-89	7.48
1989-90	7.92
1990-91	2.50
1991-92	8.93
1992-93	10.10
1993-94	13.73
1994-95	12.03
1995-96	14.37
Mean	8.12

11.2.6.4 Cashew yield at CRS, Bhubaneswar

a. Mean yield of cashew (Kg/tree) at Bhubaneswar (Planted in 1976)

Year	BPT-40	Vengurla 36/3 Bhubaneswar-1	M 10/4 VRI-1	A2/12 BPP-2
1979-80	4.58	3.87	3.58	4.06
1980-81	4.59	4.25	3.65	5.19
1981-82	6.41	6.89	7.61	10.14
1982-83	6.52	13.00	7.75	12.05
1983-84	5.22	10.00	6.85	9.10
1984-85	8.05	8.61	8.83	8.29
1985-86	9.56	11.05	9.06	9.02
1986-87	15.06	12.45	11.05	10.05
1987-88	15.84	13.22	11.81	10.75
1988-89	16.03	14.87	12.08	11.65
1989-90	15.50	14.50	8.50	8.20
1990-91	10.20	9.50	9.25	6.50
1991-92	14.50	13.60	13.60	13.20
Total/ Mean	132.02 10.155	135.81 10.447	110.31 8.485	118.20 9.092

b. Mean yield of cashew varieties (Kg/tree) at Bhubaneswar (Planted in 1978)

Year	BPP-1	BPP-2	BPP-3	BPP-4	BPP-5	BPP-6
1982-83	3.30	2.40	2.60	1.00	2.20	0.60
1983-84	4.40	4.90	6.80	2.80	6.60	4.00
1984-85	6.70	3.90	8.70	3.20	6.50	5.20
1985-86	8.50	6.70	11.60	4.70	10.00	4.00
1986-87	6.90	7.00	11.80	5.50	12.30	7.00
1987-88	14.60	12.70	17.50	12.30	19.80	11.60
1988-89	12.60	12.90	18.30	16.00	19.70	11.00
1989-90	1.80	5.50	8.50	16.00	5.20	2.00
1990-91	8.20	14.40	8.90	8.50	7.90	5.00
1991-92	12.70	15.50	13.90	18.90	12.60	8.70
1992-93	9.60	10.60	11.80	16.40	12.50	5.20
1993-94	13.60	14.50	15.90	22.70	19.00	11.20
1994-95	9.50	20.00	19.00	20.00	21.90	13.70
1995-96	5.50	18.50	10.80	12.00	13.50	7.50
Mean yield	8.42	10.70	11.90	11.40	12.10	6.90

c. Mean yield (Kg/tree) of cashew (Var. 39) from 1978 to 1996 (Planted in 1974)

Year	Yield (Kg/tree)
1978-79	2.90
1979-80	8.70
1980-81	6.10
1981-82	13.70
1982-83	15.20
1983-84	24.80
1984-85	22.60
1985-86	37.70
1986-87	35.90
1987-88	39.90
1988-89	42.50
1989-90	33.70
1990-91	11.00
1991-92	30.00
1992-93	36.00
1993-94	32.00
1994-95	33.00
1995-96	30.00
Mean yield (Kg/tree)	25.30

11.2.6.5 Cashew yields at RFRS, Vengurla

a. Mean cashew yield (Kg/tree) of Vengurla varieties (V1 to V6) at RFRS, Vengurla

Year	Variety						Mean
	V1	V2	V3	V4	V5	V6	
1975	14.690	28.042	9.959	16.228	9.416	2.741	13.51
1976	14.968	23.220	9.622	15.774	8.673	3.519	12.63
1977	19.977	23.500	16.573	17.423	15.57	6.765	19.97
1978	16.715	22.783	17.244	23.179	19.659	11.971	18.59
1979	17.726	18.548	18.937	18.251	15.969	14.106	17.26
1980	20.354	30.550	20.581	23.789	18.559	17.784	21.94
1981	15.634	28.091	10.325	11.750	11.720	11.577	14.85
1982	17.625	23.506	17.265	27.343	22.461	15.351	20.16
1983	12.153	18.809	18.074	17.554	17.297	10.404	15.72
1984	14.555	24.618	13.864	17.650	15.427	5.468	15.26
1985	20.266	30.835	8.388	7.915	15.054	23.170	17.60
1986	7.464	25.500	13.519	11.270	11.507	15.627	14.15
1987	13.389	24.763	5.700	6.069	9.136	13.266	12.05
1988	30.386	38.760	14.424	17.620	22.943	22.953	24.51
1989	32.785	33.000	16.540	19.620	21.375	18.656	23.66
1990	28.747	25.000	19.335	23.780	24.850	15.500	22.86
1991	10.660	25.610	16.630	16.970	17.865	26.285	19.00
1992	27.25	32.000	16.000	11.760	13.000	-	20.00
1993	24.86	31.00	-	-	21.000	-	25.62
1994	-	34.81	10.800	23.600	23.845	-	23.60
Mean (Kg/tree)	18.959	28.148	14.409	17.239	16.766	13.832	18.65

11.2.6.6 Area, Production and Productivity of cashew in India

A: Area in ha, P-Production in tonnes, PY-Productivity Kg/ha

	1986-87			1987-88			1988-89		
States	A	P	PY	A	P	PY	A	P	PY
Kerala	155260	134000	1027	155260	136900	972	155390	139500	956
Karnataka	72370	22940	638	72370	23680	474	73780	24650	464
Goa	44140	12090	286	44240	12780	307	44240	13210	317
Maharashtra	22690	21360	941	22750	24380	1074	22750	27130	1196
Tamil Nadu	94770	11980	130	95370	12360	135	95370	12430	131
Andhra Pradesh	70470	31860	1024	71020	34260	896	71070	36580	826
Orissa	59790	22320	833	59980	26770	997	59980	28600	737
West Bengal	6700	3400	1000	6800	2890	431	6800	3170	473
Others	1200	310	266	1490	310	258	1490	320	266
Total	527390	260260	674	529280	274330	653	530870	285590	638

A: Area in ha, P-Production in tonnes, PY-Productivity Kg/ha

	1989-90			1990-91			1991-92		
States	A	P	PY	A	P	PY	A	P	PY
Kerala	155390	142100	978	155390	142100	978	155490	143200	972
Karnataka	74080	25770	458	74080	25770	458	74440	26750	459
Goa	44640	14100	328	44640	14100	328	45080	14490	328
Maharashtra	22750	29510	1300	22750	29510	1300	22850	31960	1408
Tamil Nadu	95620	12470	132	95620	12470	132	95970	12710	134
Andhra Pradesh	71100	37770	760	71100	37770	760	71240	40360	707
Orissa	59980	29100	646	59980	29100	646	60090	31840	655
West Bengal	6800	3400	513	6800	3440	513	6900	3660	456
Others	1490	330	275	1490	330	275	1490	340	283
Total	531850	294550	634	531850	294590	634	533550	305310	635

	1992-93			1993-94			1994-95		
States	A	P	PY	A	P	PY	A	P	PY
Kerala	155640	151600	1012	155810	140200	925	156200	119200	781
Karnataka	74590	31260	519	74790	31540	500	75300	26400	400
Goa	45630	15450	350	46160	16210	370	47500	16960	390
Maharashtra	47910	43750	1128	51220	46860	1246	58200	37600	1100
Tamil Nadu	96270	19190	202	96770	19200	203	97200	22000	232
Andhra Pradesh	71720	44880	742	72090	46570	723	73300	58700	880
Orissa	60140	39060	745	60190	43420	812	60600	37200	679
West Bengal	6900	3660	546	6900	3990	596	7000	3280	490
Others	1490	340	283	1490	360	299	1900	300	250
Total	560290	349190	709	565420	348150	694	577200	321640	631

	1995-96			1996-97			1997-98		
States	A	P	PY	A	P	PY	A	P	PY
Kerala	118600	140000	1000	119000	134000	1140	120000	100000	850
Karnataka	83900	37600	550	85000	52000	690	87000	35000	460
Goa	49600	17800	410	51000	20000	430	52000	25000	530
Maharashtra	66700	69000	1440	80000	80000	1570	103000	60000	1500
Tamil Nadu	77360	30930	330	79000	30000	390	80000	30000	390
Andhra Pradesh	118080	71700	1000	121000	60000	830	124100	50000	690
Orissa	101850	43000	720	105000	40000	670	108600	45000	750
West Bengal	8680	6960	870	9000	6000	870	9000	6000	860
Others	10200	840	560	10000	8000	870	6200	9000	610
Total	634970	417830	720	659000	430000	835	689900	360000	740

Source: Directorate of Cashewnut Development, Cochin – 16

11.2.6.7 Area, Production and Productivity of Cashew nut in India (from 1986-87 to 1997-98)

State	Area ('000 ha)	Production ('000 tonnes)	Productivity (Kg/ha)
Kerala	146.45	135.23	966
Karnataka	76.81	30.51	506
Goa	46.57	16.02	365
Maharashtra	45.30	41.76	1267
Tamil Nadu	91.61	18.81	212
Andhra Pradesh	83.86	45.87	820
Orissa	71.35	35.45	741
West Bengal	7.36	4.15	635
Other States	3.32	2.36	375
Total	572.63	330.16	577

11.2.6.8 Cashew production in Kerala from 1995-96 to 1998-99

Year	Cashew production (tonnes)
1995-96	1,40,000
1996-97	1,34,000
1997-98	1,00,000
1998-99	75,000*

*Expected production of Kerala (Source: Hindu dated 31.3.1999)

11.2.6.9 Tree wise cashewnuts (Kg/tree) of test varieties from 1995-96 to 1998-99 at RARS, Pilicode

Variety	Tree No.	1995-96	1996-97	1997-98	1998-99
BLA-139-1	118	3.68	4.90	1.34	7.74
	139	-	2.20	1.70	7.32
	172	0.60	7.05	2.45	6.28
BLA-39-4	35	6.15	4.95	3.95	14.32 (?)
	75	2.15	5.60	8.75	7.29
	123	3.17	5.20	8.80	7.52
NDR-2-1	33	1.85	0.50	16.9 (?)	4.96
	51	2.08	1.40	18.4 (?)	5.16
	179	0.25	0.60	3.15	2.63
H-1598	186	-	3.40	5.85	3.82
	209	-	0.90	2.30	3.65

11.2.6.10 Mean yield (Kg/tree) of test varieties from 1995-96 to 1998-99 at RARS, Pilicode

Variety	1995-96	1996-97	1997-98	1998-99
Ank-1 (BLA-139-1)	2.14	4.72	1.83	7.11
Mdk-1 (BLA-39-4)	3.82	5.25	7.17	9.71
Kanaka (H-1598)	0.0	2.15	4.08	3.74*
Mdk-2 (NDR-2-1)	1.39	0.83	12.82	4.25*

*Severly affected due to tea mosquito attack. Harvest was early due to no further flowering. However, second flowering was seen in some of the trees of NDR-2-1. The harvest of the above will continue till the end of May

11.2.6.11 Cashewnut yield (Kg/tree) at different locations across West and East coasts of India

Year	Vengurla	Bhubaneswar		Vriddhachalam	Chintamani
	BLA-139-1	BLA-39-4	H-1598	H-1598	H-1598
1992-93	-	-	-	-	5.7
1993-94	-	-	-	-	3.7
1994-95	3.90	-	-	-	8.0
1995-96	0.95*	-	-	-	-
1996-97	3.80	7.0	6.5	2.3	5.0
1997-98	-	8.2	9.5	2.7	-
1998-99	-	-	-	-	-
Mean	2.88	7.6	8.0	2.5	5.6

*Yield is very poor due to heavy incidence of tea mosquito

11.2.6.12 Average cashewnuts (Kg/tree) of test varieties across West and East coasts of India

Variety	Location			
	Pilicode	Chintamani	Vriddhachalam	Bhubaneswar
Kanaka (H-1598)	2.3	5.6	2.5	8.0
Mdk-1 (BLA-39-4)	4.3	-	-	7.6

11.2.6.13 Cashew yield (kg) in the year 1998-99 at RARS, Pilicode

Variety	Tree. No	Harvest																		Total yield kg
		1		2		3		4		5		6		7		8		9		
		D	Y kg	D	Y kg	D	Y kg	D	Y kg	D	Y kg	D	Y kg	D	Y kg	D	Y kg	D	Y Kg	
BLA-139-1	118	29/1	0.15	4/2	0.2	10/2	0.95	19/2	3.7	25/2	0.6	27/2	0.6	8/3	0.6	30/3	0.1		*.839	7.74
	139	29/1	0.7	11/2	2.5	18/2	2.9	24/2	0.9		*.317									7.32
	172	29/1	0.43	4/2	0.7	10/2	0.7	16/2	2.5	8/3	1.2	15/3	0.2		*.546					6.28
BLA-39-4	35	10/2	0.55	8/2	1.65	6/3	7.25	8/3	3.5	16/3	0.2	26/3	0.15		*1.019					14.32?
	75	29/1	0.65	10/2	0.8	17/2	0.7	6/3	4.0	16/3	0.2		*.935							7.29
	123	4/2	0.25	10/2	0.8	19/2	1.5	8/3	3.1	30/3	0.95		*.916							7.52
NDR-2-1	33	18/2	0.05	1/3	0.6	5/3	1.4	16/3	1.2	26/3	0.5	30/3	0.2		*1.01					4.96
	51	6/3	0.4	16/3	0.5	26/3	3.35		*.908											5.16
	179	25/2	0.7	15/3	0.4		*1.53													2.63
H-1598	186	8/3	3.2		*0.62															3.82
	209	20/2	1.0	13/3	2.1		*.552													3.65

D- Date of harvest; Y – Yield; *Collected for recording nut weight

11.2.7 Nut weight (g/nut), kernel weight (g/nut) and shelling % in test varieties at selected stations across West and East coasts of India

a. Ank-1 (BLA-139-1)

Station	1995-96			1996-97			1997-98			1998-99		
	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)
Kottarakkara	-	-	-	6.10	1.32	21.64	4.91	1.61	32.80	-	-	-
Madakkathara	-	-	-	-	-	-	-	-	-	-	-	-
Anakkayam	-	-	-	-	-	-	6.10	2.00	32.79	-	-	-
Ambalavayal	-						6.00	1.90	31.67	7.84	2.40	30.61
Pilicode	3.93	1.30	33.08	5.06	1.44	28.46	4.75	1.62	34.11	4.93	1.60	32.45

b. Mdk-1 (BLA-39-4)

Station	1995-96			1996-97			1997-98			1998-99		
	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)
Kottarakkara	-	-	-	5.89	1.68	28.52	5.00	1.66	33.20	-	-	-
Anakkayam	-	-	-	-	-	-	5.50	1.80	32.73	-	-	-
Ambalavayal	-	-	-	-	-	-	6.30	2.17	34.44	6.07	1.47	24.22
Pilicode	4.41	1.41	31.97	5.65	1.80	31.86	5.33	1.63	30.58	4.79	1.40	29.23
Bapatla	-	-	-	6.25	1.75	28.00	5.75	1.60	27.83	-	-	-

c. Mdk-2 (NDR-2-1)

Station	1995-96			1996-97			1997-98			1998-99		
	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)	Nut Wt (g/nut)	Kernel Wt (g/nut)	Shelling (%)
Ambalavayal	-	-	-	-	-	-	6.25	1.88	30.08	6.18	1.53	24.76
Pilicode	7.55	2.56	33.91	8.84	2.52	28.51	8.00	2.58	32.25	8.85	2.46	27.80
Chintamani	-	-	-	-	-	-	8.97	3.33	37.12	-	-	-

d. Kanaka (H-1598)

Station	1995-96			1996-97			1997-98			1998-99		
	Nut Wt (g/nut)	Kernel Wt	Shelling (%)	Nut Wt (g/nut)	Kernel Wt	Shelling (%)	Nut Wt (g/nut)	Kernel Wt	Shelling (%)	Nut Wt (g/nut)	Kernel Wt	Shelling (%)
Anakkayam	-	-	-	5.60	1.90	33.93	-	-	-	-	-	-
Pilicode	3.83	1.14	29.77	5.68	1.60	28.16	5.10	1.87	36.67	5.86	1.69	28.84
Chintamani	-	-	-	-	-	-	6.80	1.52	22.35	-	-	-
Vriddhachalam	6.97	2.18	31.28	6.97	1.87	26.83	6.90	1.89	27.39	-	-	-

11.2.7.1 Nut characteristics of test varieties (tree-wise) during 1998-99 at RARS, Pilicode

Sl. No.	Tree No.	Nut Weight (g/nut)	Kernel Weight (g/nut)	Shelling %
I	Anakkayam 1 (BLA-139-1)			
1	118	4.79	1.59	31.48
2	139	4.56	1.44	31.50
3	172	5.46	1.78	32.60
II.	Madakkathara 1 (BLA-39-4)			
4	35	5.10	1.45	28.46
5	75	4.68	1.41	30.16
6	123	4.59	1.35	29.46
III	Kanaka (H-1598)			
7	186	6.20	1.78	28.71
8	209	5.52	1.60	28.99
IV	Madakkathara 2 (NDR-2-1)			
9	33	8.97	2.48	27.65
10	51	9.39	2.57	27.32
11	179	8.20	2.32	28.25

11.2.7.2 Direction wise nut characteristics of different varieties of cashew at RARS, Pilicode during 1998-99

Sl. No.	Tree No.	Nut Weight (g/nut)	Kernel Weight (g/nut)	Shelling %
I	Anakkayam 1 (BLA-139-1)			
1	118 N	4.85	1.43	29.48
2	118 S	4.72	1.58	33.47
3	139 N	4.73	1.47	31.00
4	139 S	4.38	1.40	32.00
5	172 N	5.41	1.76	32.53
6	172 S	5.51	1.80	32.67
II	Madakkathara 1 (BLA-39-4)			
7	35 N	5.25	1.50	28.57
8	35 S	4.94	1.40	28.34
9	75 N	4.73	1.42	30.02
10	75 S	4.62	1.40	30.30
11	123 N	4.80	1.40	29.17
12	123 S	4.37	1.30	29.75

11.2.7.3 Nut characteristics of Mdk-2 at different intervals of harvest during 1998-99 at RARS, Pilicode

Sl No	Tree No.	1st harvest			2nd harvest			3rd harvest		
		Nut weight (g/nut)	Kernel Weight (g/nut)	Shelling %	Nut Weight (g/nut)	Kernel Weight (g/nut)	Shelling %	Nut Weight (g/nut)	Kernel Weight (g/nut)	Shelling %
1	33	8.97	2.48	27.65	7.80	2.03	26.03	-	-	-
2	51	9.39	2.57	27.32	8.40	2.23	26.55	8.94	2.38	26.62
3	179	8.20	2.32	28.25	6.68	1.78	26.65	5.82	1.50	25.77

12. RESEARCH RESULTS

12.1 Genotype, latitude, longitude, altitude and cashew flowering

12.1.1 Genotype and flowering across West and East coasts of India

The flowering time of Anakkayam-1 (BLA-139-1), Madakkathara-1 (BLA-39-4), Kanaka (H-1598) and Madakkathara-2 (NDR-2-1) was 04th December, 08th December, 28th December and 06th January, respectively at Pilicode (Table 1). Similarly, the flowering time of cashew varied among varieties at all the locations, starting from 13th November (Anakkayam-1) at Kottarakkara (Kerala) to 18th March (Kanaka) at Jhargram (West Bengal). The crop stage of three test varieties (Plate 1) as on 27th November during 1998-1999 at RARS Pilicode clearly indicated the role of variety on time of flowering. When Anakkayam-1 was in flowering stage, Madakkathara-1 was in flushing stage while Madakkathara-2 was in bud break stage. It revealed that the early season types flowered early while the late season types flowered late. Despite a variety of complex environments that prevail across West and East coasts of India, the role of genotype was distinct on flower characteristics.

12.1.2 Latitude and flowering across West and East coasts of India

Madakkathara-1 (BLA-39-4) flowered between 18th November at Kottarakkara (9°16'N) in extreme South of the country and 09th March at Jhargram (22°28'N) in the Northeast. In case of Kanaka (H-1598), the time of flowering was between 22nd November at Kottarakkara and 18th March at Jhargram. The time of flowering of all the four test varieties together also indicated that the flower delay was noticed from South (24th Novemebr at Kottarakkara) to North and Northeast (14th March at Jhargram) of the country (Table 1). Interestingly, the time of flowering of Kanaka at Vriddachalam (11°03'N) in Tamil Nadu was on 06th March while it was 11th January at Anakkayam (11°01'N) in Kerala though both these stations are located in the same latitudinal belt. In case of Anakkayam-1 (BLA-139-1), the flowering at Vengurla (15°51'N) in extreme South of Maharashtra was on 13th November while it was on 04th February (Madakkathara-1) at Bapatla (15°54'N) in Andhra Pradesh. In this case also, both these stations are located within the same latitudinal belt (Figure 3). Madakkathara-1 and Anakkayam-1 were considered for comparison at the above stations as difference in flowering dates between them was only marginal. It took only four days at Pilicode and on an average, the difference was six days when the time of flowering at all the stations was considered between Ank-1 and Mdk-1. Also, no common variety is available for comparison at the two locations (Vengurla and Bapatla), situated on the same latitude. It revealed that the flowering of cashew delayed in all the test varieties with latitude from South to North and Northeast of India except at Vengurla (West Coast) in case of Anakkayam-1 and Vriddachalam (East Coast) in case of Kanaka.

The peak flowering (Table 2) across West and East coasts of India varied between November/December and December/ January from South to North of West Coast while it was during February/March across East coast of India. It showed that there was a significant delay

Table 1. Time of cashew flowering (50%) across West and East coasts of India from 1996-97 to 1998-99

Name of Station	Latitude °N	Longitude °E	Height above MSL (m)	Soil type	Time of cashew flowering (50%)				
					Anakkayam-1 (BLA-139-1)	Madakkathara-1 (BLA-39-4)	Kanaka (H-1598)	Madakkathara-2 NDR-2-1	Mean
1.Kottarakkara	9°16'	76°37'	91	Laterite	13th Nov	18th Nov	22nd Nov	13th Dec	24th Nov
2.Madakkathara	10°31'	76°13'	40	Laterite	20th Nov	28th Nov	7th Dec	3rd Jan	7th Dec
3.Pilicode	12°12'	75°10'	15	Laterite	4th Dec	8th Dec	28th Dec	6th Jan	19th Dec
4.Vengurla	15°51'	73°38'	06	Laterite	13th Nov	-	-	-	13th Nov
5.Anakkayam	11°01'	76°01'	107	Laterite	3rd Dec	17th Dec	11th Jan	-	21st Dec
6.Ambalavayal	11°37'	76°12'	974	Laterite	13th Dec	3rd Jan	-	3rd Feb	6th Jan
7.Chintamani	13°24'	78°54'	857	Red sandy loam	26th Dec	-	11th Feb	28th Jan	22nd Jan
8.Vriddhachalam	11°03'	79°26'	43	Red laterite	-	-	6th Mar	-	6th Mar
9.Bapatla	15°54'	80°30'	06	Littoral sand	-	4th Feb	-	--	4th Feb
10.Bhubaneswar	20°15'	85°52'	26	Red sandy loam	-	27th Feb	-	-	27th Feb
11.Jhargram	22°28'	87°03'	79	Red sandy loam	-	9th Mar	18th Mar	-	14th Mar
Mean					30th Nov	6th Jan	8th Jan	11th Jan	

Ia. Anakkayam-1
(BLA-139-1)
Flowering

Ib. Madakkathara-1
(BLA-39-4)
Flushing

Ic. Madakkathara-2
(NDR-2-1)
Bud break

Plate I. Varietal difference in reproductive phase of cashew-photo taken on 27.11.98 at RARS, Pilicode

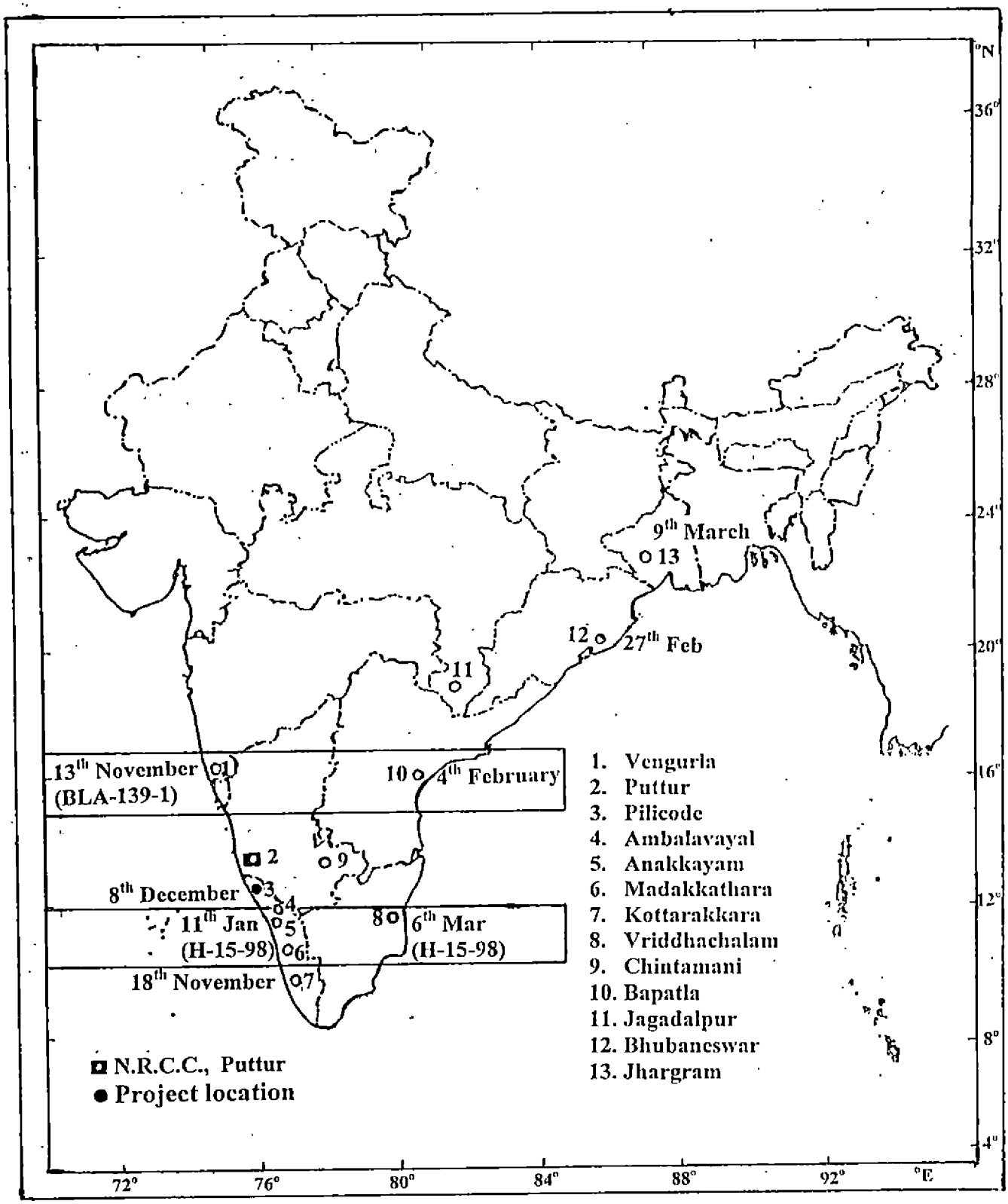


Fig 3. Isochrones of cashew flowering (BLA-39-4) across India

Table 2. Latitude, longitude, soil type, climate and peak flowering of cashew across West and East coasts of India

Sl. No	Name of Station	Latitude °N	Longitude °E	Height above msl (m)	Soil type	Temperature range (°C)		Rainfall (mm)	Month of peak flowering
						Max	Min		
	West coast								
1	Kottarakkara	9°16'	76°37'	91	Laterite	27.1-34.9	16.0-22.7	2352.2 (108)	Nov-Dec*
2	Madakkathara	10°31'	76°13'	40	Laterite	28.6-37.6	21.3-25.2	2795.0 (121)	Nov-Dec*
3	Anakkayam	11°01'	76°01'	107	Laterite	28.7-36.3	18.4-24.9	3367.0 (110)	Dec-Jan*
4	Ambalavayal	11°37'	76°12'	974	Laterite	24.4-32.3	11.0-20.8	1976.0 (123)	Jan-Feb*
5	Pilicode	12°12'	75°10'	15	Laterite	27.8-34.7	18.7-26.0	3624.0 (114)	Dec-Jan*
6	Puttur	12°45'	75°42'	90	Laterite	27.2-36.1	17.3-23.7	3660.0 (123)	Dec-Jan*
7	Vengurla	15°51'	73°38'	06	Laterite	29.0-33.7	14.7-26.7	2871.0 (98)	Dec-Jan* (Nov)
	East coast								
8	Vriddhachalam	11°03'	79°26'	43	Red laterite	30.0-42.1	19.0-24.9	1042.0 (54)	Feb-Mar*
9	Chintamani	13°24'	78°54'	857	Red sandy loam	26.2-34.4	11.5-21.7	670.0 (45)	Feb-Mar*
10	Bapatla	15°54'	80°30'	06	Littoral sand	27.9-39.8	16.4-28.3	920.0 (57)	Feb-Mar*
11	Bhubaneswar	20°15'	85°52'	26	Red sandy loam	26.8-39.1	12.9-26.9	1525.0 (99)	Feb-Mar*
12	Jhargram	22°28'	87°03'	79	Red sandy loam	25.1-39.5	07.5-24.5	1517.0 (99)	Feb-Mar*

*Peak flowering was based on the observations made outside the selected stations, which represent the cashew tract of that area.
(Nov)- Peak flowering was noticed by the end of November at RFRS, Vengurla.

in cashew flowering from West coast to East coast despite some of the stations fall on the same latitude. It indicated that the time of flowering across Tamil Nadu (Vriddhachalam) appears to be influenced by rainfall distribution other than latitude and longitude. However, the longitudinal trend was also noticed in delay of time of flowering between Kottarakkara (76°37'E) in Kerala and Jhargram (87°03'E) in West Bengal. It is also quite interesting to note that the difference in peak time of flowering across East coast (Tamil Nadu to West Bengal) was appeared to be same when the entire cashew belt of East coast was taken into account.

12.1.3 Rainfall distribution across West and East coasts of India

The monthly rainfall and potential evapotranspiration at all the locations across West and East coasts of India are depicted in Figures 4a, b and c. The rainfall distribution is bi-model to uni-model from South to North of West Coast and the rainfall is always higher than potential evapotranspiration from the middle of May to the end of October (Fig 4a). It showed that the dormant phase of cashew is never under soil moisture stress while the reproductive phase is under soil moisture stress from December onwards. It is also seen that rain ceases early (by the end of October) at Vengurla (Maharashtra). Probably, this may be one of the reasons in early bud break of cashew at Vengurla under better management when compared to that of Pilicode. However, the reproductive phase (flowering to harvest) was late at Vengurla (118 days) when compared to that of Pilicode (87 days) though the flowering was early at Vengurla (Table 3).

Table 3. Duration of reproductive phase (flowering to harvest) of Anakkayam-1 during 1996-97 to 1997-98 at different locations in West coast

Name of the station	Date of flowering	Date of harvest	Total number of days taken from flowering to harvest
Kottarakkara	06th November	02nd February	88
Madakkathara	14th November	13th February	91
Pilicode	03rd December	28th February	87
Vengurla	09th November	07th March	118
Anakkayam	20th November	02nd March	102
Ambalavyal	20th December	03rd April	104

This could be attributed to latitudinal difference, which reflects on surface air temperature. The minimum air temperature during the flowering, nut setting and nut development period (Nov-Feb) was low at Vengurla as seen in Table 4. A significant difference of 3.3°C in minimum temperature was noticed with latitude towards North from Pilicode to Vengurla. The delay in crop duration could be explained latitudinally across the West coast due to low minimum surface air temperature once the bud break is initiated in cashew immediately after the rain spell is over.

Table 4. Mean surface air temperature (°C) at Pilicode and Vengurla from 1996-97 to 1997-98

Name of the Station	Latitude °N	Longitude °E	Altitude (AMSL-m)	Max. Temp (°C)	Min. Temp (°C)	Mean Temp (°C)
Pilicode	12°12'	75°10'	15	31.4 (31.6)	23.1 (21.6)	27.3 (26.6)
Vengurla	15°51'	73°38'	06	31.2 (31.6)	21.7 (18.3)	26.5 (25.0)

The rainfall distribution at Bhubaneswar and Jhargram in the East coast appears to be similar as in case of West coast even though the monthly rainfall is less during Southwest monsoon (June to September). The reproductive phase of cashew is in soil moisture stress while the dormant phase is not so at the above two stations. The monthly peak rainfall shifted to October/November at Bapatla (Figures 4b). The rainfall distribution at Vriddhachalam (down South of East coast) is totally different and the monthly rainfall from mid September to December exceeds potential evapotranspiration due to the influence of Northeast monsoon. Probably, this is one of the reasons for delay in cashew flowering at Vriddhachalam and not comparable latitudinally. The rainfall at Chintamani (Fig.4c) is always lower than potential evapotranspiration, indicating that the crop is always under moderate to severe soil moisture stress throughout the year. The flowering behaviour in and around Chintamani is highly erratic due to weather aberrations and sometimes crop harvest extends up to July/August.

It is inferred from the foregone sections that there was a trend in flower delay (Plate II) of cashew with latitude from South to North and Northeast of India. The effect of latitude on flowering and crop duration of cashew was more evident across West coast where distribution of rainfall is alike despite flowering of cashew is highly erratic due to several biotic and abiotic factors (Fig 5). There was a significant delay in cashew flowering from West coast to East coast of India in South of the country though the cashew tract falls under the same latitudinal belt. This was probably due to difference in rainfall distribution. Of course, the soils in which cashew grown are distinctly different from West coast (laterite) to East coast (littoral sand to sandy loam) of India. The delay in cashew flowering due to lack of soil nutrients cannot be ruled out as it was noticed in the same variety where the crop was under poor management (Table 5).

Table 5. Variation in time of flowering of test varieties at Pilicode and Pariyaram

Location	Time of flowering				Soil characteristics*				
	Ank-1	Mdk-1	Mdk-2	Mean	pH	EC	OC %	Total N %	K_2O (Kg/ha)
Pilicode	04th Dec	08th Dec	06th Jan	16th Dec	5.3	0.12	1.9	0.23	216
Pariyaram	21st Dec	05th Jan	14th Feb	13th Jan	5.3	0.12	1.9	0.19	104
Diff(days)	17	28	39	28	Nil	Nil	Nil	0.04	102

Pariyaram is located at 28 km away from Pilicode towards South where the planting material is same and no fertilizers were applied. *-Soil samples were collected during December 1998

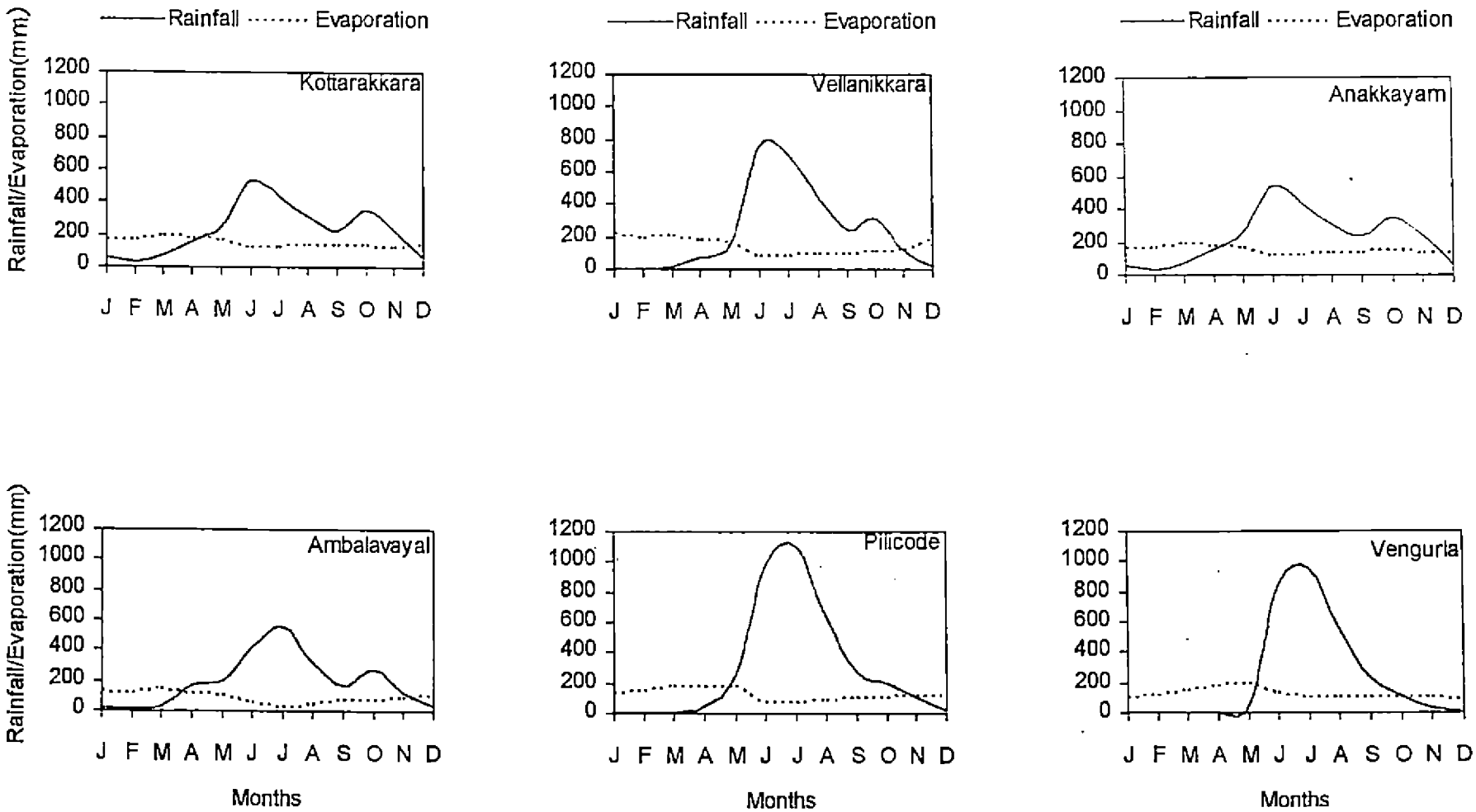


Fig 4a. Rainfall and pan evaporation (mm) at different locations in West coast of India

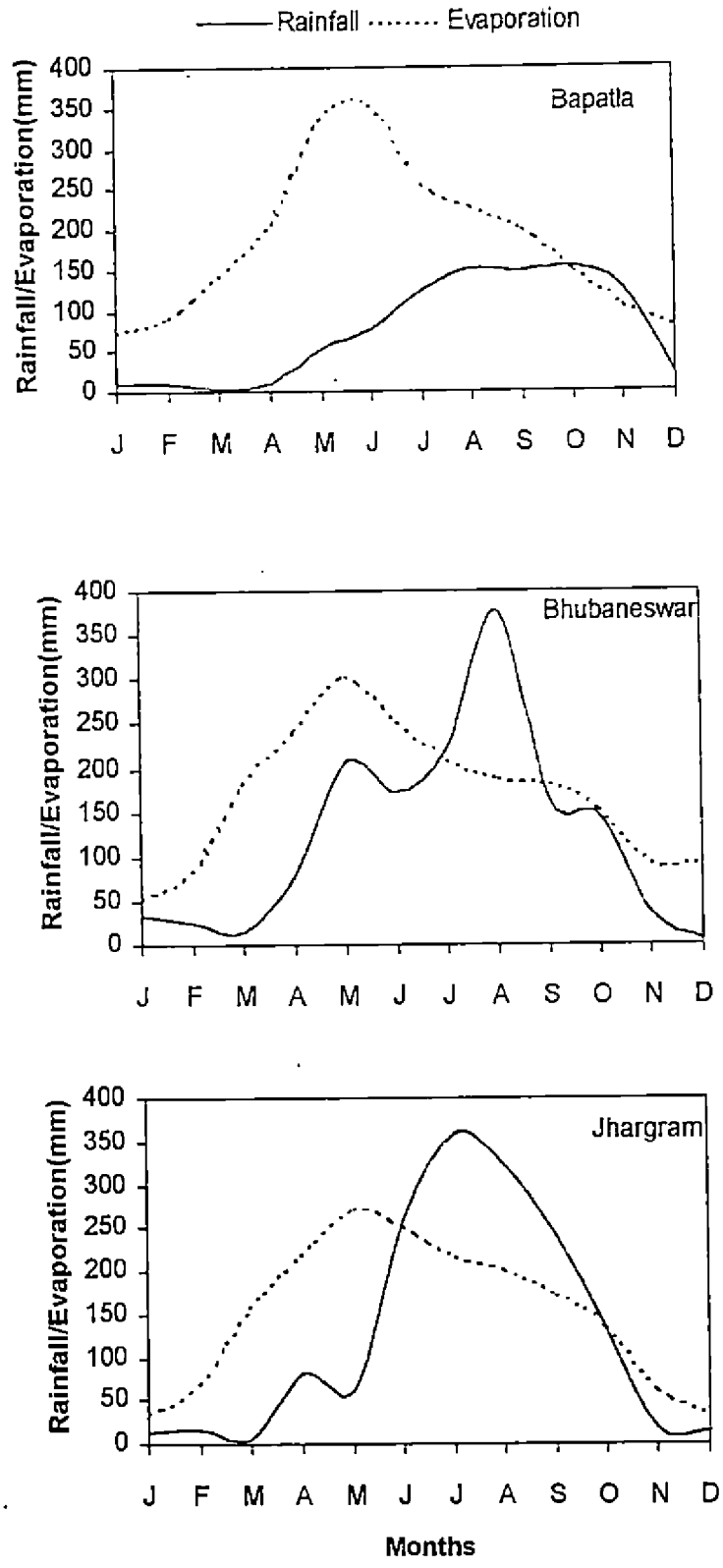


Fig 4b. Rainfall and pan evaporation (mm) at selected locations in East coast of India

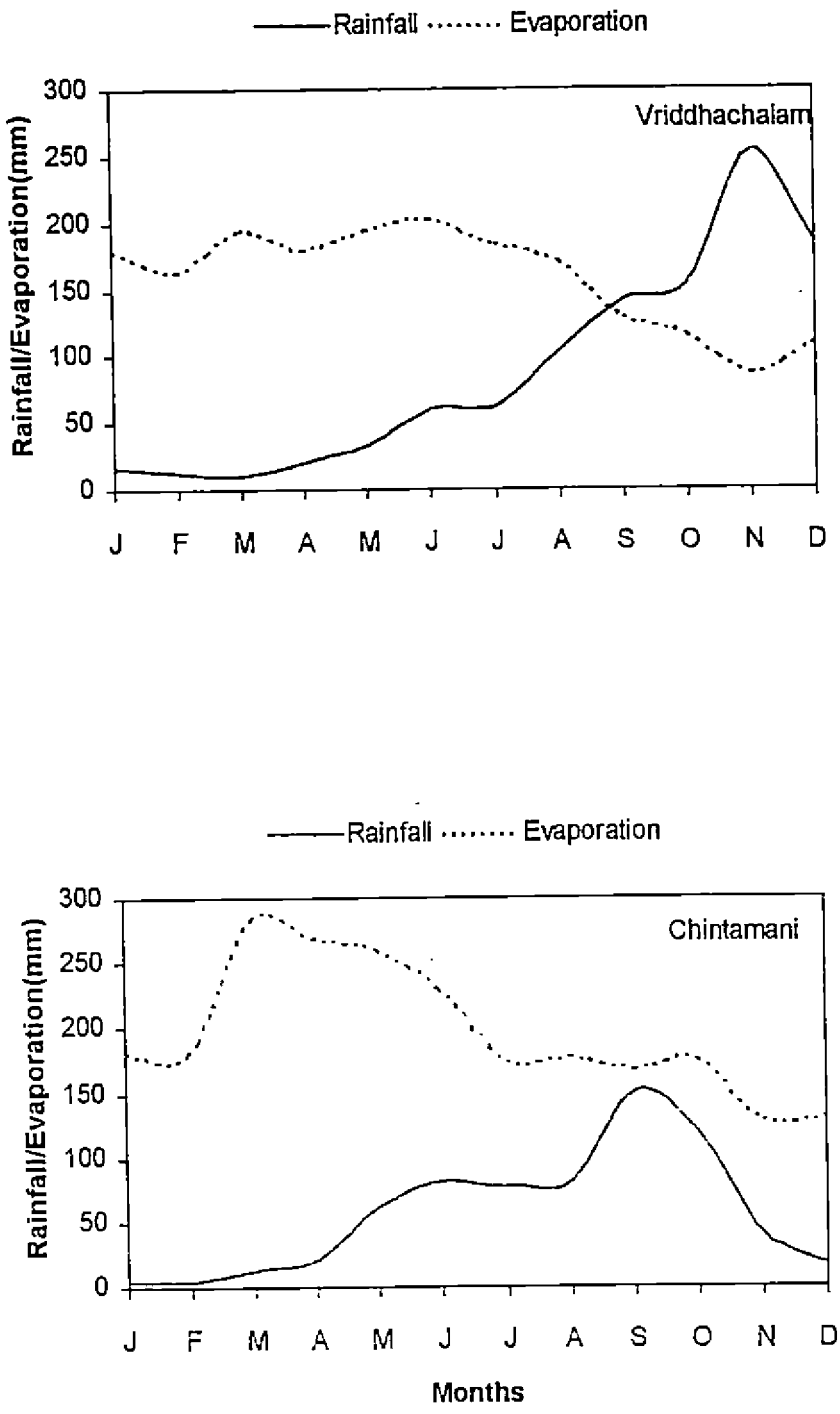
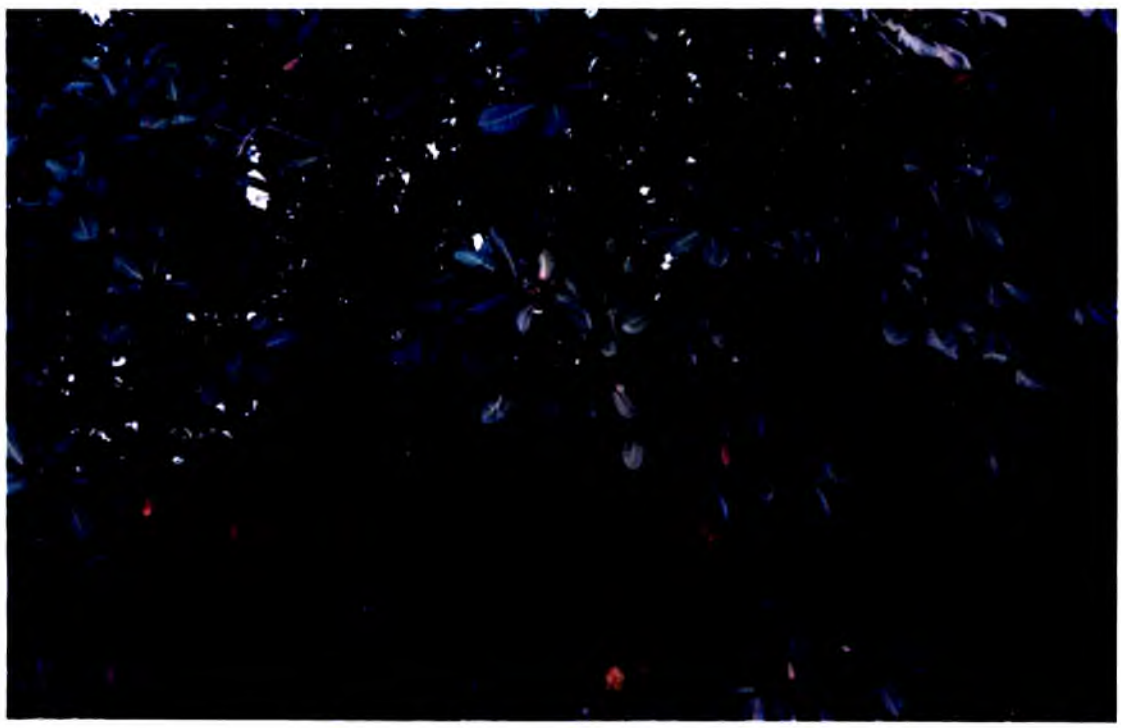


Fig 4c. Rainfall and pan evaporation (mm) at Vriddhachalam and Chintamani

Madakkathara-1 (BLA-39-4) as on 16.01.99 at RARS, Pilicode
(Flowering, Nut set and Development)



Madakkathara-1 (BLA-39-4) as on 16.01.99 at CRS, Bapatla (Bud break)

Plate II. Crop stage of Madakkathara-1 (BLA-39-4) at two different locations

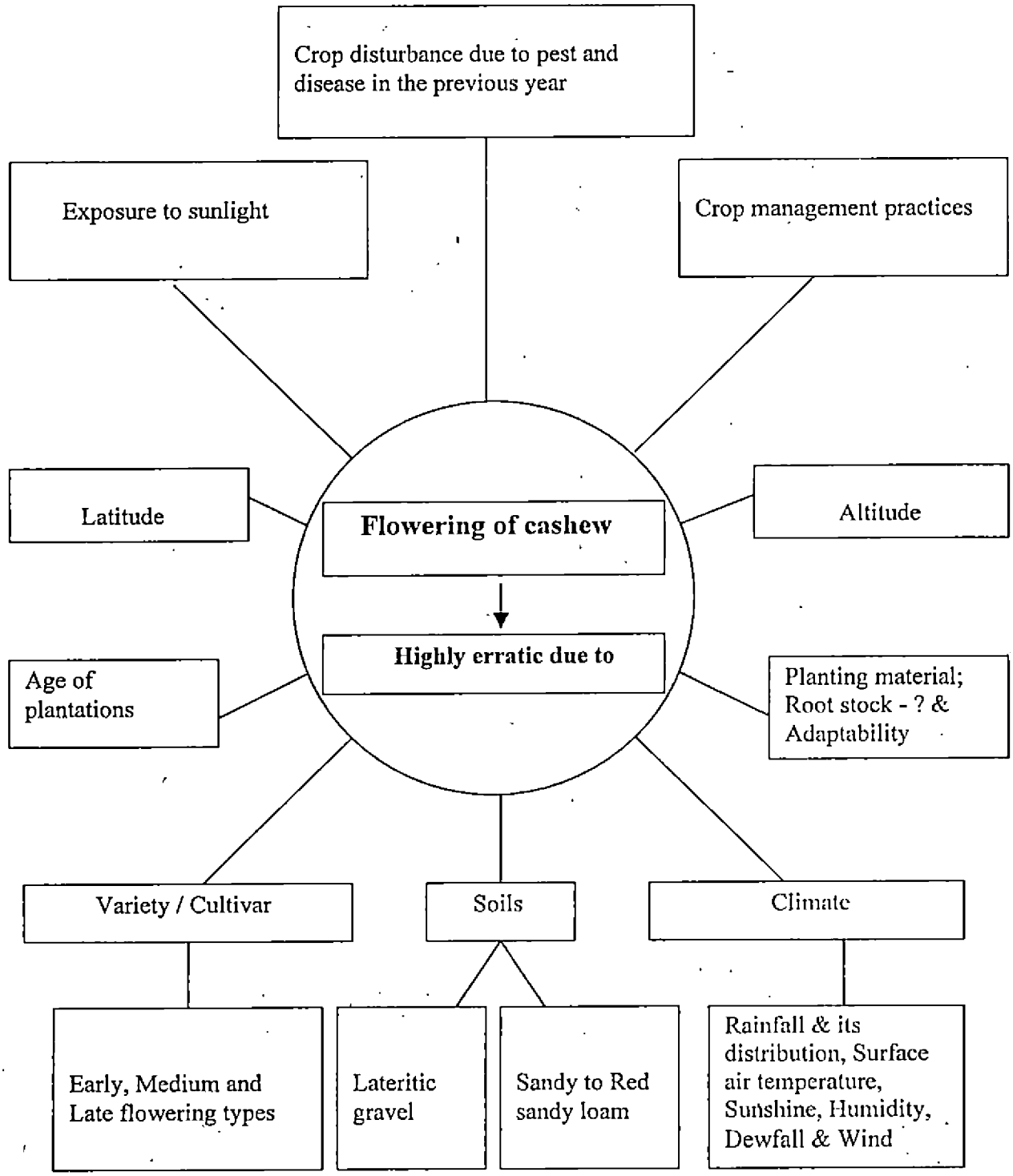


Fig 5. Effect of abiotic and biotic factors on flowering of cashew

There was a delay of 28 days in time of cashew flowering between good and poor crop management situations. However, it varied from one variety to another. When the soil characteristics were compared between good and poor crop management conditions, there was a significant difference in K_2O (216 kg/ha at Pilicode while 104 kg/ha at Pariyaram), followed by total N. This might be one of the reasons, why the flowering in cashew was early at research stations when compared to that of neglected gardens outside. It was also observed that though the flowering was early at the Regional Fruit Research Station, Vengurla, the same is not the case outside the station (Table 2). It clearly indicated that the effect of crop management on flowering behaviour of cashew is distinct.

The study indicated that the effect of latitude on biotic events of cashew can be studied well under better crop management situations if the rainfall distribution is alike and the effect of longitude on cashew flowering is taken into account. Hence, the effect of latitude and altitude on different phenophases of cashew is studied in detail based on the data collected from 1992-93 to 1997-98 across Kerala (West coast).

12.1.4 Latitudinal and altitudinal effect on cashew phenology across Kerala

Anakkayam-1 (BLA-139-1)

Bud break in cashew initiated on 1st October in the extreme South of Kerala and completed by 30th October in North of Kerala. Cashew flowering spread across Kerala from 1st November in South to 20th December in Northeast. The harvest began on 1st January in the extreme South and completed by 15th March over Northeast of Kerala. The crop duration varied between 90 and 140 days (Fig. 6a) across the State in case of Anakkayam-1.

Madakkathara-1 (BLA-39-4)

The chronological events of cashew phenology of Madakkathara-1 were similar to that of Anakkayam-1 and delayed from South to North and Northeast of Kerala (Fig.6b), depending upon latitude and altitude. The crop duration varied between100 and 160 days across the State, which showed that the crop duration was more in case of Madakkathara-1 in identical climates when compared to that of Anakkayam-1. Interestingly, there was no significant variation in onset of flowering across the State in case of Madakkathara-1 when compared to that of Anakkayam-1.

Madakkathara-2 (NDR-2-1)

Bud break initiation of Madakkathara-1 was on 20th November in South of Kerala while it was 30th November in Northeast. The flowering varied between 1st December and 1st February across Kerala. Being a late season type, the harvest delayed and varied from 15th March to 31st May across Kerala. Interestingly, the crop duration was also late in late season types and varied between 120 and 180 days (Fig. 6c) across the State of Kerala.

The time of flowering varied from 15th November to 15th January across Kerala when all the three test varieties pooled together. The total crop duration was between 100 and 160 days across the State (Fig. 6d). There was a delay of 60 days each in cashew flowering and crop duration across the State of Kerala. The harvest commenced by 1st February in extreme South and ceased by 15th April in the extreme North of the State. There appeared to be a delay of six days in cashew flowering at every 1°N of latitude and for every 100 metres altitude, the delay was three days (Fig.7).

A close look at the surface air temperature from one location to another depending upon latitude and altitude (Table 6) indicated that it varied between 27.8°C at Madakkathara and 22.4°C at Ambalavayal, showing a difference of 5.4°C across the State.

Table 6. Mean surface air temperature (°C) at the selected locations from 1995 to 1998

Location	Surface air temperature (°C)		
	Max. temp	Min. temp	Mean. temp
Kottarakkara (9°16' N)	31.6 (32.0)	23.6 (22.8)	27.6 (27.4)
Madakkathara (10°31' N)	32.3 (32.9)	23.3 (22.5)	27.8 (27.7)
Pilicode (12°12' N)	31.4 (31.9)	23.1 (21.0)	27.3 (26.5)
Anakkayam (11°01'N)	32.7 (33.0)	22.8 (21.3)	27.8 (27.1)
Ambalavayal (11°37' N)	27.3 (27.4)	17.4 (15.6)	22.4 (21.5)

When the mean surface air temperature was examined during flowering phase (Nov-Feb) across the State, the difference (27.7 to 21.5°C) between Madakkathara and Ambalavayal was relatively higher (6.2°C). There was a difference of 0.5 to 1.2°C in mean surface air temperature from South to North of Kerala with increase in latitude also. It indicated that the difference in atmospheric temperature across the State was less latitudinally while it was high altitudinally. The low surface air temperature with latitude may be due to the marine influence. However, there was a difference of 1.8°C in minimum surface air temperature from Kottarakkara (9°16'N) to Pilicode (12°12'N) during the flowering period. It revealed that the influence of latitude and altitude reflected on the surface air temperature which led to delay in biotic events of cashew.

All the biotic events of cashew in the three test varieties delayed with increase in latitude and altitude from South to North and Northeast of Kerala. It is evident that the delay in biotic events such as bud break, flowering, harvest and the total crop duration of cashew depend on latitude and altitude if the longitude is same and the rainfall distribution is alike under better crop management situation in rainfed conditions.

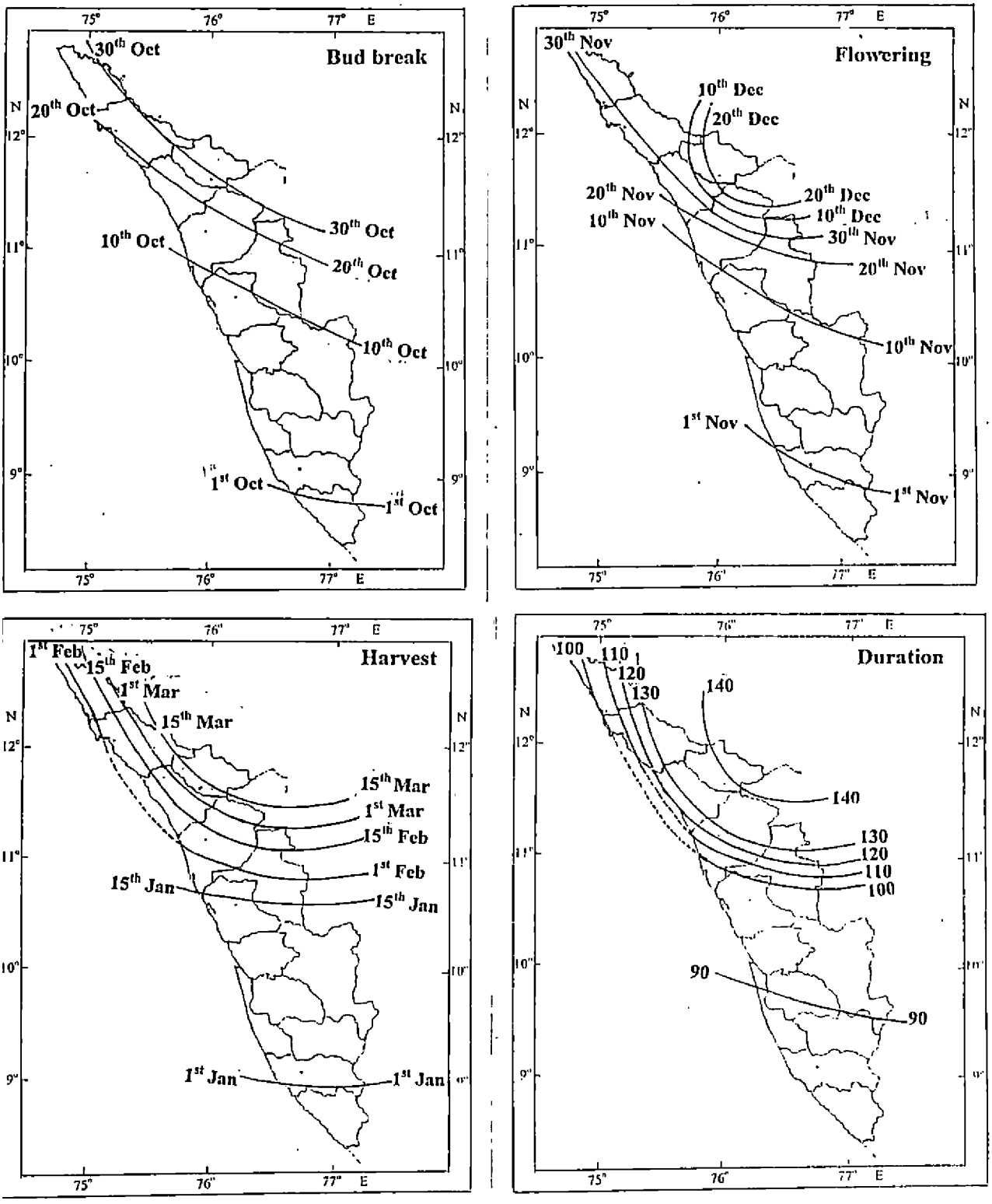


Fig 6a. Isophanes of cashew (BLA-139-1) across Kerala

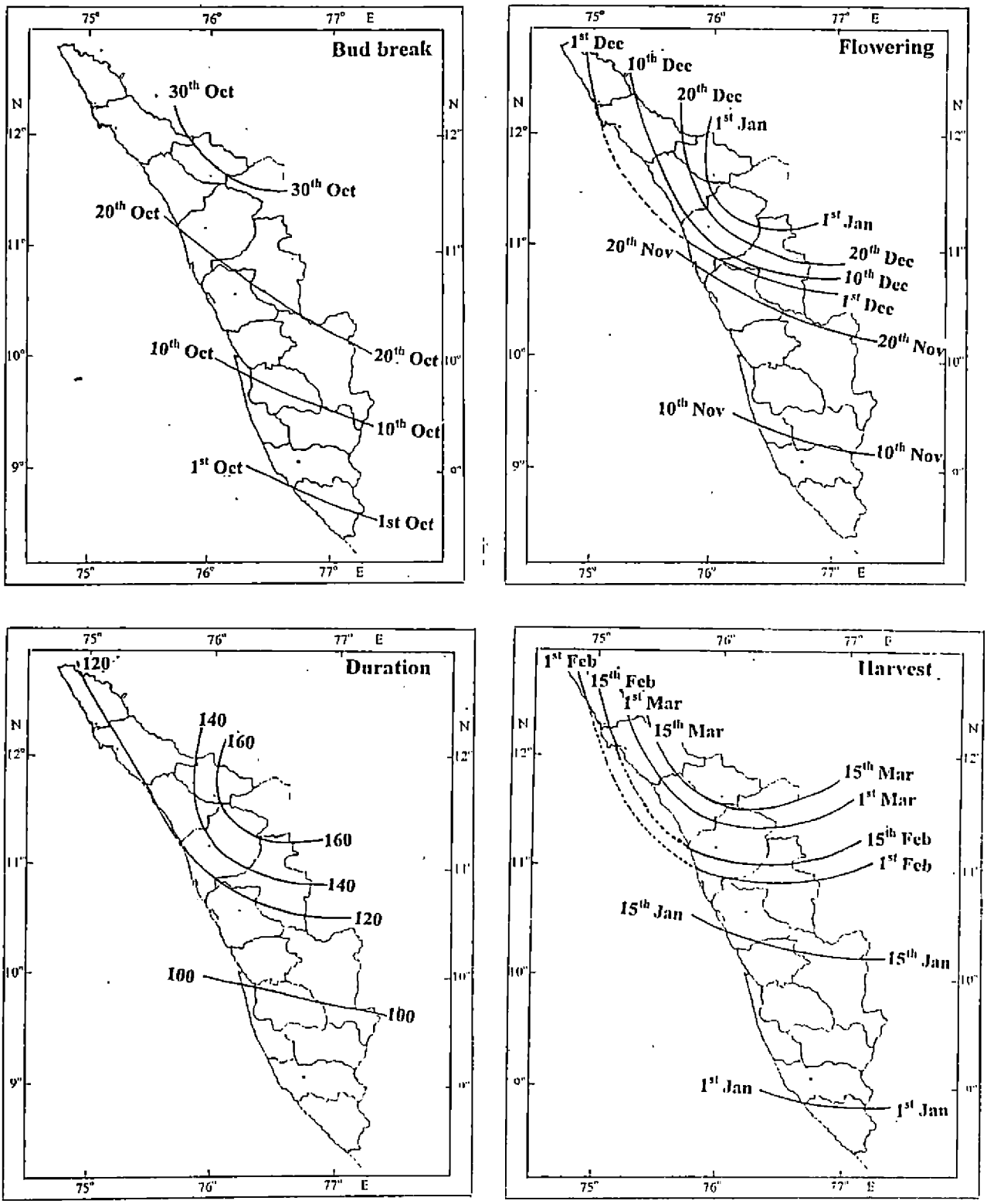


Fig 6b. Isophanes of cashew (BLA-39-4) across Kerala

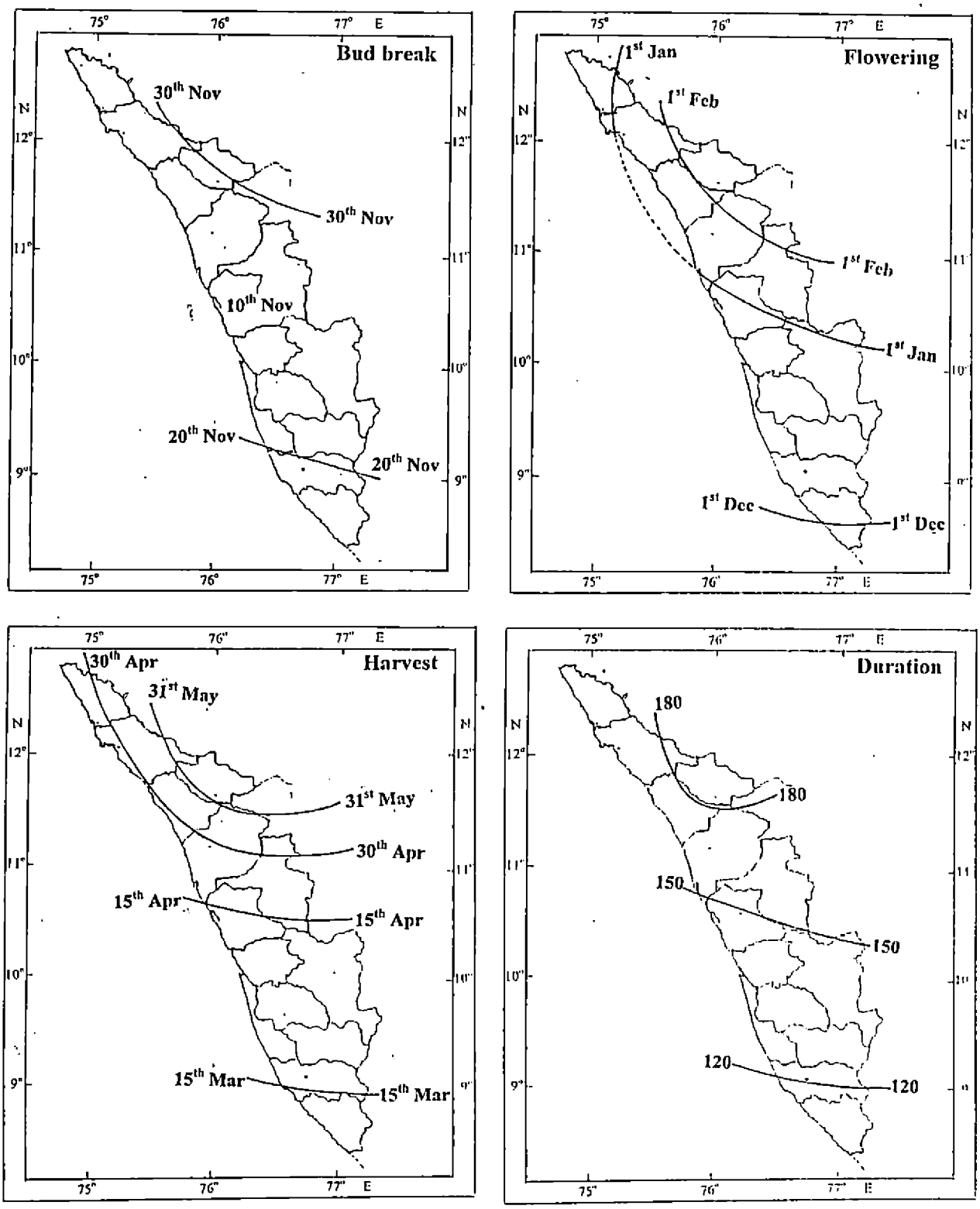


Fig 6c. Isophanes of cashew (NDR-2-1) across Kerala

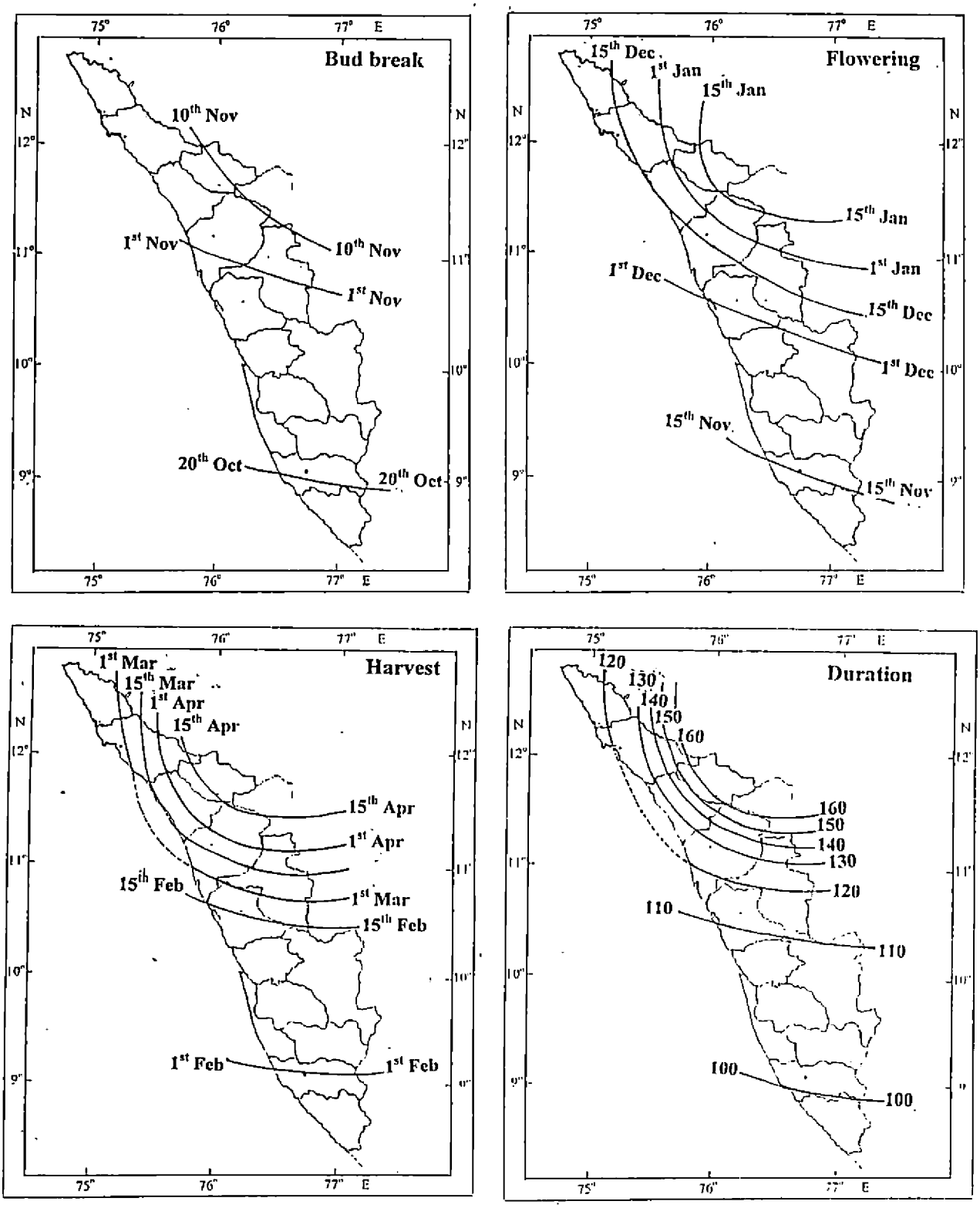


Fig 6d. Mean isophanes of cashew across Kerala

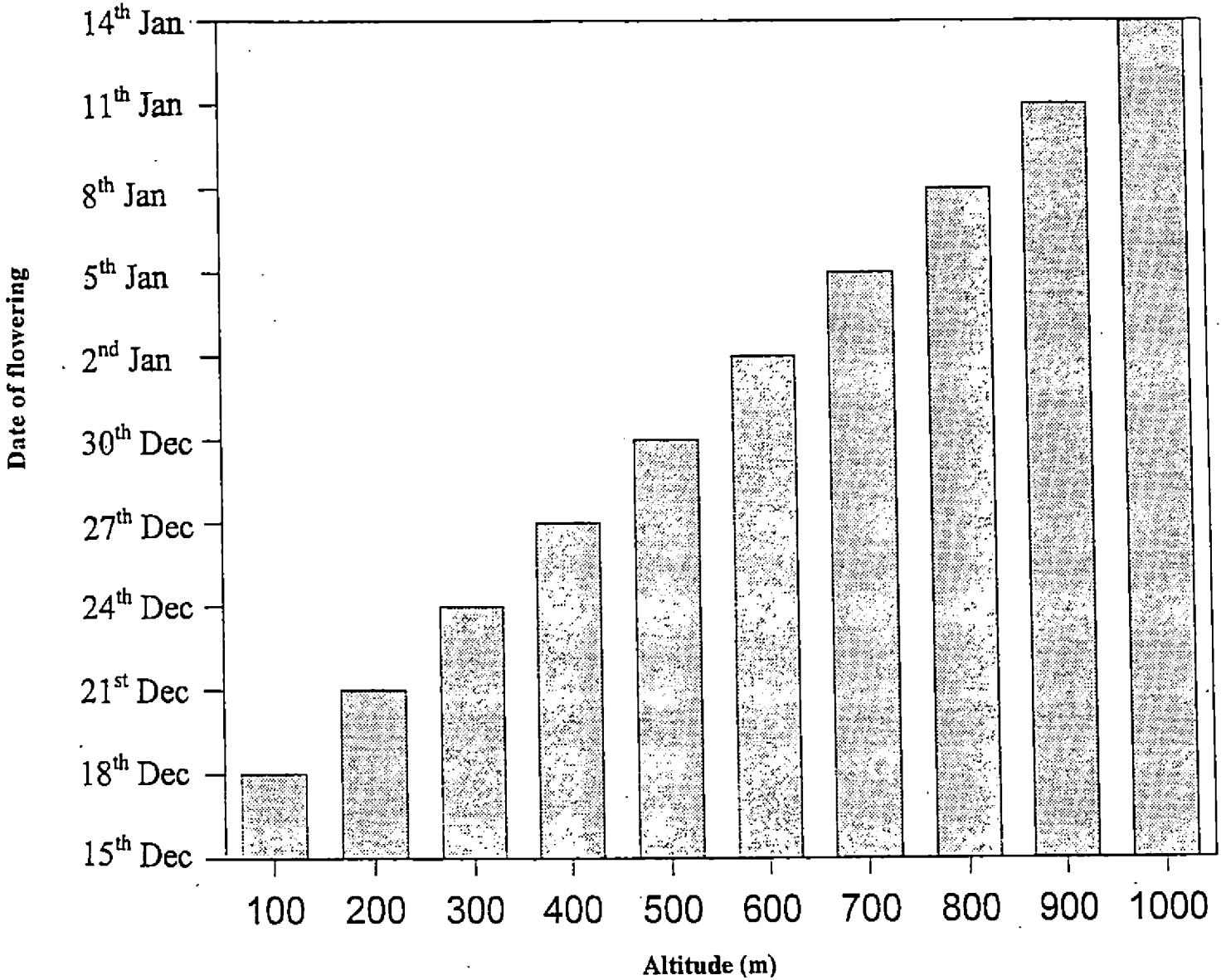


Fig 7. Influence of altitude on cashew flowering

Hopkins (1938) attempted to express the importance of latitude, longitude and altitude in the distribution and rate of development of plants by means of a "Bio climatic law". It may be stated as "A biotic event in North America will, in general, show a lag of four days for each degree of latitude, five degree of longitude and 400 feet of altitude, northward, eastward and upward in spring and early summer". In case of mango, the India Meteorological Department also established that there was a delay in flowering from South to North of India, which generally followed Hopkins' Bio climatic law (Anonymous, 1957).

Evans (1931), after studying blooming dates of timothy, said that Hopkins' law did not give proper emphasis to increasing day length with higher latitudes. The day-length factor tends to compensate in part for the delay in growth caused by an increase in latitude. However, the compensatory effect of longer days is difficult to evaluate precisely.

The compensatory effect of longer days in part for the delay in biotic events of cashew with latitude towards North is ruled out in the present case as the delay in biotic events of cashew was noticed due to rainfall distribution and surface air temperature. In fact, it is the other way happens as the day-length is shorter with latitude during the flowering phase of cashew (Table 7) across West and East coasts of India, which may sometimes influence late flowering with latitude to some extent. Of course, the low elevation of Sun's angle towards North leads to less intensity of solar radiation during winter. The above situation together with short-days may reflect on low surface air temperature.

Table 7. Maximum possible duration of bright sunshine with latitude expressed in units of 30 days and 12 hours.

Location	Mean annual maximum possible sunshine hours per day	Mean maximum possible sunshine hours during flowering period (Nov-Feb) per day
Kottarakkara (9°16' N)	1.02	0.98
Madakkathara (10°31' N)	1.02	0.98
Pilicode (12°12' N)	1.02	0.98
Anakkayam/Vriddhachalam (11°01' N) / (11°03' N)	1.02	0.98
Ambalavayal (11°37' N)	1.02	0.98
Vengurla/Bapatla (15°51' N) / (15°54'N)	1.03	0.97
Bhubaneswar (20°15' N)	1.03	0.93
Jhargram (22°28' N)	1.03	0.92

The law stated by Hopkins is sound in biotic events of cashew in tropical monsoon climates under better crop management in rainfed situations, provided the genotype and rainfall distribution are uniform. However, there was a difference in number of days delayed in cashew flowering at each degree of North latitude while the effect of altitude on time of cashew flowering is similar as stated by Hopkins (1938). In humid tropic monsoon climates, there appeared to be a delay of six days in cashew flowering at every 1^0 of North latitude and for every 100 meters of altitude, the delay in cashew flowering was three days.

12.2 Weather and Cashew Production

12.2.1. Cashew production of Kerala

A gradual decline was noticed in cashew production of Kerala from 1995-96 to 1998-99. The cashew production of the State was high (1,40,000 tonnes) in 1995-96 and the expected yield during 1998-99 may be the lowest (75,000 tonnes). Though there was a marginal increase in cashew area from 1995-96 to 1998-99, the decline in cashew production when compared to that of 1995-96 varied between 4.3% and 46.4 % in 1996-97 and 1998-99, respectively. Similar was the trend in Kannur and Kasaragod districts (Table 8). These two districts together may record the lowest (less than 30,000 tonnes) cashew production during 1998-99, accounting for more than 57.1% decline when compared to that of 1995-96. Normally, the percentage share of the above two districts was around 65% of the total cashew production of Kerala.

Table 8. Area and cashew production of Kerala from 1995-96 to 1998-99

Year	Area (ha.)	Production (in tonnes)	Production of Kannur and Kasaragod districts	Remarks
1995-96	1,18,600	1,40,000	70,000	Flowering was good and relatively free from tea mosquito attack
1996-97	1,19,600 (0.34%)	1,34,000 (-4.3 %)	32,000 (-54.3 %)	Flowering was moderate and tea mosquito attack was noticed
1997-98	1,20,000 (1.18 %)	1,00,000 (-28.6 %)	54,000 (-22.9 %)	Flowering was very poor and late in mid and late season types and relatively free from tea mosquito
1998-99	NA	75,000* (-46.4 %)	<30,000* (more than –57.1 %)	Profuse flowering and unprecedented pest complex (Tea mosquito and the fungus *Colletotrichum sp.*) was noticed across cashew tract of Kasaragod and Kannur districts. Similar was the case in entire Kerala.

* Estimated figures; ( ) figures in parenthesis indicate percentage increase in area and decrease in production when compared to that of 1995-96.

In Kerala, a bumper crop of two lakh tonnes of cashewnut is expected in 1998-99 as abundant flowering was noticed in December/January due to favourable weather. However, the crop was severely damaged due to a pest complex (Tea mosquito and the fungus *Colletotrichum. sp*) during 1998-99. The crop was relatively better wherever scientific pest control measures were taken up (Table 9).

Table 9. Cashew production in an area of 1327.57 ha. at the Central State Farm, Aralam (Kannur district)

Year	Cashew Production (in tonnes)	Remarks
1996-97	870	Better yield due to scientific pest control
1997-98	460	Poor yield due to bad weather. Poor and late flowering was also noticed. Relatively free from tea mosquito.
1998-99	600(Expected)	Profuse flowering due to good weather. Conducive for pest complex. Relatively better yield due to scientific pest control.

The Central State Farm at Aralam (Kannur district) recorded the highest (870 tonnes) cashew production in 1996-97 due to scientific pest control despite a poor cashew output (32,000 tonnes in 1996-97 as against 70,000 tonnes in 1995-96) in Kannur and Kasaragod districts. The crop output in 1997-98 was only 460 tonnes and it is expected to be around 600 tonnes in 1998-99 as against the initial target of 900 tonnes. The relatively better yield in 1998-99 at Aralam was attributed to scientific pest control against severe attack of a pest complex.

The test varieties, in particular, early season types gave higher yield during 1998-99 under scientific pest control measures at RARS Pilicode. ANK-1 yielded 7.1 kg/tree (Table 10) during 1998-99 as against 1.8 kg/tree in 1997-98 while it was 9.7 kg/tree in case of MDK-1 as against 7.1 kg/tree in 1997-98. The mid and late season types (Kanaka and Mdk-2) suffered heavily due to a pest complex (Tea mosquito and the fungus *Colletotrichum.sp*) in 1998-99. The early season types like Ank-1 and Mdk-1 escaped to some extent and yielded better.

Table 10. Cashew yield (kg/tree) of test varieties during 1997-98 and 1998-99

Variety	Yield (kg/tree)	
	1997-98	1998-99
Ank-1	1.8	7.1
Mdk-1	7.1	9.7
Kanaka	4.0	3.7*
Mdk-2	12.8**	4.3*

* Severely affected due to a pest complex. Yield of Mdk-2 will be more as the crop under second flowering is yet to be harvested during which the pest complex incidence is meagre.

** High yield was due to second flowering. Harvest delayed till the end of May. High yield also could be attributed to better nut weight.

Low cashew output in 1997-98 was attributed to adverse weather, which affected flowering phase during 1997-98. Tea mosquito or pest complex was reported to be relatively less

during the year, 1997-98. Similar was the case to some extent during 1996-97, but tea mosquito incidence was noticed. Profuse flowering was noticed during 1998-99 due to favourable weather; but cashew yield was very poor due to unprecedented attack of a pest complex (Tea mosquito and the fungus *Colletotrichum. sp*). Flowering was good in 1995-96 and the incidence of tea mosquito was meagre. In 1996-97 and 1998-99, the cashew yield was relatively better wherever scientific pest control measures were taken up as was the case at Aralam and Pilicode despite the poor yield obtained as a whole. However, 1998-99 was the worst year from cashew production point of view despite weather was conducive for profuse flowering while 1997-98 was the worst year due to bad weather, resulted in poor and late flowering.

From the above four situations (1995-96, 1996-97, 1997-98 and 1998-99), it is understood that profuse flowering was noticed during 1995-96 and 1998-99. The cashew production was good in 1995-96, while poor in 1998-99 due to severe attack of a pest complex. The year 1997-98 was the worst year in which flowering was very poor and late, resulted in low cashew production. It was also observed that the cashew plantations in Kannur and Kasaragod districts were relatively free from tea mosquito during 1997-98. Keeping the above in view, an attempt was made to understand the effect of weather elements on cashew flowering and its impact on cashew yield.

12.2.2 Cashew flowering

The time of flowering was early (08th December) during 1995-96 and late (29th December) during 1997-98, followed 1998-99 when all the test varieties pooled together. There was a significant delay (02.02.1998) in peak flowering of MDK-2, followed by Kanaka (13.01.1998) during 1997-98 (Table 11). However, the early varieties flowered on normal dates during the above year. The delay in flowering during 1997-98 was attributed to the late season types as they flowered very late.

Table 11. Flowering time of test varieties at RARS Pilicode from 1995- 96 to 1998-99

Variety	Time of flowering (50%)				
	1995-96	1996-97	1997-98	1998-99	Mean
Ank-1	29.11.95	04.12.96	02.12.97	07.12.98	03, Dec
Mdk-1	25.11.95	06.12.96	05.12.97	12.12.98	05,Dec
Kanaka	17.12.96 *	15.12.96	13.01.98	26.12.98	29,Dec
Mdk-2	22.12.95	25.12.96	02.02.98	21.12.98	01st,Jan
Mean	08, Dec	13, Dec	29, Dec	17, Dec	17th Dec

* Date found through missing value technique

CD (0.05) – 20 days CD (0.01) – 28 days

The peak flowering was noticed during the first week of December in early season types (Ank-1 and Mdk-1), while it was by the end of December/beginning of January in late

varieties (Kanaka and Mdk-2) under better crop management. However, the time of peak flowering outside the station was during January/February (one month delay) due to poor crop management and the planting material, which was from seedlings of unknown pedigree.

12.2.3. Weather

Rainfall

There was no significant rainfall from January to March in all the four years 1996,1997,1998, and 1999 (Table 12). The daily distribution of rainfall during November and December indicated that there was no rainfall since 09th November onwards in 1995. The daily rainfall in 1996 showed that there was a wet spell in the end of November and between 7th and 17th December. Interestingly, there was few wet spells spread between November and December, 1997 (Fig.8). Almost similar to that of 1995, there was no wet spell since 18th November onwards except instant rains on 1st and 13th December, 1998. It was also noticed that cloudy weather prevailed during December in 1996 (09th to 19th December), 1997 (Intermittent) and 1998 (Second week of December). Exceptionally, no cloudy weather was seen in December, 1995 (Fig.9).

Table 12. Monthly rainfall (mm), bright sunshine (h/day), dew fall (mm) and pan evaporation (mm) at RARS, Pilicode during reproductive phase of cashew from 1995-96 to 1998-99

Weather parameter	Year	Nov	Dec	Jan	Feb	Mar
Rainfall (mm)	1995-96	68.7 (4)	0.0	0.0	0.0	0.0
	1996-97	65.4 (2)	45.6 (3)	0.0	0.0	0.0
	1997-98	115.3 (9)	59.3 (5)	0.0	0.0	1.4
	1998-99	60.9 (7)	60.6 (2)	0.0	0.0	1.2
Bright sunshine (h/day)	1995-96	08.7	10.3	09.6	10.1	09.2
	1996-97	08.3	08.0	10.1	10.1	09.4
	1997-98	06.8	08.0	09.8	10.1	09.8
	1998-99	07.5	07.9	09.6	10.0	09.3
Dew fall (mm)	1995-96	4.85 (15)	7.16 (26)	3.71 (17)	0.56(3)	0.07(1)
	1996-97	6.80 (22)	7.07 (19)	5.48 (28)	2.61(15)	1.67(12)
	1997-98	3.44 (19)	3.28 (22)	3.60 (21)	1.48(14)	0.0
	1998-99	0.58 (2)	7.22 (24)	5.30 (28)	2.77(19)	0.61(3)
Pan evaporation (mm)	1995-96	111.0	133.3	124.0	142.0	174.7
	1996-97	107.3	99.4	127.6	132.4	159.7
	1997-98	98.8	103.4	127.4	140.8	181.3
	1998-99	112.2	107.1	107.4	122.1	151.9

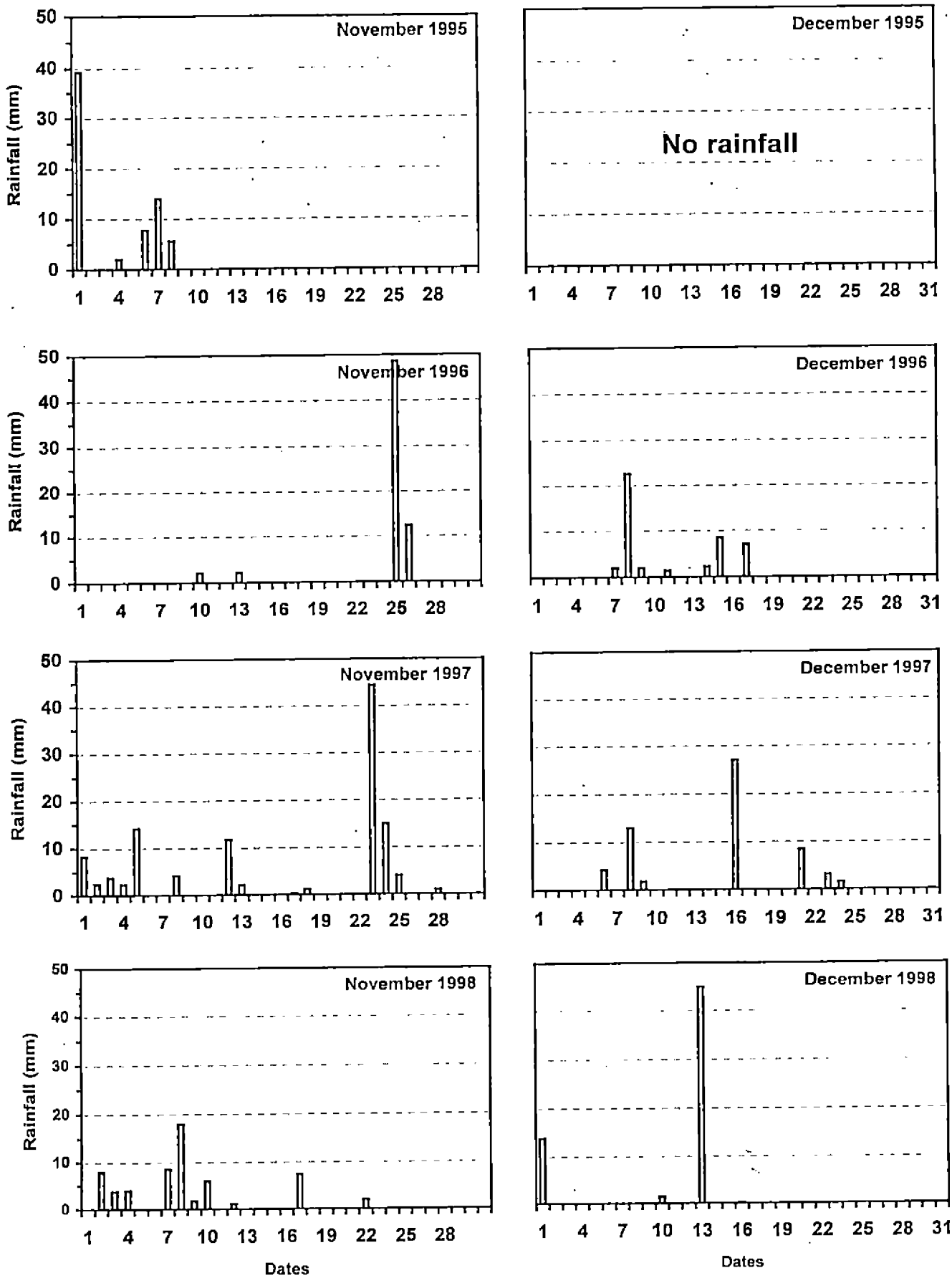


Fig 8. Daily rainfall distribution during November and December from 1995 to 1998 at RARS, Pilicode

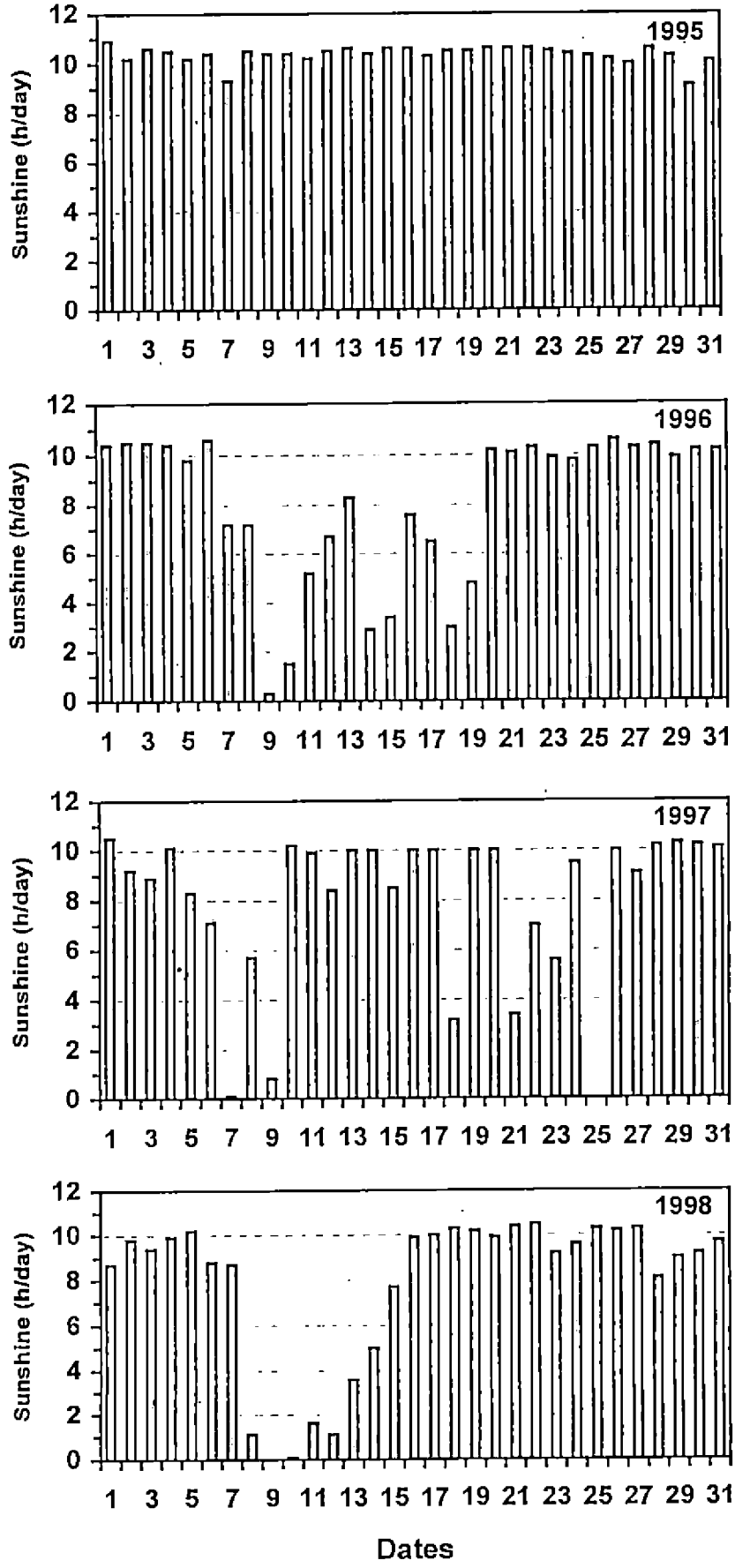


Fig 9. Daily bright sunshine (h/day) during December from 1995 to 1998 at RARS, Pilicode

Sunshine

The duration of bright sunshine hours was relatively more (10.3 h/day) in December, 1995 (Table 12) when compared to that of December, 1996 (8.00 h/day), 1997 (8.00 h/day) and 1998 (7.9 h/day). The low number of bright sunshine hours in 1998 was due to cloudy weather in the second week of December. Thereafter, it was similar to that of 1995. The number of bright sunshine hours was almost similar (Between 9.2 and 10.1 h/day) from January to March in all the four years. It indicated that the atmosphere was relatively bright with more number of sunshine hours during November and December, 1995.

Maximum Temperature

The maximum temperature was similar (Table 13) in December (31.3 °C in 1995and 31.2 °C in 1998) and January (31.3 °C in 1995 and 31.2 °C in 1998) during 1995-96 and 1998-99. An increase in maximum temperature (31.8 °C in December 1997 and 32.5 °C in January 1998) was noticed during December and January in 1997-98. A low of 30.7 °C was noticed during December in 1997.

Table 13. Monthly surface air temperature (°C) at RARS, Pilicode during reproductive phase of cashew from 1995-96 to 1998-99

Weather parameter	Year	Nov	Dec	Jan	Feb	Mar
Max. temp (°C)	1995-96	31.0	31.3	31.3	32.2	33.0
	1996-97	31.3	30.7	31.2	31.1	32.5
	1997-98	31.6	31.8	32.5	32.6	32.9
	1998-99	31.1	31.2	31.2	32.8	33.1
Min. temp (°C)	1995-96	22.8	18.7	18.7	20.8	24.1
	1996-97	23.0	20.3	19.8	20.3	23.6
	1997-98	23.4	23.1	21.3	21.6	23.5
	1998-99	22.3	21.1	19.1	20.1	24.0
Mean. temp (°C)	1995-96	26.9	25.0	25.0	26.5	28.6
	1996-97	27.2	25.5	25.5	25.7	28.1
	1997-98	27.5	27.5	26.9	27.1	28.2
	1998-99	26.7	26.2	25.2	26.5	28.6
Temp. Range (°C)	1995-96	08.2	12.6	12.6	11.4	08.9
	1996-97	08.3	10.4	11.4	10.8	08.9
	1997-98	08.2	08.7	11.2	11.0	09.4
	1998-99	08.8	10.1	12.1	12.7	09.1

Minimum Temperature

The minimum temperature varied between 16 and 20°C except on five days during December 1995 (Fig 10). Similar was the case during second fortnight of December, 1998 and January, 1999. It was quite interesting to note that the minimum temperature was

always above 20 °C during December, 1997 and above 19 °C in January, 1998. In December 1996 and January 1997, the minimum temperature was below 20 °C in 65% of the days.

Dew fall

The number of dew nights and dew amount were higher (7.16 mm in 26 nights) during December 1995, followed by 1998(7.22 mm in 24 nights). In 1996, the number of dew nights was 19, having a dew amount of 7.07mm. A similar trend was followed during January in 1997 (5.48mm in 28 days) and 1998 (5.3 mm in 28 days) and continued in February, 1997 also. The least (3.28mm in 22 nights during December and 3.6 mm in 21 nights during January) was the case during 1997-98 (Table 12). It revealed that the dew amount was very low during 1997-98 when compared to that of 1995-96 and 1998-99, which recorded profuse flowering in cashew.

Relative Humidity

The morning relative humidity was always more than 90% (Table 14) in all the four years during December and January. Interestingly, the atmosphere was relatively dry (Relative humidity was around 50% in the Afternoon) during 1995-96. It was wet in 1997-98 (RH-65% in AN). Relative humidity was intermediary during 1996-97 (RH-59% in AN) and 1998-99 (RH-59% in AN). The atmosphere was relatively dry in the afternoon during 1995-96 (54 %), followed by 1998-99 (59 %) when the entire reproductive phase (November to March) was taken into account. It was 61% during 1996-97 and 62% during 1997-98.

Pan evaporation

The Pan evaporation varied from 99.4 mm during December, 1996 to a maximum of 181.3 mm in March, 1998 (Table 12). From this also, it is understood that the atmosphere was relatively dry during December and January in 1995-96 as there was no rainfall and the pan evaporation rate was high. It also indicated that the flowering period (December and January) of cashew is always under soil moisture stress as evapotranspiration is always more than rainfall. Of course, the intensity of soil moisture stress varies depending upon rainfall received during December, which may be detrimental for cashew flowering. The flowering in cashew delayed during 1997-98 when rainfall received in intermittent wet spells during November and December, 1997.

Soil Moisture

The soil moisture availability expressed in terms of index of moisture adequacy (AE/PE x 100) showed that there was a decline in soil moisture from 69 to 28% during December 1995 and reached to nine per cent by the end of January 1996. In contrast, the availability of soil moisture was high (75 to 100%) during December and January (33 to 69%) in 1997-98, followed by 1996-97 (57 to 100% during December and 21 to 48% during January). It

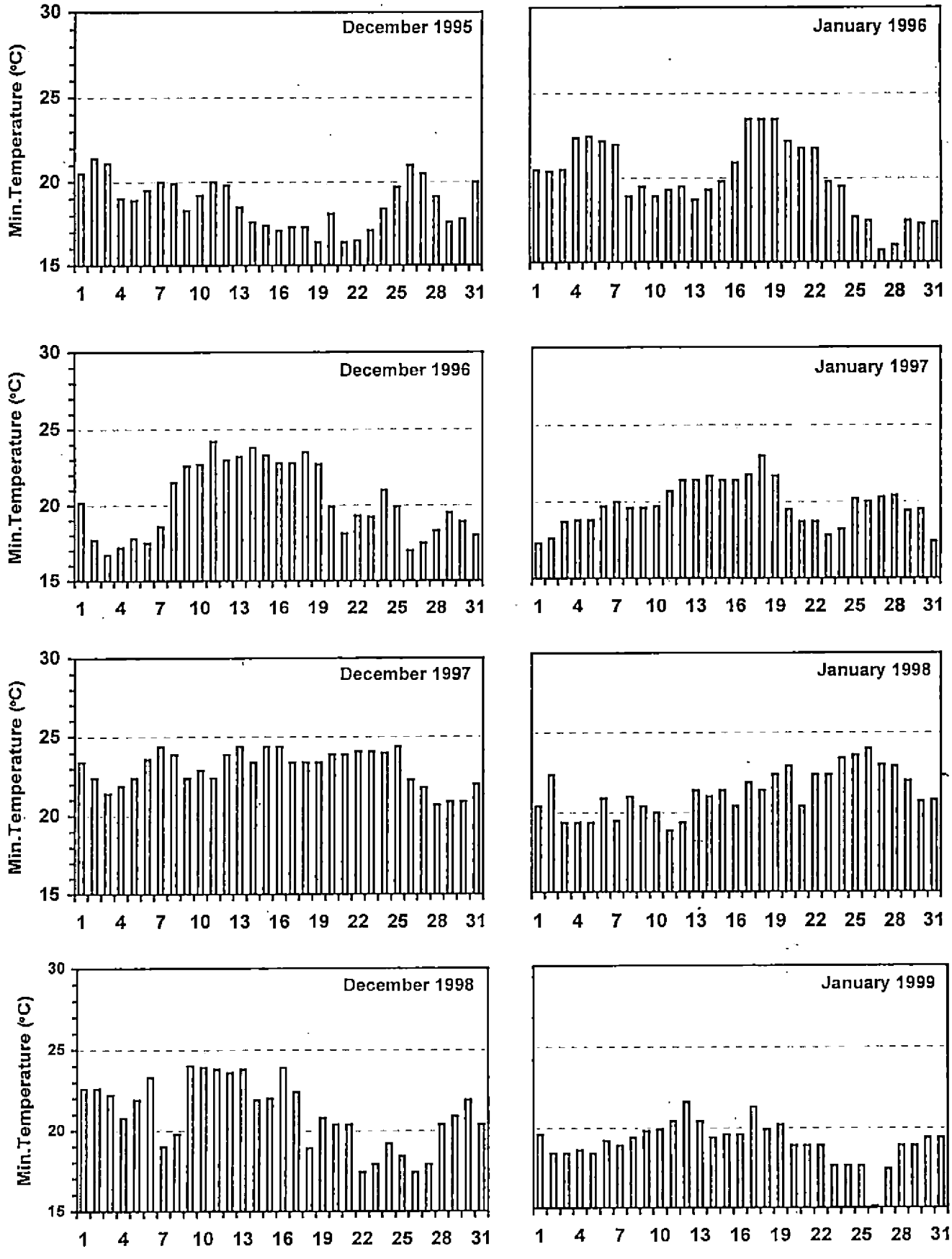


Fig 10. Daily minimum temperature (°C) during December and January from 1995-96 to 1998-99 at RARS, Pilcode

revealed that the soil moisture availability was low during 1995-96, followed by 1998-99 while it was relatively better during 1997-98, followed by 1996-97 (Table 15).

Table 14. Monthly relative humidity (%) at RARS, Pilicode during reproductive phase of cashew from 1995-96 to 1998-99

Weather parameter	Year	Nov	Dec	Jan	Feb	Mar
Relative humidity-morning (%)	1995-96	93	92	90	90	91
	1996-97	97	96	92	85	87
	1997-98	93	94	91	89	85
	1998-99	93	95	94	93	87
Relative humidity-AN (%)	1995-96	71	50	52	52	63
	1996-97	68	60	57	61	65
	1997-98	70	67	62	57	61
	1998-99	71	59	58	58	61
Mean relative humidity (%)	1995-96	82	71	71	71	77
	1996-97	83	78	75	73	76
	1997-98	82	81	77	73	73
	1998-99	82	77	76	76	74
Relative humidity range (%)	1995-96	22	42	38	38	28
	1996-97	29	36	35	24	22
	1997-98	23	27	29	32	24
	1998-99	22	36	36	35	26

Table 15. Weekly index of moisture adequacy ((AE/PE X 100) from 1995-96 to 1998-99

Std.Week No.	Index of moisture adequacy (%)			
	1995-96	1996-97	1997-98	1998-99
48 December	69	89	96	85
49	71	100	95	54
50	45	89	100	100
51	35	80	88	58
52	28	57	75	57
Mean	50	83	91	71
01 January	22	48	69	44
02	21	43	59	35
03	15	31	45	32
04	14	33	38	30
05	09	21	33	21
Mean	16	35	49	32

It is understood that the unusual rains during November and December, 1997 led to inordinate delay in flowering phase of the late season types Mdk-2 (02.02.98) and Kanaka (13.01.98). The flowering phase of the late varieties/ unknown pedigree also missed the normal winter season (December and January). It was likely that the number of bisexual

flowers produced might be less as a whole during 1997-98. This might be true in case of outside cashew plantations also, where the flowering was still prolonged. In 1997-98, the minimum temperature was always more than 20^0C during December and more than 19°C in January and quite interestingly, the amount of dew was very poor though the number of dew nights was normal during 1997-98. The flowering was better in 1995-96 and 1998-99 during which the minimum temperature was between 16 and 20^0C during December and January. Also, the amount of dew was relatively high with more number of dew nights during the flowering period in the above years.

From the above, it can be inferred that the flowering of cashew may require relatively dry atmosphere with mild winter for better flowering. The mild winter may be defined as "low minimum surface air temperature ranging between 16 and 20°C coupled with more dew nights having moderate dew" in humid climates. The better availability of soil moisture during flowering period (December and January) may not influence the flowering in cashew as evident in 1997-98. The unusual rains during November and December led to inordinate delay in reproductive phase of late season types/unknown planting material, which was detrimental for cashew production as the number of bisexual flowers produced might be less.

12.2.4 Cashew productivity across West and East coast of India

The productivity of cashew was high (1267 kg/ha) in Maharashtra, followed by Kerala (966 kg/ ha) and Andhra Pradesh (820 kg/ha). The lowest cashew productivity was noticed in Tamil Nadu (212 kg/ha), followed by Goa (365 kg/ha). When the major cashew States pooled together across West and East coast of India, the cashew productivity across West coast (Kerala,Karnataka, Goa and Maharashtra) was 776 kg/ha and it was less (602 kg/ha) across East coast (Tamil Nadu, Andhra Pradesh, Orissa and West Bengal) as against the average production (654 kg/ha) of the country (Table 16). The West coast of India contributes 67.7% of the total production of the country from 55% of area of the total cultivable land under cashew. Whereas, the East coast contributes 31.6% of the total production in 44% of the total area. It clearly indicated the contribution in terms of cashew production and productivity is much better from West coast when compared to that of East coast. However, the productivity of cashew among West (612 kg/ha) and East (602 kg/ha) coasts were comparable when the cashew productivity of Maharashtra was taken away, where cashew production was the highest (1267 kg/ha) due to the policies of state agencies. Of course, the rainfall distribution and surface air temperature were also conducive for better cashew production across Maharashtra as seen in case of RFRS, Vengurla (Maharashtra). It also revealed that Maharashtra dominates in cashew production and productivity across the West coast.

Table 16. Average Area, Production and Productivity of Cashew in India from 1986-87 to 1997-98

State	Area ('000 ha)	Production ('000 tonnes)	Productivity (kg/ha)
Kerala	146.45	135.23	966
Karnataka	76.81	30.51	506
Goa	46.57	16.02	365
Maharashtra	45.30	41.76	1267
Tamil Nadu	91.61	18.81	212
Andhra Pradesh	83.86	45.87	820
Orissa	71.35	35.45	741
West Bengal	7.36	4.15	635
Other States	3.32	2.36	375
Total	572.63	330.16	654

The average cashew yield (Table 17) at different locations also indicated that Vengurla (Maharashtra) outyielded (18.7 kg/tree) when compared to that of Madakkathara (4.9 kg/ha) in Kerala, Chintamani (4.4 kg/tree) in Karnataka, Vriddhachalam (8.2 kg/tree) in Tamil Nadu and Bhubaneswar (10.0 kg/tree) in Orissa.

Table 17. Average yield of cashew at different locations

Locations	Average yield of cashew (kg/tree)
Vengurla (Maharashtra)	18.7
Madakkathara (Kerala)	04.9
Chinthamani (Karnataka)	04.4
Vriddhachalam (Tamil Nadu)	08.2
Bhubaneswar (Orissa)	10.0

At the same time, same Vengurla varieties did not perform well outside the State though did well at Vengurla. The performance of Anakkayam-1 at Vengurla was poor though it was identified as one of the early and best varieties across the West coast. It was noticed that Vengurla recorded relatively low cashew yield (3.8 kg/tree) when compared to that of Pilicode (4.6 Kg/tree). In case of Mdk-1, Pilicode (7.4 Kg.tree) and Bhubaneswar (7.6 kg/tree) performed on par. However, Jhargram recorded low (3.1 kg/tree) cashew yield in case of Mdk-1. Interestingly, Bhubaneswar performed better (8 kg/tree), followed by Jhargram (5.9 kg/tree) in case of Kanaka (Table 18) and the least (2.5 kg/tree) at Vriddhachalam. Chintamani also recorded better yield (5.0 kg/tree) in case of Kanaka. At the same time, Vriddhachalam recorded better yield (8.2 kg/tree) when all the varieties pooled together (Table 17). It revealed that the adaptibility of genotype under a given

management is very important for obtaining better yield as the varieties behaved differently at different locations.

Table 18. Average cashew yield (kg/tree) of test varieties across West and East coasts of India from 1996-97 to 1998-99

Location	Yield (kg/tree)			
	Ank-1	Mdk-1	Kanaka	Mdk-2
Pilicode	4.6	7.4	3.3	6.0
Vengurla	3.8	-	-	-
Chintamani	-	-	5.0	-
Vriddhachalam	-	-	2.5	-
Bhubaneswar	-	7.6	8.0	-
Jhargram	-	3.1	5.9	-

From the above, it is clear that the cashew yield depends on the adaptability of a particular genotype, crop management practices and the weather that prevails in a particular year. Pest complex is another major problem across the West coast which sometimes decides the crop harvest. Though weather was favourable for profuse flowering as the case in 1998-99, the cashew production was severely affected due to the pest complex. This is one of the major reasons, why, the better yields in cashew could not be obtained though weather is conducive for better flowering across West coast. However, Maharashtra is an exceptional case where crop is given considerable importance by the State agencies. The cashew productivity in Maharashtra stands high while among West and East coasts, the productivity looks on par (Fig 11).

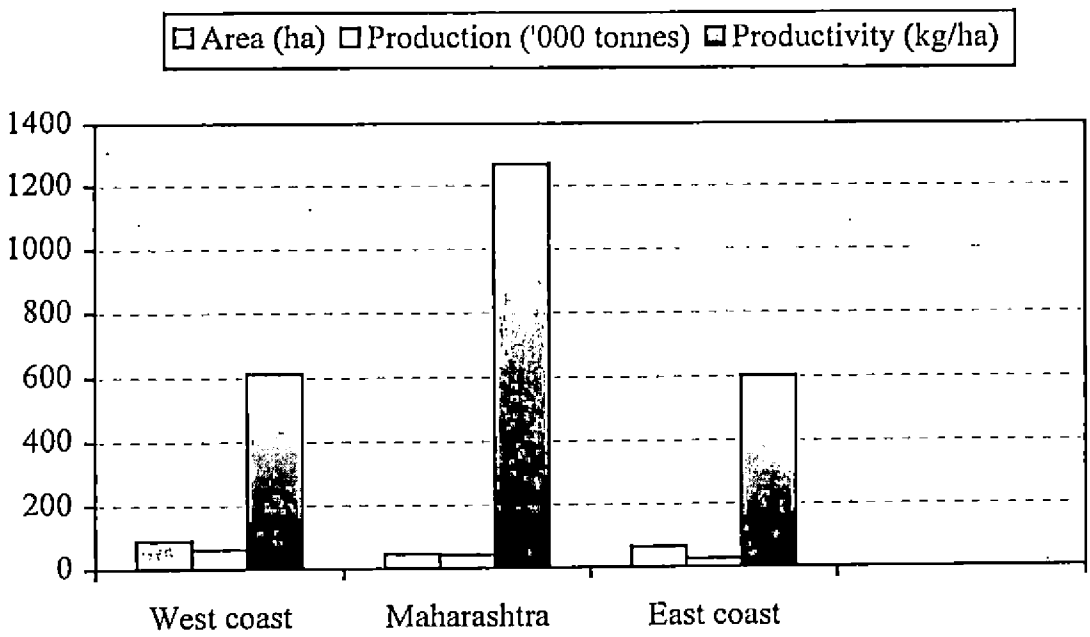


Fig 11. Area, production and productivity of cashew across West and East coasts of India

Goa, Karnataka and Tamil Nadu need a special attention to exploit a similar situation like Maharashtra, which will help to improve cashew production of the country to a greater extent as the area under cashew is more and its productivity was relatively less. The nutritional status of soils also must be improved further in the East coast as the soils are sandy to sandy loam. The availability of K_2O was much less in the East coast (Bapatla-44.33 kg/ha; Bhubaneswar-25.36 kg/ha and Jhargram-162.98 kg/ha) when compared to that of West coast (Pilicode-215.68 kg/ha and Vengurla-204.96 kg/ha). The total available Nitrogen and Organic Carbon were also less in the East coast (Table 19).

Table 19. Soil characteristics at selected locations during 1998-99*

Location	Soil characteristics				
	Organic Carbon (%)	pH	EC mmhos/cm	Total available Nitrogen (%)	K_2O (kg/ha)
Pilicode	1.94	5.27	0.124	0.23	215.68
Vengurla	1.26	5.54	0.111	0.08	204.96
Bapatla	0.20	6.29	0.124	0.08	44.33
Bhubaneswar	0.20	5.16	0.110	0.09	25.36
Jhargram	0.15	5.58	0.097	0.14	162.98

* Soil samples were collected at the time of bud break and flushing (Nov-Jan)

Despite technological improvement in cashew cultivation of Kerala, the cashew production (1,00,000 tonnes) and the productivity (850 kg/ha) was in negative trend during 1997-98 when compared to that of average production (1,35,230 tonnes) and productivity (966 kg/ha). Though the area under cashew was marginally in increasing trend, there was a decreasing trend recently in cashew production as well in productivity. This temporary phenomenon was mostly attributed to unfavourable weather conditions. In addition, pest complex is a menace for cashew production of the State as noticed during 1998-99 though weather was favourable for profuse flowering. It is quite interesting to note that a situation which is favourable for flowering in cashew, also conducive for incidence of pest complex across cashew tract of Kerala. Unless something is done concretely to mitigate the ill effects of pest complex on cashew production, it is difficult to sustain cashew production of Kerala. Hence, it is suggested that a multidisciplinary team consisting of various related organizations should be constituted to tackle the problem effectively and sustain cashew production of Kerala as proven technology is available for sustenance of cashew production.

12.3 Rainfall and bright sunshine versus bud break of cashew

12.3.1. Bud break of cashew

The time of bud break of early season types viz., Ank-1 and Mdk-1 was on 21, October and 16, October, respectively. In case of late varieties viz., Kanaka and Mdk-2, the bud break was on 01, November and 20, November respectively (Table 20). It revealed that the time of bud break of cashew was early in early season types and late in late season types. The time of bud break in Mdk-1 showed alternate tendency. However, it needs to be examined further. The bud break was early (06, October) during 1995-96 and late (10, November) during 1998-99, followed by 1996-97 (09, November). The bud break of MDK-2 was too late (16, December) during 1997-98. It also revealed that year to year variations in time of bud break was not uncommon irrespective of genotype, indicating that the bud break was influenced very much by other environmental factors.

Table 20. Time of bud break (25%) of test varieties at RARS, Pilicode from 1995-96 to 1998-99

Variety	Time of bud break (25%) of test varieties				
	1995-96	1996-97	1997-98	1998-99	Mean
Ank-1	26, Sept	30, Oct	23, Oct	03, Nov	21, Oct
Mdk-1	22, Sept	02, Nov	03, Oct	03, Nov	16, Oct
Kanaka	08, Oct*	14, Nov	30, Oct	15, Nov	01, Nov
Mdk-2	28, Oct	19, Nov	16, Dec	17, Nov	20, Nov
Mean	06, Oct	09 Nov	02, Nov	10, Nov	30, Oct

*Obtained through missing value technique

12.3.2. Rainfall versus bud break

The weekly rainfall versus bud break of cashew showed that the bud break was noticed after prolonged wet spell, which normally ends up by September/October (Fig.12) across the West coast. Since the bud break of cashew varied between September and December depending upon the variety and it was seen immediately after wet spell, it may not be subjected to soil moisture stress. A moderate soil moisture stress (less than 50% of Ima) could be seen only from the middle of December, indicating that the soil moisture stress begins only after bud break occurs. As there is no dearth of soil moisture and bud break of cashew varied depending upon genotype and rainfall distribution, it is likely that the bud break may be more dependent on atmospheric variables under better crop management situations.

A close examination on the daily distribution of rainfall from August to December during 1995, 1996, 1997 and 1998 (Fig 13) indicated that early cessation of rains and intermittent dry spells during August and September, 1995 might have led to early bud break in cashew during that year. In contrast, it was not the case during 1998-89, which led to delay in bud break of cashew. However, the delay in bud break of late variety was

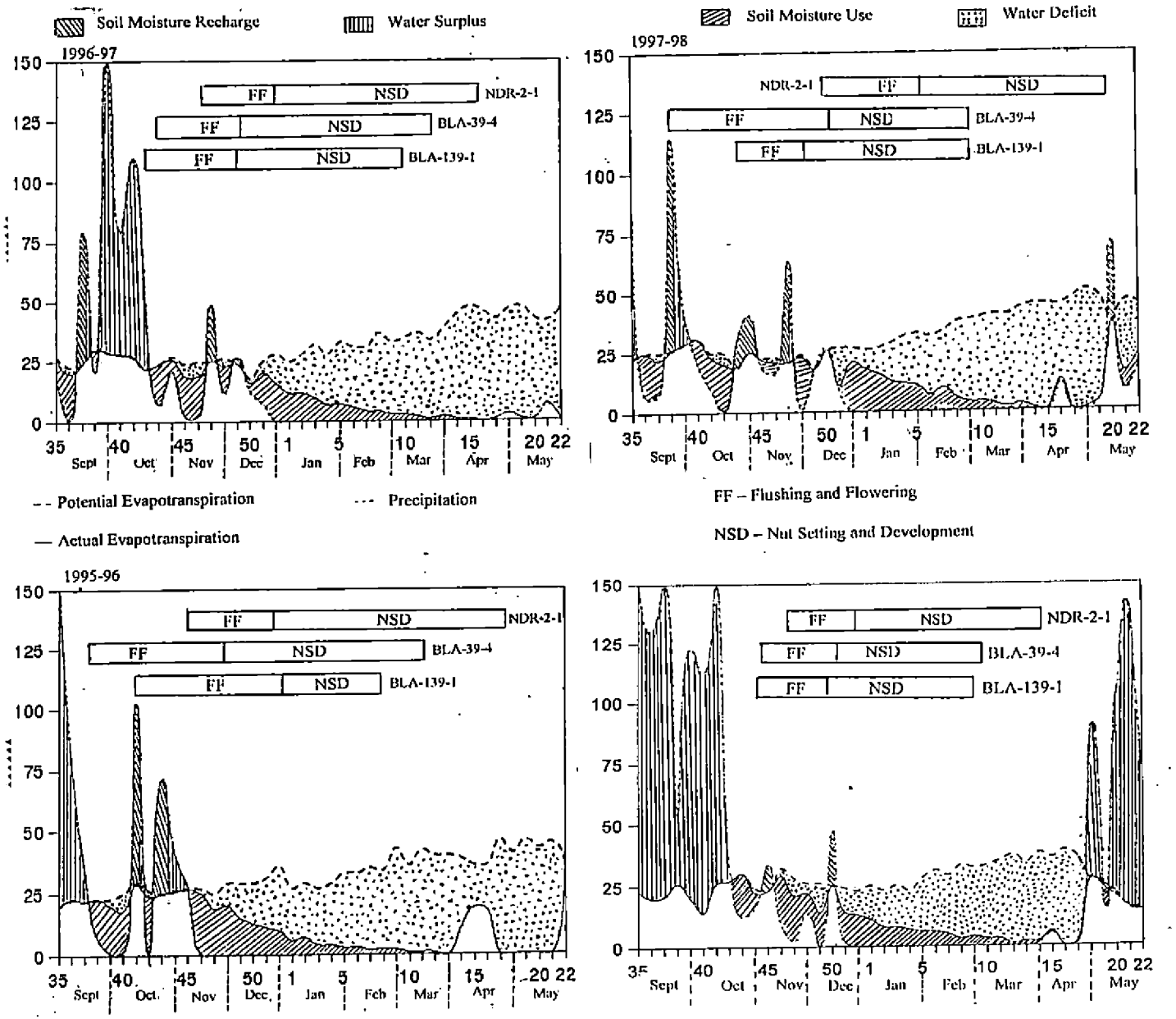


Fig 12. Weekly water balance and reproductive phase of cashew at RARS, Pilicode from 1995-96 to 1998-99

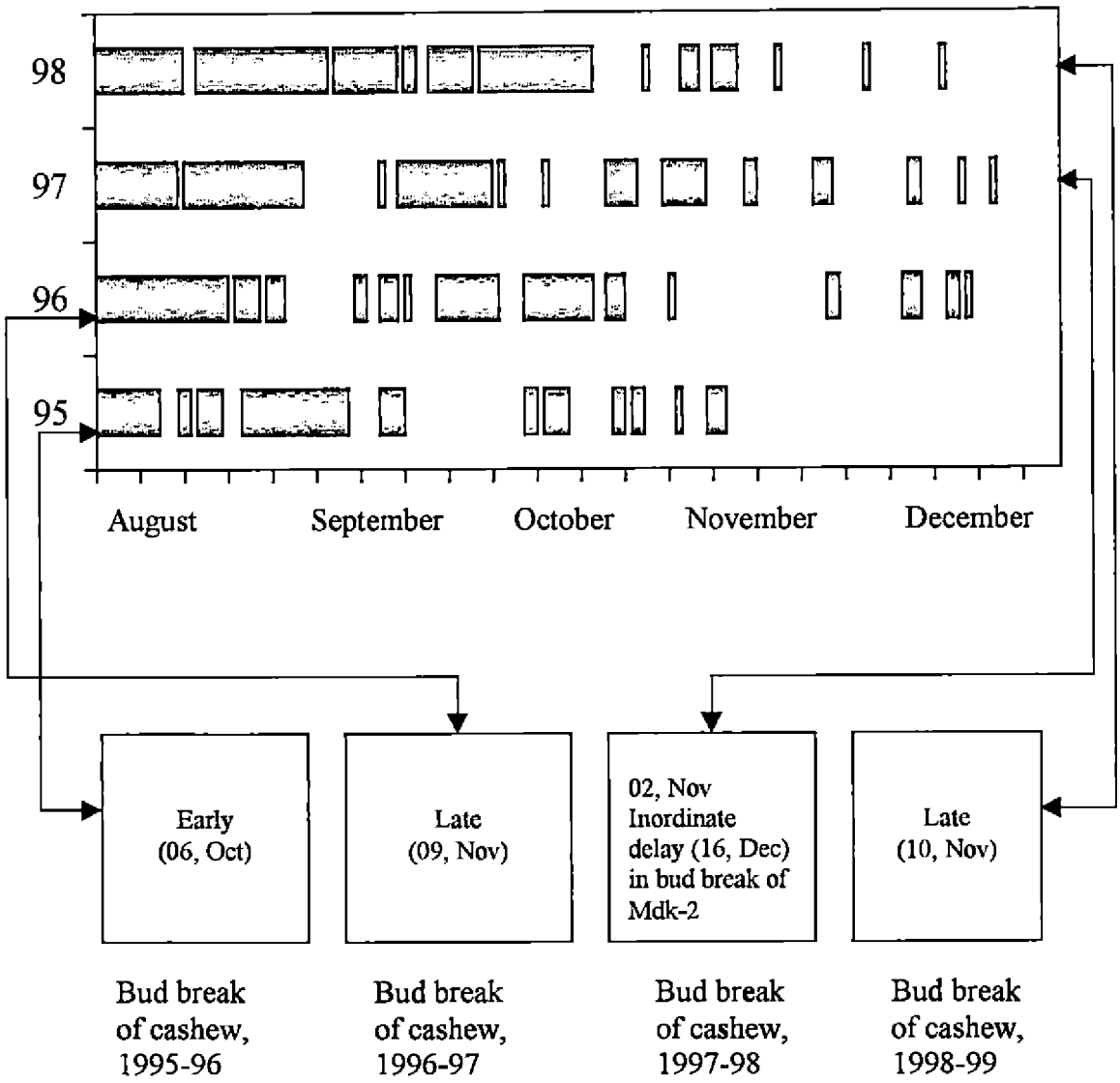


Fig 13. Daily rainfall distribution during August-December from 1995 to 1998 at RARS, Pilicode

distinct as seen in MDK-2 during 1997-98. It was due to the distribution of rainfall during November and December.

On an average, a dry spell of 12 to 16 days (may be continuous or intermittent with one or two showers) was noticed prior to bud break of cashew depending upon genotype (Table 21). There was no significant difference in duration of dry spell prior to bud break among the four test varieties. A dry spell of five to nine days was also noticed 27 to 32 days prior to bud break. In both the cases, the mean number of bright sunshine hours varied between 6.20 and 8.51 h/day. It may be inferred that, on an average, a dry spell of seven days may require 30 days prior to bud break along with a minimum bright sunshine of six hours per day. If that is the case, the minimum dry spell required for bud break 30 days prior of it was not seen during 1998-99. Probably, it might be the reason for delay in bud break of cashew during the above year in early season types. Quiet interestingly, the bud break in late varieties (Kanaka and Mdk-2) was normal as the required dry spell of seven days was noticed 22 – 26 days prior to bud break during 1998-99.

12.3.3. Sunshine versus bud break

The duration of bright sunshine hours was relatively more (9.35 h/day) from November to December in 1995 when compared to that of 1996 (7.69 h/day), 1997 (7.37 h/day) and 1998 (7.96 h/day). Interestingly, the number of bright sunshine hours during October 1998 was relatively less (5.14 h/day) when compared to that of 1995 (7.79 h/day), 1996 (7.12 h/day) and 1997 (7.40 h/day). The number of bright sunshine hours was only between 1.61 and 3.19 h/day during the first fortnight of October 1998 (Table 22). The rainfall as well as number of rainy days were also high (404.8 mm in 20 days) during October 1998. It revealed that the prolonged rain during October together with less number of bright sunshine hours might have led to delay in bud break of cashew during 1998-99 (10, November), followed by 1996-97 (09, November). However, the number of bright sunshine hours during October 1996 was relatively high.

Though the bud break was seen visually during the occurrence of a dry spell (immediately after a prolonged wet spell), the physiological processes leading to bud break might have initiated about one month prior to it, coinciding the first dry spell. The dry spell with bright sunshine may have stimulatory effect on triggering the hormonal activities leading to bud break after one month. It seems that the second dry spell is also significant as bud break occurs only during that time. A cashew plant, which undergoes a first dry spell may wait for the second dry spell to occur for break the bud. Hence, it appears that both the dry spells at the time of bud break and 30 days prior to bud break with bright sunshine are critical as far as the cashew bud break is concerned. The soil moisture stress has no relevance as the bud break of cashew begins much earlier before soil moisture stress starts. However, the influence of dry spell and bright sunshine in the mechanism of bud break of cashew is yet to be understood.

Table 22. Weekly rainfall (mm) and bright sunshine (h/day) at RARS, Pilicode during October-December from 1995 to 1998

Month	Standard Week	Date	1995		1996		1997		1998	
			Rain fall (mm)	Bright sunshine (h/day)	Rain fall (mm)	Bright sunshine (h/day)	Rain fall (mm)	Bright sunshine (h/day)	Rain fall (mm)	Bright sunshine (h/day)
Oct	40	1-7	0.2 (0)	7.64	78.8 (3)	7.21	20.2 (1)	9.31	117.8 (5)	3.19
	41	8-14	102.8 (5)	4.85	110.0 (7)	7.01	10.7 (1)	7.20	225.7 (7)	1.61
	42	15-21	0.0 (0)	11.06	43.6 (4)	5.62	0.1 (0)	6.95	33.3 (4)	6.26
	43	22-28	71.8 (2)	8.70	7.2 (1)	7.81	27.5 (1)	5.87	12.2 (1)	8.86
	44	29-4	41.3 (1)	6.71	20.6 (1)	7.95	68.0 (5)	7.74	15.8 (3)	5.80
Total/Mean			216.1 (8)	7.79	260.2 (16)	7.12	126.5 (8)	7.41	404.8 (20)	5.14
Nov	45	5-11	27.4 (3)	6.92	2.2 (0)	8.47	18.4 (2)	6.50	34.4 (3)	6.60
	46	12-18	0.0 (0)	9.81	2.2 (0)	7.92	15.5 (1)	6.87	8.7 (1)	9.01
	47	19-25	0.0 (0)	8.81	48.6 (1)	7.33	63.4 (3)	6.08	2.0 (0)	7.83
	48	26-2	0.0 (0)	10.2	12.4 (1)	9.58	1.0 (0)	8.35	14.0 (1)	9.47
Dec	49	3-9	0.0 (0)	10.11	26.6 (1)	7.46	19.1 (2)	5.85	0.0 (0)	7.01
	50	10-16	0.0 (0)	10.15	12.0 (1)	4.57	27.0 (1)	9.57	46.6 (1)	4.14
	51	17-23	0.0 (0)	9.78	7.0 (1)	6.82	11.5 (2)	7.00	0.0 (0)	10.07
	52	24-31	0.0 (0)	9.03	0.0 (0)	9.39	1.6 (0)	8.70	0.0 (0)	9.55
Total/Mean			27.4 (3)	9.35	111.0 (5)	7.69	157.5 (11)	7.37	105.7 (6)	7.96

Figures in parenthesis indicate number of rainy days

12.4 Phototropism in cashew

It was noticed that cashew shows a tendency to grow more towards South in response to sunlight in the Northern Hemisphere. This was more evident in higher latitudes towards North. The biotic events on direction-wise indicated that there was a clear-cut difference in the number of flushes produced, number of panicles and the number of fruits set/m^2 with in the canopy of cashew tree (Table 23).

The branches of cashew in South produced maximum number of fruits (54.28/sq.m), followed by West (44.43/sq.m) and East (42.57/sq.m). The biotic events occurred towards North was the least. It showed that cashew responds well to sunlight, which indicated that it has a predominant phototropism character.

Table 21. Occurrence of dry spell, sunshine hours and bud break of cashew at RARS, Pilicode

Variety	Year	Time of bud break	Dry spell prior to bud break (BB)		Bright sunshine (h/day)	Dry spell one month prior to bud break (BB)			Bright sunshine (h/day)
			Period	Duration (No. of days)		Period	Duration (No. of days) .	Time of occurrence (No. of days before BB)	
Ank-1	1995-96	26, Sept	07-14, Sept; 17-26, Sept	8+10=18	8.18	19-23, Aug	5	34	7.30
	1996-97	30, Oct	17-20, Oct; 23-30, Oct	4+8=12	7.62	20-26, Sept	7	34	6.70
	1997-98	23, Oct	05-10, Oct; 12-21, Oct	6+10=16	7.10	22-27, Sept	6	26	6.90
	1998-99	03, Nov	19-26, Oct; 28 Oct-01 Nov	8+5=13	9.15	30, Sept-1, Oct	2	33	3.90
Mean				15 days	8.01		5 days	32 days	6.20
Mdk-1	1995-96	22, Sept	07-14, Sept; 17-21, Sept	8+5=13	7.66	19-23, Aug	5	30	7.30
	1996-97	02, Nov	17-20, Oct; 23-30, Oct	4+8=12	7.62	20-26, Sept	7	37	6.70
	1997-98	03, Oct	22-27, Sept; 01-03, Oct	6+3=9	7.48	03-08, Sept	6	25	9.53
	1998-99	03, Nov	19-26, Oct ; 28, Oct- 1, Nov	8+5=13	9.15	30, Sept-1, Oct	2	33	3.90
Mean				12 days	7.98		5 days	31 days	6.86
Mdk-2	1995-96	28, Oct	14-21, Oct; 23-24, Oct 26-28, Oct	8+2+3=13	8.71	17-28, Sept	12	30	8.08
	1996-97	19, Nov	01-19, Nov	19	8.40	17-20, Nov	4	30	8.76
	1997-98	16, Dec	25, Nov- 7, Dec; 09-15, Dec	13+7=20	7.66	13-22, Nov	10	24	7.22
	1998-99	17, Nov	28, Oct-1, Nov; 11-16, Nov	5+6=11	9.30	19-26, Oct	8	22	9.20
Mean				16 days	8.51		9 days	27 days	8.32
Kanaka	1996-97	14, Nov	01-14, Nov	14	7.89	17-20, Oct	4	25	8.76
	1997-98	30, Oct	12-21, Oct ; 23-29, Oct	10+7=17	6.47	22-27, Sept	6	33	6.90
	1998-99	15, Nov	03-06, Nov; 11-15, Nov	4+5=9	6.92	19-26, Oct	8	26	9.20
Mean				13 days	7.09		6 days	28 days	8.29

Table 23. Pooled data of biotic events in cashew of all the locations together

Biotic events	Directional variation in biotic events			
	North	South	East	West
No. of flushes per sq. m.	25.14	28.43	29.71	38.86
No. of panicles per sq. m.	19.71	22.29	22.00	29.57
No. of fruits per sq. m.	39.14	54.28	42.57	44.43

Interestingly, harvest was estimated to be more in South (60 to 80 %) when compared to that of North (20 to 40%) of a cashew tree (Fig. 14a).

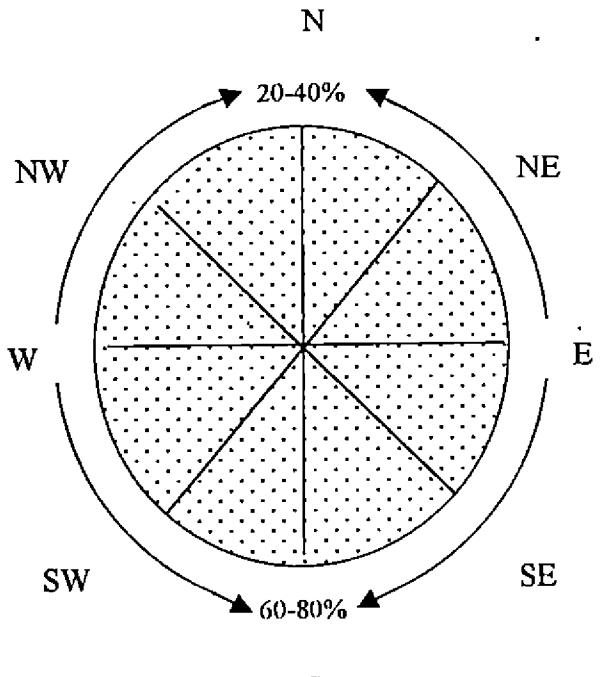


Fig 14a. Direction-wise yield pattern in a cashew tree

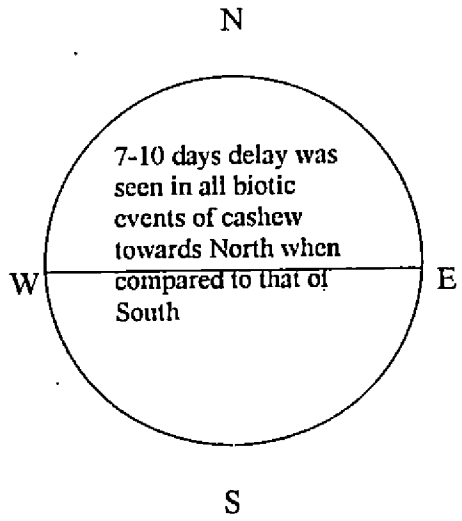


Fig 14b.Time of biotic events between North & South of a cashew tree

It was also noticed that there was a delay of one week to ten days in all the biotic events of cashew towards North within the cashew tree (Fig. 14b).

Also, cashew appears to be photosensitive as the reproductive phase is confined to season bound, varying between October and May (Figs 15 a, b & c) across West and East coasts of India. However, the harvest (<10-20%) falls in June/July at higher altitudes (Ambalavayal and Chintamani). Of course, the de-colouration of nut, its weight and quality will be very poor as regular rains start by that time. Though the delay in bud break and flowering was seen towards North (Bapatla, Bhubaneswar and Jhargram), the crop matures early and ends up by the end of April or first week of May. This could be attributed to high maximum temperature (35 to 40^0C) that prevails during the summer

(March to May). It appears that cashew is not only photosensitive but also thermosensitive as the biotic events responds to low minimum and high maximum temperatures. It seems that a temperature range between 13°C and 35°C may be optimum for better growth and production of cashewnuts. However, the temperature range for cashew is yet to be worked out since it was only observational.

12.5 Heat units and cashew yield

There was a significant variation in heat unit requirement of cashew depending upon genotype. Early variety like Ank-1 required only 1953 day^{0}C for reproductive phase (25% bud break to 75% harvest) while it was 2483 day^{0}C in case of late season type like Mdk-2. The heat unit requirement of mid season type was intermediary (2245 day^{0}C). It was interesting to note that early season types require less heat units while late season types require more heat units and the heat unit requirement of the mid season types are intermediary (Table 24).

Table 24. Heat units and cashew yield (kg/tree) of test varieties at RARS, Pilicode

Year	Number of heat units (hu) and yield (y)							
	Ank-1		Mdk-1		Mdk-2		Mean	
	hu	y	hu	y	hu	y	hu	y
1995-96	2302	2.3	2122	2.8	3091	1.1	2505	2.1
1996-97	1850	3.1	2219	2.9	2287	1.0	2119	2.3
1997-98	1983	0.8	2837	4.0	2419	8.2	2413	4.3
1998-99	1675	7.1	1803	7.1	2135	4.3	1871	6.2
Mean	1953	3.3	2245	4.2	2483	3.6	2227	3.7

The heat units versus cashew yields of test varieties showed that there was no definite relationship existed between them as negative relationship was seen in 50% of the cases and positive in other 50% of cases. This was mainly attributed to the incidence of a pest complex, which is not uncommon during the flowering season of cashew across West coast. This is a severe menace and effects the duration of crop and cashew production as the case during 1998-99.

12.6 Weather and pest and disease complex of cashew

12.6.1. Weather and Inflorescence blight in cashew

Incidence of unprecedented pest and disease complex was noticed as Inflorescence and twig blight across the cashew tract of Kasaragod and Kannur districts during 1998-99. The younger shoots and inflorescence were dried up in large numbers. Immature shrunken nuts were also noticed hanging with panicles to a considerable extent. On detailed investigation, it was observed that there was a severe infestation of tea mosquito. Besides, Inflorescence blight was also observed to a large extent due to the involvement of fungal pathogens viz., *Colletotrichum gloeosporioides* and *Gloeosporium mangiferae* which were considered as secondary infection.

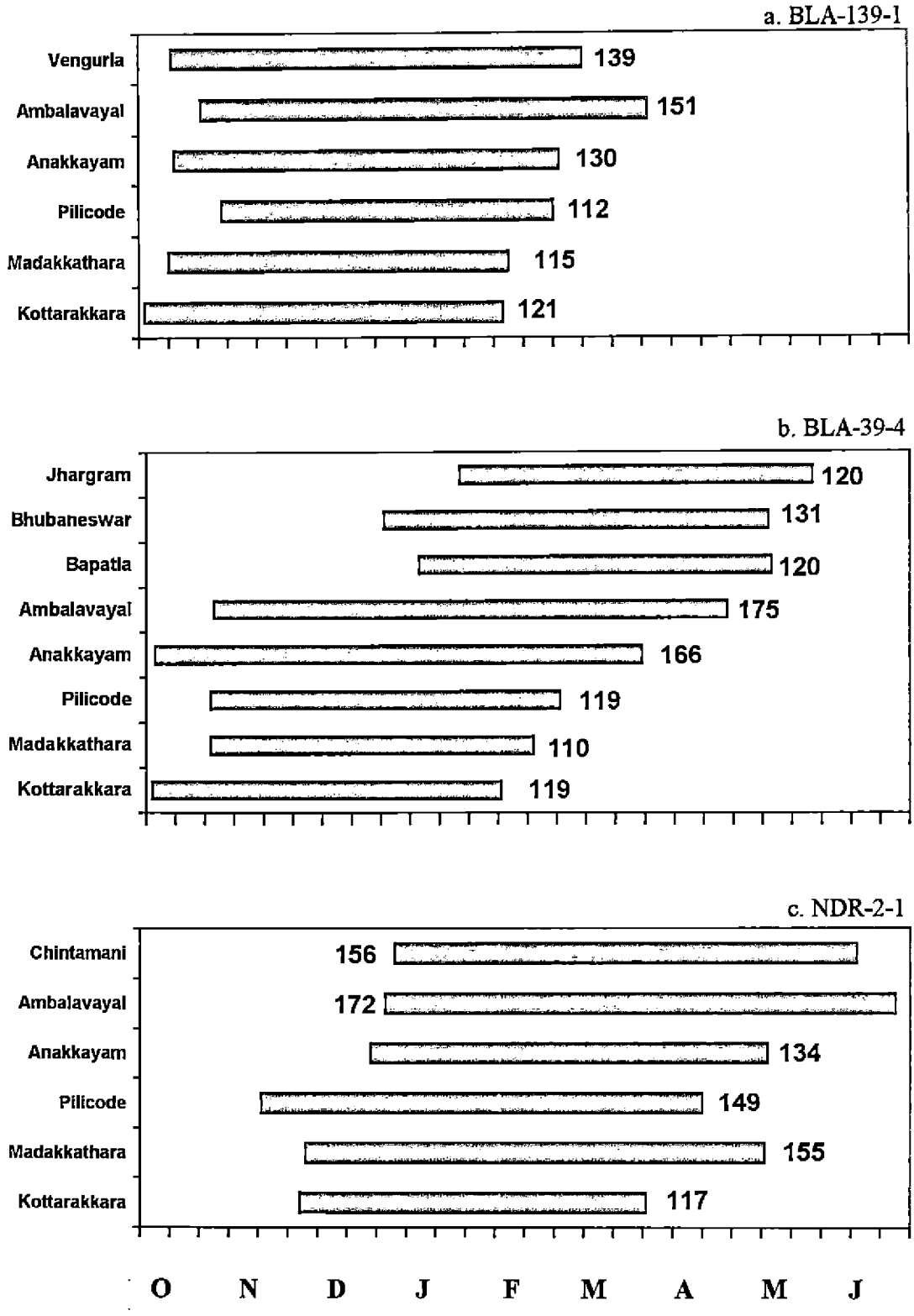


Fig 15. Reproductive phase (25% of bud break to 75% of harvest) of test varieties across West and East coasts of India from 1996-97 to 1998-99

A study of the comparative weather parameters during 1997-98 and 1998-99 showed that it had played an important role in the disease severity during 1998-99. A comparison of the daily sunshine hours showed that there was cloudy weather from 8th to 14th December 1998 (less than 2 h/day from 8th to 12th), which was not prevalent during the previous year (Fig.16). The relative humidity (%) in the forenoon during December 1998 and January and February 1999 was above 90 (Table 25), ideal for sporulation of the fungi. So also was the case with the daily minimum temperature, which was between 18-20°C during the second half of December 1998 and January 1999 unlike the previous year where it was around 22°C (Fig.17). Similar trend continued during February 1999 also (Monthly mean of 20.1°C compared to 21.6°C during the previous year).

Table 25. Monthly relative humidity (%) at RARS, Pilicode during reproductive phase of cashew from 1997-98 to 1998-99

Weather parameter	Year	Nov	Dec	Jan	Feb	Mar
Relative humidity-morning (%)	1997-98	93	94	91	89	85
	1998-99	93	95	94	93	87
	Mean	93	95	93	91	86
Relative humidity-afternoon (%)	1997-98	70	67	62	57	61
	1998-99	71	59	58	58	61
	Mean	71	63	60	58	61
Mean relative humidity (%)	1997-98	82	81	77	73	73
	1998-99	82	77	76	76	74
	Mean	82	79	77	75.	74
Relative humidity range (%)	1997-98	23	27	29	32	24
	1998-99	22	36	36	35	26
	Mean	23	32	33	34	25

A decline in maximum temperature (Table 26) was also noticed during December 1998 (0.6°C) and January 1998 (1.3°C).

Table 26. Monthly surface air temperature (°C) at RARS, Pilicode during reproductive phase of cashew from 1997-98 to 1998-99

Weather parameter	Year	Nov	Dec	Jan	Feb	Mar
Max. temp (°C)	1997-98	31.6	31.8	32.5	32.6	32.9
	1998-99	31.1	31.2	31.2	32.8	33.1
	Mean	31.4	31.5	31.9	32.7	33.0
Min. temp (°C)	1997-98	23.4	23.1	21.3	21.6	23.5
	1998-99	22.3	21.1	19.1	20.1	24.0
	Mean	22.9	22.1	20.2	20.9	23.8
Mean. temp (°C)	1997-98	27.5	27.5	26.9	27.1	28.2
	1998-99	26.7	26.2	25.2	26.5	28.6
	Mean	27.1	26.9	26.1	26.8	28.4
Temp. range (°C)	1997-98	08.2	08.7	11.2	11.0	09.4
	1998-99	08.8	10.1	12.1	12.7	09.1
	Mean	08.5	09.4	11.7	11.9	09.3

In addition to the above, a significant increase was observed in the case of dew fall during this season unlike the previous year, which is considered as one of the most important factors favouring the growth and sporulation of the fungi. Immediately after the cloudy weather during the second week of December 1998, there was an increase in dew fall with more number of dew nights during the third and fourth week of December (Fig 18). The least (3.28mm in 22 nights during December and 3.60mm in 21 nights during January) was the case in 1997-98.

The above favourable weather conditions of cloudiness, low minimum and maximum temperatures together with relatively continuous dew fall under ideal humid conditions not only triggered the growth of the fungi but have helped in the sporulation, multiplication and spread during 1998-99. A peculiar weather during the above year led to the pest and disease complex and devastated cashew production in Kannur and Kasaragod districts.

12.6.2 Weather and tea mosquito

Tea mosquito (*Helopeltis antonii*) of Family Miridae is an important pest of cashew. It suck the sap of tender parts of cashew including inflorescence, young nuts etc. During feeding, the insect injects its saliva into the plant which causes drying of the affected parts. During 1998-99, there was a severe incidence of the pest, followed by inflorescence blight in Kannur and Kasaragod districts and identified as a pest and disease complex.

Severe leaf scorching was noticed during the second fortnight of February 1999, which means that the pest population reached maximum during the second fortnight of January. The egg and nymphal periods of the insect are 6-7 and 10 days, respectively at 24 to 32^{0}C. It may take around fifteen days from egg to egg stage. The minimum temperature was below 20°C from 17th December 1998 onwards (Fig.17) and continued in January, 1998 in majority of the days. Similar situation continued in February (Table 26), 1999 also. In contrast, the minimum night temperature was around 22°C in majority of the days from December to February during 1997-98. The relative humidity in the afternoon was relatively low (60%) during 1998-99 when compared to that of 1997-98 (62-67%). However, the morning relative humidity was high (around 94%) from December to February, 1998-99 (Table 25) when compared to that 1997-98 (around 90%). It revealed that the minimum night temperature and relative humidity in the afternoon were less during the flushing/flowering phase of cashew in 1998-99 when compared to that 1997-98. In a period of two and half months, the pest might have completed three to four overlapping generations, thus increasing in number by six to seven fold, causing serious damage during 1998-99. The minimum night temperature below 20°C along with relatively dry weather in the afternoon during majority of the days from December to January might have triggered the pest population during 1998-99. The build up of pest population was relatively late and coincided with mid and late season types as early season types escaped from the incidence of tea mosquito and yielded better.

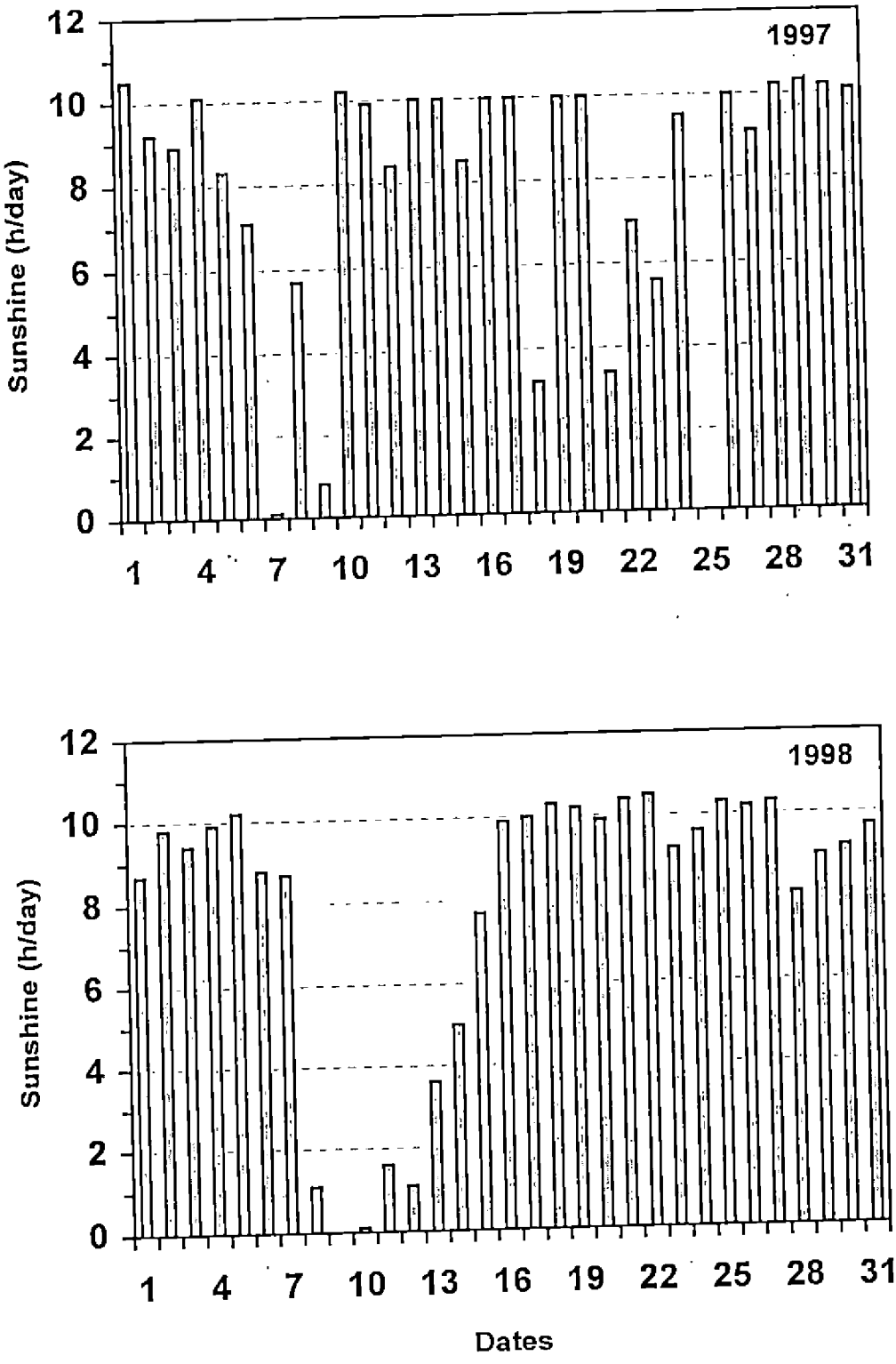


Fig 16. Daily bright sunshine (h/day) during December from 1997 to 1998 at RARS, Pilicode

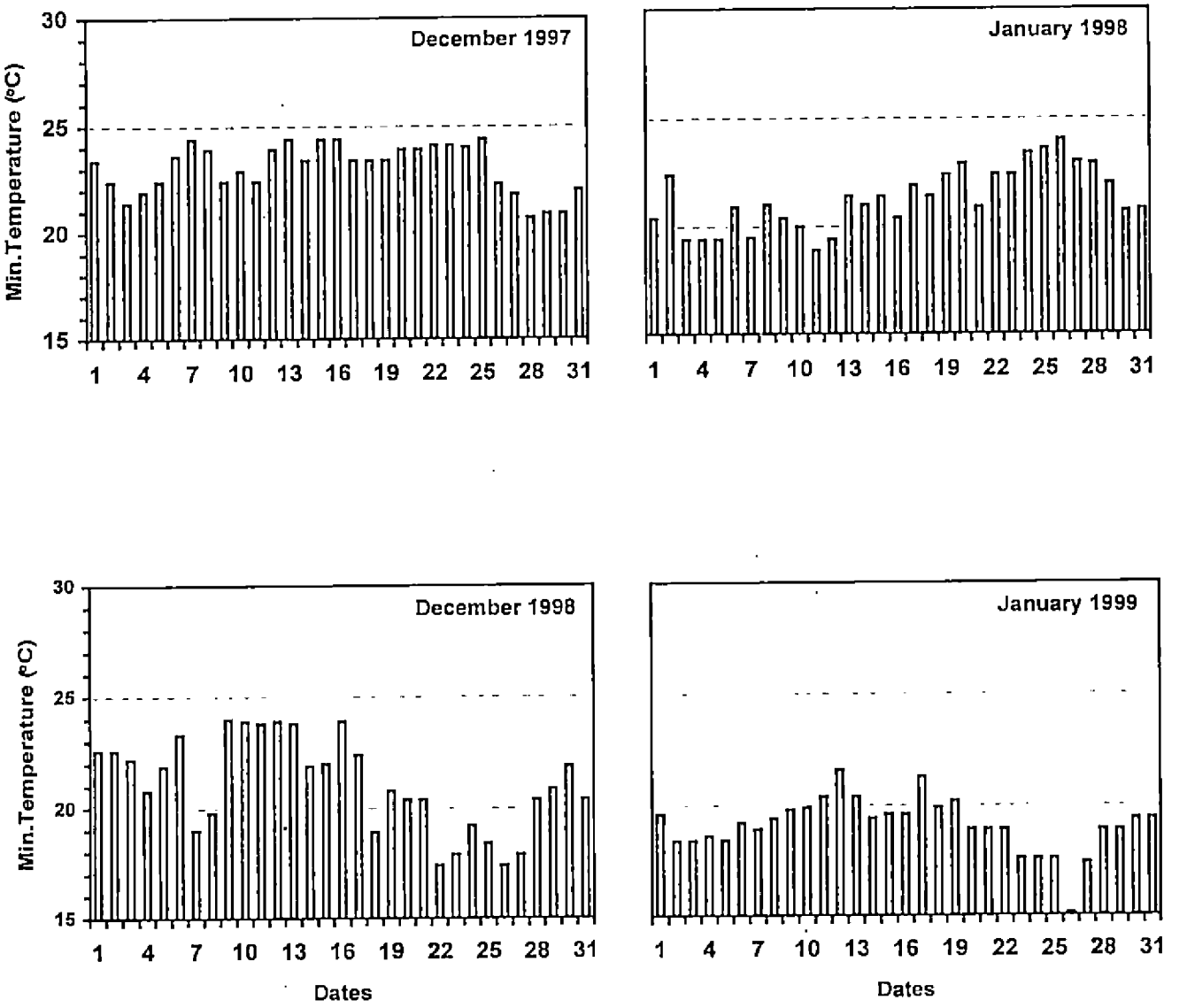


Fig 17. Daily minimum temperature (°C) during December and January from 1997-98 to 1998-99 at RARS, Pilicode

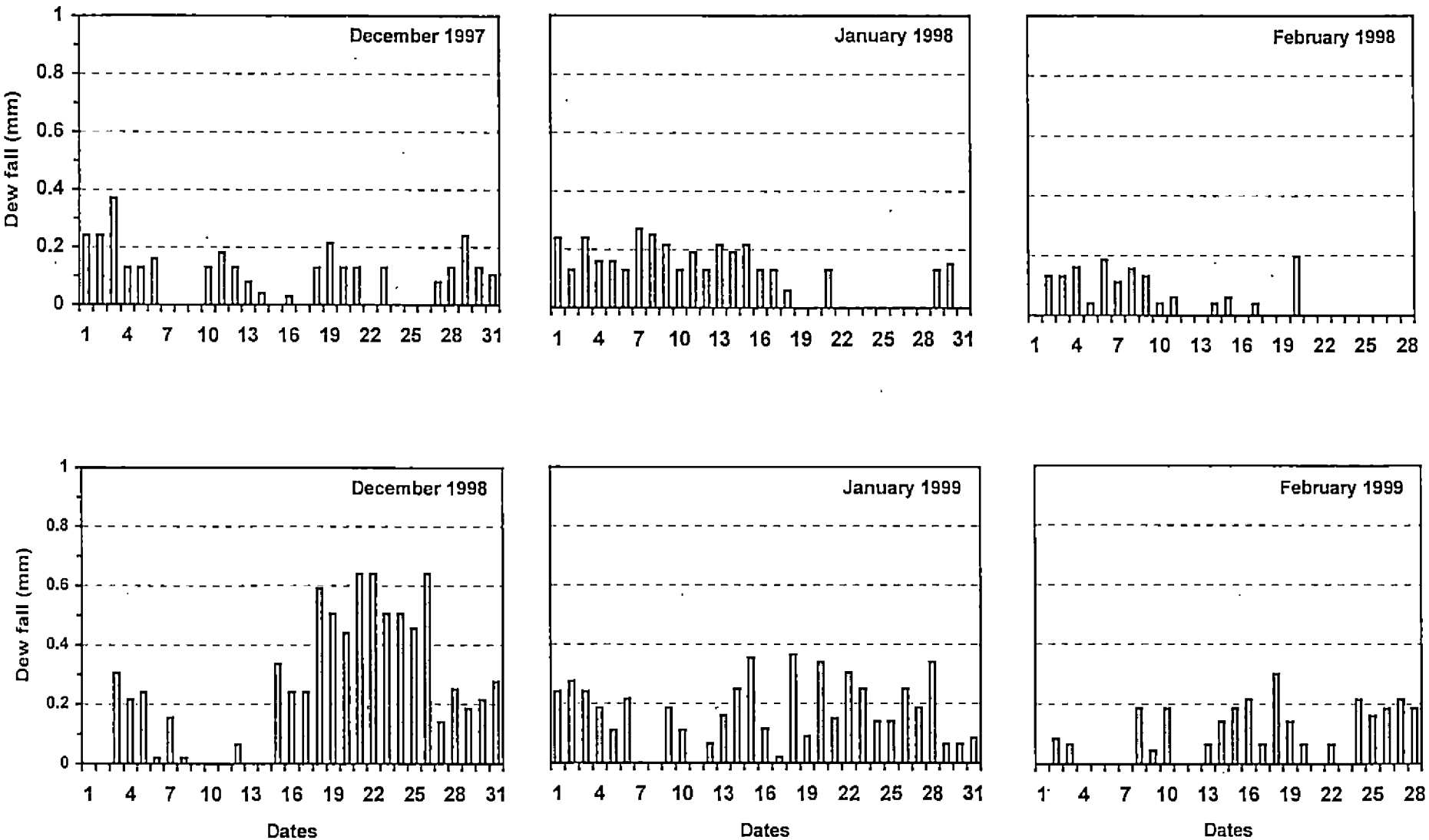


Fig 18. Daily distribution of dew fall (mm) during December-February from 1997-98 to 1998-99 at RARS, Pilicode

12.7 Weather and nut characteristics of cashew

12.7.1 Genotype and nut weight of cashew

The kernel weight of Mdk-2 (NDR-2-1) was more (2.6 g/nut), followed by Kanaka (H-1598: 1.7 g/nut) and Mdk-1 (BLA-39-4: 1.6 g/nut). The kernel weight was less (1.5 g/nut) in case of Ank-1 (BLA-139-1). Similar was the trend almost in case of nut weight also (Table 27).

Table 27. Nut characteristics of test varieties at RARS Pilicode from 1995-96 to 1998-99

Varieties	Year	Nut characteristics of cashew		
		Nut weight (g/nut)	Kernel weight (g/nut)	Shelling (%)
Ank-1	1995-96	3.9	1.3	33.3
	1996-97	5.1	1.4	27.5
	1997-98	4.8	1.6	33.3
	1998-99	4.9	1.6	32.7
	Mean	4.7	1.5	31.7
Mdk-1	1995-96	4.4	1.4	31.8
	1996-97	5.7	1.8	31.6
	1997-98	5.3	1.6	30.2
	1998-99	4.8	1.4	29.2
	Mean	5.1	1.6	30.7
Mdk-2	1995-96	7.6	2.6	34.2
	1996-97	8.8	2.5	28.4
	1997-98	8.0	2.6	32.5
	1998-99	8.9	2.5	28.1
	Mean	8.3	2.6	30.8
Kanaka	1995-96	3.8	1.1	29.0
	1996-97	5.1	1.9	37.3
	1997-98	5.1	1.9	37.3
	1998-99	5.9	1.7	28.8
	Mean	5.0	1.7	33.1

It was also observed that the nut and kernel weights of Mdk-2 were maximum in all the four years while minimum in case of Ank-1 and Mdk-1, indicating the role of the genotype in deciding nut and kernel weights.

12.7.2 Inter- annual variation in kernel weight of cashew

The kernel weight was maximum (1.9 g/nut each) in 1996-97 and 1997-98, followed by 1998-99 (1.8 g/nut) when the kernel weight of all the varieties pooled together. Interestingly,

the shelling percentage was more (33.3) during 1997-98 (Table 28). The minimum (1.6 g/nut) kernel weight was recorded in 1995-96.

Table 28. Mean nut characteristics of test varieties at RARS, Pilicode from 1995-96 to 1998-99

Year	Nut characteristics of cashew		
	Nut weight (g/nut)	Kernel weight (g/nut)	Shelling (%)
1995-96	4.9	1.6	32.1
1996-97	6.2	1.9	31.2
1997-98	5.8	1.9	33.3
1998-99	6.1	1.8	29.7
Mean	5.8	1.8	31.6

12.7.3 Rainfall and soil moisture versus nut weight of cashew

There was no rainfall during nut setting and development period (January-March) in all the four years (Table 12). However, there was a significant rainfall during November and December 1997, followed by 1996 and 1998. Interestingly, there was no rainfall from 9th November to 31st March during 1995-96. The low kernel weight during the above year could be attributed to the prolonged drought. In contrast, the kernel weight was high during 1997-98 and 1996-97. This could be attributed to better availability of soil moisture. The soil moisture availability (Ima) in January 1998 was maximum (49%), followed by 1997 (35%) and 1999 (32%). It was the minimum (16%) during January 1996 (Table 15). It clearly indicated that the availability of soil moisture during nut setting and development is very important as it decides the final kernel weight.

12.7.4 Harvest and nut weight of cashew

The nut characteristics at different intervals of harvest during 1998-99 in case of Mdk-2 (Table 29) showed that all the three nut characteristics viz., the nut weight, kernel weight and shelling percentage declined from first harvest (Nut weight – 8.85 g/nut; Kernel weight – 2.46 g/nut and Shelling percentage – 27.74) to third harvest (Nut weight – 7.38 g/nut; Kernel weight – 1.94 g/nut and Shelling percentage – 26.2).

Table 29. Nut characteristics of Mdk-2 at different intervals of harvest during 1998-99 at RARS Pilicode

Sl .No.	Tree No.	1st harvest			2nd harvest			3rd harvest		
		Nw	Kw	Sp	Nw	Kw	Sp	Nw	Kw	Sp
1	33	8.97	2.48	27.65	7.80	2.03	26.03	-	-	-
2	51	9.39	2.57	27.37	8.40	2.23	26.55	8.94	2.38	26.62
3	179	8.20	2.32	28.29	6.68	1.78	26.65	5.82	1.50	25.77
Mean		8.85	2.46	27.77	7.62	2.01	26.41	7.38	1.94	26.20

Nw-Nut Weight; Kw- Kernel Weight; Sp- Shelling percentage

The interval between the harvest was around three weeks. The third harvest was over by the end of April. The nuts harvested was very less when compared to that of previous harvest. There was no rain during nut setting and development period. The nut decline could be attributed to depletion in stored assimilates and nutrients and decrease in available soil moisture with time.

12.7.5 Direction-wise nut characteristics

The kernel weight of Ank-1 was 1.55 g/nut in North while it was 1.59 g/nut towards South (Table 30).

Table 30. Direction-wise nut characteristics of different varieties of cashew at RARS, Pilicode during 1998-99

Sl.No.	Tree No. & Direction	Nut weight (g/nut)	Kernel weight (g/nut)	Shelling (%)
Anakkayam-1 (BLA-139-1)				
1	118 N	4.85	1.43	29.48
2	118 S	4.72	1.58	33.47
3	139 N	4.73	1.47	31.07
4	139 S	4.38	1.40	31.96
5	172 N	5.41	1.76	32.53
6	172 S	5.51	1.80	32.67
Mean	S	4.87	1.59	32.70
	N	4.99	1.55	31.03
Madakkathara-1 (BLA-39-4)				
1	35 N	5.25	1.50	28.57
2	35 S	4.94	1.40	28.34
3	75 N	4.73	1.42	30.02
4	75 S	4.62	1.40	30.30
5	123 N	4.80	1.40	29.17
6	123 S	4.37	1.30	29.75
Mean	S	4.64	1.37	29.46
	N	4.92	1.44	29.25
Mean of two varieties	S	4.76	1.48	31.10
	N	4.96	1.50	30.10

In case of Mdk-1, the kernel weight was 1.44 g/nut in North and it was 1.37 g/nut towards South. Interestingly, the nut weight was more towards North in both the varieties while the shelling percentage was less when compared to that of South. It revealed that the availability of better sunlight towards South may lead to higher shelling percentage. As the observations were based only on one year (1998-99), further studies in this direction will give more information on "The impact of phototropism on different nut characteristics of cashew".

12.7.6 Nut characteristics of test varieties across West and East coasts of India

In case of Kanaka, Vriddhachalam recorded the maximum (1.98 g/nut) kernel weight, followed by Jhargram (1.69 g/nut) and Pilicode (1.64 g/nut) while the minimum (1.52 g/nut) at Chintamani. In contrast, Chintamani recorded the maximum (3.33 g/nut) kernel weight, followed by Pilicode (2.53 g/nut) and Ambalavayal (2.14 g/nut) in case of Mdk-2. At the same time, Ambalavayal recorded the maximum (1.85 g/nut) kernel weight, followed by Anakkayam (1.8 g/nut) in case of Mdk-1. Bapatla and Kottarakkara recorded 1.67 g/nut each and Pilicode recorded a low of 1.56 g/nut. The kernel weight was the least (1.33 g/nut) at Jhargram in case of Mdk-1 (Table 31).

Table 31. Nut characteristics of test varieties across West and East coast of India

Location	Nut characteristics of test varieties								
	Mdk-1			Mdk-2			Kanaka		
	Nw	Kw	Sp	Nw	Kw	Sp	Nw	Kw	Sp
West coast									
Pilicode	5.05	1.56	30.9	8.31	2.53	30.6	4.97	1.64	32.9
Kottarakkara	5.45	1.67	30.9	-	-	-	-	-	-
Anakkayam	5.50	1.80	32.7	-	-	-	-	-	-
Mean	5.33	1.68	31.5	8.31	2.53	30.6	4.97	1.64	32.9
High range									
Ambalavayal	6.24	1.85	29.7	7.05	2.14	30.4	-	-	-
Chintamani	-	-	-	8.97	3.33	37.1	6.80	1.52	22.4
Mean	6.24	1.85	29.7	8.01	2.74	33.8	6.80	1.52	22.4
East coast									
Bapatla	5.88	1.67	28.4	-	-	-	-	-	-
Vriddhachalam	-	-		-	-	-	6.95	1.98	28.3
Jhargram	4.68	1.33	28.4	-	-	-	5.26	1.69	32.1
Mean	5.28	1.50	28.4	-	-	-	6.11	1.84	30.2

Nw – Nut weight (g/nut); Kw – Kernel weight (g/nut); Sp – Shelling percentage

It revealed that the test varieties performed differently at different locations in terms of nut characteristics of cashew. It also highlights the adaptability of a genotype to a particular agroclimatic situation.

Across East coast (Vriddhachalam, Bhubaneswar and Jhargram), Kanaka performed well in terms of nut (6.11 g/nut) and kernel (1.84 g/nut) weights when compared to that of West coast (nut weight – 4.97 g/nut; kernel weight 1.64 g/nut). In contrast, West coast was superior in case of Mdk-1 (nut weight: 5.33 g/nut; kernel weight 1.68 g/nut) when compared to that of East coast (nut weight- 5.28 g/nut; kernel weight-1.50 g/nut). It, again, revealed that depending upon the adaptability of a genotype, the nut and kernel weights were superior in both East and West coasts of India. However, the shelling percentage was low (28.4 % in

case of Mdk-1 and 30.2 % in case of Kanaka) across East coast when compared to that of West coast (31.5% in case of Mdk-1 and 32.9 in case of Kanaka) irrespective of variety. This could be explained due to high maximum temperature (35 to 40°C), which reduces the nut development phase of cashew. In turn, the shelling percentage may be less. Occasionally, the maximum temperature shoots up to 42°C during the nut development phase of cashew across East coast, which is not the case across West coast.

12.7.7 Altitude and nut characteristics of cashew

There was an increasing trend in kernel weight of Mdk-1 (1.85 g/nut) and Mdk-2 (2.74 g/nut) with the altitude as noticed at high ranges (Table 31). In case of Ank-1 also, similar was the trend. The kernel weight was 1.69 g/nut at Ambalavayal while 1.49 g/nut at Pilicode (Table 32).

Table 32. Nut characteristics of Ank-1 (BLA-139-1) at different locations

Location	Year	Nut characteristics		
		Nut weight (g/nut0	Kernel weight (g/nut)	Shelling (%)
Pilicode	1995-96	3.93	1.30	33.08
	1996-97	5.06	1.44	28.46
	1997-98	4.75	1.62	34.11
	1998-99	4.93	1.60	32.45
	Mean	4.67	1.49	32.03
Ambalavayal	1997-98	6.00	1.90	31.67
	1998-99	6.07	1.47	24.22
	Mean	6.04	1.69	27.95
Kottarakkara	1996-97	6.10	1.32	21.64
	1997-98	4.91	1.61	32.80
	Mean	5.51	1.47	27.22
Anakkayam	1997-98	6.10	2.00	32.79
	Mean	6.10	2.00	32.79

It revealed that the kernel weight was more with altitude. However, Ambalavayal recorded low kernel weight (2.14 g/nut) in case of Mdk-2 while Chintamani recorded maximum (3.33 g/nut), which is also located at high ranges. It could be attributed to the different weather conditions that prevail at Ambalavayal when compared to that of Chintamani. However, the shelling percentage (22.4) was very poor at Chintamani in case of Kanaka. It revealed that there was a decreasing trend in shelling percentage with altitude in early and mid season types like Ank-1, Mdk-1 and Kanaka. The nut and kernel weights were better in early season types at Ambalavayal whereas the performance was poor in all nut characteristics in case of the late season type, Mdk-2. As the harvest is late in the late season type like Mdk-2 and coincides with rains, the deterioration of nut weight and its quality is expected at Ambalavayal. At the same time, the nut and kernel weights may be better in early season

types with altitude though shelling percentage was less at the above location as the duration of nut development takes more time with altitude due to low surface air temperature. However, one should be careful in selection of genotype with altitude across West coast as the crop duration will be late for harvest, which sometimes may coincide with the rainy season. This results in poor nut weight and its quality. Similar studies with a network of more observational points along the altitude may pinpoint the suitability of a particular genotype in terms of nut yield and its characteristics.

12.8 Crop weather diagrams of cashew

In order to provide information on actual weather conditions against normal weather, biotic events of cashew, crop duration and its performance and incidence of pest and disease, the crop weather diagrams become relevant. They provide information on weather conditions in good crop years as well as adverse weather conditions in bad crop years. They also will be useful to understand the different weather conditions, which are conducive for build-up of pest and disease incidence. Using the crop weather diagrams, attempts can be made for obtaining better yield through agronomic manipulations. Of course, they could be very well used as a tool for prediction of crop yield if they are available for more number of years for different agroclimatic situations and are handy for agroadvisory service to the cashew growers, crop managers and planners for taking on time decisions.

The time of bud break, flushing, flowering, nut setting and harvest of cashew was plotted against mean monthly rainfall (mm) and surface air temperature in degree Celsius (maximum, minimum and mean temperature) as they are considered to be the prime weather elements in deciding cashew yield and its quality. The crop weather diagrams was prepared for the four years viz., 1995-96, 1996-97, 1997-98 and 1998-99 based on weather data and biometric observations collected at RARS, Pilicode. The crop weather calendar of cashew was given from June to May as reproductive phase of cashew begins from September/October and ceases by May.

12.8.1 Crop weather diagrams of cashew during 1995-96

There was a gradual decline in rainfall from July (1173 mm) to November (69mm) as the case normally happens. Quite interestingly, there was no rainfall from December to March. Again few rains were noticed during April and May, which was below normal (Fig. 19) and not relevant as the harvest was over in April. There was a gradual increase in maximum temperature from August (28.9°C) to March (33.0°C) while a decline in minimum temperature was noticed from September (24.5°C) to December (18.7°C). The minimum air temperature during January, 1996 was the same as December. A significant increase was noticed in minimum temperature from March (24.1°C) to May (26.0°C).

The bud break was early in Mdk-1 (22, Sept), followed by Ank-1 (26, Sept) and it was late in NDR-2-1 (28, Oct). It was interesting to note that the duration of reproductive phase (25% of bud break to 75% of harvest) of Ank-1 was less (142 days) while it was more (182 days) in

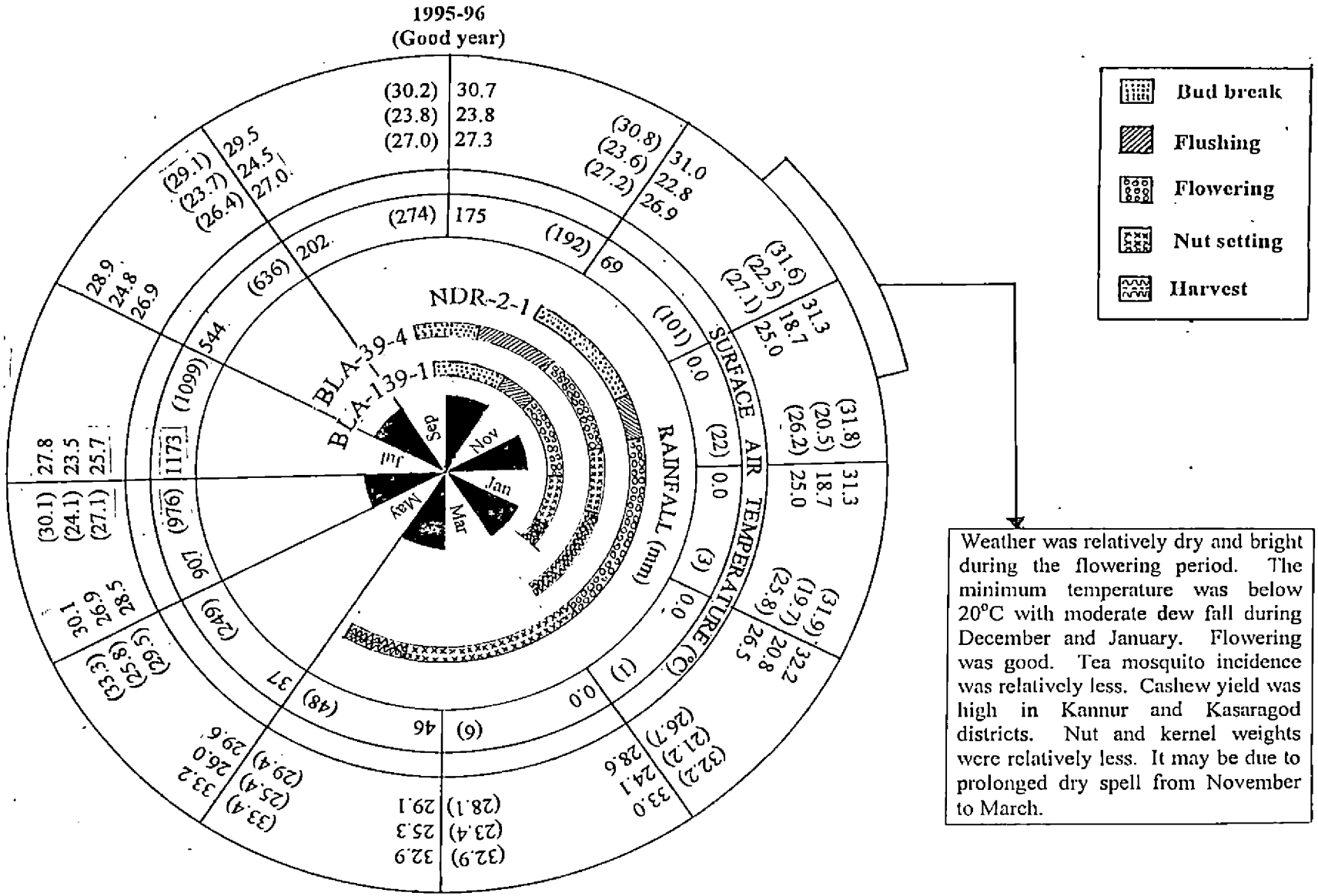


Fig 19. Crop weather diagram of cashew during 1995-96 at RARS, Pilicode

case of NDR-2-1. It was intermediary (159 days) in case of BLA-39-4. The time of harvest extended though the bud break was early in the above variety when compared to that of BLA-139-1. The duration of flowering and harvest phases was longer in Mdk-1 when compared to that of Ank-1.

As a whole, weather was conducive (relatively dry and bright during the reproductive phase) for better flowering and tea mosquito incidence or pest complex was relatively less. The cashew production in Kannur and Kasaragod districts was the maximum during 1995-96. It was considered as good year as the cashew production was high. The nut and kernel weights were relatively less. This could be explained due to prolonged dry spell from December to March during which the availability of soil moisture was very less.

12.8.2 Crop weather diagrams of cashew during 1996-97

There was a gradual decline in rainfall from July (1174 mm) to December (46mm). Unlike in 1995-96, there was rain during December and it was more (46 mm) against normal (22 mm). Cloudy weather and wet spell were noticed during November and December, which was not the case in 1995-96. There was no rainfall from January to April (Fig.20). There was a gradual increase in maximum temperature from September (29.4°C) to May (33.7°C) except during December (30.7°C), January (31.2°C) and February (31.1°C). The dip in maximum temperature during December was due to cloudy weather and rain spell. The maximum temperature was less from December to February when compared to that of 1995-96. In contrast, the minimum temperature was higher from December to January (19.9°C-20.3°C) when compared to that of 1995-96 (18.7°C). A significant increase was noticed in minimum temperature from March (23.6°C) to May (25.5°C), but less when compared to that of 1995-96. However, the trend during the summer was similar to that 1995-96.

Unlike in 1995-96, the bud break was late (30, Oct) in BLA-139-1, BLA-39-4 (02, Nov) and NDR-2-1 (19, Nov). Interestingly, the bud break of BLA-39-4 was relatively late when compared to that of BLA-139-1 as was not the case in 1995-96. The duration of harvest was more in BLA-39-4 and NDR-2-1 when compared to that of BLA-139-1. The duration of reproductive phase was 115, 136, and 138 days in BLA-139-1, BLA-39-4 and NDR-2-1, respectively. Interestingly, the duration of reproductive phase was short in all the test varieties when compared to that of 1995-96.

As a whole, weather was not that good for better flowering due to rains in November and December. The minimum temperature was also around 20°C during flowering period, which may not conducive for better flowering. The delay in flowering was noticed across cashew tract of Kannur and Kasaragod districts and tea mosquito incidence was severe. The cashew yield was affected. Wherever scientific pest control measures were taken up, the cashew yield was better. The year 1996-97 was a bad year as the cashew production was moderate. The nut and kernel weights were relatively better. This could be attributed to better availability of soil moisture.

12.8.3 Crop weather diagrams of cashew during 1997-98

There was heavy rain in July (1570 mm), followed by August (761 mm). A gradual decline was noticed in rainfall from July (1570 mm) to October (82 mm). There was rains during November (115 mm) and December (59 mm) like in 1996-97 (Fig. 21), but high during the year. Unlike in 1995-96 and 1996-97, the rainfall was less during September and October. The dry spells during the above months may lead to early bud break in cashew in early season types. There was a gradual increase in maximum temperature from August (28.8°C) to April (34.7°C). During the winter (December to February), the minimum temperature was high and varied between 21.3°C and 23.1°C. It was higher when compared to that of 1995-96 (18.7°C and 20.8°C) and 1996-97 (19.9°C and 20.3°C). A significant increase was noticed in minimum temperature during the winter, which coincides with the flowering period of cashew. It may be detrimental to cashew flowering.

The bud break was 23rd October, 03rd October and 16th December in BLA-139-1, BLA-39-4 and NDR-2-1, respectively. Quite interestingly, inordinate delay in bud break was noticed in late variety as seen in case of NDR-2-1. This was attributed to intermittent rains during November and December. The duration of reproductive phase was 115, 163 and 133 days in case of BLA-139-1, BLA-39-4 and NDR-2-1, respectively. It showed that BLA-39-4 took more number of days for crop maturity when compared to that of BlA-139-1 and NDR-2-1. Normally, NDR-2-1 takes more number of days for crop maturity being a late season type, having longer crop duration., The reproductive phase was short in all the test varieties except in BLA-139-1.

As a whole, poor flowering and yield were noticed in cashew during the year. The unusual rain during November and December led to delay in flowering of late varieties/cultivars, which coincided during February and March. Tea mosquito incidence was relatively absent. The number of bisexual flowers produced might be less as the flowering phase missed the mild winter. It was true in all the cases of early, mid and late season types. The yield recorded was the lowest in Kannur and Kasaragod districts. This was mainly attributed to unfavourable weather during the reproductive phase of cashew. Thus, the year 1997-98 was the worst year as the cashew production was the minimum due to unfavourable weather. However, the kernel weight was more like in 1996-97. Interestingly, the shelling percentage was high as the soil moisture availability was better during the reproductive phase of cashew. It may also be attributed to less number of nuts produced during the year.

12.8.4. Crop weather diagrams of cashew during 1998-99

There was a gradual decline in rainfall from July (945 mm) to December (61 mm). Except two showers received during December, the rainfall distribution was almost similar to that of 1995-96 from December to March. However, heavy rains received during May (Fig. 22). Unlike in previous years, there was a gradual increase in maximum temperature from October (29.5°C) to April (33.2°C) while a decline in minimum temperature from November

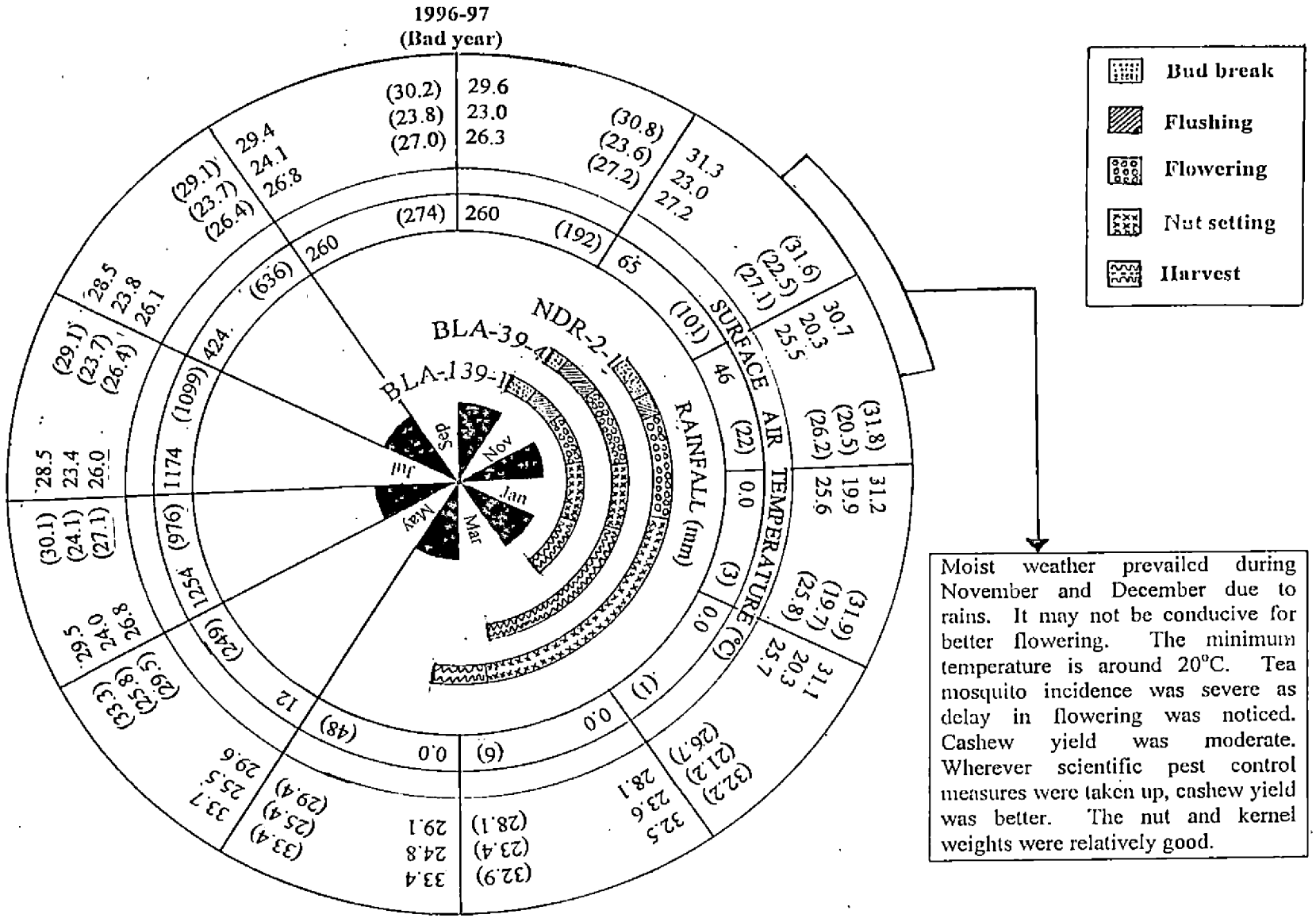


Fig 20. Crop weather diagram of cashew during 1996-97 at RARS, Pilicode

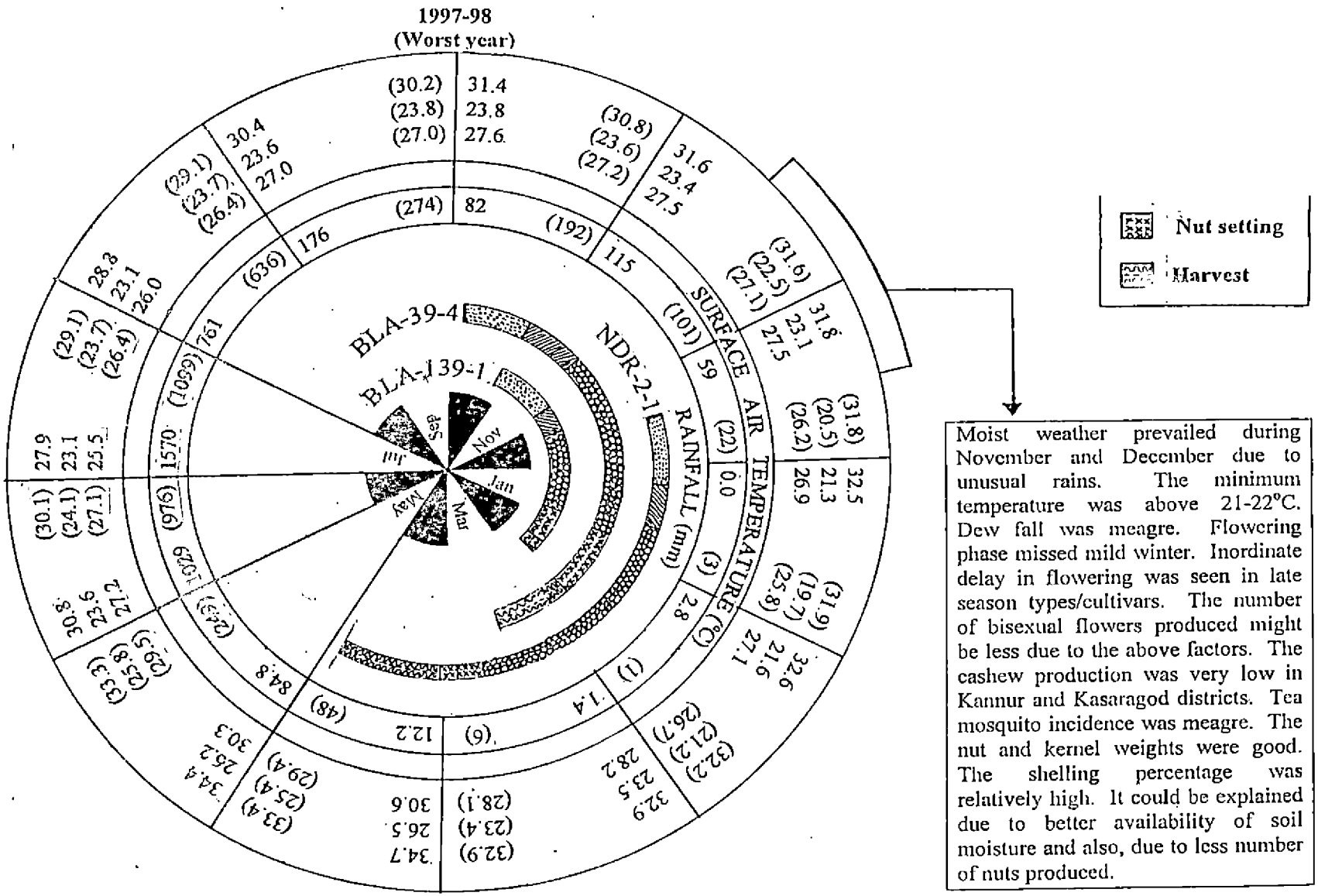


Fig 21. Crop weather diagram of cashew during 1997-98 at RARS, Pilicode

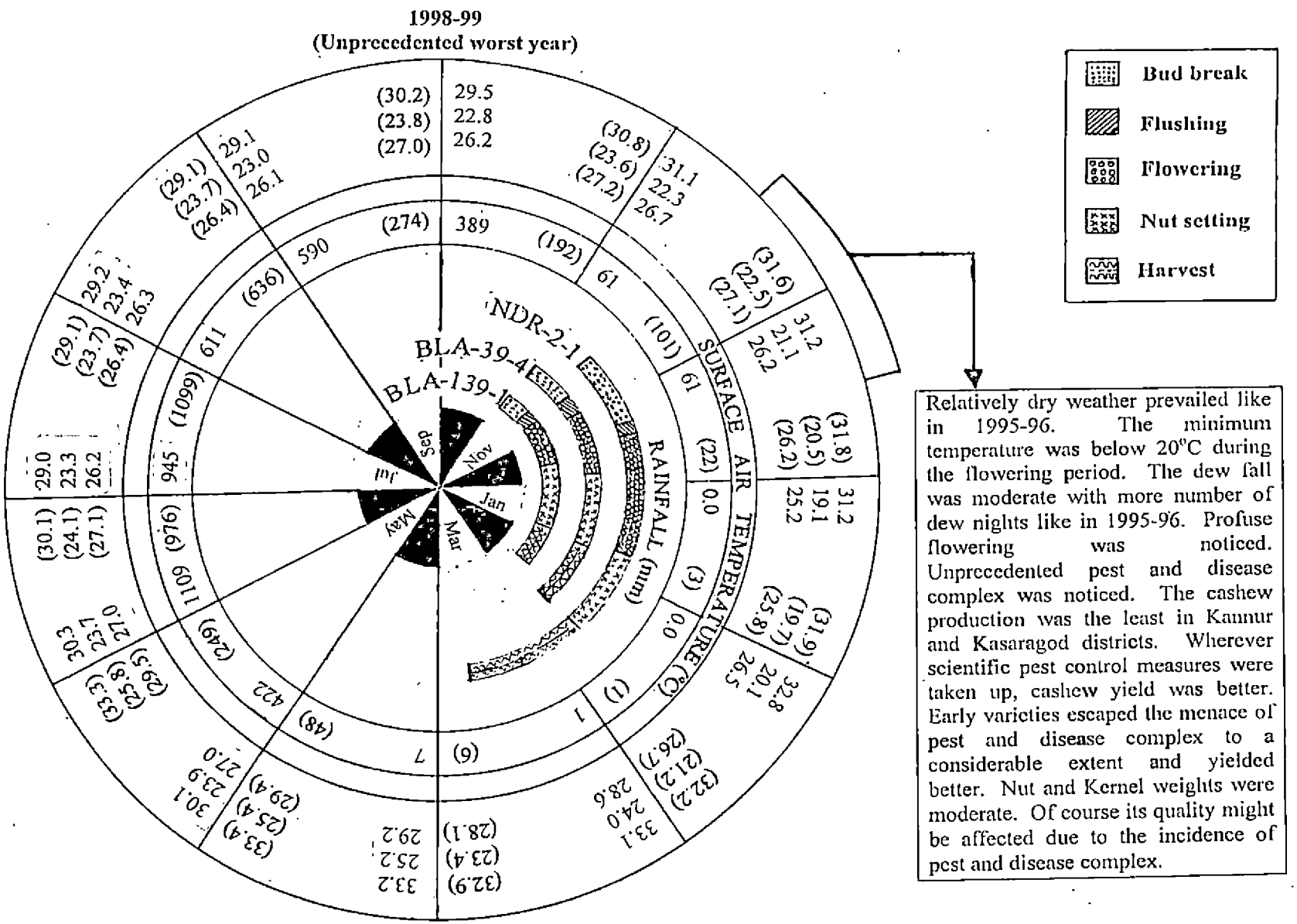


Fig 22. Crop weather diagram of cashew during 1998-99 at RARS, Pilicode

(22.3°C) to January (19.1°C). In February, 1999 the minimum temperature was around 20°C and relatively less when compared to that of previous year. A sharp increase was noticed in minimum temperature from March (24.0°C) to April (25.2°C). A similar situation of December, 1995 was seen during January, 1999 in terms of minimum temperature.

The bud break was relatively late in early season types. It was on 3rd November in both the varieties, BLA-139-1 and BLA-39-4. The duration of reproductive phase was 105, 111 and 128 days in BLA-139-1, BLA-39-4 and NDR-2-1 respectively. The duration of crop in all the test varieties was less when compared to that all the previous three years. This may be due to the incidence of pest and disease complex during 1998-99.

As a whole, profuse flowering was noticed in cashew though it was delayed to some extent. The unprecedented incidence of pest and disease complex (Tea mosquito and Inflorescence blight) was noticed during the year and devastated cashew production in Kannur and Kasaragod districts. The estimated cashew production was the lowest during the year. Whatever was left or escaped (less than 10 to 20 per cent of harvest) in late flowering types from the menace of pest and disease complex, which come for harvest during May also lost due to early and continuous rains in May, 1999. Early varieties escaped the menace of pest and disease complex to some extent and yielded better. Also, the cashew yield was relatively better wherever scientific pest control measures were taken up. The year 1998-99 could be classified as a good year since there was profuse flowering due to favourable weather. As the same weather conditions led to a pest and disease complex to develop and devastated the cashew production, the year 1998-99 also could be classified as the unprecedented worst year from cashew production point of view.

It can be inferred that the reproductive phase of cashew experienced relatively dry weather during 1995-96 and 1998-99. The minimum temperature was below 20^0 C and the dew fall was moderate with more number of dew nights during the reproductive phase of cashew (December to February) in both the years. However, the minimum temperature was relatively high and the dew fall was less during February 1996 when compared to that of 1999. The cashew flowering was profuse in both the years. The incidence of pest and disease complex was meagre during 1995-96 when compared to that of 1998-99. The cashew yield was the worst affected during 1998-99 and estimated to be a record low in Kannur and Kasaragod districts while 1995-96 recorded the maximum cashew production. The estimated record low of cashew production during 1998-99 could be attributed to the unprecedented incidence of pest and disease complex though weather was conducive for profuse flowering. Of course, early varieties escaped the menace of pest and disease complex and yielded better during 1998-99 and wherever scientific pest control measures were taken up, the cashew yield was better. The nut and kernel weights were relatively low to moderate in both the years. The low kernel weight during 1995-96 could be attributed to prolonged dry spell from November to March and more number of nuts produced. In 1998-99, the nut quality might be affected due to the incidence of pest and disease complex and heavy rains received during May 1999.

Unlike in 1995-96 and 1998-99, moist weather prevailed during the reproductive phase of cashew in 1996-97 and 1997-98. The minimum temperature was around 20^0 C and dew fall was moderate in 1996-97 during the reproductive phase of cashew while the minimum temperature was above 21-22^0 C and dew fall was very poor during 1997-98. The incidence of tea mosquito was severe during 1996-97 and meagre in 1997-98. The cashew production in Kannur and Kasaragod districts was hit in both the years very badly (32,000 tonnes in 1996-97 and 54,000 tonnes in 1997-98 as against 70,000 tonnes in 1995-96). The low yield during 1996-97 could be attributed to moderate flowering and the incidence of tea mosquito while it was the unfavourable weather (the minimum night temperature was above 21-22^0 C and dew fall was meagre) during the reproductive phase of cashew, which hit the cashew production to its low. Of course, the cashew yield was better in 1996-97 wherever scientific pest control measures were taken up. The nut characteristics viz., nut weight, kernel weight and shelling percentage were better in both the years. This might be due to better availability of soil moisture and less number of nuts produced.

It was clear from the above crop weather diagrams that the cashew yields would have been much better if scientific pest control measures were taken up during the years in which profuse/moderate flowering was noticed as the case might be in 1996-97 and 1998-99. The good and poor cashew yields obtained during 1995-96 and 1997-98, respectively could be attributed to weather factors. In 1998-99, the expected cashew production in Kannur and Kasaragode districts will be the lowest ever recorded though profuse flowering was noticed due to favourable weather during the reproductive phase. Of course, one of the factors for unprecedented pest and disease complex during 1998-99 was due to conducive weather, which destroyed cashew production to its bottom low.

12.9. Varietal response to the environment

a. RFRS, Vengurla

i) Climate

The annual rainfall is 2779 mm, spread in 97 days. 93 % of the annual rainfall falls during June-September. Insignificant (0.22% of annual) rainfall is received from December to February (Table 33). The maximum temperature varied between 29°C (August) and 33.4°C (May) while the minimum temperature was between 17.4°C (January) and 25.5°C (May). The minimum temperature during the reproductive phase (December to February) is 18°C while the maximum temperature is 32.1°C (Fig. 23). It appears that the maximum and minimum temperatures may be conducive during the reproductive phase while it is under moderate to severe soil moisture stress from December to May as the rainfall during the above period is insignificant.

Table 33. Mean monthly rainfall (mm) and surface air temperature (°C) at different locations

Station	Weather parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total/ Mean
Vengurla (1976-1998)	Rainfall (mm)	0.5 (0)	0.0 (0)	0.9 (0)	3.0 (1)	38.0 (1)	851.9 (21)	946.8 (28)	560.9 (25)	220.0 (11)	114.8 (9)	36.0 (1)	5.7 (0)	2778.5 (97)
	Max (°C)	31.9	31.6	31.8	32.2	33.4	30.8	29.5	29.0	30.0	31.8	32.9	32.7	31.5
	Min (°C)	17.4	17.5	20.6	23.7	25.5	25	24.6	24.1	23.6	23.0	20.5	19.0	22.0
	Mean (°C)	24.7	24.6	26.2	28.0	29.5	27.9	27.1	26.6	26.8	27.4	26.7	25.9	26.8
Pilicode (1942-1998)	Rainfall (mm)	2.6 (0)	1.1 (0)	6.4 (0)	46.5 (2)	234.8 (8)	991.6 (24)	1116.5 (27)	632.6 (23)	270.1 (13)	200.8 (10)	98.6 (5)	24.2 (1)	3625.8 (113)
	Max (°C)	32.0	32.3	32.9	33.5	33.1	30.2	29.1	29.2	30.2	30.8	31.5	31.8	31.4
	Min (°C)	19.6	21.2	23.3	25.5	25.7	24.1	23.7	23.7	23.7	23.6	22.5	20.5	23.1
	Mean (°C)	25.8	26.8	28.1	29.5	29.4	27.2	26.4	26.5	27.0	27.2	27.0	26.2	27.3
Madakkathara (1983-1998)	Rainfall (mm)	2.5 (0)	2.7 (0)	8.2 (0)	67.1 (5)	148.9 (7)	728.0 (21)	715.4 (27)	440.1 (21)	265.4 (15)	303.5 (14)	110.9 (6)	22.6 (1)	2815.5 (117)
	Max (°C)	32.9	34.9	36.2	35.6	34.0	30.1	29.1	29.4	30.4	31.2	31.7	31.9	32.3
	Min (°C)	22.1	22.6	23.8	24.9	24.9	23.5	23	23.2	23.3	23.0	22.9	22.6	23.3
	Mean (°C)	27.5	28.8	30.0	30.3	29.5	26.8	26.1	26.3	26.9	27.1	27.3	27.3	27.8
Chintamani (1983-1998)	Rainfall (mm)	4.1 (1)	4.5 (0)	11.5 (1)	21.3 (2)	62.4 (4)	81.3 (5)	17.4 (6)	82.9 (6)	152.0 (8)	118.2 (7)	40.4 (4)	18.4 (2)	675.4 (46)
	Max (°C)	26.9	29.0	32.4	34.3	33.6	31.3	29.5	29.1	29.0	28.5	27.3	26.2	29.8
	Min (°C)	15.0	16.7	19.2	22.4	23.1	21.8	21.1	20.8	20.9	20.3	17.7	15.5	19.5
	Mean (°C)	21.0	22.9	25.8	28.4	28.4	26.6	25.3	25.0	25.0	24.4	22.5	20.9	24.7
Bhubaneswar (1982-1998)	Rainfall (mm)	24.0 (2)	32.2 (4)	23.2 (4)	42.7 (5)	110.7 (6)	189.3 (15)	314.1 (20)	351.8 (22)	223.3 (17)	144.7 (10)	47.0 (3)	3.2 (1)	1506.2 (109)
	Max (°C)	28.6	31.3	34.9	36.6	37	35.0	32.9	32.0	32.4	32.1	30.4	28.6	32.7
	Min (°C)	16.1	18.7	22.2	24.7	26.5	26.2	25.7	25.5	25.2	23.0	18.8	15.1	22.3
	Mean (°C)	22.4	25.0	28.6	30.7	31.8	30.6	29.3	28.8	28.8	27.6	24.6	21.9	27.5
Ambalavayal (1992-1998)	Rainfall (mm)	16.8 (1)	7.9 (1)	25.8 (2)	151.5 (9)	175.2 (9)	399.3 (17)	554.1 (25)	299.4 (19)	157.6 (12)	253.7 (13)	122.5 (8)	36.4 (2)	2200.2 (118)
	Max (°C)	27.6	29.1	31.2	30.5	29.1	25.8	24.2	24.8	26.5	26.4	26.2	26.4	27.3
	Min (°C)	14.6	16.6	17.9	19.2	19.5	18.8	18.3	18.2	18.0	17.8	17.0	14.7	17.6
	Mean (°C)	21.1	22.9	24.6	24.9	24.3	22.3	21.3	21.5	22.3	22.1	21.6	20.6	22.5
Vriddhachalam (1973-1998)	Rainfall (mm)	15.8 (1)	14.5 (1)	12.4 (1)	15.4 (1)	36.6 (2)	53.7 (3)	83.9 (8)	115.3 (7)	159.9 (8)	140.9 (7)	256.4 (9)	136.7 (6)	1041.5 (54)
	Max (°C)	32.2	33.3	36.5	39.6	40.7	40.0	38.1	37.0	36.4	34.8	33.7	32.2	36.2
	Min (°C)	23.7	24.1	27.1	29.8	30.7	30.0	29.0	27.6	27.3	26.9	25.8	23.6	27.1
	Mean (°C)	28.0	28.7	31.8	34.7	35.7	35.0	33.6	32.3	31.9	30.9	29.8	27.9	31.7
Bapatla (1960-1999)	Rain fall	8.7	8.8	4.4	13.6	53.4	75.2	123.6	159.6	162.2	168.3	124.1	23.5	925.4
	Max (°C)	28.7	30.4	32.5	33.9	37.4	36.9	34.2	33.4	32.8	31.5	30.1	29.1	32.6
	Min (°C)	17.6	19.5	22.0	25.4	27.4	26.7	25.9	25.4	25.1	23.8	20.9	18.3	23.2
	Mean (°C)	23.2	25.0	27.3	29.7	32.4	31.8	30.1	29.4	29.0	27.7	25.5	23.7	27.9

( ) – Figures in parenthesis indicate no. of rainy days

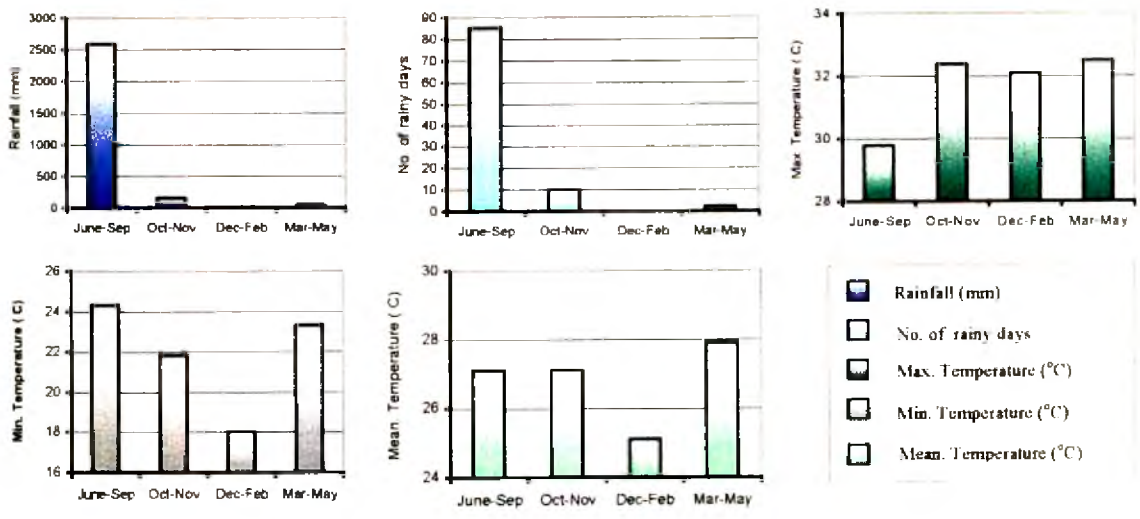


Fig 23. Seasonal distribution of rainfall (mm) and surface air temperature (°C) at RFRS, Vengurla (1976 to 1998)

ii) Soil

Soil type: Shallow to moderately deep, well drained, loamy soils on undulating moderate to steep sloppy with moderate to severe erosion, associated with low available water and non calcareous soil with moderate to strong surface stoniness.

Chemical composition: Organic Carbon – 1.26 %; pH – 5.54; EC – 0.111 mmhos/cm; Total Nitrogen (%) – 0.08 and available K_2O – 204.96 kg/ha.

Taxonomy: Inceptisol, Alfisol Lithic Rhodustalfs

iii) Variety

From the monthly rainfall data of Vengurla, the years were grouped into two viz., an year having a continuous dry spell of six months (Nov/Dec-April/May) and an year having a continuous dry spell of seven months (Nov-May). In the above two situations, the response of cashew yield to dry spell was analysed through the two-way analysis of variance.

A continuous dry spell of six months was noticed from November/December to April/May in all the thirteen years except 1977-78 (only five months dry spell) and the corresponding yield data are given in Table 34. The yield variation was significant among the years, which indicated that cashew yield is vulnerable to weather aberrations. The years 1976-77, 1980-81, 1982-83, 1983-84 and 1986-87 recorded relatively poor yield as against the average yield

of 18.5 kg/tree. Among the poor yielded years, 1986-87 recorded the lowest (12.06 kg/tree). This could be explained due to the early and prolonged dry spell, which occurred from September 1986 to May 1987 (Table 11.2.1.8). The year 1986 recorded the second lowest rainfall (1992 mm) from 1976 to 1998 as against the normal rainfall of 2779 mm.

Table 34. Occurrence of dry spell (six months) and cashew yield at RFRS, Vengurla

Year	Dry spell	Yield (kg/tree)						
		V1	V2	V3	V4	V5	V6	Mean
1976-77	Dec-May	19.98	23.50	16.57	17.42	15.57	06.77	16.64
1979-80	Dec-May	20.35	30.55	20.58	23.79	15.56	17.78	21.44
1980-81	Dec-May	15.63	28.09	10.33	11.75	11.72	11.58	14.85
1981-82	Dec-May	17.63	23.51	17.27	27.34	22.46	15.35	20.59
1982-83	Dec-May	12.95	18.81	18.07	17.55	17.30	10.40	15.85
1983-84	Dec-May	14.56	24.62	13.86	17.65	15.43	05.47	15.27
1984-85	Dec-May	20.07	30.84	08.39	17.92	15.05	23.17	19.24
1986-87	Dec-May	13.39	24.76	05.70	06.07	09.14	13.27	12.06
1987-88	Dec-May	30.09	38.76	14.42	17.62	22.94	22.95	24.46
1989-90	Nov-Apr	28.75	25.00	19.34	23.78	24.85	15.50	22.87
1990-91	Dec-May	10.66	25.67	16.63	16.97	17.87	26.29	19.02
1991-92	Nov-Apr	27.27	32.00	16.00	11.76	13.00	15.32	19.23
1992-93	Nov-Apr	24.86	31.00	14.76	17.47	16.74	15.32	20.03
Mean		19.75	27.46	14.76	17.47	16.74	15.32	18.58

CD (variety) – 3.47 CV – 24.3% CD (year) – 5.10

The variety "V2" was significantly superior (27.46 kg/tree), followed by "V1" (19.75 kg/tree). All the other varieties viz., V3, V4, V5 and V6 were on par. The variety "V2" always performed better in all the years from 1975 to 1993 (Fig. 24). It clearly indicated that "V2" can be recommended for wide cultivation under Vengurla situation, where five to seven months dry spell was noticed during the reproductive phase of cashew from November to May. However, the nut size of "V2" is relatively small. This variety can be tried in crop improvement programme for increasing nut size, retaining the other desirable characters as the yield is excellent.

The duration of seven months dry spell also was seen from November to May in 1978-79, 1985-86 and 1988-89 (Table 35). All the six cashew varieties (V1-V6) of Vengurla performed well even under dry spell of seven months duration and yielded more than 16 kg/tree. Among the varieties, there was no significant difference. However, year to year variation in cashew yield was significant. The yield was the minimum (14.15 kg/tree) during 1985-86 while the maximum (23.67 kg/tree) during 1988-89. On an average, the cashew yield was 18.5 kg/tree at Vengurla.

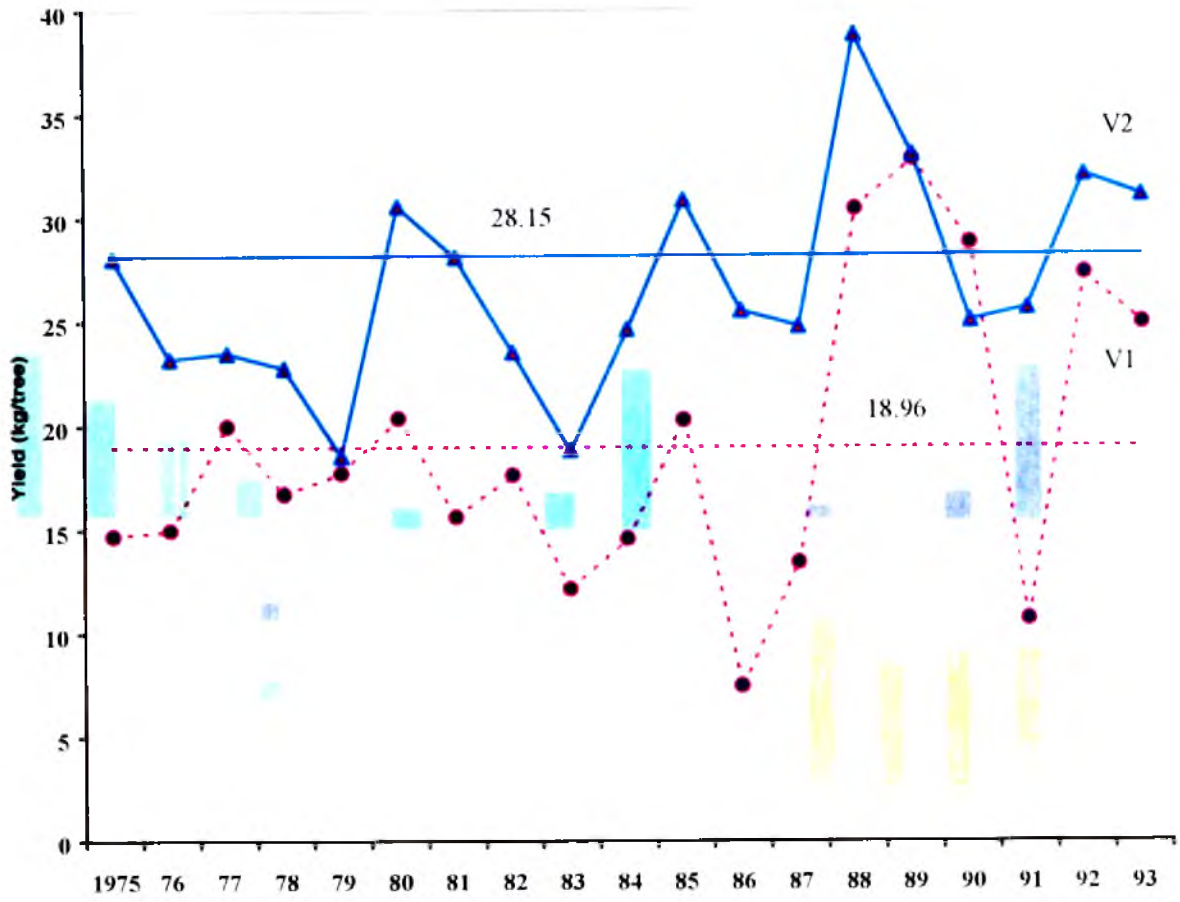


Fig 24. Mean cashew yield (kg/tree) of V1 and V2 at RFRS, Vengurla from 1975 to 1993

Table 35. Occurrence of dry spell (7 months) and yield at RARS, Vengurla

Year	Dry spell	Yield (kg/tree)						
		V1	V2	V3	V4	V5	V6	Mean
1978-79	Nov-May	17.73	18.55	18.94	18.25	15.97	14.11	17.26
1985-86	Nov-May	07.46	25.50	13.52	11.27	11.51	15.63	14.15
1988-89	Nov-May	32.79	33.00	16.54	19.63	21.38	18.66	23.67
	Mean	19.33	25.68	16.33	16.38	16.29	16.13	18.36

CV – 27.8 % CD(year) –6.57

b. CRS, Madakkathara

i) Climate

The annual rainfall is 2816 mm, spread in 117 days. 76.3% of the annual rainfall is received during the Southwest monsoon (June-Sept). Insignificant (1%) rainfall is received from

December to February (Table 33) like in Vengurla, which coincides with the reproductive phase of cashew. The maximum temperature varied between 29.1°C(July) and 36.2°C (March) while the minimum temperature was between 22.1°C (January) and 24.9°C(April and May). Unlike at Vengurla, considerable amount (8%) of annual rainfall is received from March to May (Fig. 25), which may not be conducive as the wet spells during the above period may coincide with the nut development and ripening phase. At Vengurla, the surface air temperature was relatively less when compared to that of Madakkathara.

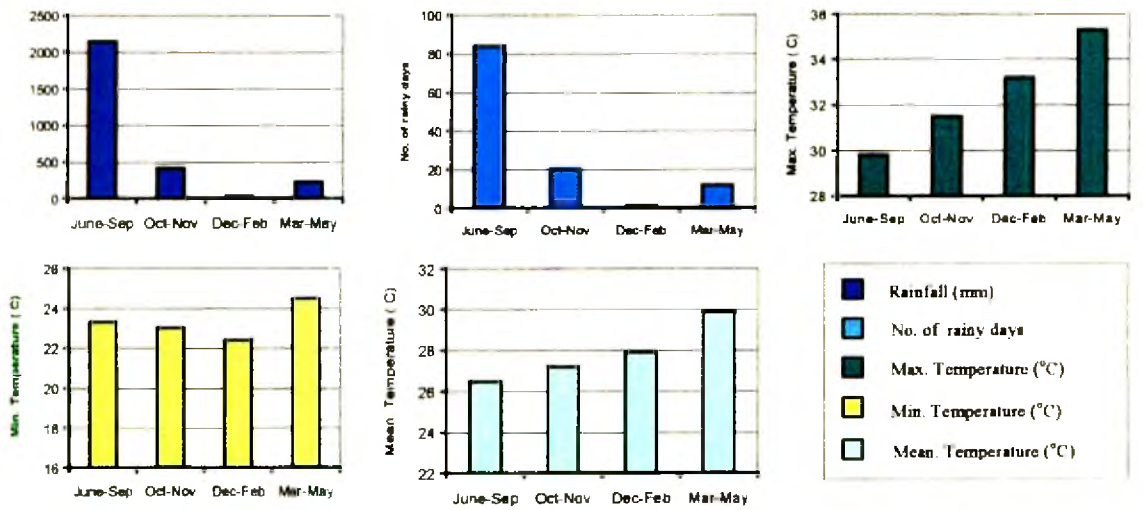


Fig 25. Seasonal distribution of rainfall (mm) and surface air temperature (°C) at CRS, Madakkathara (1983 to 1998)

ii) Soil

Soil type: Very deep, well drained, gravelly clay soils on gently sloping coastal laterites, with moderate erosion, associated with very deep, well drained, gravelly clay soils with moderate surface gravelliness.

Chemical composition: Organic Carbon– 0.72 to 1.01 %; Available P_2O_5– 6 to 12.6 kg/ha and Available K_2O – 186 to 345 kg/ha.

Taxonomy: Clayey-skeletal, kaolinitic, Typic kandiusbelts/Typic kanhaplustults

iii) Variety

The cashew yield during 1993 was 9.7 kg/tree and significantly high when compared to that of 1994 (7.91 kg/tree) and 1995 (7.32 kg/tree) when all the MLT varieties pooled together. All the varieties, having more than 9.05 kg/tree were on par (Table 36) and performed well

in a situation where four to five months dry spell is noticed normally during the reproductive phase from December to April. The varieties on par were Kanaka (H-1598), H-1608, T-30/4, V3, V5, M-44/3, M-26/2 and AKM-1.

Table 36. Mean cashew yield (kg/tree) data of MLT varieties at CRS, Madakkathara

Variety	Mean yield (kg/tree)			Mean
	1993	1994	1995	
H-1598	11.67	12.17	11.04	11.63
H-1600	11.33	08.20	06.80	08.78
H-1608	11.97	10.33	07.77	09.69
H-1610	08.17	08.13	02.20	06.17
T-30/4	09.83	07.60	09.73	09.05
T-59/2	09.17	05.27	05.57	06.67
T-129	05.90	03.03	0346	04.13
T-40	05.23	04.50	04.67	04.80
H-2/15	06.47	07.33	08.03	07.28
H-2/16	07.87	04.80	04.81	05.83
V2	07.27	04.27	05.26	05.60
V3	11.52	08.73	07.09	09.11
V4	11.83	07.53	06.91	08.76
V5	09.00	12.10	13.89	11.67
M-33/3	11.15	07.30	05.41	07.95
M-44/3	10.70	11.20	10.17	10.69
M-26/2	14.47	10.00	10.22	11.56
AKM-1	11.00	10.87	09.64	10.17
Mean	09.70	07.91	07.32	08.31

CD (var) –2.70 CV – 19.5 % CD (year) - 1.10

In another varietal trial, the year 1984 was the worst year in which the yield was the least (1.85 kg/tree). The low yield obtained at Madakkathara in 1984 (1.85 kg/tree) was due to wet spells received from March to May, which might have coincided with the nut development process. At the same time, the cashew yield (4.66 kg/tree) was relatively better during the unprecedented drought that occurred during the summer 1983. K-10-2 (5.62 kg/tree) and M76/1 (5.15 kg/tree) yielded better among all the varieties (Table 37). However, the cashew yield was very poor when compared to that of the MLT varieties in which the cashew yield was more than 9.05 kg/tree. On an average, the cashew yield of superior MLT varieties was 10.5 kg/tree.

Table 37. Mean cashew yield (kg/tree) of 16 varieties from 1982 to 1988 at CRS, Madakkathara

Variety	Mean cashew yield (kg/tree)							
	1982	1983	1984	1985	1986	1987	1988	Mean
ANSUR-1	3.18	4.79	1.67	3.40	5.58	5.32	4.33	4.04
VENGURLA 36-3	3.23	3.39	1.02	4.15	5.77	5.68	4.33	3.94
SWANTWADI	3.95	3.32	1.34	3.70	4.03	4.67	5.21	3.75
VENGURLA 37-3	2.84	4.60	2.42	3.04	4.43	3.50	2.87	3.53
BLA (TREE NO.1)	3.29	2.95	1.55	3.22	4.16	4.44	6.23	3.69
BLA (TREE NO.40)	2.03	3.93	0.77	2.73	3.47	2.59	5.79	3.04
BLA (TREE NO.56)	3.43	3.77	1.21	3.95	3.82	3.64	4.92	3.53
BLA (TREE NO.273)	2.75	2.99	0.66	3.44	4.46	3.21	5.32	3.26
M-10/4	3.28	5.53	2.18	3.53	3.73	3.96	4.57	3.83
M-6/1	4.12	5.89	2.58	3.81	5.15	3.52	5.52	4.37
K 27/1	4.28	6.45	0.64	2.95	6.56	5.79	2.72	4.20
M –76/1	4.46	7.07	3.97	4.97	4.62	5.05	5.90	5.15
H-4-7	4.06	4.90	3.78	5.06	5.35	4.10	3.86	4.44
K-10-2	5.41	5.37	3.73	6.54	10.14	5.66	2.47	5.62
BLA-139-1	4.70	4.12	1.39	4.21	5.14	6.16	6.86	4.65
BLA-259-1	1.54	5.47	0.73	4.80	3.27	4.13	5.08	3.57
Mean	3.53	4.66	1.85	3.97	4.98	4.46	4.75	4.03

CD (Var) – 1.13 CV – 26.6 % CD (Year) - 0.75

c. ARS, Chintamani

i) Climate

The annual rainfall is 675 mm, spread in 46 days. The rainfall during June-September contributes 58% of the annual, followed by October-November (23.5%). The rainfall distribution during flushing and flowering (December to February) is insignificant (4% of annual) and comparatively better when compared to that of Vengurla and Madakkathara (Fig.26). There is significant (14.1% of annual) rainfall from March to May like in Madakkathara. The annual rainfall is the lowest at Chintamani when compared to that of all other cashew growing locations (Table 33). The maximum temperature varied between 26.2^{0}C (December) and 34.3^{0}C (April) while the minimum temperature was between 15^{0}C (January) and 23.1^{0}C (May). Being located at high ranges (857AMSL), the mean air surface temperature was low (24.7^{0}C) when compared to that of coastal stations. The low (<15^{0}C) night temperature during the flowering period of cashew from December to February may hit the yield adversely.

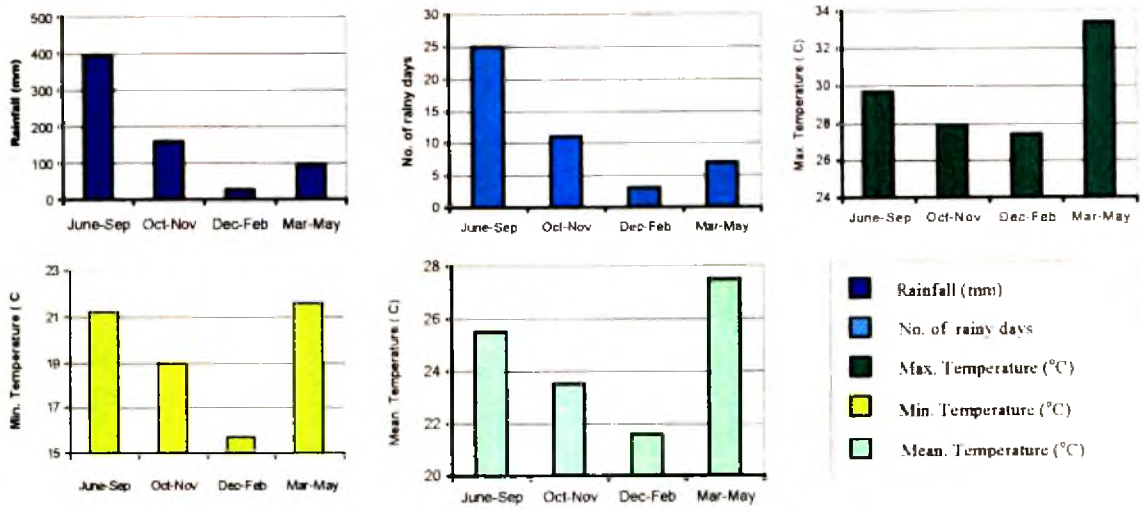


Fig 26. Seasonal distribution of rainfall (mm) and surface air temperature (°C) at ARS, Chintamani (1983 to 1998)

ii) Soil

Soil type: Red sandy loam

Chemical composition: Organic Carbon– 0.1 – 0.15 (0.35 – 0.55%); pH– 5.1– 6.4; EC– 0.1 to 0.15 mmhos/cm; P_2O_5 – 28 kg/acre (12.5 to 22 kg/ha); K_2O- 80 kg/acre (>200 kg/ha).

iii) Variety

The year 1995 recorded the maximum yield (6.96 kg/tree) when compared to that of 1993 (5.21 kg/tree) and 1994 (3.55 kg/tree) when all the MLT varieties pooled together (Table 38). The entry viz., M-44/3VRI (8.48 kg/tree) outyielded all the varieties and significantly high, followed by H-1608 (7.45 kg/tree). However, it was on par with the above variety. The average yield of the superior varieties was 7.97 kg/tree.

In another trial at Chintamani, the year 1994 recorded the least (4.15 kg/tree) when compared to that of 1993 (5.95 kg/tree) and 1995 (8.76 kg/tree). The year to year variation in cashew yield was also significant. Vengurla–3 (8.44 kg/tree) and Bapatla-2 (8.02 kg/tree) outyielded (Table 39) among the vengurla and Bapatla varieties, respectively. The mean yield of superior varieties was 8.2 kg/tree. On an average, the yield was 8.14 kg/tree when both the above yield sets of data are pooled together.

Table 38. Average cashew yield (kg/tree) at ARS Chintamani (planted in 1986)

Entries	Average cashew yield (kg/tree)			
	1993	1994	1995	Mean
H-1610	5.39	4.04	8.18	5.87
H- 1600	6.10	4.02	5.45	5.19
H-1608	5.79	6.25	10.32	7.45
H-1598	5.67	3.70	8.00	5.79
TN-129	5.13	3.21	6.17	4.84
TN-40	7.29	2.48	2.71	4.16
Hyb 2/15	4.19	2.69	6.78	4.55
Hyb 2/16	3.13	2.55	6.17	3.95
M44/3VRI	8.05	6.24	11.14	8.48
M44/3(Vengurla)	2.84	0.90	5.38	3.04
H-24	5.21	4.21	6.65	5.36
M-44/3(VTH-12)	5.09	2.26	7.71	5.02
M30/3(VTH-12)	3.65	2.96	4.87	3.83
59/2 (VTH-59)	5.45	4.23	7.93	5.87
Mean	5.21	3.55	6.96	5.24

CD (var) – 1.98 CV – 22.5 CD (year) – 0.92

In both the cases, the year 1995 recorded better yield when compared to that of 1993 and 1994. The low yield during 1994 may be attributed to the poorest rainfall and its distribution received from December 1993 to June 1994 (Table 11.2.1.3). The year 1994 was the poorest rainfall year (436.6mm in 45 days). However, the monthly rainfall distribution appeared almost the same from November to May in all the three years except December 1993 (63.2 mm on single day) and May (163.3 mm in eight days), 1995. It appears that other than rainfall, some other environmental factors must be contributing to troughs and ridges in cashew yield. It needs further examination.

Table 39. Mean cashew yield (kg/tree) of different varieties of Vengurla and Bapatla at ARS, Chintamani (planted in 1986)

Variety	Mean cashew yield (kg/tree)			
	1993	1994	1995	Mean
Vengurla-1	6.74	3.21	9.65	6.53
Vengurla-2	7.31	5.44	9.21	7.32
Vengurla-3	8.32	6.46	10.54	8.44
Vengurla-4	2.15	3.38	6.12	3.88
Vengurla-5	6.72	4.05	13.04	7.94
Bapatla-1	3.25	2.22	6.42	3.96
Bapatla-2	8.99	4.60	10.48	8.02
Bapatla-3	4.68	4.50	6.62	5.27
Bapatla-4	5.58	4.23	7.73	5.85
Bapatla-5	5.71	3.42	7.77	5.63
Mean	5.95	4.15	8.76	6.28

CD (var) – 2.06; CV – 19.1%; CD (year) – 1.13

d. CRS, Bhubaneswar

i) Climate

The annual rainfall is 1506 mm, spread in 109 days (Table 33). Like at Madakkathara, 72% of the annual rainfall is seen during the Southwest monsoon (June to September). The contribution of rainfall from October to November and from March to May was 12% each, respectively of the annual. The remaining four per cent comes from December to May (Fig. 27). The maximum temperature varied between 28.6°C (December and January) and 37°C (May) while the minimum temperature was between 15.1°C (December) and 26.5°C (May). The maximum (36.2°C) temperature during the nut setting and development phase (March to May) may hit badly cashew yield and its quality occasionally.

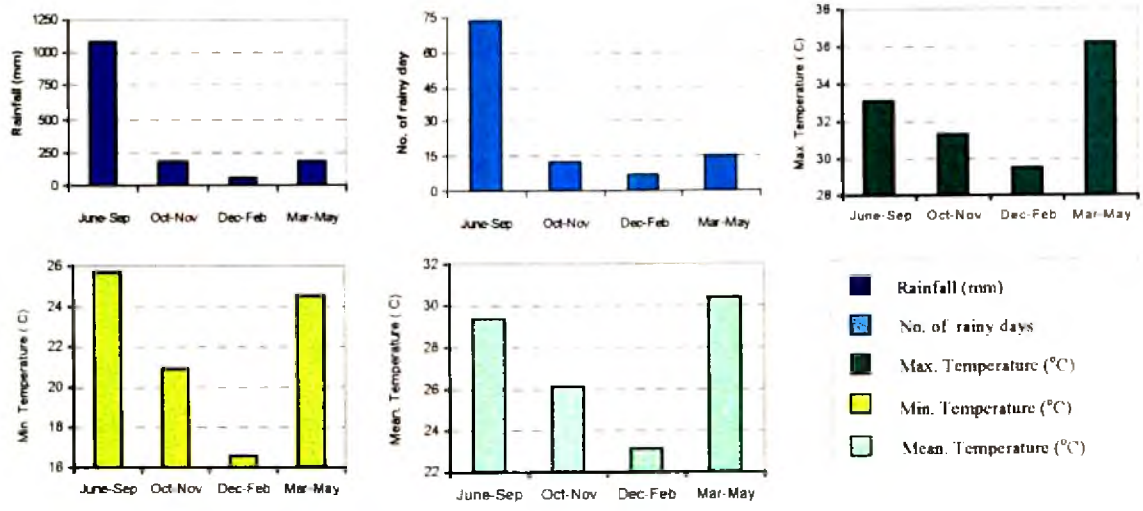


Fig 27. Seasonal distribution of rainfall (mm) and surface air temperature (°C) at CRS, Bhubaneswar (1982 to 1998)

ii) Soil

Soil type: Shallow to moderately deep, well drained loamy soils on gently sloppy lands with slight erosion associated with low available water and neutral soil reaction.

Chemical composition: Organic Carbon – 0.20 %; pH – 5.16; EC – 0.110 mmhos/cm; Total Nitrogen (%) – 0.09 and available K_2O – 25.36 kg/ha.

Taxonomy : Typic Ustropepts, Typic Ustorthents

iii) Variety

The year 1985 recorded the minimum (5.7kg/tree) cashew yield, followed by 1990 (6.5 kg/tree). The maximum Yield (17.4 kg/tree) was recorded in 1995, followed by 1994 (16.2 kg/tree). The low yield during 1985 and 1990 could be attributed to the rainfall received

during January and May, which coincides with the reproductive phase. However, the rainfall was high in 1990 when compared to that of 1985. There was a trend that the cashew yield was low whenever significant rains received from January to May (11.2.1.2a). It also appeared that whenever the maximum temperature from March to May was high (35-38°C), the yield appeared to be low. The variety viz., BPP1 and BPP6 were significantly inferior when compared to that of BPP2, BPP3, BPP4 and BPP5, which were on par and yielded more than 11.85 kg/tree (Table 40). The average yield of the superior varieties was 12.84 kg/tree.

Table 40. Mean yield of cashew (kg/tree) at CRS, Bhubaneswar (planted in 1978)

Year	Mean yield of cashew (kg/tree)						Mean
	BPP-1	BPP-2	BPP-3	BPP-4	BPP-5	BPP-5	
1985	6.70	3.90	8.70	3.20	6.50	5.20	5.70
1986	8.50	6.70	11.60	4.70	10.00	4.00	7.58
1987	6.90	7.00	11.80	5.50	12.30	7.00	8.42
1988	14.60	12.70	17.50	12.30	19.80	11.60	14.80
1989	12.60	12.90	18.30	16.00	19.70	11.00	15.10
1990	1.80	5.50	8.50	16.00	5.20	2.00	6.50
1991	8.20	14.40	8.90	8.50	7.90	5.00	8.82
1992	12.70	15.50	13.90	18.90	12.60	8.70	13.70
1993	9.60	10.60	11.80	16.40	12.50	5.20	11.00
1994	13.60	14.50	15.90	22.70	19.00	11.20	16.20
1995	9.50	20.00	19.00	20.00	21.90	13.70	17.40
1996	5.50	18.50	10.80	12.00	13.50	7.50	11.30
Mean	9.18	11.85	13.06	13.02	13.41	7.68	11.37

CD (Var)-2.40 CV-26.4% CD (Year)-3.70

e. RRS, Vriddhachalam

i) Climate

The annual rainfall is 1042 mm, spread in 54 days. Unlike at other cashew growing stations, 54% of the annual rainfall is received from October to February, followed by June to September (40%). The remaining six percent of annual rainfall comes from March to May (Fig. 28). The maximum temperature varies from 32.2°C (December and January) to 40.7 °C (May) while the minimum temperature (Table 33) was between 23.6°C (December) and 30.7°C (May). Like at Bhubaneswar, high maximum (38.9°C) temperature during nut setting and development phase (March to May) may be detrimental to cashew yield (Fig.28). The night temperature is also high during flushing/flowering period (December to February) unlike at Bhubaneswar, which may not be conducive for better flowering.

ii) Soil

Soil type: Moderate to very deep, well drained, loamy soil with laterite and underlying sandstone rocks, associated with low to medium available moisture and acidic non calcareous soil with slight to moderate erosion (Red laterite and sandy loam).

Chemical composition: Organic Carbon – 0.5 %; pH – 5.5 to 6.5; EC – 0.05 mmhos/cm; Available Nitrogen (%) – 332.44 kg/ha and Available K_2O – 123.2 kg/ha and Available P_2O_5 – 6.97 kg/ha.

Taxonomy: Inceptisols, halaquepts, Ustropepts and Rhodustalfs

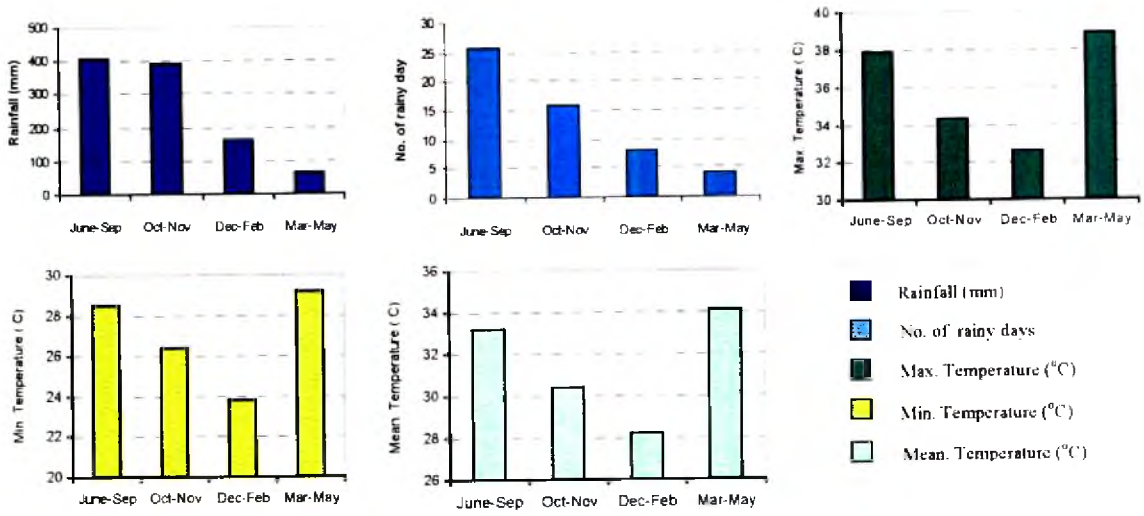


Fig 28. Seasonal distribution of rainfall (mm) and surface air temperature (°C) at RRS, Vriddhachalam (1973 to 1998)

iii) Variety

It is interesting to note that varietal and year-wise variation in yield was statistically not significant. All the three varieties (VRI-1, VRI-2 and VRI-3) performed well. The average yield of all the three varieties was 8.9 kg/tree (Table 41). The coefficient of variation was 49.9 per cent. It showed that the cashew yield may be highly vulnerable to weather aberrations unlike at Vengurla (24 to 28 per cent), Madakkathara (20 to 27 per cent), Chintamani (19 to 23 per cent) and Bhubaneswar (26.4 per cent), where the coefficient of variation was below 30 per cent.

The low yield (3.08 kg/tree) during 1975 could be explained as there was little rain from November to June, which was considered to be abnormal year. Similar was the case during 1972-73 (4.09 kg/tree) and 1990-91 (5.87 kg/tree) in which the cashew yield was poor. In contrast, the low yield during 1987-88 was attributed to the heavy rains received during November and December (11.2.1.1), followed by wet spells during March to May. Similar situation existed in 1987-88 also in which the yield was poor (5.33 kg/tree).

It revealed that abnormal dry spell from November to June in one situation and heavy rains during November and December, followed by intermittent wet spells during March-May in another situation may be detrimental to cashew yield. The cashew yield was highly inconsistent (Fig. 29) as the above situation at Vriddhachalam is not uncommon.

Table 41. Mean cashew yield (kg/tree) of Vriddhachalam varieties (planted in 1964) from 1975 to 1992

Year	Mean cashew yield (kg/tree)			
	VRI-1	VRI-2	VRI-3	Mean
1971	9.20	7.06	7.15	7.80
1972	8.50	6.80	3.10	6.13
1973	5.35	0.38	6.55	4.09
1974	6.44	7.32	9.46	7.74
1975	0.50	7.15	1.60	3.08
1976	10.10	6.99	10.17	9.09
1977	3.70	6.90	14.20	8.27
1978	7.94	7.30	16.83	10.69
1979	5.94	8.30	14.65	9.63
1980	10.20	5.40	11.26	8.95
1981	16.60	11.92	8.35	12.29
1982	11.45	7.00	22.58	13.68
1985	7.75	6.90	22.18	12.28
1986	5.70	7.30	11.35	8.12
1987	11.25	8.30	19.05	12.87
1988	5.70	5.40	4.90	5.33
1989	12.25	11.92	7.16	10.44
1990	8.85	7.00	12.20	9.35
1991	2.49	10.66	4.45	5.87
1992	4.53	22.01	10.25	12.26
Mean	7.72	8.10	10.87	8.9

CV – 49.9%

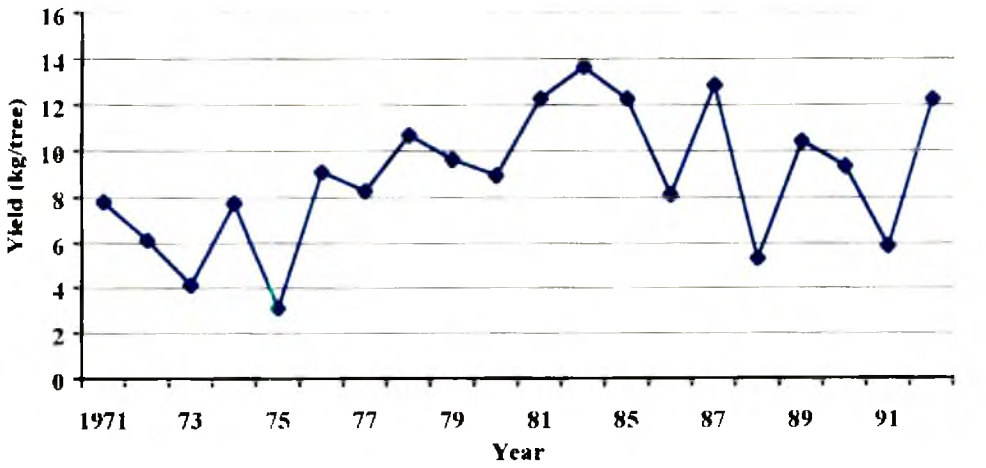


Fig 29. Mean cashew yield (kg/tree) of Vriddhachalam varieties (V1, V2 and V3) from 1971 to 1992

From the above, it is very clear that the cashew yield varies significantly from year to year and vulnerable to weather aberrations. Similarly, varietal variation was also found significant at all the locations except at Vriddhachalam. Interestingly, all the superior varieties were found dependable except in extreme adverse weather conditions as the coefficient of variation was below 30%. However, it was 49.9% at Vriddhachalam. It is also understood that the year wise performance of cashew yield at various locations is totally different as evident in Table 42.

Table 42. Cashew yield at different locations during the same period (1993-1995)

Location	1993	1994	1995
Vengurla	Good	Good	NA
Madakkathara	Good	Poor	Poor
Chintamani	Poor	Poor	Good
Bhubaneswar	Poor	Poor	Good
Vriddhachalam	NA	NA	NA

The cashew yield in a particular year may not be the same at all the locations due to diverse environmental conditions. For example, the year 1993 was the good year in case of Vengurla and Madakkathara while it was not the case at Chintamani and Bhubaneswar. In contrast, 1995 was the good year in case of Chintamani and Bhubaneswar while it was not so at Madakkathara. It also appears that the yield trend of cashew across the west coast is alike and the same may be true across the east coast. Interestingly, the yield trend may be totally different across the west and east coasts in a given year. Across the west and east coasts of India, cashew yield was consistently the highest (18.5 kg/tree) at Vengurla while the lowest (8.9 kg/tree) at Vriddhachalam. However, the cashew yield at Chintamani was the bottom low (8.1 kg/tree) when compared to that of the west and east coasts of India. From the yield data, it is also established that the stable yield could be obtained between fifth and seventh year depending upon genotype and its environment.

12.9.1. Drought and cashew yield

Cashew exists across the west and east coasts of India from South to North, lying between 09°N and 23° N latitude. Though it grows beyond 23°N of latitude in northeastern States of India, the area under cashew is less and its contribution in terms of production is relatively low. As the low night temperature during the reproductive phase beyond 13°C may not be conducive, the cashew cultivation is not economic and thus, cashew tract lies within the tropical belt of India as a tropical crop. The cashew cultivation is given prime importance from the last one to one-and-a half decade due to its economic value though it exists since long across the west and east coasts of India. Still, it remains as a neglected crop when the majority of cashew grown areas are examined across the west and east coasts of India. It is more so across the west coast except in Maharastra to some extent.

Across the west coast at lower latitudes, cashew is spread from coastal belt to hill slopes, extending up to 1000 m(AMSL). The States covered across the west coast are Kerala, Karnataka, Goa and Maharashtra. Whereas, cashew is mostly grown in plains across the east

coast (Tamil Nadu, Andhra Pradesh, Orissa and West Bengal). The cashew cultivation is also seen in the extreme Southeast of Madhya Pradesh (Jagadalpur) and the inland plateau of Karnataka (Chintamani).

The rainfall distribution across the cashew tract of the west coast is uni-model, followed by prolonged dry spell from November to May if pre monsoon showers fail. The above pattern is more prevalent towards North of Kerala (Fig. 30) and beyond (up to Vengurla in Maharastra). The rainfall, evaporation and the surface air temperature distribution at different locations could be very well seen in Figs. 4a, 23 &25. The dry spell from October/November to April/May coincides with the reproductive phase of cashew. It indicated that the reproductive phase from flushing/flowering to harvest experiences moderate to severe soil moisture stress across the west coast. The cashew tract across Maharastra experiences prolonged dry spell of five to seven months as rain ceases by the end of October and experiences more soil moisture stress. However, the dormant phase (June to September) of cashew across the west coast was under prolonged wet spell and no soil moisture stress is seen during the period. Though the reproductive phase of cashew is under soil moisture stress, cashew plantations at different locations (Kottarakkara, Madakkathara, Anakkayam, Pilicode, Puttur and Vengurla) across the west coast are healthy. Similar was the situation in Orissa and West Bengal where cashew is cultivated across the east coast. Though the annual rainfall is less over the cashew tract of the above States, the distribution of rainfall is alike (Figs. 4b & 27) to some extent as in case of the west coast. In contrast, Tamil Nadu receives more rains from September to November (Figs. 4b & 28) due to the influence of Northeast monsoon. However, sometimes rains extend up to December over Tamil Nadu where cashew is grown. Across the cashew tract of Andhra Pradesh, the monthly rainfall exceeds evapotranspiration from August to October. Sometimes rains extended up to November due to cyclones, which are not uncommon. Quite interestingly, the cashew at Chintamani (Karnataka) is always under soil moisture stress throughout the year as rainfall was less than evapotranspiration round the year (Figs. 4c & 26), except during September and October. Despite of the above fact, cashew plantations are better and comparable at Chintamani (Karnataka). It is worth seeing the cashew plantations over there. The ground water table is also very low at Chintamani. The reproductive phase of cashew from February to May is under soil moisture stress as the crop is grown under sandy to sandy loam in which water holding capacity is very poor, although rains exceeds evaporation from August/September to October/November across Tamil Nadu and Andhra Pradesh. Across the east coast also, healthy cashew plantations are seen where cashew experiences soil moisture stress.

From the above, it is understood that cashew experiences moderate to severe soil moisture stress across the west coast under rainfed conditions and prolonged further in the east coast as rain received was late and it is below crop water need. At Chintamani, cashew almost suffers due to soil moisture stress round the year.

As seen at Vengurla, the performance of cashew was excellent where prolonged dry spell is predominant during the reproductive phase of cashew. The cashew yield at Vengurla was the highest (18.5 kg/tree), where the crop is under moderate to severe soil moisture stress for five to seven months during its reproductive phase. The cashew yield of the superior varieties was

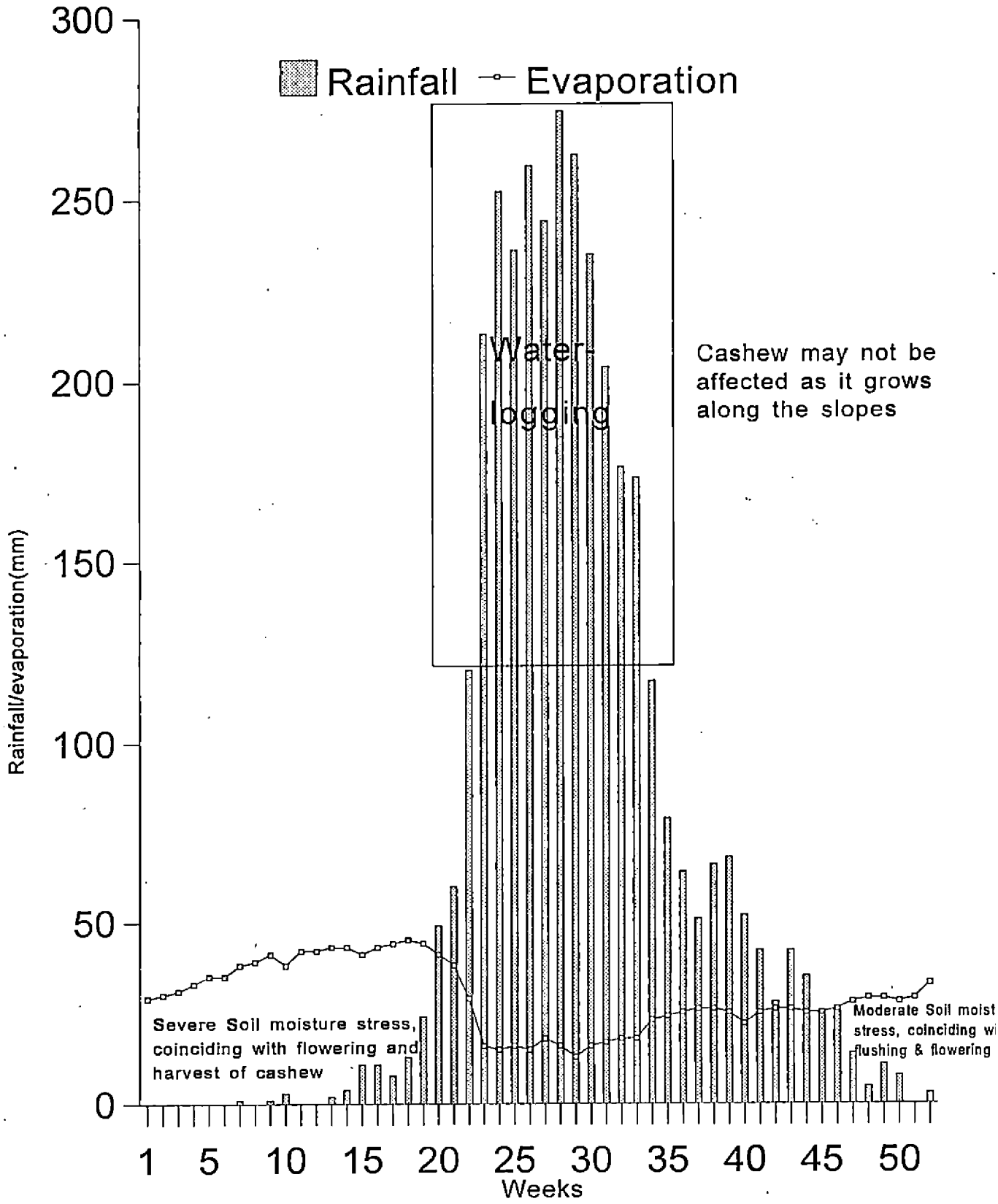


Fig 30. Weekly rainfall versus evaporation at RARS, Pilicode (1983-1998)

10.5 kg/tree at Madakkathara, where a prolonged dry spell of three to five months is seen during the reproductive phase of cashew.

Bhubaneswar and Vriddhachalam recorded 12.8 kg/tree and 8.9 kg/tree, respectively where the maximum temperature during the nut setting and development phase (March to May) is high and considered to be a constraint occasionally under severe soil moisture stress. At Chintamani, the cashew yield was 8.1 kg/tree where crop is under soil moisture stress round the year unlike at other growing cashew locations (Fig. 31). It revealed that cashew productivity was relatively low where the crop is under soil moisture stress for eight to ten months as the case at Vriddhachalam and Chintamani. However, the yield was much better at cashew research stations where cashew is grown under rainfed conditions in better crop management when compared to that of country's average (less than 4 kg). Also, the cashew production was high in Kannur and Kasaragod districts during 1995 – 96 during which prolonged dry spell was noticed from November to March, coincided with the reproductive phase of cashew. At the same time, the yield was low whenever intermittent rains received from November to May across the west and east coasts of India. It appears that cashew is enamoured with dry spell/ drought during its reproductive phase and provides relatively better yield.

With all the supporting data on the performance of cashew under dry spell/drought, it can be inferred that cashew thrives well under drought situation and yields relatively better. However, the abnormal drought situation affects the cashew yield very much under rainfed conditions. This is possible if the duration of dry spell is prolonged from the normal as the varieties/cultivars are susceptible to abnormal severe soil moisture stress. The varieties/cultivars are tolerant to soil moisture stress under normal rainfed conditions due to their adaptability over a period of long time, beyond which they may fail to yield at the desired levels. Also, the cashew yield and its quality are affected due to prevalence of high maximum temperature (35 to 40^0 C and beyond) during the reproductive phase of cashew (flowering/nut setting to harvest) in a situation where prolonged abnormal drought is noticed. The above situation was noticed across the east coast at Vriddhachalam, Bapatla, Bhubaneswar and Jhargram. Sometimes, the maximum temperature shoots up to 42°C during the nut development period across the east coast. However, it was not the case across the west coast. The moderate (30-33°C) maximum temperature that persists across the west coast during the reproductive phase may be ideal for better nut development and its quality. In this context, the physiology of the crop is to be totally understood to find out the mechanisms which are working internally in favour of drought tolerance of cashew.

12.9.2 Crop weather relationships of cashew

An attempt was made to understand the effect of weather elements on cashew yield based on time series analysis. The correlation coefficients between minimum temperature and yield were significant at Vengurla and Bhubaneswar. Interestingly, the minimum temperature round the year was favourable at Vengurla while it was not so at Bhubaneswar during the flowering period (Dec-Feb). It revealed that the night temperature during the flowering period would be detrimental beyond a certain limit (<15°C). It appears that cashew flowering is sensitive to surface night temperature.

Table 43. Correlation coefficients between weather and cashew yield at different locations

Weather parameter		Correlation coefficients between weather elements and cashew yield		
		Vegurla (1977-1994)	Vriddhachalam (1974-1992)	Bhubaneswar (1983-1996)
Rainfall (mm) (June-May)		-0.27	-0.11	-0.16
Rainfall (mm) (Nov-May)		0.18	-0.21	0.28
Max. Temp (°C)	June-May	0.10	-	0.15
	Mar-May	-0.46	-	0.25
Min. Temp (°C)	June-May	0.51 *	-	-0.43
	Dec-Feb	0.11	-	-0.60 *

* Significant at 0.05 level

At all the locations, the annual rainfall with yield had a negative correlation though it was not significant. It indicates that cashew may like dry weather better instead of wet spells. This may be one of the reasons, why, cashew performs relatively better even under soil moisture stress. To quantify crop weather relations of cashew, weather and crop information are to be gathered systematically for more number of years at each location.

12.9.3 Agroclimatic zones for cashew

Based on the information available and presented in the previous sections on various aspects, an attempt has been made to demarcate "Agroclimatic zones for cashew" across the west and east coasts of India. The cashew productivity can be improved towards north along both the coasts up to a certain limit while the cashew productivity may be comparatively poor towards inland plateau (Fig. 32). However, the agroclimatological zones for cashew can be tested and improved further with more data gathered on weather, soil and plant characteristics in detail.

13. SUMMARY

The law stated by Hopkins holds good in biotic events of cashew under better crop management in rainfed situations of tropical climates, provided the genotype and rainfall distribution are uniform. However, there was a difference in number of days delayed in cashew flowering at each degree of North latitude while the effect of altitude on time of cashew flowering is similar as stated by Hopkins (1938). In humid tropic monsoon climates, there appeared to be a delay of six days in cashew flowering at every 1^0 of North latitude and for every 100 meters of altitude, the delay in cashew flowering was three days.

Hopkins (1938) attempted to express the importance of latitude, longitude and altitude in distribution and rate of development of plants by means of a "Bio climatic law". It may be stated as "A biotic event in North America will, in general, show a lag of four days for each degree of latitude, five degree of longitude and 400 feet of altitude, northward, eastward and upward in spring and early summer".

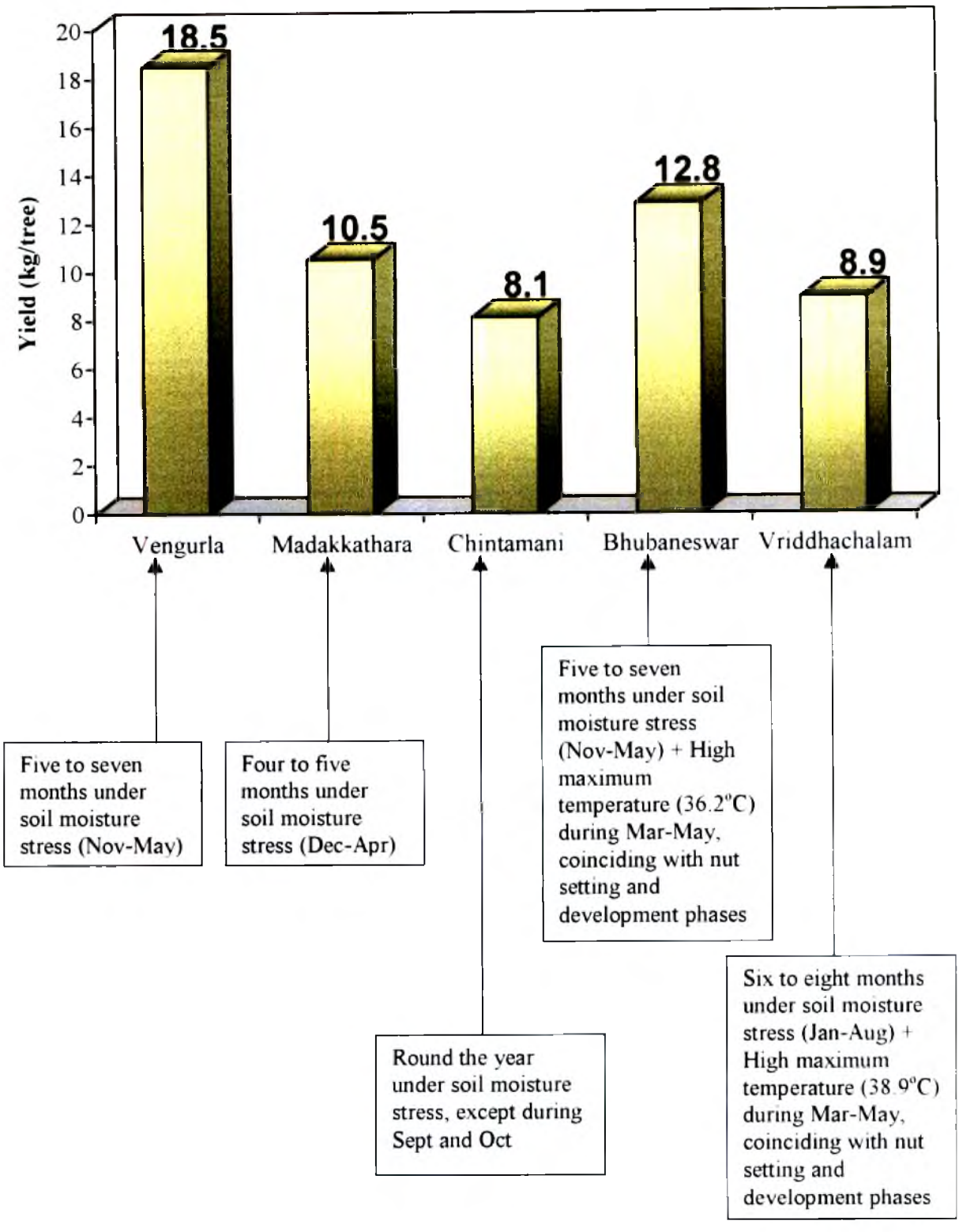


Fig 31. Mean cashew yield (kg/tree) of superior varieties at selected locations under different agroclimatic conditions

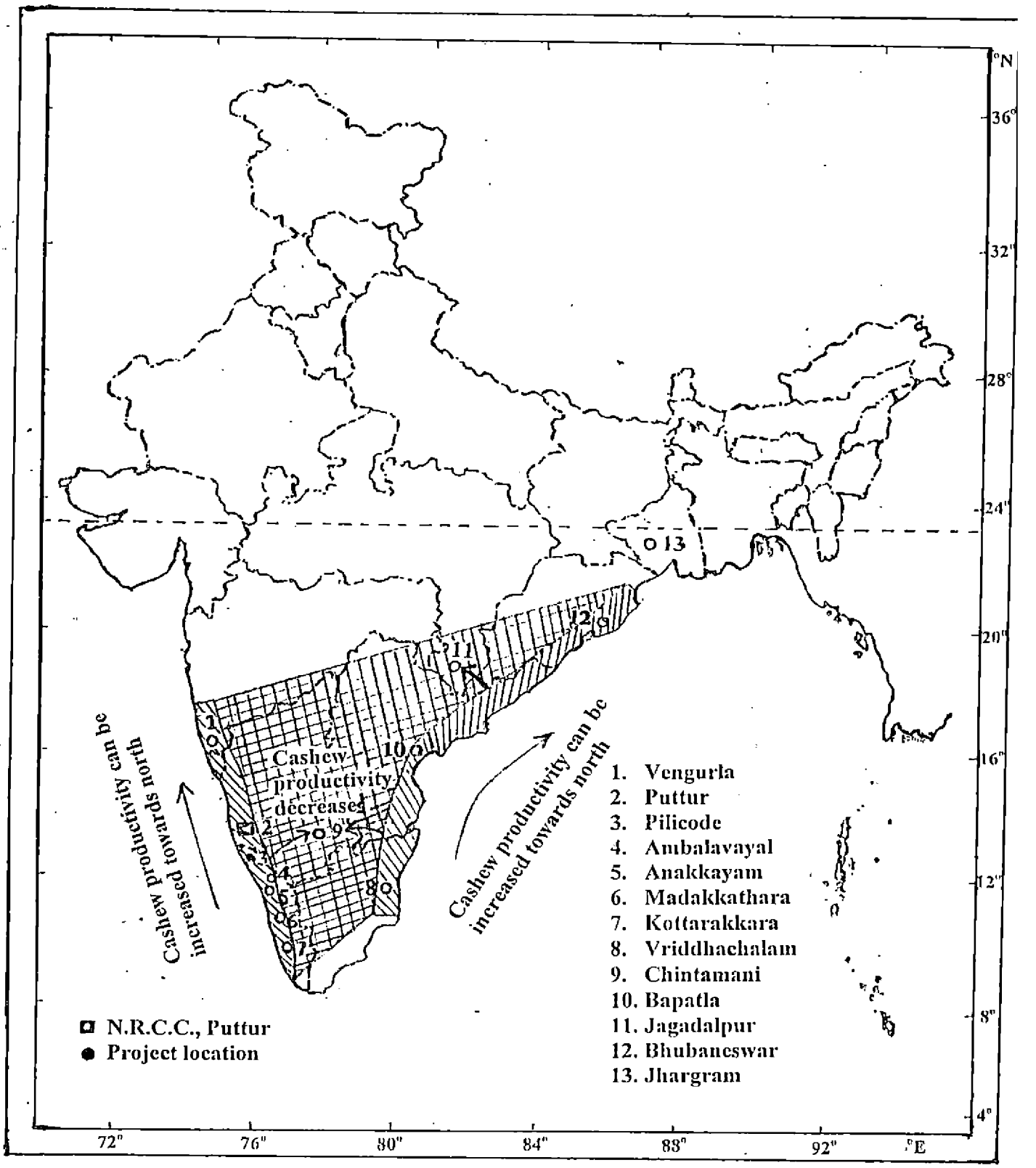


Fig 32. Agroclimatological zones for cashew

The flowering of cashew may require relatively dry atmosphere with mild winter for better flowering. If that is not the case, it may be detrimental for cashew production as the number of bisexual flowers might be less. The mild winter may be defined as "Low minimum surface air temperature ranging between 16 and 20^{0}C coupled with more dew nights having moderate dew" in humid climates. The better availability of soil moisture during flowering period (December and January) may not influence the flowering in cashew as evident in 1997-98.

The continuous rains without critical dry spell may delay the bud break of cashew. The unusual rains during November and December led to delay in reproductive phase of late season types/unknown planting material.

A cashew plant, undergoes a first dry spell may wait for the second dry spell to occur for break the bud. It appears that both the dry spells at the time of bud break and thirty days prior to bud break with bright sunshine are critical as far as the cashew bud break is concerned. The soil moisture stress has no relevance as the bud break of cashew begins much earlier before soil moisture stress starts. This holds good across the west coast only as the studies are based under the above agroclimatic situation. However, the influence of dry spell and bright sunshine in the mechanism of bud break of cashew is yet to be understood.

It appears that cashew is not only photosensitive but also thermo-sensitive as the biotic events response to low minimum and high maximum surface air temperature. It seems that a temperature range between 15^{0}C and 35^{0}C may be the optimum for better growth and production of cashew. The nut characteristics also appear to respond to phototropism. The surface air temperature is conducive across the west coast for better cashew yield while it may not be so across the east coast.

The heat units versus cashew yields showed that there was no definite relationship existed between them as the incidence of pest complex during the reproductive phase of cashew across the west coast is impediment.

Cloudiness, low minimum and maximum air temperatures together with relatively continuous dew fall under ideal humid conditions (>90 % of relative humidity) not only triggered the growth of the fungi but also helped in the sporulation, multiplication and spread during 1998-99. The minimum night temperature below 20°C and relatively dry weather in the after noon during majority of the days from December to February also stimulated in triggering pest population during 1998-99.

All the three nut characteristics of cashew declined from first to last harvest. The kernel weight appears to be dependent on availability of soil moisture. It is very important during nut setting and development. The shelling percentage also is high under the above conditions. The nut and kernel weights may be better with altitude in early season types though the shelling percentage is less. It may not be the case with the late season types. However, further studies are needed in this direction.

It was clear from the crop weather diagrams that the cashew yields would have been much better if scientific pest control measures were adopted during the years in which profuse/moderate flowering was noticed as the case might be in 1996-97 and 1998-99. The good and poor cashew yields obtained during 1995-96 and 1997-98 respectively could be attributed to weather factors. Of course, one of the factors for unprecedented pest and disease complex during 1998-99 was due to conducive weather during the flowering period.

All the superior varieties were found dependable except in extreme adverse weather conditions. It also appears that the yield trend of cashew across the west coast is alike and the same may be true across the east coast. Interestingly, the yield trend may be totally different across the west and east coasts of India in a given year.

It appears that cashew is enamoured with dry spell/drought during its reproductive phase and provides relatively better yield. However, the abnormal drought situation affects the cashew yield very much under rainfed conditions.

The cashew productivity can be increased towards north across the west and east coasts of India up to a certain limit while it may not be possible towards inland plateau under rainfed conditions.

14. RESULTS WHICH CAN BE EXPLOITED IN PILOT OR FIELD SCALE

Identified the weather constraints, which inhibit cashew production. The ill effects of the same could be mitigated to a greater extent through crop management/protection practices.

The phenological information is quite useful to planners/crop managers for effective crop yield manipulations. The crop weather diagrams will provide the status of cashew ahead, which in turn helps the planners to decide the policy on cashew price and its marketing.

Identified the agroclimatic zones for cashew, which can give a bird's eye view for spreading of cashew cautiously.

15. PUBLICATIONS

Prasada Rao, G.S.L.H.V and Gopakumar, C.S. 1998. Weather inflicted damage on cashew production – A remedy. The Cashew (accepted)

Prasada Rao, G.S.L.H.V., Giridharan, M.P., Jayaprakash Naik., B., Gopakumar, C.S., Krishnakumar, K.N and Xavier Tony. 1998. Influence of weather factors on cashew phenology. International Tropical Agriculture (communicated)

Prasada Rao, G.S.L.H.V and Gopakumar, C.S.1999. Latitudinal and altitudinal influence on cashew flowering over Kerala. Proceedings of the Eleventh Kerala Science Congress. Feb-March, 1999, Kasaragod. pp. 242 – 246.

16. FUTURE LINE OF WORK

Location specific studies of this nature will be of immense use in crop improvement and management of cashew under different agroclimatic situations.

A multidisciplinary team consisting of various disciplines may be identified for taking up "Crop growth simulation modeling " in cashew, for which KAU may be identified in collaboration with the ICAR. It will be the first of its kind in cashew growing countries if taken up by the ICAR.

At all the cashew research stations under "AICRP on cashew", the chronology of biotic events on identified varieties may be taken up systematically. It will help in simulation modeling of cashew.

At several cashew centres, the meteorological data recorded and maintained are in question. The above situation must be improved if studies on crop weather relationships are to be taken up effectively.

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