FINAL REPORT OF THE ICAR Ad hoc PROJECT

FOREWARNING TEA MOSQUITO BUG

Helopeltis antonii Sign. (Miridae:Hemiptera) in Cashew

2006

DEPARTMENT OF AGRL. ENTOMOLOGY
COLLEGE OF HORTICULTURE
KERALA AGRICULTURAL UNIVERSITY
VELLANIKKARA –680 656
THRISSUR

RESEARCH CENTRES AND RESEARCH TEAM

Research centers	Research team
Lead centre	
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	Dr. S. Pathummal Beevi & PI Associate professor, Dept .of Entomology
	Dr. Biju. C. R. (SRF) M.Sc. Zoology
Sub centers	
2. Regional Agricultural Research Station Pilicode-671353 Kasargode Dist, Kerala	**Dr. Jayaprakash Naik** Associate Professor Plant breeding
	Mrs. Rejimol. M. (SRF) M. Sc. Zoology
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INTRODUCTION

The ICAR ad hoc research project on' **Forewarning tea mosquito bug, *Helopeltis antonii* Sign. (Miridae:Hemiptera) in cashew'** has been started functioning w.e f. 01/09/2003 at the following four centres.

1. Lead centre: College of Horticulture, Kerala Agrl.University, Vellanikkara. For the lead center, field experiments were conducted at the Cashew Research Station, Madakkathara.

2. Sub centers:

i). Regional Agricultural Research Station, Pilicode (Kerala)

ii). Regional Fruit Research Station, Vengurle (Maharashtra)

iii). Agricultural Research Station, Chintamani (Karnataka).

Objectives

The following were the broad objectives of the project:

- To monitor the seasonal variation of TMB population and its damage in relation to the phenological changes and age of the trees
- To record the weather parameters prevailing in the experimental sites
- To assess the TMB population on alternative host plants during off season
- To assess the population of natural enemies
- To forewarn pest incidence based on weather variables

As per the approved technical programme of the project the experiments were conducted at the lead centre and three sub centers during third year of the project, i.e., from 1st September 2005 to 31st August 2006. The results of third year of the project are presented below.

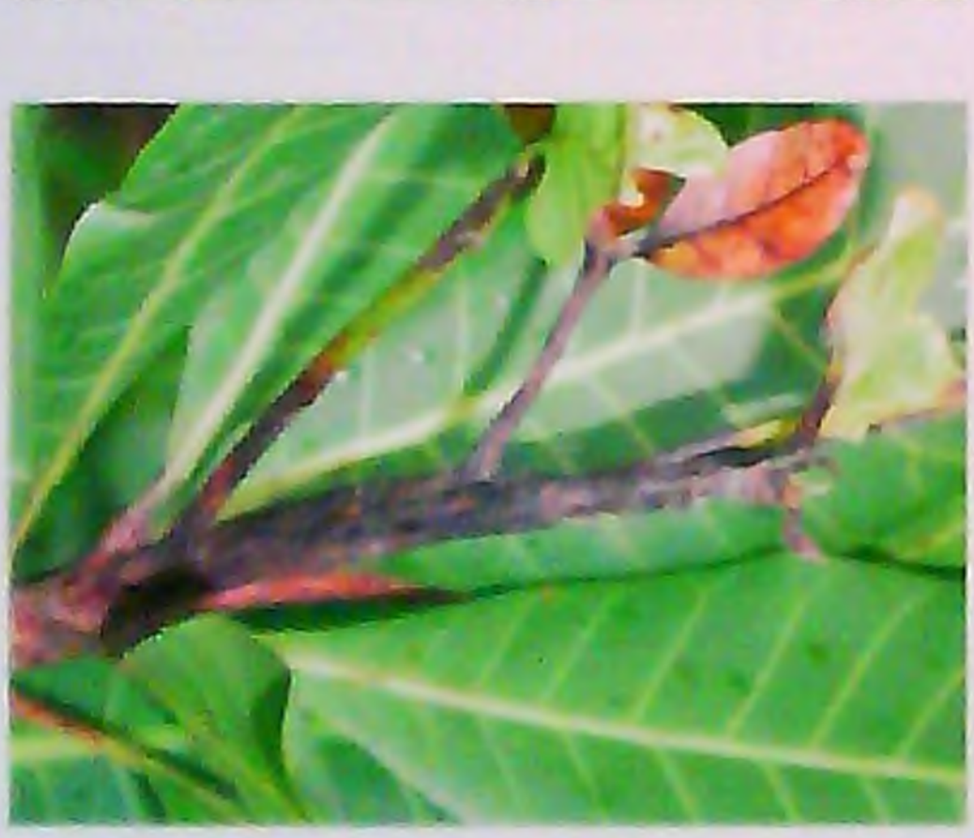
Expt. 1. Seasonal occurrence of TMB population and damage

At the Cashew Research Station, Madakkathara, the following four varieties were selected for the experiments, representing three categories as early, mid and late season varieties.

Early- Anakkayam-1 and Madakkathara-1; **Mid-** Kanaka

Late- Madakkathara-2

Tea mosquito bug adult, nymphs and symptom



RESULTS

TMB Population on different Varieties

The weekly observations on tea mosquito population on four varieties for the period from September 2005 to August 2006 are presented in table-1 and fig-1. During the regular flushing and flowering season TMB occurrence was noticed on different varieties, during the period from November 4th week to February 4th week. Highest population was during Jan.3rd week in Anakkayam-1(7.50), Madakkathara-1(7.25) and Kanaka (2.5). The variety, Madakkathara-1, has recorded one more peak in December 4th week (6.0). In the case of kanaka, TMB population started at a later period (Dec.4th) and attained a low peak in Jan.3rd week (2.5). When the overall mean population was considered, TMB population was high in the early varieties Anakkayam-1 (0.447) and Madakkathara-1(0.446) followed by Madakkathara-2 (0.284) and lowest in the variety, kanaka (0.149).

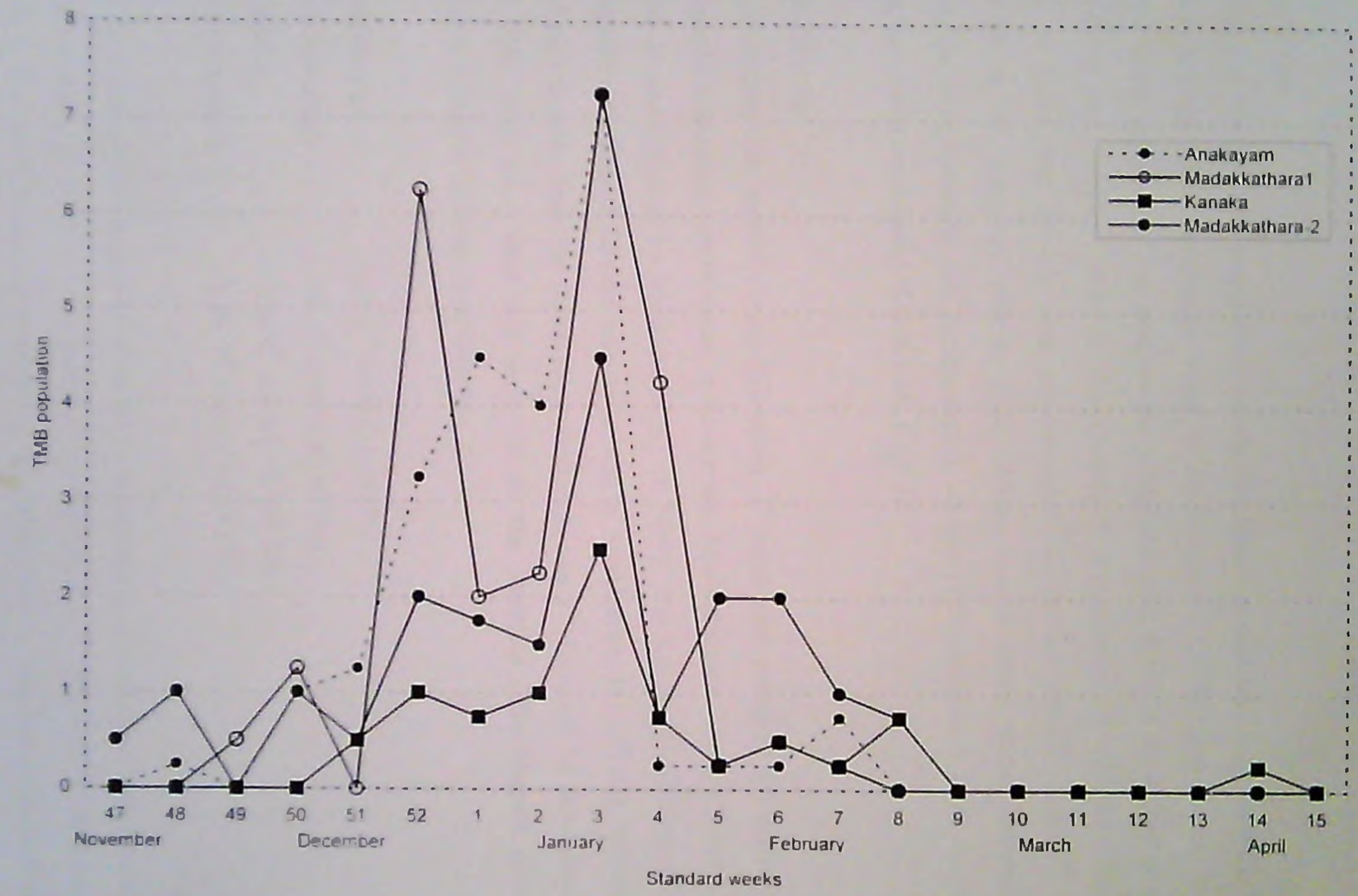
Table 1. Seasonal occurrence of TMB on different varieties ((Mean of four replications)

Std. Week	Months/Weeks	Anakkayam 1	Madakkathara-1	Kanaka	Madakkathara-2	Mean
36	2005 Sep-1st	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
37	2nd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
38	3rd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
39	4th	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
40	Oct-1st	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
41	2nd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
42	3rd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
43	4th	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
44	Nov-1st	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
45	2nd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
46	3rd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
47	4th	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.500 (0.926)	**0.125 (0.762)**
48	5th	0.250 (0.837)	0.0 (0.707)	0.0 (0.707)	1.000 (1.127)	**0.313 (0.845)**
49	Dec-1st	0.0 (0.707)	0.500 (0.926)	0.0 (0.707)	0.0 (0.707)	**0.125 (0.762)**
50	2nd	1.00 (1.184)	1.0 (1.127)	0.0 (0.707)	1.000 (1.127)	**0.750 (1.037)**
51	3rd	1.250 (1.274)	0.0 (0.707)	0.0 (0.707)	0.500 (0.966)	**0.438 (0.913)**
52	4th	3.250 (1.917)	6.000 (2.375)	1.000 (1.127)	2.000 (1.548)	**3.063 (1.742)**
1	2006 Jan-1st	4.500 (2.041)	2.000 (1.386)	0.750 (1.055)	1.750 (1.215)	**2.250 (1.424)**
2	2nd	4.000 (1.912)	1.500 (1.403)	1.000 (1.061)	1.500 (1.319)	**2.000 (1.424)**

3	3rd	7.500 (2.755)	7.250 (2.715)	2.500 (1.588)	0.0 (0.707)	**4.313 (1.941)**
4	4th	0.250 (0.837)	4.250 (1.924)	0.750 (1.055)	0.750 (1.055)	**1.500 (1.218)**
5	Feb-1st	0.250 (0.837)	0.0 (0.707)	0.250 (0.837)	2.000 (1.465)	**0.625 (0.962)**
6	2nd	0.0 (0.707)	0.500 (0.926)	0.500 (0.966)	2.000 (1.507)	**0.750 (1.027)**
7	3rd	0.750 (1.055)	0.250 (0.837)	0.250 (0.837)	1.000 (1.127)	**0.563 (0.964)**
8	4th	0.250 (0.837)	0.0 (0.707)	0.0 (0.707)	0.750 (1.055)	**0.250 (0.827)**
9	Mar-1st	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
10	2nd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
11	3rd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
12	4th	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
13	5th	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
14	Apr-1st	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
15	2nd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
16	3rd	0.0 (0.707)	0.0 (0.707)	0.250 (0.250)	0.0 (0.707)	**0.063 (0.739)**
17	4th	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
18	May-1st	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
19	2nd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
20	3rd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
21	4th	0.0 (0.707)	0.0 (0.707)	0.250 (0.250)	0.0 (0.707)	**0.063 (0.739)**
22	5th	0.0 (0.707)	0.0 (0.707)	0.250 (0.250)	0.0 (0.707)	**0.063 (0.739)**
23	Jun-1st	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
24	2nd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
25	3rd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
26	4th	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
27	Jul-1st	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
28	2nd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
29	3rd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
30	4th	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
31	5th	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
32	Aug-1st	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
33	2nd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
34	3rd	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
35	4th	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	**0.0 (0.707)**
	Mean	**0.447 (0.855)**	**0.446 (0.847)**	**0.149 (0.770)**	**0.284 (0.822)**	

CD value for varieties – 0.050, weeks – 0.182, interaction – 0.364

Fig 1 TMB population (Mean No.) on different varieties (2005-06)



Damage intensity:

The TMB infested shoot, Panicle and nuts were counted and presented as mean percentage infestation.

Shoot infestation

Similar to that of TMB population, the shoot infestation was also high during December and January, highest mean percentage being in Anakkayam-1 (5.998) and lowest in kanaka (1.194). The shoot infestation was comparatively high ranging from 25 to 45 per cent during December-2005 and January- 2006 in Anakkayam-1. Irrespective of varieties, high shoot infestation of more than 10 per cent was recorded during the period from 2nd week of December-05 to 3rd week of January-2006. When overall mean shoot infestation was considered, the three varieties, viz. Anakkayam-1, -1 and Madakkathara 2 were on par. Shoot infestation was lowest in Kanaka (Table 2). ← Fig 2.

Panicle infestation

Panicle infestation was started during November 1st week and persisted till April 2nd week. Highest panicle infestation was recorded in the variety, Madakkathara-2 with a mean infestation of 9.696 %. It was followed by Madakkathara-1 (6.749%) and Kanaka (8.097 %), which were on par. Significantly lowest panicle infestation was in Anakkayam-1(1.797 %). Panicle damage fluctuated significantly over the flowering period from the 2nd fortnight of December 2005 to February 2006 with more than two peaks in all the varieties (The highest peak panicle infestation on different varieties is as follows:

Anakkayam -1	-Jan 2nd week (31.158%)
Madakkathara - 1	- Jan 4th week (80.997%)
Kanaka	- Jan 4th week (70.025 %)
Madakkathara- 2	- Feb 3rd week (55.742 %)

A high panicle infestation of more than 10 per cent in Anakkayam was recorded as two peaks , one in Dec 1st week (11 %) followed by the January 1st (12.445 %) and Jan 2nd week (31.158 %). The same trend was observed in Madakkathara -1, the first peak in December 1st week (16.822) followed by a second peak starting from January 2nd week (41.572) through

January 3rd week (69.612 %) and Jan 4th Week (80.997 %). Interestingly in the mid and late varieties viz Kanaka and Madakkathara -2, a high panicle infestation persisted for a longer period with overlapping peaks starting from December and continued upto March and these varieties suffered heavy panicle damage. The easily variety, Anakkayam-1 recorded only a low panicle infestation as compared to mid and late varieties (Table.3 & Fig 2)

Table 2. Shoot infestation (mean %) on different varieties (Mean of four replications)

Std. Week	Months/Weeks	Anakkayam 1	Madakkathara-1	Kanaka	Madakkathara-2	Mean
36	2005 Sep-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
37	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
38	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
39	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
40	Oct-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
41	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
42	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
43	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
44	Nov-1st	0.000 (0.710)	0.962 (1.052)	0.000 (0.710)	0.000 (0.710)	**0.241 (0.796)**
45	2nd	0.000 (0.710)	12.500 2.310)	0.000(0.710)	0.000 (0.710)	**3.125 (1.110)**
46	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
47	4th	9.027 (2.470)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**2.257 (1.150)**
48	5th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
49	Dec-1st	25.750 3.862)	2.500 (1.342)	0.000 (0.710)	0.410 (0.897)	**7.165 (1.703)**
50	2nd	45.000(5.103)	0.000 (0.710)	0.025 (0.725)	50.000(5.365)	**23.756 (2.976)**
51	3rd	21.875(2.878)	0.000 (0.710)	0.000 (0.710)	27.273(3.635)	**12.287(1.983)**
52	4th	39.375(6.158)	54.375(6.465)	4.168 (1.567)	15.005(3.382)	**28.231(4.393)**
1	2006 Jan-1st	33.333(4.315)	43.750(5.723)	0.000 (0.710)	51.168(5.755)	**32.063(4.126)**
2	2nd	31.390(4.327)	25.000(3.038)	0.000 (0.710)	8.543 (2.880)	**16.233(2.739)**
3	3rd	23.863(3.828)	26.612(3.520)	37.500(4.638)	19.530(4.247)	**26.876(4.058)**
4	4th	25.000(3.885)	1.563 (1.182)	0.000 (0.710)	15.333(3.422)	**10.474(2.300)**
5	Feb-1st	0.000 (0.710)	0.000 (0.710)	12.852(2.478)	7.693(1.930)	**5.136 (1.457)**
6	2nd	14.168(2.980)	0.000 (0.710)	4.168 (1.567)	21.875(3.430)	**10.053(2.172)**
7	3rd	5.480 (2.155)	25.000(3.038)	3.363 (1.790)	7.852 (2.313)	**10.424(2.324)**
8	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
9	Mar-1st	3.387 (1.780)	8.333 (1.988)	0.000 (0.710)	3.750 (1.752)	**3.868 (1.558)**
10	2nd	2.208 (1.460)	2.515 (1.528)	0.000 (0.710)	0.430 (0.905)	**1.288 (1.151)**

11	3rd	4.615 (1.885)	0.430 (0.905)	0.000 (0.710)	0.863 (1.030)	**1.477 (1.133)**
12	4th	3.140 (1.692)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.785 (0.956)**
13	5th	1.087 (1.082)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.272 (0.803)**
14	Apr-1st	6.250 (1.795)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**1.563 (0.981)**
15	2nd	16.667(2.582)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**4.167 (1.178)**
16	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
17	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
18	May-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
19	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
20	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
21	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
22	5th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
23	Jun-1st	0.000 (0.710)	0.000(0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
24	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
25	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
26	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
27	Jul-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
28	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
29	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
30	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
31	5th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
32	Aug-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
33	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
34	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
35	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
	Mean	**5.998 (1.507)**	**3.914 (1.163)**	**1.194 (0.874)**	**4.418 (1.306)**	

CD value for varieties – 0.278, weeks – 0.1001, interaction – 2.003

Nut infestation:

The mean per cent nut infestation at weekly interval on all the four varieties is presented in table 4. Unlike that of panicle infestation, the overall nut damage was significantly high in the early variety, Anakkayam-1 (4.994 %) followed by Madakkathara-1 (4.571 %). Significantly low nut infestation was in the late variety, Madakkathara-2 (0.036%). Nut infestation was also highest during January- February period in all the three varieties of early and mid season varieties, while nut infestation was significantly low in the late variety Madakkathara-2.

Irrespective of varieties highest nut infestation ranging from 19.06 to 35.77 % was during the period from Jan 2nd week to Feb. 1st Week (Table 4 ~~&~~ Fig 2).

Table 3. Panicle infestation on different varieties (mean percentage ,mean of four replications)

Std. Week	Months	Anakkayam 1	Madakkathara-1	Kanaka	Madakkathara-2	Mean
36	2005 Sep-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
37	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
38	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
39	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
40	Oct-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
41	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
42	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
43	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
44	Nov-1st	1.330 (1.135)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.333 (0.816)**
45	2nd	0.720 (0.992)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.180 (0.781)**
46	3rd	0.825 (1.020)	1.352 (1.140)	0.000 (0.710)	0.000 (0.710)	**0.544 (0.895)**
47	4th	2.557 (1.352)	3.170 (1.660)	0.000 (0.710)	0.000 (0.710)	**1.432 (1.108)**
48	5th	8.377 (2.125)	5.155 (2.135)	0.000 (0.710)	0.000 (0.710)	**3.383 (1.420)**
49	Dec-1st	11.002 (2.667)	16.822 (3.835)	2.413 (1.617)	3.290 (1.457)	**8.382 (2.394)**
50	2nd	2.780 (1.703)	9.245 (3.087)	7.390 (2.740)	19.147 (3.573)	**9.641 (2.776)**
51	3rd	2.750 (1.685)	8.753 (3.037)	7.363 (2.775)	25.032 (3.490)	**10.974 (2.747)**
52	4th	7.165 (2.510)	22.600 (4.625)	18.277 (4.258)	26.017 (4.992)	**18.515 (4.096)**
1	2006 Jan-1st	12.445 (3.007)	20.675 (4.247)	19.118 (4.363)	16.067 (3.595)	**17.084 (3.803)**
2	2nd	31.158 (4.465)	41.572 (6.338)	32.025 (5.690)	19.825 (4.398)	**31.145 (5.223)**
3	3rd	3.125 (1.435)	69.612 (8.175)	49.45 (7.007)	39.020 (6.055)	**40.302 (5.668)**
4	4th	4.668 (1.630)	80.997 (8.958)	70.025 (8.303)	49.352 (6.770)	**51.261 (6.415)**
5	Feb-1st	4.54 (1.613)	4.545 (1.613)	53.632 (7.130)	41.717 (6.288)	**26.110 (4.161)**
6	2nd	0.000 (0.710)	18.333 (3.400)	64.177 (7.938)	51.198 (6.853)	**33.427 (4.725)**
7	3rd	0.000 (0.710)	10.000 (2.123)	47.152 (6.560)	55.742 (7.248)	**28.224 (4.160)**
8	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	36.667 (4.648)	**9.167 (1.694)**
9	Mar-1st	0.000 (0.710)	19.047 (3.197)	25.000 (3.038)	46.400 (6.498)	**22.612 (3.361)**
10	2nd	0.000 (0.710)	0.000 (0.710)	25.000 (3.038)	27.378 (5.150)	**13.094 (2.402)**
11	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	10.630 (2.900)	**2.658 (1.258)**
12	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	36.667 (4.648)	**9.167 (1.694)**
13	5th	0.000 (0.710)	19.047 (3.197)	0.000 (0.710)	0.000 (0.710)	**4.762 (1.332)**
14	Apr-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
15	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**

16	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
17	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
18	May-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
19	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
20	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
21	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
22	5th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
23	Jun-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
24	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
25	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
26	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
27	Jul-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
28	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
29	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
30	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
31	5th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
32	Aug-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
33	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
34	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
35	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
	Mean	**1.797 (1.045)**	**6.749 (1.660)**	**8.097 (1.772)**	**9.696 (2.002)**	

CD value for varieties – 0.228, weeks – 0.821, interaction – 1.643

Varietals impact on TMB damage

The overall mean TMB population and the damage on shoot ,panicle and nut on different varieties is presented in table 5 & Fig.-2. TMB population was highest in Anakkayam-I and Madakkathara-1 followed by Madakkathara-2. Shoot infestation was highest in Anakkayam-1 followed by Madakkathara-2, whereas panicle infestation was highest in the late variety, Madakkathara-2,followed by the mid season variety, Kanaka. However nut infestation was lowest in Madakkathara-2 (late variety) and high in early varieties (Table 5)

Expt.2.Phenological phases in different varieties at the CRS, Madakkathara 2005-06

The observation trees were monitored at weekly interval and recorded the events separately such as ,Date of bud break, Date of flushing ,Date of panicle infestation and flowering ,Date of start of harvest , Date of completion of harvest and the Off season flushing

The whole tree canopy architecture was considered as a circle, which can be divided into four equal sectors (quadrants), each sector comprising of 25 per cent canopy area. Visual assessment was done on the extent of flushing and flowering on all the observation trees.

Table 4. Nut infestation on different varieties (mean percentage, Mean of four replications)

Std. Week	Months	Anakkayam 1	Madakkathara-1	Kanaka	Madakkathara-2	Mean
36	2005 Sep-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
37	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
38	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
39	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
40	Oct-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
41	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
42	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
43	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
44	Nov-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
45	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
46	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
47	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
48	5th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
49	Dec-1st	1.125 (1.185)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.281 (0.829)**
50	2nd	29.960 (4.343)	2.500 (1.342)	0.000 (0.710)	0.000 (0.710)	**8.115 (1.776)**
51	3rd	4.207 (1.997)	1.563 (1.182)	0.000 (0.710)	0.000 (0.710)	**1.442 (1.150)**
52	4th	13.862 (3.385)	15.290 (3.142)	3.485 (1.720)	0.000 (0.710)	**8.159 (2.239)**
1	2006 Jan-1st	10.528 (3.023)	21.538 (3.067)	1.683 (1.330)	0.000 (0.710)	**8.437 (2.167)**
2	2nd	20.577 (3.925)	27.917 (4.103)	27.740 (4.418)	0.000 (0.710)	**19.059 (3.289)**
3	3rd	35.085 (5.090)	48.438 (5.288)	32.355 (5.512)	0.000 (0.710)	**28.969 (4.150)**
4	4th	55.995 (6.630)	62.500 (6.965)	24.565 (5.003)	0.000 (0.710)	**35.765 (4.827)**
5	Feb-1st	50.833 (6.105)	50.825 (6.105)	4.595 (1.890)	0.000 (0.710)	**26.563 (3.703)**
6	2nd	37.500 (4.638)	3.572 (1.495)	8.572 (2.450)	0.000 (0.710)	**12.411 (2.32)**
7	3rd	0.000 (0.710)	3.572 (1.495)	1.167 (1.190)	0.595 (0.957)	**1.334 (1.088)**
8	4th	0.000 (0.710)	0.000 (0.710)	30.000 (3.993)	0.000 (0.710)	**7.500 (1.531)**
9	Mar-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	1.293 (1.230)	**0.323 (0.840)**
10	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
11	3rd	0.000 (0.710)	0.000 (0.710)	5.000 (1.665)	0.000 (0.710)	**1.250 (0.949)**
12	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**
13	5th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	**0.000 (0.710)**

14	Apr-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
15	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
16	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
17	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
18	May-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
19	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
20	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
21	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
22	5th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
23	Jun-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
24	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
25	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
26	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
27	Jul-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
28	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
29	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
30	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
31	5th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
32	Aug-1st	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
33	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
34	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
35	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
	Mean	**4.994 (1.349)**	**4.571 (1.241)**	**2.676 (1.134)**	**0.036 (0.725)**	

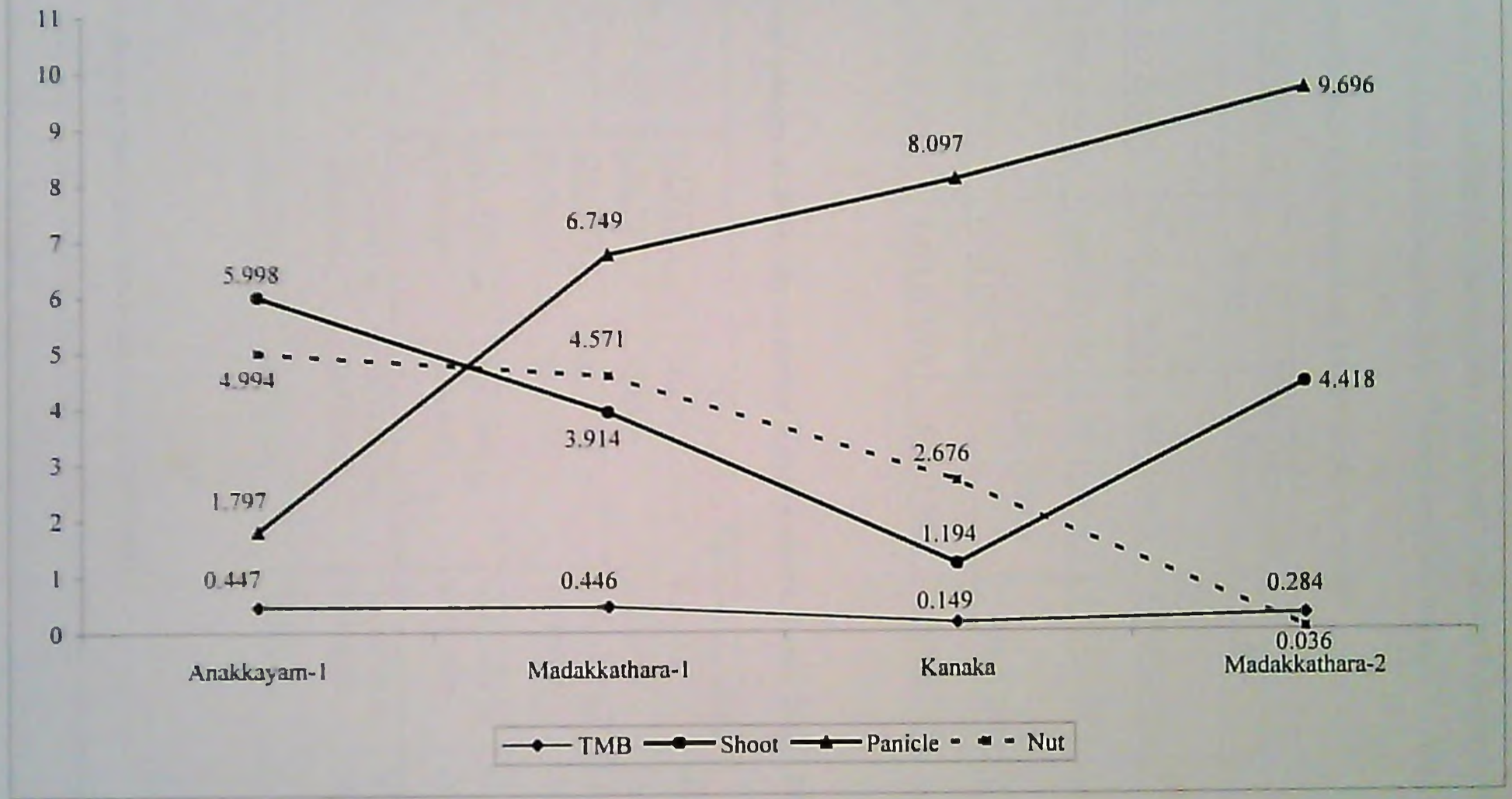
CD value for varieties – 0.214, weeks – 0.770, interaction – 1.540

Results

The details on the phenological events observed on all the four selected varieties are presented in Table 6 .

In the early variety, Anakkayam-1, flushing started during Sep.1st week and completed by 4th week of September. Panicle initiation was during 1st week of October and 100 % flowering was completed by November 1st week. Nut formation started during November 2nd week and harvesting was completed by February 2nd week. In the variety Madakkathara-1, flushing duration was comparatively longer than in Anakkayam-1 and completed in October 1st week, in both the varieties bud break and flushing started in the same period. Nut formation and harvest phase in Madakkathara-1 was from November 4th to February 4th week. In the mid-season variety Kanaka, flushing phase was from October 1st to October 3rd week and was for a short period as compared

Fig. 2 TMB population and infestation in 4 varieties (2005-06)



to Madakkathara-1. Panicle initiation and flowering lasted from October 3rd to November 4th week. Nut formation and harvest was from December 2nd to April 1st week. In the late variety, Madakkathara-2, flushing, flowering and harvest was very late recording 100 per cent flushing in December 1st week; 100 per cent flowering January 3rd week and last harvest by April (Table 6)

Table 5. Shoot, panicle and nut infestation on different varieties

Varieties	TMB mean no.	Mean Percentage			
		Shoot	Panicle	Nut	mean
Anakkayam-1	0.447 (0.855)	5.998 (1.507)	1.797 (1.045)	4.994 (1.349)	**4.263**
Madakkathara-1	0.446 (0.847)	3.914 (1.163)	6.749 (1.660)	4.571 (1.241)	**5.078**
Kanaka	0.149 (0.770)	1.194 (0.874)	8.097 (1.772)	2.676 (1.134)	**3.989**
Madakkathara-2	0.284 (0.822)	4.418 (1.306)	9.696 (2.002)	0.036 (0.725)	**4.717**

Table 6. Phenological phases in different varieties Age: 14 years, Year: 2005- 2006

Phenological events	Duration in different varieties			
	Anakkayam-1	Madakkathara-1	Kanaka	Madakkathara-2
Bud break	24/8/05	24/8/05	26/09/05	14/11/05
Flushing	06/09/05 to 26/09/05	06/09/05 to 03/10/05	03/10/05 to 17/10/05	14/11/05 to 05/12/05
Panicle Initiation to Flowering	03/10/05 to 02/11/05	10/10/05 to 07/11/05	17/10/05 to 28/11/05	26/12/05 to 23/01/06
Nut formation to Last harvest	14/11/05 to 10/02/06	28/11/05 to 26/02/06	12/12/05 to 02/04/06	16/01/06 to 18/04/06
Off season flushing	06/02/06	06/03/06	18/04/06	-

Expt. 3. Weather data at the CRS, Madakkathara (2005-06)

Weekly data on the weather parameters viz. maximum temperature, minimum temperature, forenoon relative humidity, afternoon relative humidity, sunshine hours, rainy days and rainfall amount (mm) recorded at the CRS, Madakkathara are presented in table 7.

Table 7. Mean weekly weather data from September 2005 to July 2006 at Madakkathara

	Std. week	Temperature			Relative Humidity			Brightness	Rain fall	Wind speed	Rainy days
		Temp	Min.	Max	Rel Hum.	Min	Max				
SEP 05	36	24.97	23.77	27.16	99.00	96.71	100.00	0.18	30.76	3.61	7
	37	25.47	23.54	29.20	97.29	88.86	100.00	0.24	17.06	3.64	5
	38	25.87	22.83	30.17	94.71	82.71	100.00	0.30	9.80	3.77	2
	39	25.91	22.40	31.11	92.14	75.57	100.00	0.34	0.31	3.36	0
OCT	40	26.04	22.53	31.37	92.57	74.57	100.00	1.42	8.29	3.07	1.
	41	26.00	22.86	30.91	94.86	79.00	100.00	0.26	9.10	2.83	3
	42	26.21	22.77	31.40	93.14	75.00	100.00	0.29	2.76	2.96	2
	43	26.29	23.77	30.69	93.86	77.43	100.00	2.50	4.94	2.90	3
NOV	44	25.96	23.43	30.47	94.29	76.43	100.00	1.41	0.56	2.66	0.
	45	26.86	23.46	31.64	88.43	70.29	100.00	2.51	0.59	4.06	0.
	46	25.31	21.67	31.06	89.86	65.57	100.00	0.33	0.91	3.89	1.
	47	25.51	21.91	29.71	85.14	68.71	98.43	0.27	0.00	7.67	0
	48	26.60	22.73	31.93	84.29	61.14	99.14	1.75	0.00	4.90	0
DEC	49	26.40	22.00	32.09	83.43	57.57	99.57	0.39	0.11	4.97	0
	50	26.84	24.29	30.54	79.86	64.14	92.43	0.38	0.34	8.39	0
	51	25.64	20.86	32.51	85.29	58.71	100.00	1.48	0.00	3.29	0
	52	25.36	19.97	31.21	73.43	48.57	95.71	0.40	0.00	8.30	0
JAN 06	1	26.69	22.50	31.60	70.29	52.29	89.57	0.39	0.00	9.73	0
	2	27.71	23.89	32.36	69.43	50.86	93.57	1.75	0.00	9.71	0.00
	3	26.83	21.14	34.17	71.14	40.29	98.71	0.39	0.00	6.56	0.00
	4	26.00	19.63	33.53	73.57	40.29	96.43	0.40	0.00	6.80	0.00
FEB	5	27.74	22.96	33.13	56.57	39.71	76.00	0.40	0.00	11.44	0.00
	6	27.84	21.37	34.17	52.00	31.14	83.00	1.77	0.00	10.16	0.00
	7	26.31	19.86	35.14	67.43	31.57	92.43	0.41	0.00	5.37	0.00
	8	27.24	20.73	36.44	71.86	22.57	100.00	0.40	0.00	5.04	0.00
MAR	9	26.39	22.36	35.07	72.36	45.71	92.86	6.66	2.86	3.99	1.00
	10	27.29	23.93	34.87	70.36	54.00	86.71	8.29	5.34	3.89	1.00
	11	26.52	22.17	34.60	63.50	42.43	84.57	8.29	0.00	3.97	0.00
	12	27.52	24.86	35.29	64.93	44.86	85.00	7.13	0.00	4.01	0.00
	13	27.8	24.33	34.33	71.36	53.71	89.00	7.27	5.40	3.77	1.00
APR	14	28.01	24.99	33.63	80.86	71.00	90.71	7.37	0.00	3.54	0.00
	15	28.26	24.79	34.36	80.21	74.43	86.00	7.11	3.63	3.77	1.00
	16	27.62	24.06	33.30	75.14	59.71	90.57	7.51	4.51	3.73	1.00
	17	27.66	24.80	32.26	76.00	60.43	91.57	5.80	3.89	3.39	1.00
MAY	18	27.54	25.00	33.11	74.93	59.86	90.00	7.36	2.11	3.44	1.00
	19	28.26	24.90	34.13	72.79	56.14	89.43	8.00	0.00	3.33	0.00
	20	27.41	24.60	32.79	74.79	60.00	89.57	5.60	12.11	3.83	3.00
	21	26.73	23.63	29.94	82.93	72.43	93.43	5.94	34.59	3.51	7.00
	22	25.10	26.13	25.31	86.50	90.00	83.00	1.36	49.53	4.79	7.00
JUN	23	27.11	30.19	24.04	84.07	93.00	75.14	3.66	6.69	3.71	5.00
	24	27.38	31.09	23.67	80.57	93.14	68.00	8.03	10.09	4.00	4.00
	25	26.52	29.36	23.69	86.43	95.29	77.57	2.49	41.20	4.43	5.00
	26	25.93	28.69	23.17	89.07	93.00	85.14	0.74	29.91	3.71	7.00
JUL	27	26.87	30.20	23.54	84.50	94.43	74.57	2.46	15.40	5.14	7.00
	28	25.92	28.51	23.33	86.43	95.43	77.43	2.27	27.03	3.86	7.00
	29	26.54	29.56	23.51	85.93	94.57	77.29	1.46	14.14	3.57	7.00

During September to November (Post monsoon), the minimum temperature ranged from 21.67 ^{0} C to 23.77 ^{0} C and minimum relative humidity ranged from 61.14% to 96.71%. During winter season (December to February) rainfall was not received; minimum temperature varied from 19.63 to 24.29 and minimum relative humidity varied from 22.57 to 64.14 %. During summer months (March to May, 2006), the weather was normal with scattered rain in March- April and pre-monsoon rain in May (Table 7).

YOUNG TREES

Expt. 4. Tea mosquito population and damage on young cashew trees

Observations were recorded on TMB population and damage on young trees at the age of six years which were available at the CRS, Madakkathara. Altogether 20 trees were observed at weekly intervals and recorded TMB population and damage. The technical programme followed was the same as that of mature trees.

Results

TMB population

TMB population was present almost all throughout the year. This was due to the frequent flushing nature of the young trees. Population build up of TMB started from the 2nd week of September at a low density (0.100). A significantly high population was observed from November 2nd week (2.5) onwards and reached a peak of 3.9 during the 4th week of November and continued up to January 1st week. Population was absent during the month of April, because of the non availability of the succulent flushes. Population build up again started coinciding with the emergence of pre-monsoon flushes during May and June and recorded a mean population of 1.35 during June 4th week (Table 8 ← Fig. 3).

Damage intensity

On young trees the shoot damage was observed throughout the year, except during the 2nd week of September, 2nd, 3rd and 4th weeks of April. Highest shoot damage of 21.53 % was during 3rd week of November. This is due to the high population of TMB both in the previous week (November 2nd week) and the current week (November 3rd week) with mean population of 2.5 and 2.05 respectively. Highest shoot damage was also observed during the off season, in the 1st week of April (33.23%) followed by June 1st week (24.89 %) (Table 8). Panicle damage

Table 8. TMB population and infestation on young trees (2005-06) Mean of 20 trees

Std. Week	Months	TMB	Mean percentage		
			Shoot	Panicle	Nut
36	2005 Sept 1st	0.000(0.710)	0.128 (0.762)	0.000 (0.710)	0.000 (0.710)
37	2nd	0.100 (0.761)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
38	3rd	0.300 (0.844)	1.125 (0.981)	0.000 (0.710)	0.000 (0.710)
39	4th	0.050 (0.735)	0.526 (0.840)	0.000 (0.710)	0.000 (0.710)
40	Oct-1st	0.050 (0.735)	0.455 (0.829)	0.000 (0.710)	0.000 (0.710)
41	2nd	0.100 (0.761)	3.929 (1.340)	0.000 (0.710)	0.000 (0.710)
42	3rd	0.600 (0.944)	8.121(1.848)	0.000 (0.710)	0.000 (0.710)
43	4th	0.200 (0.812)	5.539 (1.849)	3.889 (1.336)	0.000 (0.710)
44	Nov-1st	0.900 (1.017)	9.958 (2.533)	0.000 (0.710)	0.000 (0.710)
45	2nd	2.500 (1.502)	18.328 (3.843)	39.328 (5.286)	0.000 (0.710)
46	3rd	2.050 (1.484)	21.532 (4.306)	54.132 (6.627)	0.000 (0.710)
47	4th	3.900 (1.878)	13.316 (3.064)	77.314 (8.378)	0.000 (0.710)
48	5th	3.550 (1.853)	11.682 (2.991)	73.270 (8.107)	0.000 (0.710)
49	Dec-1st	3.500 (1.858)	6.369 (2.345)	67.451 (7.511)	0.000 (0.710)
50	2nd	2.750 (1.659)	5.528 (2.070)	66.972 (7.546)	0.000 (0.710)
51	3rd	2.200 (1.468)	3.281 (1.725)	50.446 (6.022)	0.000 (0.710)
52	4th	3.700 (1.851)	1.486 (1.193)	41.125 (4.684)	0.000 (0.710)
1	2006 Jan-1st	2.200 (1.546)	1.610 (1.270)	39.615 (4.415)	5.000 (1.176)
2	2nd	0.000 (0.710)	1.487 (1.212)	23.846 (2.977)	0.000 (0.710)
3	3rd	0.000 (0.710)	1.127 (1.124)	15.417 (2.296)	0.000 (0.710)
4	4th	0.200 (0.780)	2.998 (1.343)	6.500 (1.416)	0.000 (0.710)
5	Feb-1st	0.350 (0.870)	3.979 (1.639)	1.667 (0.965)	0.000 (0.710)
6	2nd	0.650 (0.970)	12.617 (2.648)	4.333 (1.275)	0.000 (0.710)
7	3rd	0.700 (0.955)	10.359 (2.659)	5.500 (1.302)	0.000 (0.710)
8	4th	0.600 (0.962)	16.878 (3.391)	7.500 (1.496)	0.000 (0.710)
9	Mar-1st	0.250 (0.830)	20.405 (3.431)	3.333 (1.084)	1.177 (0.919)
10	2nd	0.800 (0.964)	12.207 (2.471)	0.000 (0.710)	0.000 (0.710)
11	3rd	1.050 (1.047)	10.269 (2.503)	0.000 (0.710)	0.000 (0.710)
12	4th	0.200 (0.804)	7.487 (2.103)	1.667 (0.965)	0.000 (0.710)
13	5th	0.400 (0.868)	12.929 (2.834)	0.000 (0.710)	0.000 (0.710)
14	Apr-1st	0.600 (0.978)	33.226 (4.576)	0.000 (0.710)	0.000 (0.710)
15	2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
16	3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)

17	4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
18	May-1st	0.000 (0.710)	1.098 (1.066)	0.000 (0.710)	0.000 (0.710)
19	2nd	0.600 (0.982)	19.494 (3.342)	0.000 (0.710)	0.000 (0.710)
20	3rd	0.400 (0.891)	13.818 (2.644)	0.000 (0.710)	0.000 (0.710)
21	4th	0.400 (0.891)	13.818 (2.644)	0.000 (0.710)	0.000 (0.710)
22	5th	0.150 (0.779)	13.594 (3.046)	0.000 (0.710)	0.000 (0.710)
23	Jun-1st	0.200 (0.804)	24.896 (4.316)	0.000 (0.710)	0.000 (0.710)
24	2nd	1.050 (1.114)	12.234 (2.693)	0.000 (0.710)	0.000 (0.710)
25	3rd	1.300 (1.151)	20.583 (3.334)	0.000 (0.710)	0.000 (0.710)
26	4th	1.350 (1.229)	21.000 (3.770)	0.000 (0.710)	0.000 (0.710)
	Mean	**0.928**	**9.289**	**13.565**	**0.144**
	CD	1.358	5.432	5.599	0.970

started from the last week of October with a mean per cent damage of 3,889. More than 50 % panicle damage was observed during November -December months. Highest panicle damage was during 4th week of November (77.31 %) which coincided with high population of TMB during this period. Nut damage was very less. Highest nut damage was only 5 % during January 1st week, followed by 1.17 % during March 1st week (Table 8+ Fig. 3).

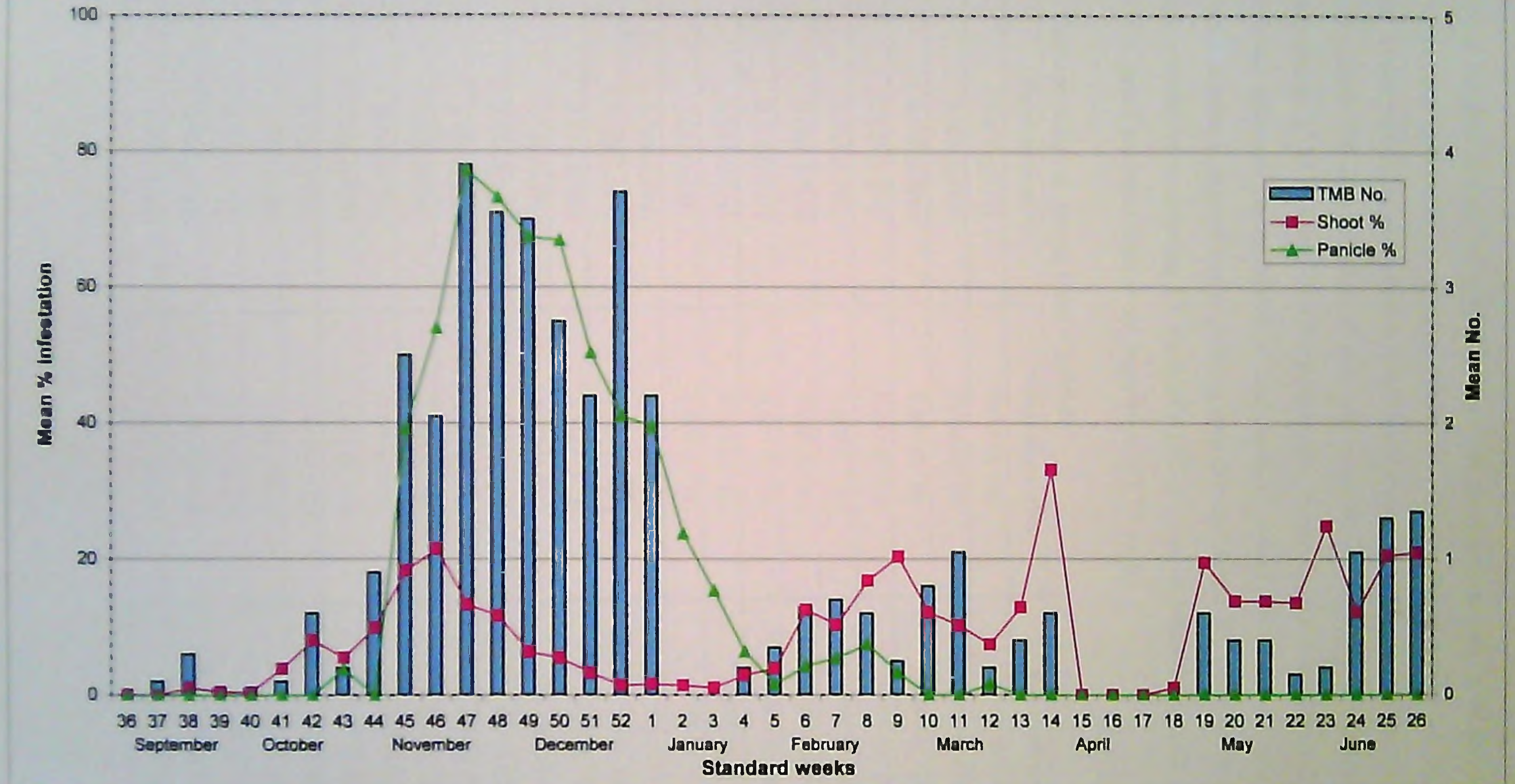
Damage Score of TMB infestation on young Trees

Highest shoot damage was observed during April 1st week followed by June 1st and last week, November 3rd and December 3rd week with mean score damage of 0.625, 0.898, 0.936, 0.668, and 0.612 respectively. Shoot damage persisted throughout the year except during the 2nd, 3rd and last weeks of April. Panicle damage started during the 2nd week of November with a mean score value of 1.080 and reached a peak during 4th week of November and recorded a mean score damage of 2.311 and persisted upto last week of January. Nut damage was more or less absent on young trees during the year 2005-06. Nut damage was observed only during 2nd and 3rd weeks January with mean score damage of 0.2 (Table -9).

Expt. 5. Assessment of population of ants in cashew ecosystem

Observation on population of ants was taken at weekly intervals from all the three categories viz., early, middle and late varieties. In situ count of ant population present in each quadrant (m^2) was taken and presented as the mean no. per quadrant/tree.

Fig. 3 TMB population and infestation on young trees (2005-06), CRS, Madakkathara



Results

The mean number of ants (all species) present per quadrant per tree, at weekly intervals on different categories/varieties is presented in Table 10 Highest mean ant population was recorded in the variety Madakkathra-1 (13.058), followed by Madakkathara-2 (11.773). Irrespective of varieties, high population of ants was recorded during April 2nd and 3rd weeks with mean population of 28.813 and 24.875 respectively. In the variety Anakkayam-I, highest ant population was observed during March 3rd and April 3rd weeks with a mean population of 23.25. In Madakkathara-1, highest ant population was during March 2nd week (47.50) and in Kanaka a high population was during 2nd week of April (31.00). In Madakkathara-2, April 4th week and May 1st week recorded highest ant population (37.75 each).

Table 9: Damage score in young trees – 2005-06

Weeks	Shoot mean score	Panicle mean score	Nut mean score
2005 Sep-1st	0.003 (0.711)	0.000 (0.710)	0.000 (0.710)
2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
3rd	0.029 (0.728)	0.000 (0.710)	0.000 (0.710)
4th	0.010 (0.716)	0.000 (0.710)	0.000 (0.710)
Oct-1st	0.005 (0.713)	0.000 (0.710)	0.000 (0.710)
2nd	0.086 (0.756)	0.000 (0.710)	0.000 (0.710)
3rd	0.111 (0.771)	0.000 (0.710)	0.000 (0.710)
4th	0.071 (0.754)	0.053 (0.741)	0.000 (0.710)
Nov-1st	0.215 (0.828)	0.000 (0.710)	0.000 (0.710)
2nd	0.508 (0.982)	1.080 (1.191)	0.000 (0.710)
3rd	0.668 (1.059)	1.561 (1.367)	0.000 (0.710)
4th	0.474 (0.955)	2.311 (1.625)	0.000 (0.710)
5th	0.335 (0.891)	2.092 (1.557)	0.000 (0.710)
Dec-1st	0.180 (0.818)	1.874 (1.471)	0.000 (0.710)
2nd	0.158 (0.805)	2.145 (1.558)	0.000 (0.710)
3rd	0.612 (0.896)	1.290 (1.254)	0.000 (0.710)
4th	0.041 (0.736)	0.940 (1.079)	0.000 (0.710)
2006 Jan-1st	0.022 (1.723)	1.301 (1.195)	0.000 (0.710)
2nd	0.036 (0.733)	0.808 (1.011)	0.200 (0.797)
3rd	0.031 (0.729)	0.542 (0.913)	0.200 (0.780)
4th	0.073 (0.751)	0.113 (0.765)	0.000 (0.710)
Feb-1st	0.067 (0.752)	0.000 (0.710)	0.000 (0.710)
2nd	0.217 (0.826)	0.020 (0.722)	0.000 (0.710)

3rd	0.203 (0.822)	0.060 (0.742)	0.000 (0.710)
4th	0.277 (0.862)	0.075 (0.750)	0.000 (0.710)
Mar-1st	0.277 (0.861)	0.092 (0.751)	0.012 (0.710)
2nd	0.229 (0.828)	0.000 (0.710)	0.000 (0.710)
3rd	0.197 (0.822)	0.000 (0.710)	0.000 (0.710)
4th	0.209 (0.810)	0.000 (0.710)	0.000 (0.710)
5th	0.289 (0.863)	0.000 (0.710)	0.000 (0.710)
Apr-1st	0.936 (1.113)	0.000 (0.710)	0.000 (0.710)
2nd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
3rd	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
4th	0.000 (0.710)	0.000 (0.710)	0.000 (0.710)
May-1st	0.011 (0.716)	0.000 (0.710)	0.000 (0.710)
2nd	0.502 (0.940)	0.000 (0.710)	0.000 (0.710)
3rd	0.061 (0.748)	0.000 (0.710)	0.000 (0.710)
4th	0.061 (0.748)	0.000 (0.710)	0.000 (0.710)
5th	0.084 (0.757)	0.000 (0.710)	0.000 (0.710)
Jun-1st	0.625 (0.960)	0.000 (0.710)	0.000 (0.710)
2nd	0.342 (0.869)	0.000 (0.710)	0.000 (0.710)
3rd	0.534 (0.956)	0.000 (0.710)	0.000 (0.710)
4th	0.898 (1.107)	0.000 (0.710)	0.000 (0.710)
Mean	**0.225 (0.820)**	**0.380 (0.864)**	**0.01 (0.714)**
CD	0.582	0.693	0.166

Table 10. Population of ants (mean no.) as influenced by different periods and varieties

Weeks	Anakkayam 1	Madakkathara-1	Kanaka	Madakkathara-2	Mean
2005 Sep 1st	6.000 (2.467)	6.000 (2.467)	5.000 (2.060)	4.500 (2.178)	**5.375 (2.293)**
2nd	5.250 (2.338)	4.500 (2.164)	7.500 (2.780)	7.750 (2.776)	**6.250 (2.515)**
3rd	5.250 (2.338)	4.500 (2.164)	7.500 (2.780)	7.750 (2.776)	**6.250 (2.515)**
4th	6.000 (2.320)	6.000 (2.525)	8.250 (2.928)	3.250 (1.869)	**5.875 (2.410)**
Oct-1st	1.250 (1.257)	8.750 (2.785)	10.250 (3.138)	3.000 (1.707)	**5.813 (2.222)**
2nd	2.250 (1.637)	3.000 (1.851)	7.250 (2.576)	7.250 (2.576)	**4.938 (2.160)**
3rd	2.250 (1.594)	3.250 (1.896)	6.000 (2.299)	3.500 (1.943)	**3.750 (1.933)**
4th	4.250 (1.964)	4.250 (1.964)	7.500 (2.563)	6.750 (2.512)	**5.688 (2.251)**
Nov-1st	16.000 (3.878)	15.500 (3.826)	7.750 (2.840)	7.500 (2.760)	**11.688 (3.326)**
2nd	6.750 (2.641)	7.250 (2.651)	4.250 (2.122)	3.500 (1.996)	**5.438 (2.353)**

3rd	5.750 (2.439)	4.750 (2.241)	14.250 (3.579)	7.250 (2.770)	**8.000 (2.575)**
4th	3.750 (2.042)	3.500 (1.980)	5.250 (2.332)	6.250 (2.428)	**4.668 (2.196)**
5th	2.500 (1.673)	3.500 (1.968)	8.000 (2.661)	6.750 (2.491)	**5.188 (2.198)**
Dec-1st	5.250 (2.271)	6.750 (2.319)	8.250 (2.480)	1.750 (1.375)	**5.500 (2.111)**
2nd	13.250 (3.488)	4.250 (2.101)	8.500 (2.543)	1.250 (1.190)	**6.813 (2.330)**
3rd	0.750 (1.055)	7.250 (2.676)	2.750 (1.755)	1.500 (1.403)	**3.063 (1.722)**
4th	1.500 (1.246)	3.250 (1.742)	1.000 (1.127)	5.500 (2.384)	**2.813 (1.624)**
2006 Jan-1st	1.500 (1.279)	8.250 (2.680)	7.000 (2.309)	4.500 (2.131)	**5.313 (2.100)**
2nd	5.750 (2.055)	5.000 (1.966)	7.750 (2.579)	3.000 (1.649)	**5.375 (2.062)**
3rd	3.750 (1.972)	3.500 (1.916)	5.500 (2.105)	4.500 (2.114)	**4.313 (2.027)**
4th	2.250 (1.554)	14.000 (3.213)	13.000 (3.093)	7.500 (2.636)	**9.188 (2.624)**
Feb-1st	1.250 (1.190)	12.750 (2.619)	11.750 (3.409)	5.250 (2.072)	**7.750 (2.323)**
2nd	6.000 (2.408)	18.750 (3.475)	13.500 (3.593)	7.250 (2.494)	**11.375 (2.992)**
3rd	6.000 (2.310)	2.750 (1.677)	14.250 (3.417)	10.000 (2.838)	**8.250 (2.561)**
4th	9.250 (2.921)	15.250 (3.135)	5.000 (2.241)	11.750 (3.071)	**10.313 (2.842)**
Mar-1st	16.500 (3.835)	17.000 (3.574)	18.500 (4.094)	27.500 (5.008)	**19.875 (4.128)**
2nd	9.750 (3.144)	47.500 (6.387)	9.000 (2.827)	22.000 (4.721)	**22.063 (4.270)**
3rd	23.250 (4.320)	19.500 (3.773)	12.750 (3.554)	12.500 (3.362)	**17.000 (3.752)**
4th	8.750 (2.954)	36.750 (5.731)	8.750 (2.954)	4.500 (2.143)	**14.688 (3.446)**
5th	16.000 (4.027)	26.500 (4.734)	7.000 (2.606)	24.000 (3.490)	**18.375 (3.714)**
Apr-1st	9.000 (3.026)	13.750 (3.451)	28.000 (4.811)	23.000 (4.633)	**18.438 (3.980)**
2nd	16.250 (4.005)	35.750 (5.844)	31.000 (4.389)	32.250 (5.702)	**28.813 (4.985)**
3rd	23.250 (4.723)	29.750 (5.446)	21.250 (4.592)	25.250 (4.688)	**24.875 (4.862)**
4th	2.750 (1.651)	25.250 (4.668)	15.500 (3.849)	35.750 (5.541)	**19.813 (3.932)**
May-1st	2.000 (1.481)	11.000 (3.291)	10.000 (3.010)	35.750 (5.541)	**14.688 (3.331)**
2nd	7.500 (2.764)	13.250 (3.596)	16.250 (3.967)	27.000 (5.015)	**16.000 (3.836)**
3rd	10.000 (3.161)	33.000 (5.780)	8.750 (3.003)	22.000 (4.129)	**18.438 (4.018)**
4th	6.500 (2.600)	15.750 (3.539)	17.500 (4.011)	14.000 (3.782)	**13.438 (3.483)**
5th	10.750 (3.311)	9.000 (3.076)	14.250 (3.815)	9.750 (3.105)	**10.938 (3.327)**
Jun-1st	5.750 (2.446)	16.250 (4.071)	14.250 (3.786)	14.500 (3.859)	**12.688 (3.540)**
2nd	6.750 (2.671)	8.500 (2.879)	12.500 (3.457)	15.500 (3.939)	**10.813 (3.236)**
3rd	6.250 (2.527)	19.000 (4.381)	9.750 (3.168)	12.500 (3.538)	**11.875 (3.404)**
4th	4.000 (2.060)	7.500 (2.777)	12.500 (3.438)	9.750 (3.002)	**8.438 (2.819)**
Mean	**7.180 (2.489)**	**13.058 (3.187)**	**10.802 (3.038)**	**11.773 (3.054)**	

CD value for varieties – 0.287, weeks – 0.940, interaction – 1.879

Common ants in Cashew ecosystem

Polyrhachis rastellata

Unidentified

Unidentified

Crematogaster sp.

Unidentified

Camponotus parius

Unidentified

Expt. 6. Diversity and abundance of Spiders on cashew trees at Madakkathara

Spiders were collected from cashew fields by following the direct observation/hand picking method. Wide mouth test tubes or polythene bags were used to capture the spiders. The collected specimens were preserved in diluted isopropyl alcohol. Collection was made only from the cashew trees. The spiders collected were identified up to genus/ species level and the list of spider fauna observed at CRS, Madakkathara is presented in Table 11.

The mean number of spiders (all species) present per quadrant per tree, at weekly intervals on different varieties is presented in Table 12. Highest mean spider population was recorded in the variety Madakkathra-2 (2.081), followed by Kanaka (1.884). High population of spiders was recorded during December 4th and September 1st weeks with mean no of 5.125 and 5.00 respectively. In Anakkayam-1, highest spider population was during January 1st week (5.00). In Madakkathara-1, highest spider population was during November 2nd week (6.50). The variety Kanaka, recorded a high population of spiders during 1st week of September (7.25) and in Madakkathara-2, it was during November 1st week (6.75).

Table 11: List of spiders identified at CRS, Madakkathara

Sl. No.	Species	Occurrence/status
	1. Family: Salticidae	
1	*Phidippus pateli*	Common
2	*Bianor* sp.	Rare
3	*Hyllus diacanthes*	Very common
4	*Hyllus* sp.	Common
5	*Phintella vittata*	Very common
6	*Plexippus paykully*	Very common
7	*Plexippus petersi*	Common
8	*Rhene* sp.	Rare
9	*Telamonia dimidiata*	Common
10	*Telamonia elagans*	Common
11	*Salticus renjithus*	Rare
12	*Myrmarachne* Sp. I	Common
13	*Myrmarachne* Sp 2	Common
	2. Family: Argiopidae	
14	*Cyrtorachne* sp.	Rare
15	*Neoscona rumphi*	Very rare
16	*Cyrtophora citricola*	Common
17	*Argiope anasuja*	Common
18	*Gasteracantha germinata*	Common
19	*Araneus* Sp.	Rare
20	*Argyrodes* Sp.	Common
21	*Eriovixia* Sp.	Rare
22	*Cyclosa* Sp.	Rare

Spiders in the Cashew ecosystem

Spiders in the Cashew ecosystem

Spiders feeding on tea mosquito bug

23	*Leucauge decorata*	Common
	3. Family: Lycosidae	
24	*Lycosa pseudoannulata*	Rare
25	*Pardosa sumatrana*	Rare
26	*Lycosa* sp.	Rare
	4. Family: Tetragnathidae	
27	*Nephilia maculata*	Rare
28	*Tetragnatha mandibulata*	Very rare
	5. Family: Oxyopidae	
29	*Oxyopes sunandae*	Common
30	*Oxyopes swetha*	Common
	6. Family: Uloboridae	
31	*Uloborus* sp.	Very common
	7. Family: Sparassidae	
32	*Olios milleti*	Very rare
	8. Family: Lysomanidae	
33	*Lysomanes ludhianensis*	Common
	9. Family Theridiidae	
34	*Chrysso* Sp.	Very rare
35	*Theridion* Sp.	Rare

Table 12 population of spiders (mean no./quadrant/tree/) in different varieties

Weeks	Anakkayam 1	Madakkathara-1	Kanaka	Madakkathara-2	Mean
2005 Sep-1st	3.750 (2.059)	3.750 (2.059)	7.250 (2.729)	5.250 (2.369)	**5.000 (2.304)**
2nd	4.500 (2.228)	5.250 (2.376)	4.000 (2.115)	4.250 (2.150)	**4.500 (2.217)**
3rd	4.500 (2.228)	5.250 (2.376)	4.000 (2.115)	4.250 (2.150)	**4.500 (2.217)**
4th	1.750 (1.435)	4.000 (2.103)	5.500 (2.383)	3.250 (1.891)	**3.625 (1.953)**
Oct-1st	1.000 (1.225)	2.750 (1.762)	0.750 (1.095)	4.500 (2.233)	**2.250 (1.579)**
2nd	1.500 (1.403)	2.750 (1.705)	2.250 (1.610)	2.250 (1.610)	**2.188 (1.582)**
3rd	3.250 (1.891)	3.750 (2.036)	2.000 (1.507)	4.500 (2.197)	**3.375 (1.908)**
4th	2.000 (1.465)	2.000 (1.465)	4.000 (2.087)	3.500 ()1.980	**2.875 (1.749)**
Nov-1st	3.750 (1.907)	3.750 (1.907)	4.750 (2.284)	6.750 (2.679)	**4.750 (2.194)**
2nd	3.000 (1.818)	6.500 (2.301)	1.500 (1.246)	4.750 (2.273)	**3.938 (1.910)**
3rd	4.500 (2.080)	3.500 (1.726)	3.750 (1.976)	5.000 (2.340)	**4.188 (2.031)**
4th	2.500 (1.700)	2.500 (1.700)	1.500 (1.403)	3.000 (1.835)	**2.375 (1.659)**
5th	3.500 (1.958)	2.500 (1.700)	0.500 (0.966)	1.500 (1.363)	**2.000 (1497)**
Dec-1st	3.250 (1.812)	1.500 (1.289)	0.750 (1.055)	0.500 (0.966)	**1.500 (1.281)**
2nd	3.250 (1.891)	1.750 (1.475)	1.500 (1.386)	2.000 (1.465)	**2.125 (1.554)**
3rd	1.500 (1.403)	2.750 (1.772)	4.000 (2.115)	1.500 (1.346)	**2.438 (1.659)**
4th	1.000 (1.184)	4.500 (1.862)	13.750 (3.151)	1.250 (1.274)	**5.125 (1.868)**
2006 Jan-1st	5.000 (2.340)	2.750 (1.789)	3.2502 (1.907)	2.750 (1.755)	**3.438 (1.948)**

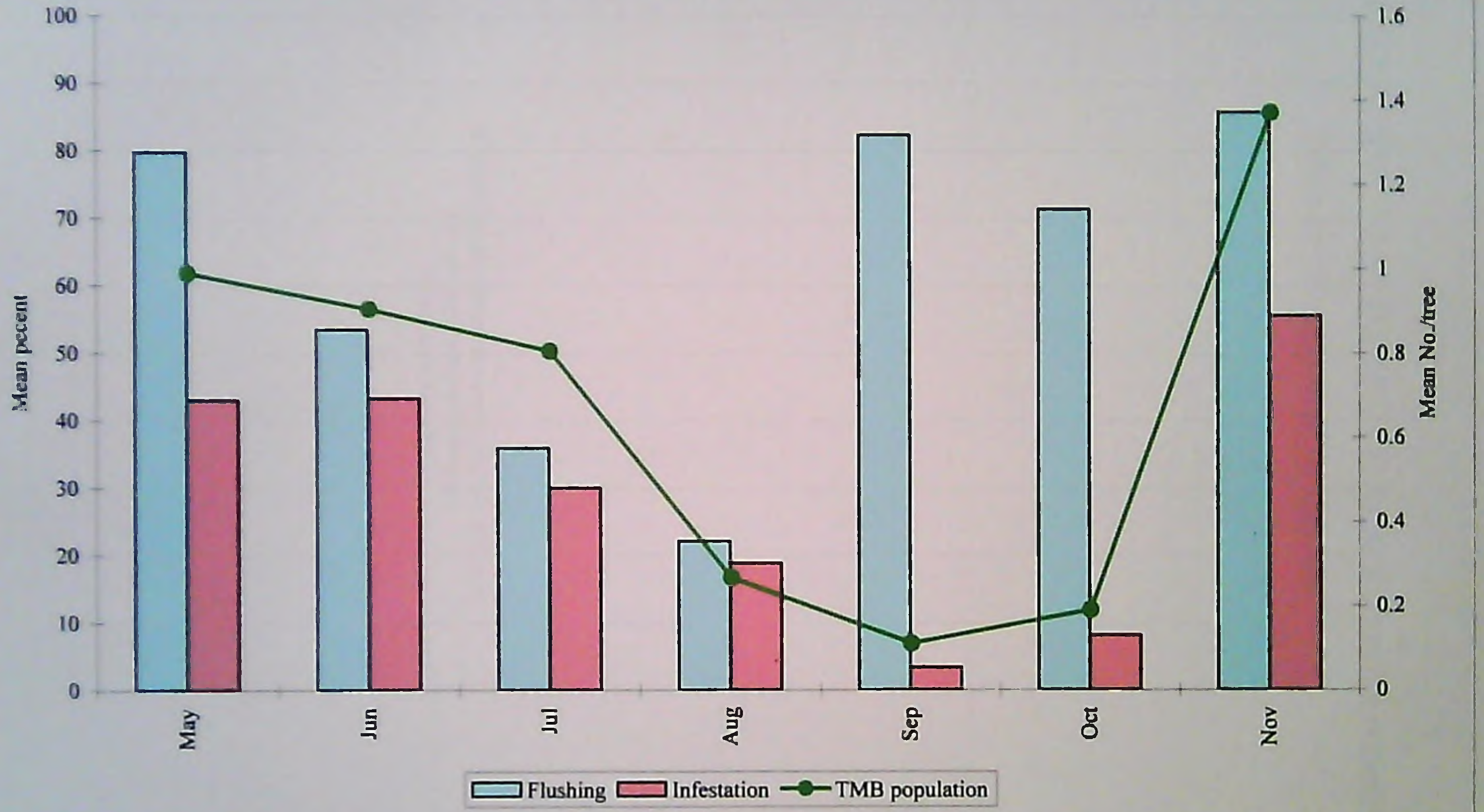
2nd	1.250 (1.274)	1.750 (1.409)	1.750 (1.435)	1.250 (1.257)	1.500 (1.344)
3rd	1.500 (1.319)	1.500 (1.319)	1.250 (1.274)	3.250 (1.827)	1.875 (1.435)
4th	1.250 (1.257)	1.000 (1.184)	1.250 (1.274)	3.000 (1.807)	1.625 (1.380)
Feb-1st	0.500 (0.966)	2.000 (1.507)	1.500 (1.403)	2.500 (1.709)	1.625 (1.396)
2nd	0.500 (0.926)	0.250 (0.837)	0.250 (0.837)	1.000 (1.127)	0.500 (0.932)
3rd	0.250 (0.837)	0.500 (0.926)	0.500 (0.966)	1.750 (1.418)	0.750 (1.037)
4th	0.500 (0.966)	0.000 (0.707)	0.250 (0.837)	1.750 (1.375)	0.625 (0.971)
Mar-1st	1.500 (1.346)	0.000 (0.707)	0.750 (1.055)	1.750 (1.435)	1.000 (1.136)
2nd	0.250 (0.837)	0.250 (0.837)	0.000 (0.707)	0.000 (0.707)	0.125 (0.772)
3rd	1.000 (1.127)	0.500 (0.966)	0.500 (0.966)	0.500 (0.926)	0.625 (0.996)
4th	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
5th	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	2.000 (1.259)	0.500 (0.845)
Apr-1st	0.250 (0.837)	1.000 (1.127)	0.250 (0.837)	0.750 (1.055)	0.563 (0.964)
2nd	1.000 (1.184)	0.000 (0.707)	0.000 (0.707)	0.500 (0.926)	0.375 (0.881)
3rd	0.750 (1.055)	0.500 (0.926)	0.250 (0.837)	1.750 (1.475)	0.813 (1.073)
4th	0.500 (0.966)	1.750 (1.475)	0.250 (0.837)	0.750 (1.095)	0.813 (1.093)
May-1st	0.750 (1.095)	1.000 (1.184)	0.750 (1.055)	0.750 (1.095)	0.813 (1.108)
2nd	0.500 (0.966)	0.750 (1.095)	0.250 (0.837)	1.000 (1.127)	0.625 (1.006)
3rd	0.250 (0.837)	1.500 (1.279)	1.000 (1.144)	0.250 (0.837)	0.750 (1.024)
4th	0.250 (0.837)	1.500 (1.346)	1.500 (1.403)	-0.500 (0.966)	0.938 (1.138)
5th	0.500 (0.966)	1.750 (1.475)	0.250 (0.837)	0.750 (1.095)	0.813 (1.093)
Jun-1st	0.500 (0.966)	0.750 (1.095)	0.250 (0.837)	1.000 (1.127)	0.625 (1.006)
2nd	0.250 (0.837)	0.500 (0.926)	0.500 (0.966)	1.750 (1.418)	0.750 (1.037)
3rd	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
4th	0.250 (0.837)	0.750 (1.055)	0.000 (0.707)	0.250 (0.837)	0.313 (0.859)
Mean	**1.576 (1.311)**	**1.884 (1.386)**	**1.820 (1.326)**	**2.081 (1.470)**	

CD value for varieties – 0.103, weeks – 0.336, interaction – 0.672

TMB population and infestation on young plants during off season (Extensity studies)

The extensity of TMB infestation on young plants was observed during the off season starting from May 2005. All the trees in the scion bank and MLT were surveyed at monthly intervals and recorded the no. of trees which have put forth new flushes, no. of trees showing TMB infestation and the no. of TMB present on the infested trees. The percentage was estimated for the extent of flushing and infestation and the results are presented in Fig. 4.

Fig. 4. Damage extensity studies on Young plants during off-season 2005



ANNUAL REPORT OF THE ICAR *Ad hoc* SCHEME

FOREWARNING TEA MOSQUITO BUG *Helopeltis antonii* Sign. (Miridae:Hemiptera) in Cashew

01-09-2005 to 31-08-2006

Regional Agricultural Research Station, Pilicode
Kerala Agricultural University
Kasaragod District

PROJECT IMPLEMENTATION DETAILS

1.Project year	Third year, 2005-06
2.Title of the project	:Forewarning tea mosquito bug *Helopeltis antonii* Sign. (Miridae: Hemiptera) in cashew
3.ICAR Sanction order	:F.No.15(16)/2002- Hort.I.dtd.04-06-2003.
4.University Sanction order	:No.R2-67282/02 dtd.16.07.03.
5.Total amount sanctioned	:
6.Centrewise details	

RESEARCH CENTRES	RESEARCH TEAM
Lead center	
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Regional Agricultural Research Station, Pilicode

Annual Report of the ICAR ad hoc project

FOREWARNING TEA MOSQUITO BUG IN CASHEW

The project was implemented at the Regional Agricultural Research Station, Pilicode as one of the sub centers. The experiments as per the technical programme were implemented during the period 2005-06.

Expt. 1: Seasonal occurrence of TMB population and damage

From the trees available at the Regional Agricultural Research Station, the following varieties were selected to represent three categories as early, mid and late season varieties. Observations were taken up as per the technical programme given for other centers.

Early- Anakkayam 1 (Age: 15 years) and Madakkathara 1 (6 years)
Mid- Kanaka (Age: 12 years)
Late- Madakkathara 2 (Age: 9 years)
No. of trees: 4 / variety except Anakkayam-1(3 nos)

Results

TMB population

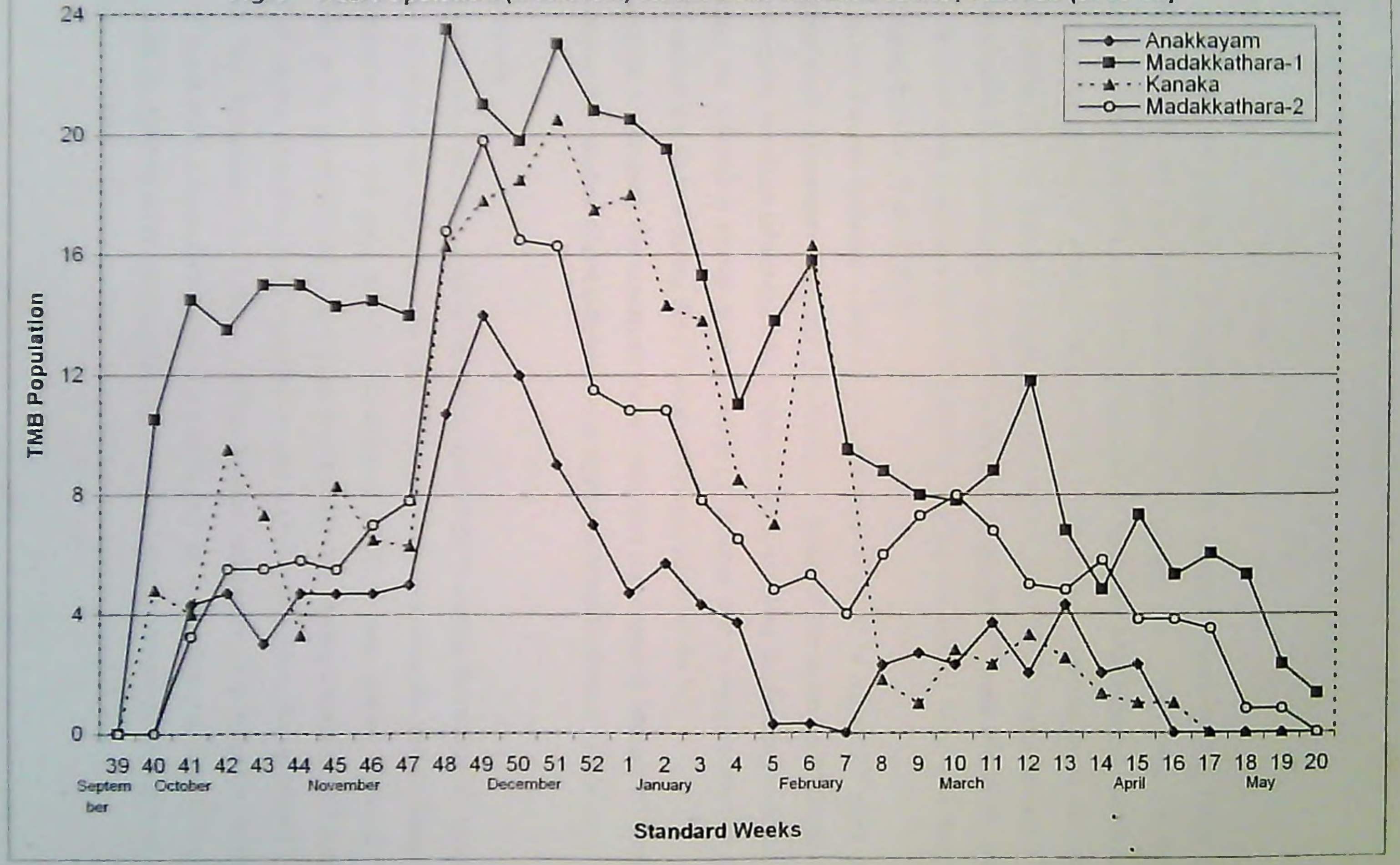
The data on seasonal variations of TMB population at weekly intervals during the period from September 2005 to May 2006 are presented in table 1, + Fig 1. TMB population was present on all the varieties at a moderate to high intensity throughout the period of study. However, the populations was highest in the variety Madakkathara -1 with a mean of 23.50 during December 1st week. The occurrence of TMB population started from the first week of October with a mean population of 10.50 and continued up to the last week of May with a mean population of 1.25.

In the variety Anakkayam-1, the TMB population started during October 1st week with a mean of 0.33 and reached its peak during December 2nd week (14.00) and continued up to 3rd week of April with a mean no. of 2.33. The variety Kanaka recorded a highest TMB population of 20.50 during December 4th week. TMB population started from the 1st week of October with 4.75 and continued up to the end of April. In Madakkathara 2, peak TMB population of 19.75 was recorded during December 2nd week. The TMB population was present from the 2nd week of October to 3rd week of May.

Table1. Seasonal occurrence of TMB on different varieties

Mean No. of TMB in various varieties					
Date	**Ank-1**	**Mdk-1**	**Kanaka**	**Mdk-2**	**Mean**
05/9/2005	0.00(0.71)	0.00(0.71)	0(0.71)	0.00(0.71)	**0.00**(0.71)
13/9/2005	0.00(0.71)	0.00(0.71)	0(0.71)	0.00(0.71)	**0.00**(0.71)
23/9/2005	0.00(0.71)	0.00(0.71)	0(0.71)	0.00(0.71)	**0.00**(0.71)
30/9/2005	0.00(0.71)	0.00(0.71)	0(0.71)	0.00(0.71)	**0.00**(0.71)
7/10/2005	0.33(0.91)	10.50(3.32)	4.75(2.29)	0.00(0.71)	**3.90**(2.10)
14/10/05	4.33(2.20)	14.50(3.87)	4(2.12)	3.25(1.94)	**6.52**(2.65)
21/10/05	4.67(2.27)	13.50(3.74)	9.5(3.16)	5.50(2.45)	**8.29**(2.97)
31/10/05	3.00(1.87)	15.00(3.94)	7.25(2.78)	5.50(2.45)	**7.69**(2.86)
4/11/2005	4.67(2.27)	15.00(3.94)	3.25(1.94)	5.75(2.50)	**7.17**(2.77)
11/11/2005	4.67(2.27)	14.25(3.84)	8.25(2.96)	5.50(2.45)	**8.17**(2.94)
18/11/05	4.67(2.27)	14.50(3.87)	6.5(2.65)	7.00(2.74)	**8.17**(2.94)
25/11/05	5.00(2.35)	14.00(3.81)	6.25(2.60)	7.75(2.87)	**8.25**(2.96)
6/12/2005	10.67(3.34)	23.50(4.90)	16.25(4.09)	16.75(4.15)	**16.79**(4.16)
15/12/05	14.00(3.81)	21.00(4.64)	17.75(4.27)	19.75(4.50)	**18.13**(4.32)
23/12/05	12.00(3.54)	19.75(4.50)	18.5(4.36)	16.50(4.12)	**16.69**(4.15)
30/12/05	9.00(3.08)	23.00(4.85)	20.5(4.58)	16.25(4.09)	**17.19**(4.21)
6/1/2006	7.00(2.74)	20.75(4.61)	17.5(4.24)	11.50(3.46)	**14.19**(3.83)
13/01/06	4.67(2.27)	20.50(4.58)	18(4.30)	10.75(3.35)	**13.48**(3.74)
20/01/06	5.67(2.48)	19.50(4.47)	14.25(3.84)	10.75(3.35)	**12.54**(3.61)
27/01/06	4.33(2.20)	15.25(3.97)	13.75(3.77)	7.75(2.87)	**10.27**(3.28)
3//2/06	3.67(2.04)	11.00(3.39)	8.5(3.00)	6.50(2.65)	**7.42**(2.81)
10/2/2006	0.33(0.91)	13.75(3.77)	7(2.74)	4.75(2.29)	**6.46**(2.64)
17/02/06	0.33(0.91)	15.75(4.03)	16.25(4.09)	5.25(2.40)	**9.40**(3.15)
24/02/06	0.00(0.71)	9.50(3.16)	9.5(3.16)	4.00(2.12)	**5.75**(2.50)
1/3/2006	2.33(1.68)	8.75(3.04)	1.75(1.50)	6.00(2.55)	**4.71**(2.28)
8/3/2006	2.67(1.78)	8.00(2.92)	1(1.22)	7.25(2.78)	**4.73**(2.29)
15/3/06	2.33(1.68)	7.75(2.87)	2.75(1.80)	8.00(2.92)	**5.21**(2.39)
22/3/06	3.67(2.04)	8.75(3.04)	2.25(1.66)	6.75(2.69)	**5.36**(2.42)
29/3/06	2.00(1.58)	11.75(3.50)	3.25(1.94)	5.00(2.35)	**5.50**(2.45)
5/4/06	4.33(2.20)	6.75(2.69)	2.5(1.73)	4.75(2.29)	**4.58**(2.25)
12/4/06	2.00(1.58)	4.75(2.29)	1.25(1.32)	5.75(2.50)	**3.44**(1.98)
20/4/06	2.33(1.68)	7.25(2.78)	1(1.22)	3.75(2.06)	**3.58**(2.02)
28/4/06	0.00(0.71)	5.25(2.40)	1(1.22)	3.75(2.06)	**2.50**(1.73)
6/5/06	0.00(0.71)	6.00(2.55)	0(0.71)	3.50(2.00)	**2.38**(1.70)
15/5/06	0.00(0.71)	5.25(2.40)	0(0.71)	0.75(1.12)	**1.50**(1.41)
22/5/06	0.00(0.71)	2.25(1.66)	0(0.71)	0.75(1.12)	**0.75**(1.12)
30/5/06	0.00(0.71)	1.25(1.32)	0(0.71)	0.00(0.71)	**0.31**(0.90)
Mean	**3.37(1.97)**	**11.03(3.40)**	**6.60(2.66)**	**6.13(2.57)**	**6.78(2.70)**

Fig. 1 TMB Population (Mean No.) on different varieties RARS, Pilicode (2005-06)



Irrespective of periods the overall TMB population was highest in the variety Madakkathara -1(11.03) and lowest (3.37) in Anakkayam-1.

TMB damage intensity

Shoot infestation

The mean per cent infestation on shoots in different varieties is presented in Table 2. TMB infestation started very early and the intensity of infestation was > 50% from the first week of December. High infestation persisted till the end of April. In Anakkayam-1, the shoot infestation started during the 2nd week of October with 25.07 % and continued up to the last week of April (20.89 %) and recorded a peak shoot infestation of 63.83 % during January 3rd week. In Madakkathara-1, a peak shoot infestation was during January 2nd week (86.23 %) and the shoot infestation was continued from October I week to the end of May with mean infestation ranging from 30.45 to 86.23 %.

The variety Kanaka recorded a peak shoot infestation of 70.29 % during 2nd week of January. Higher shoot infestations were recorded during 2nd week of December to 2nd week of February. In Kanaka, the shoot infestation was comparatively low during the flushing period. In Madakkathara-2 the infestation started in the 3rd week of October with a mean infestation of 28.70 % and reached the highest during the 2nd week of January 2006 (60.94 %).

Irrespective of varieties, the maximum shoot infestation was recorded January 2nd week (67.96 %). Among the varieties .Shoot infestation was highest in Madakkathara-1 (Table 2).

Panicle infestation

In Anakkayam-1, the peak panicle infestation was 67.29 % during November 2nd week. High panicle infestation was also observed from 3rd week of November to the end of January 2006. In Madakkathara-1 the peak panicle infestation of 83.75 % was during 1st week of February 2006. In the variety Kanaka, peak panicle infestation was during December 2nd week (69.79%). The variety Madakkathara-2 recorded a peak panicle infestation during March 3rd week (67.625 %). Irrespective of varieties, highest panicle infestation was recorded during December 2nd week with a mean infestation of 64.28 % and the infestation was noticed from October III week to April III week. Among the four varieties highest panicle infestation was in Madakkathara-1 (31.18 %). Lowest panicle infestation was in Anakkayam-1 (Table 3).

Table 2. Shoot infestation on different varieties (Mean percentage)

Date	Ank-1	Mdk-1	Kanaka	Mdk-2	Mean
5/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
13/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
23/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
30/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
7/10/2005	0.00(0.71)	53.41(7.34)	10.26(3.28)	0.00(0.71)	**15.92**(4.05)
14/10/05	25.07(5.06)	69.94(8.39)	10.51(3.32)	0.00(0.71)	**26.38**(5.18)
21/10/05	31.71(5.68)	71.76(8.50)	15.85(4.04)	28.70(5.40)	**37.01**(6.12)
31/10/05	31.05(5.62)	57.65(7.63)	19.63(4.49)	33.23(5.81)	**35.39**(5.99)
4/11/2005	44.89(6.74)	68.08(8.28)	27.27(5.27)	38.97(6.28)	**44.80**(6.73)
11/11/2005	36.58(6.09)	62.75(7.95)	27.8(5.32)	49.42(7.07)	**44.14**(6.68)
18/11/05	57.25(7.60)	67.55(8.25)	21.36(4.68)	48.77(7.02)	**48.73**(7.02)
25/11/05	50.56(7.15)	73.88(8.62)	26.04(5.15)	38.80(6.27)	**47.32**(6.92)
6/12/2005	59.25(7.73)	70.12(8.40)	49.86(7.10)	49.86(7.10)	**57.27**(7.60)
15/12/05	61.28(7.86)	75.92(8.74)	60.78(7.83)	59.04(7.72)	**64.26**(8.05)
23/12/05	57.19(7.60)	70.03(8.40)	55.33(7.47	51.08(7.18)	**58.41**(7.68)
30/12/05	56.24(7.53)	72.45(8.54)	58.95(7.71)	55.95(7.51)	**60.90**(7.84)
6/1/2006	51.92(7.24)	76.19(8.76)	63.13(7.98)	49.84(7.10)	**60.27**(7.80)
13/01/06	54.36(7.41)	86.23(9.31)	70.29(8.41)	60.94(7.84)	**67.96**(8.27)
20/01/06	63.83(8.02)	83.03(9.14)	58.14(7.66)	60.52(7.81)	**66.38**(8.18)
27/01/06	37.42(6.16)	84.50(9.22)	54.42(7.41)	59.18(7.73)	**58.88**(7.71)
3//2/06	33.12(5.80)	72.38(8.54)	54.57(7.42)	48.32(6.99)	**52.10**(7.25)
10/2/06	34.61(5.93)	71.76(8.50)	58.19(7.66)	44.21(6.69)	**52.19**(7.26)
17/02/06	36.84(6.11)	58.48(7.68)	46.21(6.83)	60.70(7.82)	**50.56**(7.15)
24/02/06	31.61(5.67)	70.76(8.44)	36.26(6.06)	47.61(6.94)	**46.56**(6.86)
1/3/2006	32.61(5.75)	38.43(6.24)	14.22(3.84)	43.58(6.64)	**32.21**(5.72)
8/3/2006	24.70(5.02)	39.21(6.30)	12.83(3.65)	29.68(5.49)	**26.61**(5.21)
15/3/06	51.15(7.19)	39.42(6.32)	16.38(4.11)	48.31(6.99)	**38.82**(6.27)
22/3/06	31.26(5.64)	43.45(6.63)	10.83(3.37)	42.36(6.55)	**31.98**(5.70)
29/3/06	23.81(4.93)	34.32(5.90)	16.79(4.16)	39.33(6.31)	**28.56**(5.39)
5/4/06	27.58(5.30)	31.76(5.68)	14.24(3.84)	42.66(6.57)	**29.06**(5.44)
12/4/06	17.04(4.19)	30.45(5.56)	16.91(4.17)	39.26(6.31)	**25.92**(5.14)
20/4/06	16.57(4.13)	41.31(6.47)	18.18(4.32)	39.88(6.35)	**28.99**(5.43)
28/4/06	20.89(4.62)	34.96(5.95)	18.21(4.33)	41.22(6.46)	**28.82**(5.41)
6/5/06	0.00(0.71)	35.59(6.01)	8.32(2.97)	44.13(6.68)	**22.01**(4.74)
15/5/06	0.00(0.71)	38.89(6.28)	0(0.71)	43.62(6.64)	**20.63**(4.60)
22/5/06	0.00(0.71)	36.19(6.06)	0(0.71)	42.98(6.59)	**19.79**(4.50)
30/5/06	0.00(0.71)	36.04(6.04)	0(0.71)	31.80(5.68)	**16.96**(4.18)
Mean	**29.74(5.50)**	**51.27(7.20)**	**26.26(5.17)**	**38.21(6.26)**	**40.84(6.43)**

Table 3 Panicle infestation on different varieties (Mean percentage)

Date	Ank-1	Mdk-1	Kanaka	Mdk-2	Mean
5/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
13/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
23/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
30/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
7/10/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
14/10/05	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
21/10/05	0.00(0.71)	62.73(7.95)	46.28(6.84)	0.00(0.71)	**27.25**(5.27)
31/10/05	47.29(6.91)	58.20(7.66)	56.17(7.53)	0.00(0.71)	**40.42**(6.40)
4/11/05	58.10(7.66)	58.14(7.66)	49.99(7.11)	0.00(0.71)	**41.56**(6.49)
11/11/05	67.29(8.23)	59.45(7.74)	58.57(7.69)	0.00(0.71)	**46.33**(6.84)
18/11/05	56.61(7.56)	66.60(8.19)	53.27(7.33)	0.00(0.71)	**44.12**(6.68)
25/11/05	60.06(7.78)	69.00(8.34)	44.07(6.68)	0.00(0.71)	**43.28**(6.62)
6/12/05	48.82(7.02)	67.91(8.27)	48.32(6.99)	56.98(7.58)	**55.51**(7.48)
15/12/05	58.41(7.68)	72.21(8.53)	69.79(8.38)	56.72(7.56)	**64.28**(8.05)
23/12/05	56.94(7.58)	74.52(8.66)	48.79(7.02)	52.89(7.31)	**58.29**(7.67)
30/12/05	55.98(7.52)	73.33(8.59)	43.98(6.67)	55.71(7.50)	**57.25**(7.60)
6/1/2006	57.19(7.60)	67.21(8.23)	61.43(7.87)	56.47(7.55)	**60.58**(7.82)
13/01/06	49.37(7.06)	61.34(7.86)	59.59(7.75)	62.22(7.92)	**58.13**(7.66)
20/01/06	48.79(7.02)	68.49(8.31)	49.72(7.09)	53.40(7.34)	**55.10**(7.46)
27/01/06	40.99(6.44)	72.62(8.55)	47.84(6.95)	52.80(7.30)	**53.56**(7.35)
3//2/06	0.00(0.71)	83.75(9.18)	50.83(7.16)	54.09(7.39)	**47.17**(6.90)
10/2/06	0.00(0.71)	77.43(8.83)	43.51(6.63)	51.41(7.20)	**43.09**(6.60)
17/02/06	0.00(0.71)	60.88(7.83)	45.52(6.78)	52.71(7.29)	**39.78**(6.35)
24/02/06	0.00(0.71)	0.00(0.71)	41.42(6.47)	49.41(7.06)	**22.71**(4.82)
1/3/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	65.33(8.11)	**16.33**(4.10)
8/3/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	63.66(8.01)	**15.92**(4.05)
15/3/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	54.74(7.43)	**13.69**(3.77)
22/3/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	63.54(8.00)	**15.89**(4.05)
29/3/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	67.62(8.25)	**16.91**(4.17)
5/4/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	56.70(7.56)	**14.18**(3.83)
12/4/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	32.74(5.77)	**8.19**(2.95)
20/4/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	5.56(2.46)	**1.39**(1.37)
28/4/06	0.00(0.71)	0.00(0.71)	0.00(0.710	0.00(0.71)	**0.00**(0.71)
6/5/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
15/5/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
22/5/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
30/5/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
Mean	**19.08(4.42)**	**31.18(5.63)**	**24.84(5.03)**	**28.78(5.41)**	**29.74(5.50)**

Nut infestation

In the variety Anakkayam-I, nut infestation started during the November 4th week and continued up to January 3rd week and the peak was during December 4th week (47.29 %).The variety Madakkathara-I, recorded peak nut infestation during January 1st and 3rd weeks with mean infestation of 66.67 and 66.78 respectively. In the case of Kanaka, peak nut infestation was during January 2nd week (33.93 %) and nut infestation continued up to February 4th week. In Madakkathara-2, nut infestation started during the 2nd week of January (41.88 %) and continued up to April 2nd week (7.14%). Irrespective of varieties, peak nut infestation was observed during January 2nd week, with a mean infestation of 44.49 % (Table 4). Among the varieties highest nut infestation was in the late variety Madakkathara-2.

Varietals impact on TMB damage

The over all mean TMB infestation on shoot, panicle and nut on different varieties over periods is presented in Table 5. A continuous TMB infestation at a low level was recorded from 3rd week of October. In all the varieties peak damage was during the period from November to February. A comparison of the overall mean infestation revealed a high TMB infestation on the varieties, Madakkathara-I and Madakkathara-2 (31.95 and 26.51%) The intensity of infestation varied in different varieties, the highest infestation was in the variety Madakkathara-1 (31.95 %) followed by Madakkathara-2 (26.51%) followed by Anakkayam-1 (19.10%) and Kanaka (18.68%). The period wise variation in the damage intensity and peak infestation in different varieties varied according to their crop phenology.

Shoot, panicle and nut damage influenced by different periods irrespective of varieties

Irrespective of varieties highest shoot infestation of 67.96 % was observed during the 2nd week of January. Panicle infestation started during October 3nd week with 27.25 % and reached the peak during 2nd week of December with a mean infestation of 64.28 %. Nut infestation was observed during November 4th week with a minimum infestation of 23.16 % and reached a peak during January 2nd week (44.49 %). After that nut infestation showed a declining trend. The overall TMB infestation was highest during December and January (Table 6).

Shoot, panicle and nut infestation in different varieties

A comparison was made on TMB infestation separately on shoot, panicle and nut as

Table 4. Nut infestation on different varieties (Mean percentage)

Date	Ank-1	Mdk-1	Kanaka	Mdk-2	Mean
5/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
13/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
23/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
30/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
7/10/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
14/10/05	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
21/10/05	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
31/10/05	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
4/11/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
11/11/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
18/11/05	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
25/11/05	39.50(6.32)	53.15(7.32)	0.00(0.71)	0.00(0.71)	**23.16**(4.86)
6/12/2005	33.74(5.85)	63.54(8.00)	0.00(0.71)	0.00(0.71)	**24.32**(4.98)
15/12/05	41.06(6.45)	65.14(8.10)	0.00(0.71)	0.00(0.71)	**26.55**(5.20)
23/12/05	31.11(5.62)	55.25(7.47)	0.00(0.71)	0.00(0.71)	**21.59**(4.70)
30/12/05	47.29(6.91)	56.65(7.56)	0.00(0.71)	0.00(0.71)	**25.99**(5.15)
6/1/2006	44.99(6.74)	66.67(8.20)	29.23(5.45)	0.00(0.71)	**35.22**(5.98)
13/01/06	46.92(6.89)	55.22(7.46)	33.93(5.87)	41.88(6.51)	**44.49**(6.71)
20/01/06	30.86(5.60)	66.78(8.20)	31.38(5.65)	46.05(6.82)	**43.77**(6.65)
27/01/06	0.00(0.71)	47.13(6.90)	22.55(4.80)	47.89(6.96)	**29.39**(5.47)
3//2/06	0.00(0.71)	22.06(4.75)	24.08(4.96)	39.48(6.32)	**21.41**(4.68)
10/2/2006	0.00(0.71)	0.00(0.71)	7.29(2.79)	41.94(6.51)	**12.31**(3.58)
17/02/06	0.00(0.71)	0.00(0.71)	20.46(4.58)	33.33(5.82)	**13.45**(3.73)
24/02/06	0.00(0.71)	0.00(0.71)	20.09(4.54)	33.91(5.87)	**13.50**(3.74)
1/3/2006	0.00(0.71)	0.00(0.71)	0.00(0.71)	39.90(6.36)	**9.98**(3.24)
8/3/2006	0.00(0.71)	0.00(0.71)	0.00(0.71)	38.90(6.28)	**9.73**(3.20)
15/3/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	27.01(5.24)	**6.75**(2.69)
22/3/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	32.14(5.71)	**8.04**(2.92)
29/3/06	0.00(0.71)	0.00(0.71)	0.00)(0.71)	34.18(5.89)	**8.55**(3.01)
5/4/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	22.16(4.76)	**5.54**(2.46)
12/4/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	7.14(2.76)	**1.79**(1.51)
20/4/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
28/4/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
6/5/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
15/5/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
22/5/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
30/5/06	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00**(0.71)
Mean	**8.53(3.00)**	**14.91(3.93)**	**5.11(2.37)**	**13.13(3.69)**	**12.74(3.64)**

Table 5. Varietal impact on TMB damage in different periods (Mean percentage)

Date	Ank-1	Mdk-1	Knk	Mdk-2	Mean
5/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00(0.71)**
13-9-2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00(0.71)**
23-9-2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00(0.71)**
30-9-2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	**0.00(0.71)**
7/10/2005	0.00(0.71)	17.80(4.28)	3.42(1.98)	0.00(0.71)	**5.31(2.41)**
14/10/05	8.36(2.98)	23.31(4.88)	3.502.00)	0.00(0.71)	**8.79(3.05)**
21/10/05	10.57(3.33)	44.83(6.73)	20.71(4.61)	9.57(3.17)	**21.42(4.68)**
31/10/05	26.11(5.16)	38.62(6.25)	25.27(5.08)	11.08(3.40)	**25.27(5.08)**
4/11/2005	34.33(5.90)	42.21(6.54)	25.75(5.12)	12.99(3.67)	**28.82(5.41)**
11/11/2005	34.62(5.93)	40.73(6.42)	28.79(5.41)	16.47(4.12)	**30.16(5.54)**
18/11/05	37.95(6.20)	44.72(6.72)	24.88(5.04)	16.26(4.09)	**30.95(5.61)**
25/11/05	50.04(7.11)	65.34(8.11)	23.37(4.89)	12.93(3.67)	**37.92(6.20)**
6/12/2005	47.27(6.91)	67.19(8.23)	32.73(5.76)	35.61(6.01)	**45.70(6.80)**
15/12/05	53.58(7.35)	71.09(8.46)	43.52(6.63)	38.59(6.25)	**51.70(7.22)**
23/12/05	48.41(6.99)	66.59(8.19)	34.71(5.93)	34.66(5.93)	**46.09(6.83)**
30/12/05	53.17(7.33)	67.48(8.24)	34.31(5.90)	37.22(6.14)	**48.04(6.97)**
6/1/2006	51.37(7.20)	70.02(8.40)	51.26(7.19)	35.44(5.99)	**52.02(7.25)**
13/01/06	50.22(7.12)	67.60(8.25)	54.60(7.42)	55.01(7.45)	**56.86(7.57)**
20/01/06	47.83(6.95)	72.77(8.56)	46.41(6.85)	53.32(7.34)	**55.08(7.46)**
27/01/06	26.14(5.16)	68.08(8.28)	41.60(6.49)	53.29(7.33)	**47.28(6.91)**
3//2/06	11.04(3.40)	59.40(7.74)	43.16(6.61)	44.63(6.72)	**39.56(6.33)**
10/2/2006	13.67(3.76)	31.39(5.65)	36.33(6.07)	45.85(6.81)	**31.81(5.68)**
17/02/06	10.00(3.24)	39.79(6.35)	37.40(6.16)	44.25(6.69)	**32.86(5.78)**
24/02/06	10.22(3.27)	23.35(4.88)	32.59(5.75)	43.64(6.64)	**27.45(5.29)**
1/3/2006	10.87(3.37)	12.81(3.65)	4.74(2.29)	49.60(7.08)	**19.51(4.47)**
8/3/2006	8.23(2.96)	13.07(3.68)	4.28(2.19)	44.08(6.68)	**17.42(4.23)**
15.3.06	17.05(4.19)	13.14(3.69)	5.46(2.44)	43.35(6.62)	**19.75(4.50)**
22.3.06	10.42(3.30)	14.48(3.87)	3.61(2.03)	46.01(6.82)	**18.63(4.37)**
29.3.06	7.94(2.90)	11.44(3.46)	3.60(2.02)	47.04(6.90)	**17.50(4.24)**
5.4.06	9.19(3.11)	10.59(3.33)	4.75(2.29)	40.51(6.40)	**16.26(4.09)**
12.4.06	5.68(2.49)	10.15(3.26)	5.64(2.48)	26.38(5.18)	**11.96(3.53)**
20.4.06	5.52(2.45)	13.77(3.78)	6.06(2.56)	15.15(3.96)	**10.13(3.26)**
28.4.06	6.96(2.73)	11.65(3.49)	6.07(2.56)	13.74(3.77)	**9.61(3.18)**
6.5.06	0.00(0.71)	11.86(3.52)	2.77(1.81)	14.71(3.90)	**7.3(2.80)**
15.5.06	0.00(0.71)	12.96(3.67)	0.00(0.71)	14.54(3.88)	**6.88(2.72)**
22.5.06	0.00(0.71)	12.06(3.54)	0.00(0.71)	14.33(3.85)	**6.60(2.66)**
30.5.06	0.00(0.71)	12.01(3.54)	0.00(0.71)	10.60(3.33)	**5.65(2.48)**
Mean	**19.10(4.43)**	**31.95(5.70)**	**18.68(4.38)**	**26.51(5.20)**	**24.06(4.96)**

Table 6. Shoot, panicle and nut infestation as influenced by in different periods (Mean percentage)

Date	Shoot	Panicle	Nut	Mean
5/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
13/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
23/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
30/9/2005	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
7/10/2005	15.92(4.05)	0.00(0.71)	0.00(0.71)	5.31(2.41)
14/10/05	26.38(5.18)	0.00(0.71)	0.00(0.71)	8.79(3.05)
21/10/05	37.01(6.12)	27.25(5.27)	0.00(0.71)	21.42(4.68)
31/10/05	35.39(5.99)	40.42(6.40)	0.00(0.71)	25.27(5.08)
4/11/2005	44.80(6.73)	41.56(6.49)	0.00(0.71)	28.79(5.41)
11/11/2005	44.14(6.68)	46.33(6.84)	0.00(0.71)	30.16(5.54)
18/11/05	48.73(7.02)	44.12(6.68)	0.00(0.71)	30.95(5.61)
25/11/05	47.32(6.92)	43.28(6.62)	23.16(4.86)	37.92(6.20)
6/12/2005	57.27(7.60)	55.51(7.48)	24.32(4.98)	45.70(6.80)
15/12/05	64.26(8.05)	64.28(8.05)	26.55(5.20)	51.70(7.22)
23/12/05	58.41(7.68)	58.29(7.67)	21.59(4.70)	46.09(6.83)
30/12/05	60.90(7.84)	57.25(7.60)	25.99(5.15)	48.04(6.97)
6/1/2006	60.27(7.80)	60.58(7.82)	35.22(5.98)	52.02(7.25)
13/01/06	67.96(8.27)	58.13(7.66)	44.49(6.71)	56.86(7.57)
20/01/06	66.38(8.18)	55.10(7.46)	43.77(6.65)	55.08(7.46)
27/01/06	58.88(7.71)	53.56(7.35)	29.39(5.47)	47.28(6.91)
3//2/06	52.10(7.25)	47.17(6.90)	21.41(4.68)	40.22(6.38)
10/2/2006	52.19(7.26)	43.09(6.60)	12.31(3.58)	35.86(6.03)
17/02/06	50.56(7.15)	39.78(6.35)	13.45(3.73)	34.59(5.92)
24/02/06	46.56(6.86)	22.71(4.82)	3.50(3.74)	27.59(5.30)
1/3/2006	32.21(5.72)	16.33(4.10)	9.98(3.24)	19.51(4.47)
8/3/2006	26.61(5.21)	15.92(4.05)	9.73(3.20)	17.42(4.23)
15.3.06	38.82(6.27)	13.69(3.77)	6.75(2.69)	19.75(4.50)
22.3.06	31.98(5.70)	15.89(4.05)	8.04(2.92)	18.63(4.37)
29.3.06	28.56(5.39)	16.91(4.17)	8.55(3.01)	18.00(4.30)
5.4.06	29.06(5.44)	14.18(3.83)	5.54(2.46)	16.26(4.09)
12.4.06	25.92(5.14)	8.19(2.95)	1.79(1.51)	11.96(3.53)
20.4.06	28.99(5.43)	1.39(1.37)	0.00(0.71)	10.13(3.26)
28.4.06	28.82(5.41)	0.00(0.71)	0.00(0.71)	9.61(3.18)
6.5.06	22.01(4.74)	0.00(0.71)	0.00(0.71)	7.34(2.80)
15.5.06	20.63(4.60)	0.00(0.71)	0.00(0.71)	6.88(2.72)
22.5.06	19.79(4.50)	0.00(0.71)	0.00(0.71)	6.60(2.66)
30.5.06	16.96(4.18)	0.00(0.71)	0.00(0.71)	5.65(2.48)
Mean	**36.37(6.07)**	**25.97(5.14)**	**10.42(3.30)**	**24.25(4.98)**

influenced by the varieties. Kanaka recorded the lowest infestation on shoot and nut. Shoot, Panicle and Nut infestation was highest in Madakkathara-1 where as in Madakkathara-2, nut damage was highest compared to Anakkayam-1 and Kanaka. In the variety Anakkayam-1, the panicle infestation was moderately low (Table 7 ~~&~~ Fig. 2).

Table 7. Shoot, panicle and nut infestation on different varieties

Varieties	Mean Percentage			Mean
	Shoot	Panicle	Nut	
Anakkayam-1	29.74 (5.50)	19.08 (4.42)	8.53 (3.00)	**19.12 (4.43)**
Madakkathara-1	51.27 (7.20)	31.18 (5.63)	14.91 (3.93)	**32.45 (5.74)**
Kanaka	26.26 (5.17)	24.84 (5.03)	5.11 (2.37)	**18.74 (4.39)**
Madakkathara-2	38.21 (6.22)	28.78 (5.41)	13.13 (3.69)	**26.71 (5.22)**
Mean	**36.37 (6.07)**	**25.97 (5.14)**	**10.42 (3.30)**	**24.25 (4.98)**

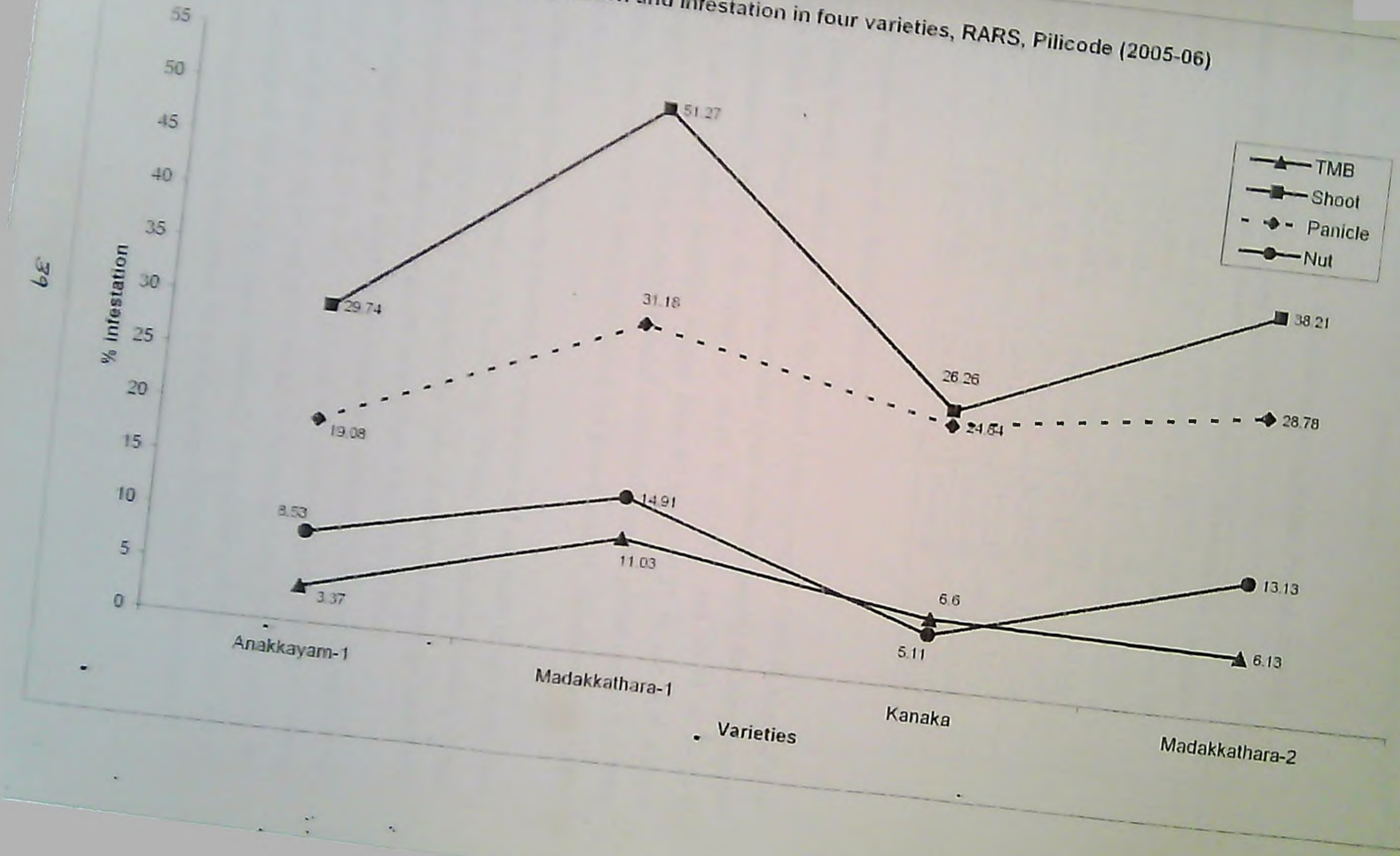
Expt. 2: Phenological phases in different varieties

The observation trees were monitored at weekly intervals and recorded the various phenological events such as flushing, flowering , nut set etc. as per the method given in part 1.

Results

In the variety Anakkayam-1, bud break started during September 2nd week and completed during September 3rd week while in Madakkathara-1, flushing started during the 2nd week of October and completed in November 1st week. Flowering was early in Anakkayam-1 and completed in November 4th week, where as in Madakkathara-1 flowering started during November 3rd week and completed in December 4th week. Nut formation and harvesting period of Anakkayam-1 was in between November 4th week and January 3rd week where as in Madakkathara-1, nut formation started during November last week and harvesting completed during February 1st week. In the variety Kanaka, flushing started during October 2nd and completed in November 2nd week. Flowering duration in Kanaka was from December 1st week to January 1st week. Flushing and flowering phases of Madakkathara-2 was comparatively late compared to all other varieties and completed during November 2nd to December 1st and

Fig. 2. TMB Population and infestation in four varieties, RARS, Pilicode (2005-06)



December 4th to January 3rd week respectively. Nut formation started during January 2nd week and the harvesting was continued till April 2nd week (Table 8).

Table 8. Phenological phases in different varieties,RARS,Pilicode-2005-06

Phenological events	Dates and duration			
	Anakkayam-1	Madakkathara-1	Madakkathara-2	Kanaka
Bud break	13-09-05 to 24-09-05	24-09-05 to 06-10-05	05-11-05 to 21-11-05	30-09-05 to 15-10-05
Flushing (0-100 %)	8-10-05 to 4-11-05	13-10-05 to 07-11-05	15-11-05 to 06-12-05	17-10-05 to 12-11-05
Panicle initiation to flowering	30-1-05 to 25-11-05	20-10-05 to 29-12-05	12-12-05 to 23-01-06	28-10-05 to 07-01-06
Nut formation	29-11-05	26-11-05	14-01-06	24-12-05
First harvest	06-01-06	14-01-06	24-02-06	09-02-06
Last harvest	21-01-06	04-02-05	13-04-06	25-02-06

Expt. 3. Weather data at the RARS, Pilicode

The mean weekly weather data for the period from September 2005 to May 2006 are presented in Table 9. During September-November (post monsoon period) the maximum and minimum temperatures were in the range of 28.19 to 31.94°C and 19.74 to 24.24°C respectively. The F.N relative humidity ranged from 87.56 to 97.27 % and A.N relative humidity ranged from 52.29 to 84.43 %. Rainfall received during the period ranged from 2.80 to 110.20 mm. Total number of rainy days during the period was 38. Sunshine hours ranged from 1.97 to 9.31 hrs

In winter season (December to February) the maximum and minimum temperatures were in the range of 31.26 to 32.97°C and 16.54 to 22.73°C. FN and A.N relative humidity ranged from 88.71 to 94.14 and 50.43 to 63.43 % respectively. Rainfall received during the period was 6.80mm. Mean sunshine hours during the period ranged from 7.46 to 10.37 hours.

During summer months (March to May) the maximum and minimum temperatures were in the range of 30.83 to 33.73 and 22.29 to 26.17°C. FN and A.N relative humidity during the season were in the range of 79.00 to 95.29 and 47.71 to 82.29 % respectively. Rainfall during the season was in the range of 1.00 to 414.80 mm respectively. Total number of rainy days was 14 days and the sunshine hours during the season were in the range of 3.70 to10.47 hrs (Table 9).

Table 9 .Weekly mean weather data at Pilicode (September 2005 to May 2006)

	WEEKLY WEATHER DATA FROM SEPTEMBER 2005 TO FEBRUARY 2006									
	TEMPERATURE (^{0}C)			RELATIVE HUMIDITY (%)			Sunshine hurs	Wind speed	Rainfall mm	Rainy days
te	Mean	Minimum	Maximum	Mean	FN	AN				
/2005 to 7/9/2005	26.05	23.04	29.06	88.21	97.29	79.14	1.97	1.39	100.40	5.00
/2005 to 14/9/05	25.71	23.24	28.19	89.86	95.29	84.43	2.39	1.01	108.80	7.00
/9/05 to 21/9/05	27.89	23.27	29.26	85.93	93.57	78.29	6.00	1.57	110.20	7.00
/9/05 to 28/9/05	26.50	23.03	29.97	81.14	91.43	70.86	9.26	1.40	14.30	4.00
/9/05 to 30/9/05	26.28	22.00	30.55	82.50	91.00	74.00	8.65	1.80	0	0
10/05 to 7/10/05	27.36	23.89	30.83	84.57	90.86	68.14	7.23	2.46	0	0
10/05 to 14/10/05	27.21	23.17	31.24	84.86	93.86	75.86	5.07	1.67	21.20	4.00
/10/05 to 21/10/05	27.34	23.53	31.14	80.64	92.86	68.43	5.17	2.30	96.60	2.00
/10/05 to 28/10/05	27.66	24.21	31.10	83.93	94.71	73.14	2.76	0.84	3.80	3.00
/10/05 to 31/10/05	27.48	23.67	31.30	82.33	95.33	69.33	4.57	0.63	10.60	3.00
11/05 to 7/11/05	27.15	23.31	30.99	84.29	95.86	72.71	5.03	1.16	55.00	3.00
11/05 to 14/11/05	27.24	23.10	31.39	79.79	92.57	67.00	6.21	0.74	48.50	1.00
/11/05 to 21/11/05	25.84	19.74	31.94	69.93	87.57	52.29	9.31	0.91	0	0
/11/05 to 28/11/05	27.70	24.24	31.16	78.07	91.86	64.29	3.24	0.60	2.80	2.00
/11/05 to 30/11/05	27.00	22.00	32.00	75.75	93.50	58.00	10.15	0.90	0	0
12/05 to 7/12/05	27.16	22.73	31.60	78.79	94.14	63.43	8.54	1.77	6.80	2.00
1205 to 14/12/05	26.61	21.57	31.64	76.36	93.14	59.57	7.46	0.79	0	0
/12/05 to 21/12/05	25.82	19.76	31.89	75.79	92.43	59.14	10.13	1.17	0	0
/12/05 to 28/12/05	25.71	20.17	31.26	73.64	88.71	58.57	9.71	1.81	0	0
/12/05 to 31/12/05	25.23	19.07	31.40	70.00	89.33	50.67	9.63	1.67	0	0
01/06 to 7/01/06	25.61	19.44	31.79	76.64	91.29	62.00	8.83	1.41	0	0
01/06 to 14/01/06	26.81	21.07	32.54	72.86	92.00	53.71	10.14	1.44	0	0
/01/06 to 21/01/06	26.32	19.76	32.89	73.64	92.86	54.43	9.99	1.61	0	0
/01/06 to 28/01/06	25.64	19.60	31.69	73.64	91.71	55.57	10.00	2.06	0	0
/01/06 to 31/01/06	25.17	18.40	31.93	73.00	92.33	53.67	10.43	1.53	0	0
02/06 to 7/02/06	25.46	18.26	32.67	72.57	92.71	52.43	10.37	1.70	0	0
2/06 to 14/02/06	24.63	16.54	32.71	70.21	90.00	50.43	9.77	1.39	0	0
2/06 to 21/2/06	26.39	20.49	32.30	75.93	91.29	60.57	9.93	1.77	0	0
2/06 to 28/02/06	26.51	20.04	32.97	71.57	90.43	52.71	10.11	2.29	0	0
/03/06 to 07/03/06	28.19	23.41	32.97	73.00	87.14	58.86	9.44	2.19	0	0
3/03/06 to 14/03/06	27.60	22.57	32.63	65.29	82.86	47.71	10.47	2.36	0	0
3/03/06 to 21/03/06	27.62	22.29	32.96	66.14	79.86	52.43	10.31	2.71	0.0	0.0
2/03/06 to 28/03/06	29.49	25.89	33.09	74.57	86.57	62.57	9.21	2.70	0.0	0.0
9/03/06 to 31/03/06	28.62	24.73	32.50	75.50	87.67	63.33	9.33	2.93	0.0	0.0
4/06 to 7/4/06	29.31	25.71	32.91	72.36	84.43	60.29	9.01	2.56	0	0
4/06 to 14/4/06	29.67	26.17	33.17	73.14	82.86	63.43	9.30	2.64	0	0
5/4/06 to 21/4/06	29.27	25.20	33.34	67.86	79.00	56.71	9.80	2.83	0	0
2/4/06 to 28/4/06	29.55	25.79	33.31	70.93	81.86	60.00	9.47	4.21	0	0
9/4/06 to 30/4/06	29.5	25.2	33.8	70.75	83	58.5	9.85	3.2	0	0
/5/06 to 7/5/06	29.43	25.40	33.46	74.50	84.14	64.86	8.31	3.67	23.0	2.0
/5/06 to 14/5/06	29.79	25.84	33.73	70.71	81.71	59.71	9.76	2.74	1.0	1.0
5/05/06 to 21/05/06	29.05	25.61	32.49	76.50	89.00	64.00	7.41	3.09	30.20	4.00
2/05/06 to 28/05/06	27.50	24.17	30.83	88.79	95.29	82.29	3.70	2.11	414.80	7.00
9/05/06 to 31/05/06	26.20	24.77	27.63	95.83	97.00	94.67	0.00	6.17	258.40	3.00

Expt. 4. Correlation studies

TMB population and damage with weather for Anakkayam-I

The weather factors such as minimum temperature, A.N. relative humidity, mean relative humidity, rainy days and rainfall showed significant negative correlation with TMB population, shoot infestation and the nut infestation in Anakkayam-1 whereas the bright sunshine hours showed a significant positive correlation. Panicle infestation also showed a similar trend except that minimum temperature which was not significant though negatively correlated (Table 10).

TMB population and damage with weather for the variety Madakkathara-I

In Madakkathara-1, TMB population and damage were significantly negatively correlated with the weather factors, minimum temperature, mean relative humidity, F.N. relative humidity, A.N. relative humidity, rainfall amount and the number of rainy days. A highly significant positive correlation was obtained for sunshine hours and maximum temperature (Table *11*).

Correlation of TMB population and damage with weather for the variety Kanaka

Population of TMB in the variety Kanaka is negatively correlated with the weather parameters - minimum temperature, mean relative humidity, F.N. relative humidity and no. of rainy days. As the rainy days and minimum temperature increases, there is a decrease in the TMB population (Table *12*

Correlation of TMB population and damage with weather for Madakkathara-2

TMB population and damage showed a highly significant positive correlation with the weather factors, maximum temperature and sunshine hours. As the duration of sunshine hours and the maximum temperature increases, TMB population also increases. Population of TMB is negatively correlated with the weather factors, minimum temperature, A.N relative humidity, rainfall amount and the number of rainy days. As the rainfall amount and the number of rainy days increases, TMB population decreases. When the relative humidity in the afternoon increases, TMB population decreases (Tables *13*

Expt. 5. Diversity and abundance of Spider fauna at the RARS, Pilicode.

Spiders were collected from cashew fields by direct observation/hand picking methods.

Table - 10

Correlation with weather in Anakkayam – 1

Weather Parameters	TMB Population	Shoot	Panicle	Nut
Minimum temperature	-.284(**)	-.254(**)	-.168	-.324(**)
Maximum temperature	.063	.013	.114	.081
Mean air temperature	-.113	-.032	.083	-.191(*)
RH % (FN)	-.093	.089	.175(*)	-.133
RH % (AN)	-.285(**)	-658(**)	-.635(**)	-.168
Mean Relative Humidity	-.407(**)	-.658(**)	-.528(**)	-.288(**)
Sunshine hours	.244(**)	.342(**)	.266(**)	.237(**)
Rainfall	-.215(*)	-.244(**)	-.208(*)	-.213(*)
Rainy days	-.304(**)	-.403(**)	-.335(**)	-289(**)
Windspeed	-.135	-.134	-.051	-.115

Correlation with weather in Mdakkathara – 1 Table - 11

Weather Parameters	TMB Population	Shoot	Panicle	Nut
Minimum temperature	-.504(**)	-.616(**)	-.665(**)	-.374(**)
Maximum temperature	.276(**)	.333(**)	.314(**)	0.151
Mean air temperature	-0.151	-.223(**)	-.374(**)	-.179(*)
RH % (FN)	-.388(**)	-375(**)	-.303(**)	-0.018
RH % (AN)	-.257(**)	-.340(**)	-.225(**)	-.399(**)
Mean Relative Humidity	-.598(**)	-.597(**)	-.375(**)	-.400(**)
Sunshine hours	.455(**)	.524(**)	.451(**)	.331(**)
Rainfall	-.406(**)	-.375(**)	-.369(**)	-272(**)
Rainy days	-.547(**)	-.591(**)	-.504(**)	-367(**)
Windspeed	-0.030	-0.002	-0.076	0.071

Correlation with weather in Kanaka – 1 - Table - 12

Weather Parameters	TMB Population	Shoot	Panicle	Nut
Minimum temperature	-.367(**)	-.261(**)	-.388(**)	-0.070
Maximum temperature	0.130	0.068	.271(**)	.180(*)
Mean air temperature	-0.129	-0.036	-0.087	0.132
RH % (FN)	-243(**)	-0.026	-0.103	0.123
RH % (AN)	-.191(*)	-.445(**)	-.421(**)	-.468(**)
Mean Relative Humidity	-.446(**)	-.472(**)	-.473(**)	-.341(**)
Sunshine hours	.320(**)	.335(**)	.399(**)	.284(**)
Rainfall	-251(**)	-.182(*)	-.297(**)	-.172(*)
Rainy days	-.389(**)	-.385(**)	-.445(**)	-.276(**)
Windspeed	-0.083	-0.034	-0.045	0.167

Correlation with weather in Madakathra – 2 - Table 13

Weather Parameters	TMB Population	Shoot	Panicle	Nut
Minimum temperature	-.362(**)	-.327(**)	-.445(**)	-.285(**)
Maximum temperature	.278(**)	.296(**)	.425(**)	.304(**)
Mean air temperature	-0.028	0.068	-0.053	0.036
RH % (FN)	-.269(**)	-.298(**)	-.461(**)	-.383(**)
RH % (AN)	-.290(**)	-.393(**)	-0.135	-0.069
Mean Relative Humidity	-.531(**)	-.638(**)	-.441(**)	-.340(**)
Sunshine hours	.431(**)	.481(**)	.556(**)	.385(**)
Rainfall	-.332(**)	-.289(**)	-.389(**)	-.236(**)
Rainy days	-.482(**)	-.531(**)	-.558(**)	-.393(**)
Windspeed	-0.017	0.080	0.101	.219(*)

Wide mouth test tubes or polythene bags were used to capture the spiders. The collected specimens were preserved in diluted iso propyl alcohol. Collection was made only from the cashew trees. The list of spider fauna observed at the RARS, Pilicode is presented in Table 14

The mean number of spiders per quadrant per tree counted at weekly intervals on different varieties is presented in Table 15. In Anakkayam-1, the highest spider population occurred during the month of January and April 2006. In Madakkathara 1 the highest population occurred during September 2005. The highest spider population was observed in the midseason variety Kanaka during September 2005 to February 2006. In Madakkathara 2, the highest spider population was observed during the month of November (Table 15). Spider population was present through out the period in all the variety selected and coincides with the occurrence of TMB. Comparatively high population of spiders was recorded in the midseason variety Kanaka, the mean number was 2.55 followed by Madakkathara -1, Madakkathara-2 and Anakkayam -1 with the mean no. of 1.53, 1.47 and 1.27 respectively(Table 15).

Table 14 List of Spiders identified at the RARS, Pilicode

SI.No.	Species	Family
01	*Oxyopes sunandae*	Oxyopidae
02	*Oxyopes swetha*	Oxyopidae
03	*Uloborus sp.*	Uloboridae
04	*Lysomanes sp.*	Lysomanidae
05	*Cyrtophora citricola*	Argiopidae
06	*Argiope anasuja*	Argiopidae
07	*Telamonia elagans*	Salticidae
08	*Hyllus diacanthes*	Salticidae
09	*Telamonia dimidiata*	Salticidae
10	*Plexippus paykully*	Salticidae

Expt. 6. Assessment of TMB population on alternative host plants

Random survey was conducted in and around the cashew plantation to locate the alternative host plants for TMB attack. Neem, Guava, Mango, Pepper, Indian gooseberry, Henna and Drumstick were available in and around cashew plantations at Pilicode. The results are presented in table 16. TMB population and damage was observed only on Guava and pepper. (Table 16).

Table 15 Population of Spiders as influenced by different periods and varieties

Mean No. of Spiders in various varieties					
Date	**Ank-1**	**Mad - 1**	**kanaka**	**Mad - 2**	**Mean**
05.09.05	2.00(1.58)	1.50(1.41)	3.50(2.00)	1.00(1.22)	**2.00**(1.58)
13.09.05	1.67(1.47)	0.00(0.71)	3.25(1.94)	0.75(1.12)	**1.42**(1.38)
23.09.05	1.33(1.35)	3.50(2.00)	2.75(1.80)	0.50(1.00)	**2.02**(1.59)
30.09.05	1.33(1.35)	0.75(1.12)	3.25(1.94)	0.00(0.71)	**1.33**(1.35)
07.10.05	1.00(1.22)	2.25(1.66)	1.25(1.32)	1.25(1.32)	**1.44**(1.39)
14.10.05	2.00(1.58)	2.00(1.58)	4.00(2.12)	1.50(1.41)	**2.38**(1.70)
21.10.05	1.67(1.47)	2.75(1.80)	3.00(1.87)	1.25(1.32)	**2.17**(1.63)
31.10.05	1.33(1.35)	1.75(1.50)	5.00(2.35)	2.00(1.58)	**2.52**(1.74)
04.11.05	1.33(1.35)	2.25(1.66)	4.00(2.12)	2.00(1.58)	**2.40**(1.70)
11.11.05	0.67(1.08)	2.50(1.73)	3.25(1.94)	0.00(0.71)	**1.61**(1.45)
18.11.05	1.67(1.47)	2.50(1.73)	3.50(2.00)	0.50(1.00)	**2.04**(1.59)
25.11.05	1.33(1.35)	0.50(1.00)	3.75(2.06)	2.75(1.80)	**2.08**(1.61)
06.12.05	1.00(1.22)	0.00(0.71)	3.50(2.00)	1.50(1.41)	**1.50**(1.41)
15.12.05	1.67(1.47)	2.00(1.58)	1.75(1.50)	2.25(1.66)	**1.92**(1.55)
23.12.05	0.67(1.08)	0.50(1.00)	3.75(2.06)	1.75(1.50)	**1.67**(1.47)
30.12.05	1.00(1.22)	2.00(1.58)	4.00(2.12)	1.00(1.22)	**2.00**(1.58)
06.01.06	3.00(1.87)	1.50(1.41)	2.25(1.66)	1.25(1.32)	**2.00**(1.58)
13.01.06	0.33(0.91)	1.75(1.50)	5.00(2.35)	1.00(1.22)	**2.02**(1.59)
20.01.06	2.33(1.68)	1.00(1.22)	3.50(2.00)	2.50(1.73)	**2.33**(1.68)
27.01.06	0.67(1.08)	1.25(1.32)	4.25(2.18)	1.25(1.32)	**1.86**(1.53)
03.02.06	0.67(1.08)	0.75(1.12)	5.75(2.50)	2.00(1.58)	**2.29**(1.67)
10.02.06	0.00(0.71)	3.75(2.06)	4.25(2.18)	1.75(1.50)	**2.44**(1.71)
17.02.06	0.67(1.08)	2.00(1.58)	2.25(1.66)	1.00(1.22)	**1.48**(1.41)
24.02.06	1.33(1.35)	1.25(1.32)	1.75(1.50)	2.50(1.73)	**1.71**(1.49)
01.03.06	1.33(1.35)	1.50(1.41)	1.25(1.32)	1.25(1.32)	**1.33**(1.35)
08.03.06	1.33(1.35)	1.25(1.32)	1.25(1.32)	1.00(1.22)	**1.21**(1.31)
15.03.06	1.33(1.35)	1.25(1.32)	1.00(1.22)	2.25(1.660	**1.46**(1.40)
22.03.06	1.33(1.35)	1.25(1.32)	1.00(1.22)	2.00(1.58)	**1.40**(1.38)
29.03.06	1.67(1.47)	1.00(1.22)	1.00(1.22)	1.25(1.32)	**1.23**(1.32)
05.04.06	0.67(1.08)	1.50(1.41)	1.00(1.22)	1.00(1.22)	**1.04**(1.24)
12.04.06	2.33(1.68)	1.25(1.32)	0.50(1.00)	1.25(1.32)	**1.33**(1.35)
20.04.06	0.67(1.08)	1.00(1.22)	2.00(1.58)	1.75(1.50)	**1.36**(1.36)
28.04.06	2.00(1.58)	1.00(1.22)	1.00(1.22)	2.50(1.73)	**1.63**(1.46)
06.05.06	1.00(1.22)	1.75(1.50)	0.75(1.12)	2.25(1.66)	**1.44**(1.39)
15.05.06	1.33(1.35)	1.25(1.32)	0.25(0.87)	1.75(1.50)	**1.15**(1.28)
22.05.06	0.67(1.08)	1.00(1.22)	0.75(1.12)	1.75(1.50)	**1.04**(1.24)
30.05.06	0.67(1.08)	1.75(1.50)	0.00 (0.71)	1.25(1.32)	**0.92**(1.19)
Mean	**1.27(1.33)**	**1.53(1.43)**	**2.55(1.77)**	**1.47(1.40)**	**1.71(1.49)**

Table. 16 TMB Population and damage on alternative host plants during off season.

Crop	Period of Observation	No. of trees observed	TMB population and damage	Remarks
Neem (*Azadirachta indica*)	April, May, June, July ,August	10	No nymphs or adults of TMB and no symptom.	New flushes were available
Guava (*Psidium guajava*)		8	Adult TMB observed	New flushes and shoots attacked by TMB during 3rd week of April 2006.
Mango (*Mangifera indica*)		15	No nymphs or adults of TMB and no symptom.	New flushes were available
Pepper (*Piper nigrum*)		5	Adult TMB observed	New flushes attacked by TMB during last week of February and 1st week of May 2006.
Indian gooseberry (*Emblica officinalis*)		5	No nymphs or adults of TMB and no symptom.	New flushes were available
Henna (*Lawsonia inermis*)		5	No nymphs or adults of TMB , no symptom.	New flushes were available
Drumstick (*Moringa oleifera*)		8	No nymphs or adults of TMB no symptom.	New flushes were available

Regional Fruit Research Station, Vengurle, Dist. Sindhudurg (Maharashtra)

(Dr. B.S. Konkan Krishi Vidyapeeth Dapoli)

Annual Report of the scheme

"FOREWARNING TEA MOSQUITO BUG IN CASHEW "

From September, 2005 to July, 2006

Submitted to : **College of Horticulture, Vellanikkara, Thrissur, Kerala**
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RFRS, VENGURLE

ANNUAL REPORT OF THE ICAR AD-HOC SCHEME

"FOREWARNING TEA MOSQUITO BUG IN CASHEW" (Sept. 2005 to Aug. 2006)

Expt . 1 Seasonal occurrence of tea mosquito population and damage.

Experiments were conducted at the Regional Fruit Research Station, Vengurle, to assess the TMB population and the intensity of damage on shoot, panicle and nut of early, mid and late season varieties. Cashew trees at the age of 12 years were selected from the plots. Under each category i.e. early, mid season and late season, ten trees were selected.

The following varieties were selected for the studies.

Early	Vengurla – 1	No. of plants = 10
Mid season	Vengurla – 4, Vengurla – 6	No. of plants = 05 of each
Late season	Vengurla – 7, Vengurla – 8	No. of plants = 05 of each

Observations on TMB population and damage were recorded at weekly intervals. A metallic frame of 1 m^2 was placed on the four sides of the tree canopy and then the total number of flushing shoots, panicles and nuts inside the frame were counted and labeled. Observations were taken from all the four quadrants of the same tree. The number of TMB affected shoots, panicles and nuts present in each quadrant was counted, recorded and estimated the percentage of damage. Intensity of TMB damage was rated on the following scale.

0 - No necrotic lesions/streaks.

1 – 1 to 3 necrotic lesions – general vigour of flushes unaffected.

2 - 4 to 6 coalescing or non – coalescing lesions/streaks – general vigour of flushes affected

3 - above 6 coalescing or non-coalescing lesions/streaks – general vigour of flushes affected.

4 - lesions or streaks confluent and drying of affected parts.

The number of adults and nymphs of TMB present on each quadrant was recorded at weekly intervals from all the four quadrants and presented as the mean number/quadrant/tree

RESULTS

TMB Population

The seasonal occurrence of TMB on mature trees for one year during September 2005 to July 2006 on different varieties is presented in Table 1. The data were subjected to square root transformation before analysis. The weekly observations on TMB population were recorded from all the five varieties. For the convenience in presenting the results for 12 months, the data on TMB population and damage are given as fortnightly data with the mean values of two weeks.

Table 1. TMB Population on mature plants (September 2005 to July, 2006)

Periods	V-1	V-4	V-6	V-7	V-8	Mean
Sept. 2005. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Sept. II	0.000 (0.707)	0.100 (0.775)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.020 (0.721)
Oct. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Oct. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Nov. I	0.000 (0.707)	0.225 (0.851)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.045 (0.736)
Nov. II	0.100 (0.775)	0.133 (0.796)	0.000 (0.707)	0.017 (0.719)	0.100 (0.775)	0.070 (0.754)
Dec. I	0.075 (0.758)	0.950 (1.204)	0.075 (0.758)	0.075 (0.758)	0.350 (0.922)	0.305 (0.880)
Dec. II	0.025 (0.725)	0.175 (0.822)	0.050 (0.742)	0.050 (0.742)	0.375 (0.935)	0.135 (0.793)
Jan. 2006 I	0.025 (0.725)	0.000 (0.707)	0.000 (0.707)	0.025 (0.725)	0.000 (0.707)	0.010 (0.714)
Jan. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.017 (0.719)	0.033 (0.730)	0.010 (0.714)
Feb. I	0.138 (0.799)	0.100 (0.775)	0.000 (0.707)	0.025 (0.725)	0.150 (0.806)	0.083 (0.762)
Feb. II	0.150 (0.806)	0.175 (0.822)	0.125 (0.791)	0.100 (0.775)	0.100 (0.775)	0.130 (0.794)
Mar. I	0.063 (0.750)	0.150 (0.806)	0.200 (0.837)	0.425 (0.962)	0.375 (0.935)	0.243 (0.858)
Mar. II	0.000 (0.707)	0.067 (0.753)	0.350 (0.922)	0.125 (0.791)	0.200 (0.837)	0.148 (0.802)
Apr. I	0.000 (0.707)	0.000 (0.707)	0.025 (0.725)	0.000 (0.707)	0.000 (0.707)	0.005 (0.711)
Apr. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
May I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
May II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
June I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
June II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
July I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
July II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Mean.	**0.026 (0.243)**	**0.090 (0.345)**	**0.038 (0.217)**	**0.039 (0.314)**	**0.077 (0.305)**	

Figures in parentheses denote square root transformation. ($\sqrt{x+0.5}$ values). CD values for varieties- 0.0728, weeks-0.1784, interaction-0.3568

Table 1. TMB Population on mature plants (September 2005 to July, 2006)

Periods	V-1	V-4	V-6	V-7	V-8	Mean
Sept. 2005. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Sept. II	0.000 (0.707)	0.100 (0.775)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.020 (0.721)
Oct. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Oct. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Nov. I	0.000 (0.707)	0.225 (0.851)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.045 (0.736)
Nov. II	0.100 (0.775)	0.133 (0.796)	0.000 (0.707)	0.017 (0.719)	0.100 (0.775)	0.070 (0.754)
Dec. I	0.075 (0.758)	0.950 (1.204)	0.075 (0.758)	0.075 (0.758)	0.350 (0.922)	0.305 (0.880)
Dec. II	0.025 (0.725)	0.175 (0.822)	0.050 (0.742)	0.050 (0.742)	0.375 (0.935)	0.135 (0.793)
Jan. 2006 I	0.025 (0.725)	0.000 (0.707)	0.000 (0.707)	0.025 (0.725)	0.000 (0.707)	0.010 (0.714)
Jan. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.017 (0.719)	0.033 (0.730)	0.010 (0.714)
Feb. I	0.138 (0.799)	0.100 (0.775)	0.000 (0.707)	0.025 (0.725)	0.150 (0.806)	0.083 (0.762)
Feb. II	0.150 (0.806)	0.175 (0.822)	0.125 (0.791)	0.100 (0.775)	0.100 (0.775)	0.130 (0.794)
Mar. I	0.063 (0.750)	0.150 (0.806)	0.200 (0.837)	0.425 (0.962)	0.375 (0.935)	0.243 (0.858)
Mar. II	0.000 (0.707)	0.067 (0.753)	0.350 (0.922)	0.125 (0.791)	0.200 (0.837)	0.148 (0.802)
Apr. I	0.000 (0.707)	0.000 (0.707)	0.025 (0.725)	0.000 (0.707)	0.000 (0.707)	0.005 (0.711)
Apr. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
May I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
May II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
June I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
June II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
July I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
July II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Mean.	**0.026 (0.243)**	**0.090 (0.345)**	**0.038 (0.217)**	**0.039 (0.314)**	**0.077 (0.305)**	

Figures in parentheses denote square root transformation. ($\sqrt{x+0.5}$ values). CD values for varieties- 0.0728, weeks-0.1784, interaction-0.3568

AT RFRS, Vengurle, during the period under study, TMB population was noticed from II fortnight of September. In the variety Vengurla – 1, the maximum TMB population was observed during II fortnight of February with a mean population of 0.150. The TMB population was started from II fortnight of November with a mean population of 0.100 and continued upto I fortnight of March. In case of V –4, TMB population was started from II fortnight of September with a mean no. of 0.100 no. and reached peak (0.950)during I fortnight of December. In V–6, the TMB population started from I fortnight of December with a mean of 0.075 and reached maximum during II fortnight of March (0.350) and the infestation continued upto I fortnight of April. In V–7, the TMB population was started from II fortnight of November with a mean of 0.017 and reached a peak of 0.425 during I fortnight of March and continued upto II fortnight of March. In V–8, TMB population reached maximum during II fortnight of December and again in I fortnight of March with a mean value of 0.375. The maximum TMB population was observed during I fortnight of December followed by I fortnight of March. Irrespective of periods, the TMB population was highest in V – 4 followed by V-8 and V-7.

Damage Intensity

Observations were recorded on the extent of TMB damage on shoots, panicles and nuts separately on early, mid and late varieties and the data are presented in Tables 2 to 4. & Fig. 1

Shoot infestation -

The shoot damage due to TMB was noticed throughout the year except June and July. However, the extent of shoot infestation was very low (<5%) in all early, mid and late season varieties (Table 2). In V–1, shoot infestation started during the II fortnight of November with a mean infestation of 0.023 per cent and reached maximum during I fortnight of December, with a mean infestation of 0.100 per cent. In V– 4, shoot infestation started during the II fortnight of September with a mean infestation of 0.080 per cent and reached 1.217 % during I fortnight of January. In V–6, shoot infestation started during I fortnight of February with a mean of 0.589 % which reached maximum of 0.851 % during II fortnight of February. In V–7, which is the late season variety, the shoot infestation started during II fortnight of December with a mean infestation of 0.043 per cent and reached maximum during I fortnight of January (0.108 %). In V–8, another late season variety, the shoot infestation was initiated from II fortnight of November and reached maximum during II fortnight of January (0.239 %).

Panicle Infestation -

Panicle infestation was started from II fortnight of November and reached its peak during II fortnight of January and continued upto II fortnight of March. Maximum panicle

infestation was observed in V– 4 during I fortnight of January with a mean infestation of 7.862 per cent. In V–1, the panicle infestation was started from II fortnight of November (0.390 %) which reached its peak during II fortnight of January with a mean infestation of 5.238 %. In V–6 and 7 the panicle infestation was started during II fortnight of November. (Table 3)

Nut infestation -

The nut infestation was observed during December to March with maximum infestation during II fortnight of March (6.810 %). The maximum nut infestation was observed in V–8 during II fortnight of March with a mean infestation of 8.773 % followed by 8.326 % in V– 7 during II fortnight of March and in V – 6 with mean infestation of 8.120 % during II fortnight of March. In V–1, the nut infestation started from II fortnight of January with a mean infestation of 0.108 % which reached its peak during II fortnight of March (6.014 %). In V–4, the nut infestation was observed from II fortnight of December with a mean infestation of 2.500 % which reached the maximum of 6.190 % during II fortnight of March. Irrespective of periods, maximum nut infestation was observed in V–4 with 1.112 % followed by V–7 and V–8 with 1.098 and 1.029 % respectively (Table 4).

Tea mosquito damage as influenced by varieties.

The varietal influence on TMB damage on shoot, panicle and nuts is depicted in Fig.1. The overall infestation was highest on panicle and nuts as compared to the shoots. Among the five varieties, the mid season variety V-4 was highly susceptible with highest damage on shoot, panicle and nuts. The damage was lowest in the early variety V-1. Except in V-7, all other varieties have recorded high damage on panicle as compared to shoots and nuts.

Expt . 2 Phenological phases in different varieties at RFRS, Vengurle

Trees were monitored at weekly interval and recorded the following events separately on all the five varieties.

Date of bud break
Date of flushing (0-25%, > 25-50%, >50-100%)
Date of panicle initiation (0-25%, >25-50%, >50-100%)
Flowering (0-25%, >25-50%, >50-100%)
Date of start of harvest
Date of completion of harvest
Off season flushing

The whole tree canopy architecture was considered as a circle, which can be divided into four equal sectors (quadrants) each sector comprising of 25 per cent canopy area. Visual

Fig. 1 : Varietal influnce on per cent shoot, panicle and nut infestation

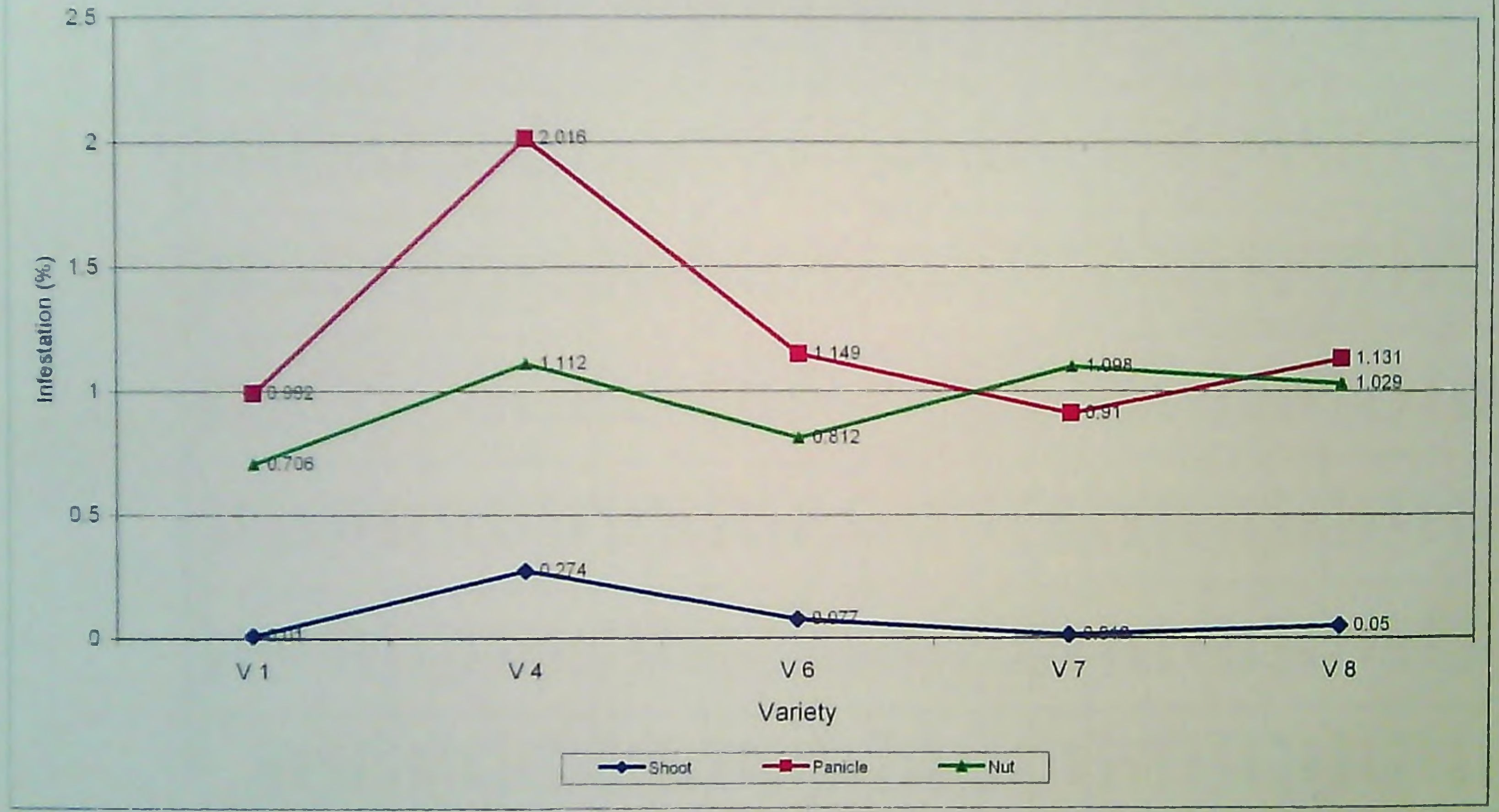


Table 2 Per cent shoot infestation on mature plants.

Month/Periods	V-1	V-4	V-6	V-7	V-8	Mean
Sept. 2005. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Sept. II	0.007 (0.712)	0.080 (0.762)	0.013 (0.716)	0.000 (0.707)	0.000 (0.707)	0.016 (0.718)
Oct. I	0.000 (0.707)	0.268 (0.876)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.054 (0.741)
Oct. II	0.000 (0.707)	0.401 (0.949)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.080 (0.755)
Nov. I	0.023 (0.723)	0.407 (0.952)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.086 (0.759)
Nov. II	0.090 (0.768)	0.618 (1.057)	0.000 (0.707)	0.000 (0.707)	0.092 (0.769)	0.160 (0.802)
Dec. I	0.100 (0.775)	0.856 (1.165)	0.000 (0.707)	0.000 (0.707)	0.168 (0.817)	0.225 (0.834)
Dec. II	0.000 (0.707)	1.116 (1.271)	0.000 (0.707)	0.043 (0.737)	0.180 (0.825)	0.268 (0.849)
Jan. 2006 I	0.000 (0.707)	1.217 (1.310)	0.000 (0.707)	0.108 (0.780)	0.130 (0.794)	0.291 (0.860)
Jan. II	0.000 (0.707)	0.887 (1.178)	0.000 (0.707)	0.100 (0.775)	0.239 (0.860)	0.245 (0.845)
Feb. I	0.000 (0.707)	0.185 (0.828)	0.589 (1.044)	0.000 (0.707)	0.000 (0.707)	0.155 (0.798)
Feb. II	0.000 (0.707)	0.000 (0.707)	0.851 (1.162)	0.000 (0.707)	0.000 (0.707)	0.170 (0.798)
Mar. I	0.000 (0.707)	0.000 (0.707)	0.263 (0.873)	0.000 (0.707)	0.000 (0.707)	0.061 (0.746)
Mar. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Apr. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Apr. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.071 (0.755)	0.014 (0.717)
May I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.112 (0.782)	0.022 (0.722)
May II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.054 (0.744)	0.011 (0.714)
June I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
June II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.707 (0.000)	0.000 (0.707)	0.000 (0.707)
July I	0.000 (0.707)	0.640 (1.068)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
July II	0.000 (0.707)	0.488 (0.994)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Mean.	**0.010 (0.714)**	**0.274 (0.856)**	**0.077 (0.751)**	**0.013 (0.715)**	**0.050 (0.740)**	

Figures in parentheses denote square root transformation ($\sqrt{x+0.5}$ values). CD values for varieties- 0.0226 weeks-0.0553, interaction-0.1105

Table 3 : Per cent Panicle infestation on mature plants

Month/Periods	V-1	V-4	V-6	V-7	V-8	Mean
Sept. 2005. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Sept. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Oct. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Oct. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Nov. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Nov. II	0.390 (0.943)	1.071 (1.253)	0.150 (0.806)	0.047 (0.740)	0.077 (0.760)	0.347 (0.900)
Dec. I	1.288 (1.337)	3.593 (2.023)	0.690 (1.091)	0.227 (0.853)	1.009 (1.228)	1.361 (1.306)
Dec. II	2.027 (1.590)	6.811 (2.704)	1.506 (1.416)	1.167 (1.291)	2.729 (1.797)	2.848 (1.760)
Jan. 2006 I	3.909 (2.098)	7.862 (2.892)	3.534 (2.008)	2.289 (1.670)	4.740 (2.289)	4.467 (2.191)
Jan. II	5.238 (2.425)	6.521 (2.650)	4.447 (2.224)	2.550 (1.746)	4.993 (2.344)	4.745 (2.278)
Feb. I	3.664 (2.041)	5.401 (2.430)	5.157 (2.378)	2.890 (1.841)	4.535 (2.244)	4.329 (2.187)
Feb. II	3.034 (1.879)	7.485 (2.826)	4.095 (2.114)	3.956 (2.111)	3.614 (2.028)	4.437 (2.158)
Mar. I	2.040 (1.594)	5.601 (2.470)	3.501 (2.000)	5.300 (2.408)	2.646 (1.774)	3.818 (2.030)
Mar. II	0.244 (0.863)	0.000 (0.707)	2.194 (.641)	1.585 (1.444)	0.541 (1.020)	0.913 (1.135)
Apr. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Apr. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
May I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
May II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
June I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
June II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
July I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
July II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Mean.	**0.992 (1.080)**	**2.016 (1.325)**	**1.149 (1.132)**	**0.910 (1.059)**	**1.131 (1.122)**	

Figures in parentheses denote square root transformation . ($\sqrt{x+0.5}$ values). CD values for varieties- 0.0775, weeks-0.1897, interaction-0.3794

Table 4. Per cent nut infestation on mature plants (September, 2005 to July, 2006)

Month/Periods	V-1	V-4	V-6	V-7	V-8	Mean
Sept. 2005 I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Sept. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Oct. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Oct. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Nov. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Nov. II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Dec. I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Dec. II	0.000 (0.707)	2.500 (1.732)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.500 (0.912)
Jan. 2006 I	0.000 (0.707)	5.000 (2.345)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	1.000 (1.035)
Jan. II	0.108 (0.780)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.022 (0.722)
Feb. I	1.836 (1.528)	0.084 (0.764)	0.076 (0.759)	0.000 (0.707)	0.417 (0.958)	0.483 (0.943)
Feb. II	4.942 (2.333)	2.130 (1.622)	0.831 (1.154)	1.357 (1.363)	3.246 (1.935)	2.501 (1.681)
Mar. I	6.014 (2.552)	5.372 (2.423)	3.389 (1.972)	4.230 (2.175)	6.304 (2.608)	5.062 (2.346)
Mar. II	2.639 (1.772)	6.190 (2.587)	8.120 (2.963)	8.326 (2.971)	8.773 (3.045)	6.810 (2.662)
Apr. I	0.000 (0.707)	3.188 (1.920)	4.415 (2.217)	7.750 (2.872)	3.545 (2.011)	3.780 (1.945)
Apr. II	0.000 (0.707)	0.000 (0.707)	1.042 (1.242)	2.500 (1.732)	0.357 (0.926)	0.780 (1.063)
May I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
May II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
June I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
June II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
July I	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
July II	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)
Mean	**0.706 (0.954)**	**1.112 (1.091)**	**0.812 (0.981)**	**1.098 (1.052)**	**1.029 (1.036)**	

Figures in parentheses denote square root transformation ($\sqrt{x+0.5}$ values). CD values for varieties- 0.0834, weeks-0.2043, interaction-0.4085

assessment was done on the extent of flushing and flowering on all the observation trees and recorded as 25, 50 and 100 per cent.

Results

The details on the time of flushing initiation, the extent and progression in the phenological events such as flowering, nut formation, harvest and off season flushing etc. were observed on all the five selected varieties and are presented in Table 5 and Fig. 2. As compared to the early variety, V-1 and mid season variety, V-4, the panicle initiation to flowering was late and extended up to January and February.

Table : 5 Phenological phases in different varieties (Age : 13 Years)

Phenological events	Dates and duration in different varieties				
	V-1	V-4	V-6	V-7	V-8
Bud Break	24-10-05	26-10-05	02-11-05	02-11-05	02-11-05
Flushing (0 to 100%)	31-10-05 to 28-11-05	02-11-05 to 23-11-05	09-11-05 to 30-11-05	08-11-05 to 29-11-05	08-11-05 to 29-11-05
Panicle initiation to Flowering	21-11-05 to 19-12-05	16-11-05 to 28-12-05	23-11-05 to 25-01-06	22-11-05 to 31-01-06	22-11-05 to 07-02-06
Nut formation	09-01-06	21-12-05	18-01-06	24-01-06	31-01-06
First harvest	06-02-06	04-01-06	22-02-06	28-02-06	28-02-06
Last harvest	24-04-06	26-04-06	04-05-06	11-04-06	09-05-06
Off season flushing	26-06-06	-	-	-	-

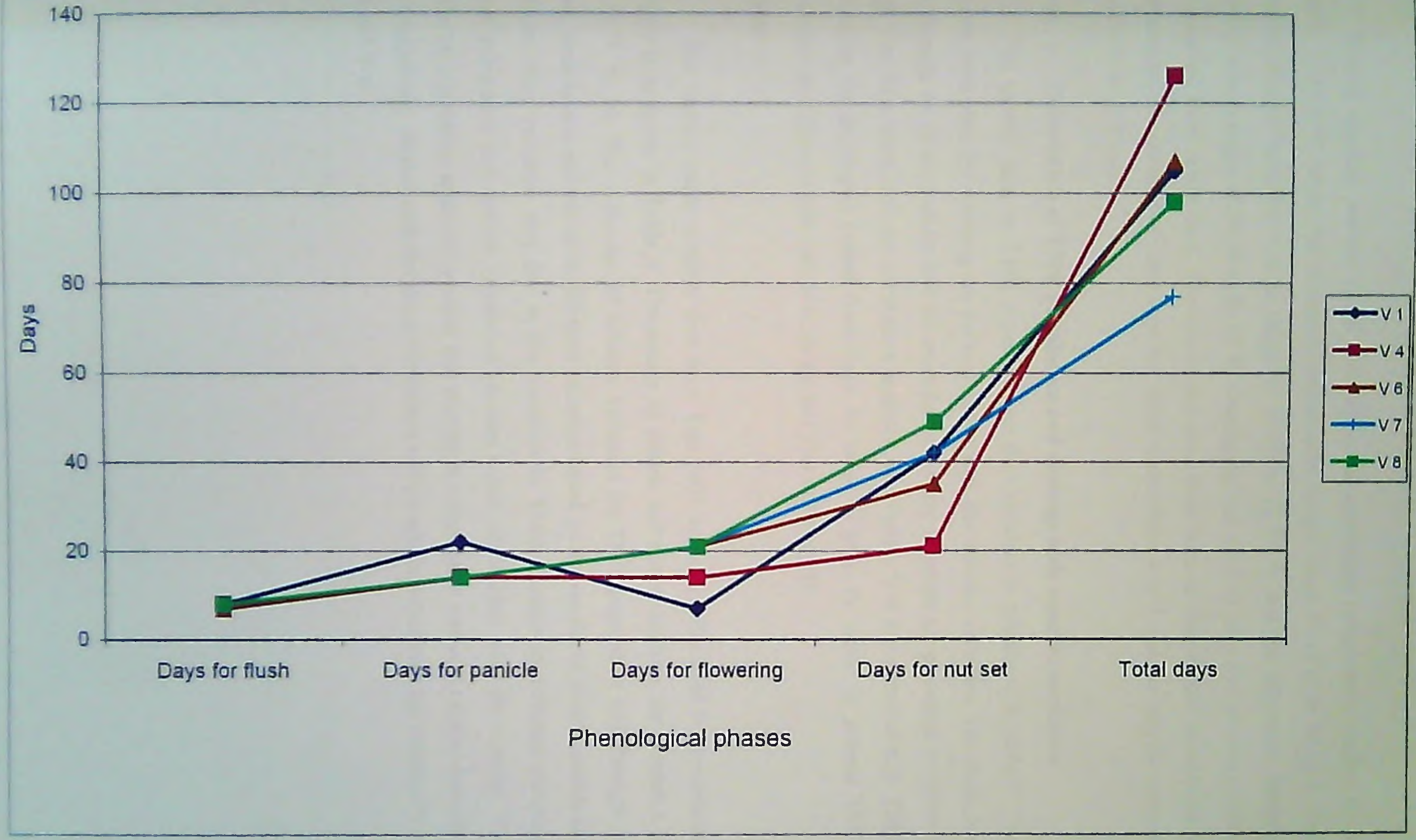
Expt . 3 Weather data at RFRS, Vengurle (September, 2005 to July, 2006)

The weather parameters viz., maximum temperature, minimum temperature, FN relative humidity, AN relative humidity, sunshine hours, Rainy days and Rainfall amount prevailed in the experimental sites were recorded daily. The mean weekly weather data for the period from September, 2005 to July, 2006 are presented in Table 6; Fig 3 & 4.

During October – November (Post monsoon period) the maximum and minimum temperatures were in the range of 31.30 ^{0}C to 34.12 ^{0}C and 17.80 ^{0}C to 24.89 ^{0}C, respectively. The forenoon and afternoon relative humidity ranged from 78.14 to 90.71% and 53.86 to 77.29 % respectively. The rainfall was zero during this period.

During winter and post winter season (December to March), 10.00 mm rainfall was received in one day in first week of March. The temperature ranged from 31.28^{0}C to 34.39^{0}C

Fig. 2 : Phenological phases of mature plants



(maximum) and 15.37^{0}C to 23.29^{0}C (minimum). The forenoon and afternoon relative humidity was varied from 72.00 to 92.43 % and 42.29 to 70.42 % respectively.

During summer months (April and May), the maximum temperature ranged from 30.00^{0}C to 33.57^{0}C while the minimum temperature ranged from 21.10^{0}C to 27.15^{0}C The forenoon relative humidity was in range of 76.00 to 92.57 % and the afternoon relative humidity was in range of 59.50 to 86.57 %. During the last week of May 591.00 mm rainfall was received from seven days. The monsoon period from June to August had received rain continuously, the number of rainy days per week varied from 4 to 7 and the rainfall amount from 14.60 to 218 mm.

Expt . 4 Correlation of TMB population and damage with weather variables

The weekly data on TMB population on five varieties is presented in table-7. The data has been used for working out the correlation with the weather variables. The mean per cent damage on shoot, panicle and nut recorded at weekly intervals are presented in tables 7 to 8 The data were used for correlation analysis. The variety V-4 has recorded high TMB population for prolonged period from Sept. IV week to Mar. IV week. In general TMB population and damage was very low during this year at Vengurla.

Results

The weekly mean weather data from Sept.2005 to April 2006 used for correlation analysis is as given in Table 6. The results of simple correlation analysis are presented in tables 9 to 10. The influence of weather variables on TMB population and damage on shoot, panicle and nut varied in different varieties based on the results of simple correlation analysis. This variation was due to the variation in TMB damage in different varieties. Shoot infestation and panicle infestation showed some relationship with the weather. The results of correlation analysis revealed that minimum temperature and A.N relative humidity were negatively related with the shoot infestation and panicle infestation in the varieties V-1, V-4 and V-6.

Table 6: Meteorological data from September, 2005 to July, 2006 (RFRS, Vengurle)

Month	Week No.	Air Temperature (^{0}C)		Relative Humidity (%)		Rainfall	No. of rainy days	Sunshine hrs
		Max.	Min.	Forenoon	Afternoon			
Sept.,05	1(36)	29.90	24.83	91.14	86.43	218.80	03	0.71
	2(37)	29.78	24.87	91.71	85.00	80.00	07	3.44
	3(38)	28.93	25.06	90.00	85.87	253.20	05	2.13
	4(39)	30.24	23.89	92.29	74.14	19.20	01	6.29
Oct. 05	1(40)	31.30	24.23	89.86	69.71	0.00	00	7.64
	2(41)	33.14	24.45	88.00	76.14	0.00	00	5.60
	3(42)	31.73	24.91	90.71	77.29	0.00	00	7.40
	4(43)	32.66	24.89	86.00	63.86	0.00	00	8.20
	5(44)	32.45	22.66	87.00	63.86	0.00	00	7.54
Nov. 05	1(45)	34.12	19.58	78.14	55.00	0.00	00	9.44
	2(46)	33.79	17.80	82.71	56.14	0.00	00	9.83
	3(47)	34.10	19.56	83.29	53.86	0.00	00	8.94
	4(48)	32.91	21.25	87.71	63.71	0.00	00	5.76
Dec. 05	1(49)	34.24	21.06	83.86	66.71	3.00	01	8.63
	2(50)	33.13	17.60	87.00	56.43	0.00	00	9.11
	3(51)	32.11	16.37	87.86	48.86	0.00	00	9.60
	4(52)	32.28	16.31	88.00	58.25	0.00	00	9.13
Jan, 06	1(01)	32.82	16.27	89.29	55.86	0.00	00	9.14
	2(02)	34.39	19.11	92.43	55.71	0.00	00	8.60
	3(03)	34.17	18.52	90.14	56.43	0.00	00	9.34
	4(04)	33.16	17.62	72.00	42.29	0.00	00	9.81
	5(05)	34.07	15.37	83.57	49.86	0.00	00	10.03
Feb.06	1(06)	34.16	15.89	87.00	48.14	0.00	00	10.10
	2(07)	32.53	17.80	85.57	59.71	0.00	00	9.90
	3(08)	32.98	21.44	89.14	68.43	0.00	00	9.50
	4(09)	31.51	21.56	89.71	70.42	0.00	00	8.31
Mar.06	1(10)	31.97	19.54	84.86	53.50	10.00	01	9.64
	2(11)	31.28	20.78	83.57	64.57	0.00	00	9.56
	3(12)	32.55	22.86	86.00	68.86	0.00	00	8.59

	4(13)	32.23	23.29	82.29	68.71	0.00	00	8.51
Apr.06	1(14)	32.40	21.10	83.20	59.50	0.00	00	9.23
	2(15)	31.80	22.80	80.20	68.10	0.00	00	9.53
	3(16)	32.20	23.60	76.50	63.80	0.00	00	9.79
	4(17)	30.00	23.80	76.50	60.40	0.00	00	9.49
May.06	1 (18)	32.60	25.70	76.00	68.40	0.00	00	8.07
	2(19)	32.71	26.88	78.71	67.00	0.00	00	6.77
	3(20)	33.57	27.15	76. 14	64.71	0.00	00	10.29
	4(21)	33.18	26.65	79.57	68.85	0.00	00	8.76
	5(22)	30.15	25.26	92.57	86.57	591.00	07	1.80
Jun.06	1(23)	31.50	24.99	91.29	75.71	78.20	07	4.57
	2(24)	31.51	25.95	82.43	73.57	14.60	04	7.39
	3(25)	31.59	25.47	88.85	80.85	91.00	07	4.60
	4(26)	29.45	25.76	86.14	86.28	218.00	07	0.50
Jul.06	1(27)	29.61	25.73	86.71	83.86	170.80	07	0.41
	2(28)	30.76	26.39	85.43	76.14	44.20	06	3.04
	3(29)	30.59	25.54	83.14	83.86	95.60	07	1.73
	4(30)	30.36	24.97	86.00	81.29	196.20	07	1.54
	5(31)	29.42	24.97	84.57	82.14	112.80	07	1.33

Fig. 3 : Weather data at RFRS, Vengurle

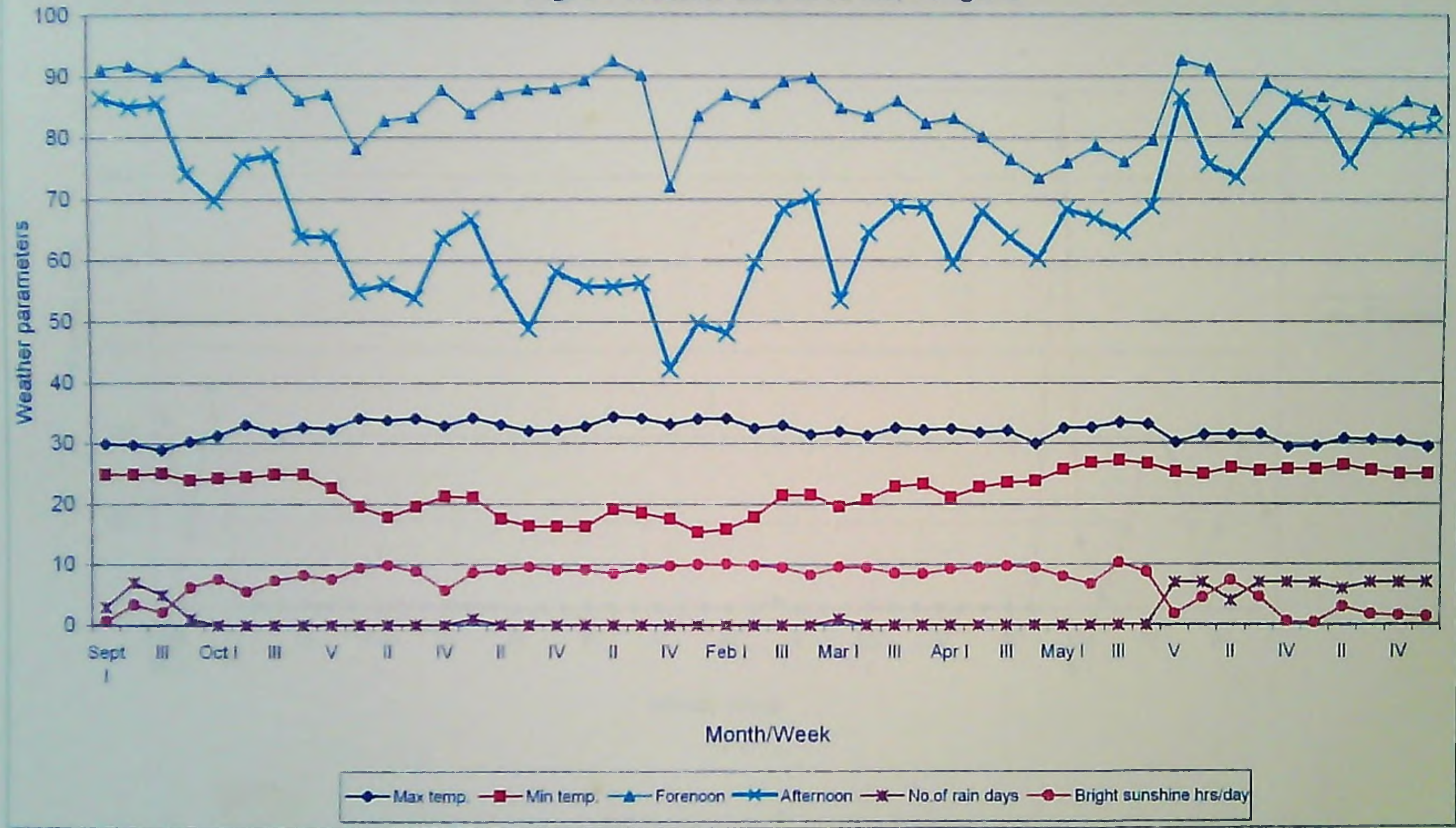


Fig. 4 : Rainfall at RFRS, Vengurle

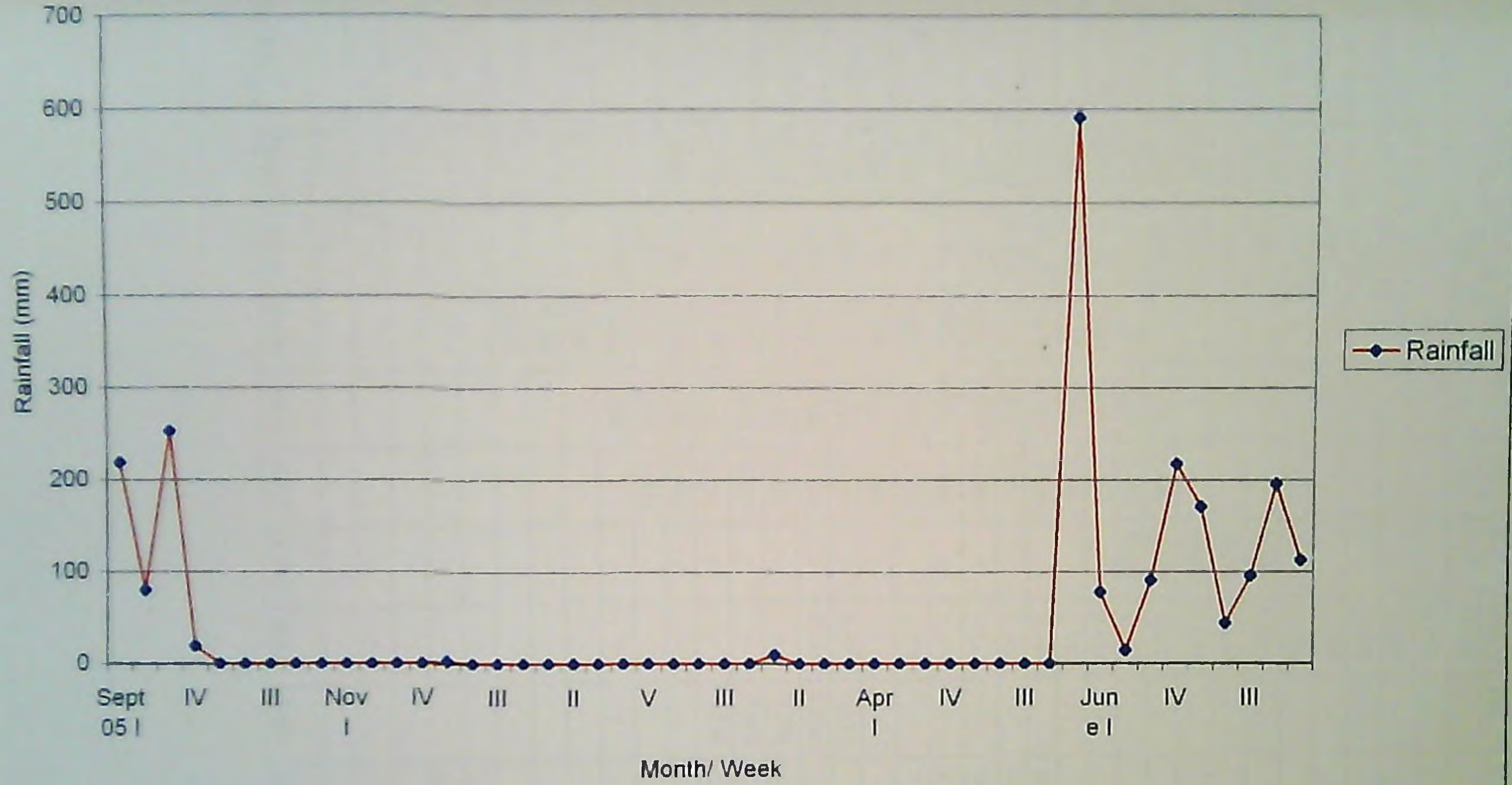


Table 7. Weekly TMB Population & Shoot Infestation on Mature Plants

Period	TMB Population in five varieties					TMB Shoot infestation (%)				
	V-1	V-4	V-6	V-7	V-8	V-1	V-4	V-6	V-7	V-8
Sept IV	-	0.200	-	-	-	-	0.160	-	-	-
Oct I	-	0.000	-	-	-	-	0.242	-	-	-
Oct II	-	0.000	-	-	-	-	0.294	-	-	-
Oct III	-	0.000	-	-	-	-	0.375	-	-	-
Oct IV	-	0.000	-	-	-	-	0.427	-	-	-
Nov I	-	0.450	-	-	-	-	0.466	-	-	-
Nov II	-	0.000	-	-	-	0.045	0.347	-	-	-
Nov III	0.100	0.050	-	-	-	0.072	0.387	-	-	0.060
Nov IV	0.050	0.100	-	-	-	0.090	0.634	-	-	0.079
Nov V	0.150	0.250	-	0.050	0.300	0.109	0.832	-	-	0.138
Dec I	0.050	1.700	0.150	0.100	0.450	0.126	0.901	-	-	0.138
Dec II	0.100	0.200	0.000	0.050	0.250	0.074	0.810	-	-	0.198
Dec III	0.000	0.200	0.100	0.000	0.250	-	1.110	-	-	0.120
Dec IV	0.050	0.150	0.000	0.100	0.500	-	1.122	-	0.086	0.240
Jan I	0.025	0.000	0.000	0.000	0.000	-	1.308	-	0.086	0.080
Jan II	0.025	0.000	0.000	0.050	0.000	-	1.125	-	0.129	0.179
Jan III	0.000	0.000	0.000	0.050	0.000	-	1.194	-	0.129	0.199
Jan IV	0.000	0.000	0.000	0.000	0.100	-	0.579	-	0.172	0.279
Jan V	0.000	0.000	0.000	0.000	0.000	-	-	-	-	0.240
Feb I	0.075	0.050	0.000	0.050	0.150	-	0.270	0.524	-	0.242
Feb II	0.200	0.150	0.000	0.000	0.150	-	0.099	0.654	-	0.102
Feb III	0.100	0.150	0.000	0.000	0.100	-	-	0.786	-	0.123
Feb IV	0.200	0.200	0.150	0.200	0.100	-	-	0.916	-	0.143
Mar I	0.100	0.250	0.200	0.300	0.250	-	-	0.526	-	0.082
Mar II	0.025	0.050	0.200	0.550	0.500	-	-	-	-	0.000
Mar III	-	0.150	0.600	0150	0.400	-	-	-	-	0.000
Mar IV	-	0.050	0.400	0.100	-	-	-	-	-	0.000
Mar V	-	-	0.050	-	-	-	-	-	-	0.000
Apr I	-	-	0.000			-	-	-	-	0.000
Apr II			0.050			-	-	-	-	0.000
Apr III						-	-	-	-	0.061
Apr IV						-	-	-	-	0.081
May I						-	-	-	-	0.102
May II						-	-	-	-	0.122
May III										0.163
Mean (Sept. to July)	**0.026**	**0.090**	**0.038**	**0.039**	**0.077**	**0.010**	**0.274**	**0.077**	**0.013**	**0.050**

Table 8. Weekly TMB Panicle & Nut infestation on Mature Plants

Period	TMB Panicle infestation (%)					TMB Nut infestation (%)				
	V-1	V-4	V-6	V-7	V-8	V-1	V-4	V-6	V-7	V-8
Nov III	0.118	0.347	0.100	-	-	-		-	-	-
Nov IV	0.351	0.859	0.150	-	0.066	-		-	-	-
Nov V	0.702	2.008	0.206	0.142	0.166	-		-	-	-
Dec I	1.108	2.994	0.543	0.091	0.778	-		-	-	-
Dec II	1.468	4.191	0.837	0.363	1..241			-	-	-
Dec III	1.777	5.682	0.934	0.885	2.008			-	-	-
Dec IV	2.277	7.940	2.078	1.449	3.450		5.000	-	-	-
Jan I	3.789	8.209	3.173	2.223	4.308		5.000		-	
Jan II	4.030	7.515	3.895	2.356	5.172		5.000			
Jan III	4.823	6.659	3.927	2.543	4.900		0.000			
Jan IV	5.205	6.383	4.966	2.647	5.474	0.156	0.000			
Jan V	5.685	-	-	2.461	4.606	0.167	-			
Feb I	4.089	5.763	5.846	2.536	4.297	0.839	0.000			
Feb II	3.239	5.038	4.467	3.244	4.773	2.833	0.167	0.152		0.833
Feb III	3.418	7.056	3.970	3.636	3.634	4.723	1.409	0.387	1.250	2.006
Feb IV	2.649	7.913	4.219	4.275	3.593	5.160	2.856	1.274	1.463	4.486
Mar I	2.809	8.909	5.109	4.885	2.552	7.287	3.546	2.615	3.397	4.669
Mar II	1.270	2.293	1.892	5.715	2.739	6.857	7.198	4.163	5.062	7.938
Mar III	0.488	-	2.515	2.669	1.082	4.183	9.364	5.760	7.073	9.680
Mar IV	-	-	1.839	0.500	-	1.094	10.372	7.546	9.578	7.866
Mar V	-	-	2.227	-	-		12.848	11.055	-	-
Apr I							6.375	5.615	10.786	4.653
Apr II							-	3.214	4.714	2.436
Apr III								2.083	5.000	0.714
Mean (Sept. to July)	**0.992**	**2.016**	**1.149**	**0.910**	**1.131**	**0.706**	**1.112**	**0.812**	**1.098**	**1.029**

Table: 9 Correlation of TMB Shoot infestation with weather parameters

Weather Parameters	Correlation coefficient on different varieties				
	V-1	V-4	V-6	V-7	V-8
Max. Temperature	0.325	0.213	0.462	0.475	- 0.126
Min. Temperature	0.083	- 0.418	- 0.880	0.608	- 0.073
Mean Temperature	0.183	- 0.400	- 0.713	0.557	- 0.123
F.N. Humidity	- 0.018	0.214	0.185	- 0.690	- 0.182
A.N Humidity	- 0.370	- 0.349	- 0.786	- 0.837	- 0.190
Mean Humidity	- 0.262	- 0.142	- 0.606	- 0.765	- 0.267
Sunshine hours	0.057	0.225	0.107	0.510	0.140

Table: 10 Correlation of TMB Panicle infestation with weather parameters

Weather Parameters	Correlation coefficient on different varieties				
	V-1	V-4	V-6	V-7	V-8
Max. Temperature	0.224	- 0.311	0.019	- 0.420	0.100
Mm. Temperature	- 0.501*	- 0.160	- 0.227	0.084	- 0.479*
Mean Temperature	- 0.411	- 0.295	- 0.225	- 0.098	- 0.434
F.N. Humidity	- 0.021	0.355	0.015	- 0.022	- 0.011
A.N Humidity	- 0.470*	0.136	- 0.169	0.042	- 0.374
Mean Humidity	- 0.338	0.278	- 0.125	0.018	- 0.289
Sunshine hours	0.419	0.222	0.386	0.430	0.544*

Expt . 5 Seasonal occurrence of TMB on young cashew trees of age 6 years

At the R.F.R.S, Vengurle, there are also young plantation of different varieties and from the available trees, five plants each of variety Vengurla – 4, Vengurla -7 and the promising hybrids Hy-303 and Hy-320 i.e. total 20 plants of age 6 years were selected for the study. The observations on TMB population and damage were done similar to that of mature trees. On young trees, 0.5 m^2 quadrant was selected on four sides of the tree.

RESULTS

TMB population

The weekly observations on TMB population from Sept.,2005 to July, 2006 were recorded from all the four varieties. For the convenience in presenting the results the data are presented as fortnightly data in Table 11. Similar to that of mature trees the TMB population was observed from November to March. In the variety V– 4, the maximum TMB population was observed during the II fortnight of December with a mean population of 2.117. The variety, V– 7 recorded a high population of TMB during I fortnight of December with a mean population of 0.570. In all the varieties highest population was during Dec.I & II fortnights followed by another low peak in the month of February. Among the four varieties TMB population was highest in V-4 followed by Hy- 303.

Damage Intensity

The extent of TMB damage on shoots, panicles and nuts on the young plants of V-4, V- 7, Hy-303 and Hy-320 are presented in Tables 12 to 14..

Shoot infestation:-

In V–4, shoot infestation reached maximum in I fortnight of January with a mean of 10.445 %. In V–7, the shoot infestation was highest in II fortnight of December (2.787 %). In the hybrid, Hy-303 the maximum infestation was during II fortnight of December (4.870 %) followed by the hybrid Hy-320 with the peak during II fortnight of December(3.386 %).

Table 11 : TMB population on Young Plants

Month/Periods	V - 4	V – 7	Hy - 303	Hy - 320	Mean
September 2005, I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
September II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
October I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
October II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
November I	0.000(0.707)	0.025(0.725)	0.000(0.707)	0.150(0.806)	0.044(0.736)
November II	0.125(0.791)	0.275(0.880)	0.100(0.775)	0.275(0.880)	0.194 (0.832)
December I	1.325(1.351)	0.570(1.034)	0.950(1.204)	0.425(0.962)	0.818(1.138)
December II	2.117(1.618)	0.317(0.904)	0.650(1.072)	0.183(0.826)	0.817(1.105)
January 2006, I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
January II	0.050(0.742)	0.000(0.707)	0.025(0.725)	0.100(0.775)	0.044(0.750)
February I	0.400(0.949)	0.075(0.758)	0.150(0.806)	0.175(0.822)	0.200(0.834)
February II	0.225(0.851)	0.125(0.791)	0.475(0.987)	0.200(0.837)	0.256(0.867)
March I	0.450(0.975)	0.250(0.866)	0.250(0.866)	0.1500.806)	0.275(0.878)
March II	0.000(0.707)	0.067(0.753)	0.017(0.719)	0.000(0.707)	0.021(0.722)
April I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
April II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
May I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
May II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
June I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
June II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
July I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
July II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
Mean	**0.159(0.813)**	**0.077(0.757)**	**0.119(0.775)**	**0.075(0.755)**	

Figures in paren heais denote square root transformation ($\sqrt{x + 0.5}$ values). CD value variety -0.0977, Period - 0.2392, interaction - 0.4784

Irrespective of the varieties, shoot infestation was maximum during I fortnight of January (4.431 %) followed by II fortnight of December (4.306 %) and II fortnight of January (2.325 %). Comparatively high shoot infestation irrespective of periods was recorded in V--4, with a mean infestation of 1.668 % (Table 12). Fig 5).

Panicle infestation

The panicle infestation was upto 32 % in V–4 during I fortnight of January. In V-7, the panicle infestation was highest in II fortnight of January (10.802 %). In the hybrid Hy-303, the panicle infestation was its peak during II fortnight of December (17.550 %) and one more peak Feb II fortnight (17.440). In hybrid Hy-320 the peak was during I fortnight of January (21.564 %). Irrespective of the varieties, the panicle infestation was maximum during I fortnight of January with a mean of 19.811 %, followed by 15.917 % during II fortnight of December and 14.467 % during II fortnight of January. Comparatively high

panicle infestation irrespective of periods was recorded in Vengurla - 4 with a mean infestation of 5.055 % (Table 13)* Fig 5).

Table :12 Per cent shoot infestation on young plants

Month/Periods	V - 4	V - 7	Hy - 303	Hy - 320	Mean
September 2005, I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
September II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
October I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
October II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
November I	0.197(0.835)	0.044(0.738)	0.000(0.707)	0.177(0.823)	0.105(0.776)
November II	0.395(0.946)	0.630(1.063)	0.000(0.707)	0.356(0.925)	0.278(0.910)
December I	1.268(1.330)	1.828(1.526)	1.984(1.576)	1.429(1.389)	1.627(1.455)
December II	6.182(2.582)	2.787(1.813)	4.870(2.317)	3.386(1.971)	4.306(2.172)
January 2006, I	10.445(3.308)	1.235(1.317)	3.558(2.014)	2.487(1.728)	4.431(2.092)
January II	6.873(2.715)	0.611(1.054)	0.647(1.071)	1.170(1.292)	2.325(1.533)
February I	2.094(1.611)	0.000(0.707)	0.282(0.884)	0.091(0.769)	0.617(0.993)
February II	3.606(2.026)	0.000(0.707)	0.019(0.787)	0.181(0.825)	0.977(1.086)
March I	4.766(2.295)	0.000(0.707)	0.000(0.707)	0.301(0.895)	1.267(1.151)
March II	0.869(1.170)	0.000(0.707)	0.000(0.707)	0.281(0.884)	0.288(0.867)
April I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
April II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
May I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
May II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
June I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
June II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
July I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
July II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
Mean	**1.668(1.241)**	**0.324(0.856)**	**0.521(0.907)**	**0.448(0.908)**	

Figures in parenthesis denote square root transformation. ($\sqrt{x + 0.5}$ values). CD value for variety -0.0813, Period -0.1991, interaction - 0.3982

Nut infestation

The nut infestation was observed during the month of January to March. It was upto 12 % in V– 4 during I fortnight of March. In V–7, infestation reached peak during II fortnight of March with a mean of 9.144 %. In the hybrid, Hy-303 the nut infestation was maximum during I fortnight of March (10.218 %). In all the varieties nut infestation was low as compared to the panicle infestation and it ranged from 1.945 to 11.941 % (Table 14)* Fig 5).

The variety influence on shoot, panicle and nut damage on young plants is depicted in Fig. 5. Except in V-7, panicle damage was highest as compared to shoots and nuts. The damage was lowest in shoots.

Table 13 : Per cent Panicle infestation on young plants

Month/Periods	V - 4	V – 7	Hy - 303	Hy - 320	Mean
September 2005, I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000 (0.707)
September II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
October I	0.000(0.707)	0.000 (0.707)	0.000 (0.707)	0.000 (0.707)	0.000(0.707)
October II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
November I	0.107(0.777)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.027(0.725)
November II	2.213(1.647)	0.177(0.823)	1.558(1.435)	3.453(1.988)	1.850 (1.473)
December I	5.953(2.540)	1.763(1.504)	8.094(2.932)	6.988(2.736)	5.699(2.428)
December II	22.808(4.828)	6.253(2.599)	17.550(4.249)	17.055(4.190)	15.917(3.967)
January 2006 I	32.201(5.718)	10.499(3.316)	14.979(3.934)	21.564(4.697)	19.811(4.416)
January II	20.661(4.600)	10.802(3.362)	10.254(3.279)	16.154(4.080)	14.467(3.830)
February I	8.502(3.000)	8.827(3.054)	12.220(3.567)	11.528(3.468)	10.269(3.272)
February II	8.465(2.994)	8.398(2.983)	17.440(4.236)	9.579(3.175)	10.971(3.347)
March I	8.976(3.078)	7.187(2.773)	12.937(3.666)	8.266(2.961)	9.342(3.120)
March II	1.333(1.354)	0.556(1.028)	0.000(0.707)	0.000(0.707)	0.472(0.949)
April I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
April II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
May I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
May II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
June I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
July I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
July II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
Mean	**5.055(2.774)**	**2.476(1.392)**	**4.320(1.691)**	**4.299(1.909)**	

Figures in parentheses denote square root transformation ($\sqrt{x + 0.5}$ values). CD value for variety -0.1055 Period -0.2584, interaction - 0.5169

Expt. 6 Correlation of TMB population and damage with weather on young trees

The TMB population recorded at weekly intervals on different varieties has been used for working out the correlation. The weekly data on population and mean per cent damage are presented in Tables 15 to 16.

The results (R values) of simple correlation analysis are given in tables 17 & 18. The minimum temperature was negatively correlated with the shoot infestation in all the five varieties of young trees. Similar was the case with A.N. relative humidity except in the case of V-7 (Table 17). In the case of panicle damage also the minimum temperature and afternoon RH showed a negative correlation (Table 18)

Table : 14 Per cent nut infestation on young plants

Month/Periods	V - 4	V – 7	Hy - 303	Hy – 320	Mean
Sept. 2005 to Jan. I	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
January II	0.000(0.707)	0.000(0.707)	0.000(0.707)	3.750(2.062)	0.938(1.346)
February I	2.473(1.724)	1.945(1.564)	2.297(1.672)	3.753(2.062)	2.617(1.756)
February II	8.625(3.021)	3.624(2.031)	6.465(2.639)	6.667(2.677)	6.345(2.592)
March I	11.941(3.527)	6.012(2.552)	10.218(3.274)	8.827(3.054)	9.250(3.102)
March II	5.020(2.349)	9.144(3.106)	9.278(3.127)	5.370(2.423)	7.204(2.751)
April I	0.000(0.707)	2.000(1.581)	0.000(0.707)	0.000(0.707)	0.500(0.926)
April II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
May I to July II	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)	0.000(0.707)
Mean	**1.275(1.061)**	**1.033(1.039)**	**1.285(1.065)**	**1.289(1.068)**	

Figures in parenthesis denote square root transformation. ($\sqrt{x}$+ 0.5 values). CD value for variety -0.1048, Period -0.2567, interaction - 0.5135

Table 15 : Weekly Data on TMB population & Shoot infestation on Young Plants

Period	Population				Shoot infestation (%)			
	V - 4	V - 7	Hy - 303	Hy – 320	V - 4	V - 7	Hy – 303	Hy – 320
Nov I	-	-	-	-	0.112	-	-	0.100
Nov II	-	0.050	-	0.300	0.282	0.087	-	0.253
Nov III	-	0.450	-	0.000	0.338	0.499	-	0.306
Nov IV	0.250	0.100	0.200	0.550	0.451	0.766	--	0.406
Dec I	0.950	0.800	0.800	0.600	0.833	1.547	1.485	0.902
Dec II	1.700	0.340	1.100	0.250	1.702	2.10	2.482	1.955
Dec III	2.450	0.550	1.000	0.400	3.523	2.592	4.006	4.647
Dec IV	3.800	0.400	0.950	0.100	6.286	3.048	4.752	2.589
Dec V	0.100	0.000	0.000	0.050	8.738	2.702	5.853	2.922
Jan I	0.000	0.000	0.000	0.000	10.665	1.565	4.367	3.731
Jan II	0.000	0.000	0.000	0.000	10.225	0.905	2.748	1.243
Jan III	0.100	0.000	0.000	0.150	8.777	0.835	0.831	1.592
Jan IV	0.000	0.000	0.000	0.100	4.968	0.387	0.462	0.747
Feb I	0.450	0.000	0.000	0.050	2.082	-	0.385	0.182
Feb II	0.350	0.150	0.300	0.300	2.105	-	0.179	0.000
Feb III	0.400	0.200	0.300	0.100	3.185	--	0.238	0.120
Feb IV	0.050	0.050	0.650	0.300	4.029	-	-	0.241
Mar I	0.750	0.300	0.450	0.200	4.488	-	-	0.241
Mar II	0.150	0.200	0.050	0.100	4.643	-	-	0.361
Mar III	-	0.200	0.050	-	2.346	-	-	0.361
Mar IV	-	-	-	-	0.260	-	-	0.482
Mean (Sept. to Jul.)	**0.159**	**0.077**	**0.119**	**0.075**	**1.668**	**0.324**	**0.521**	**0.448**

Fig. 5. Varietal influnce on shoot, panicle and nut infestation on young plants

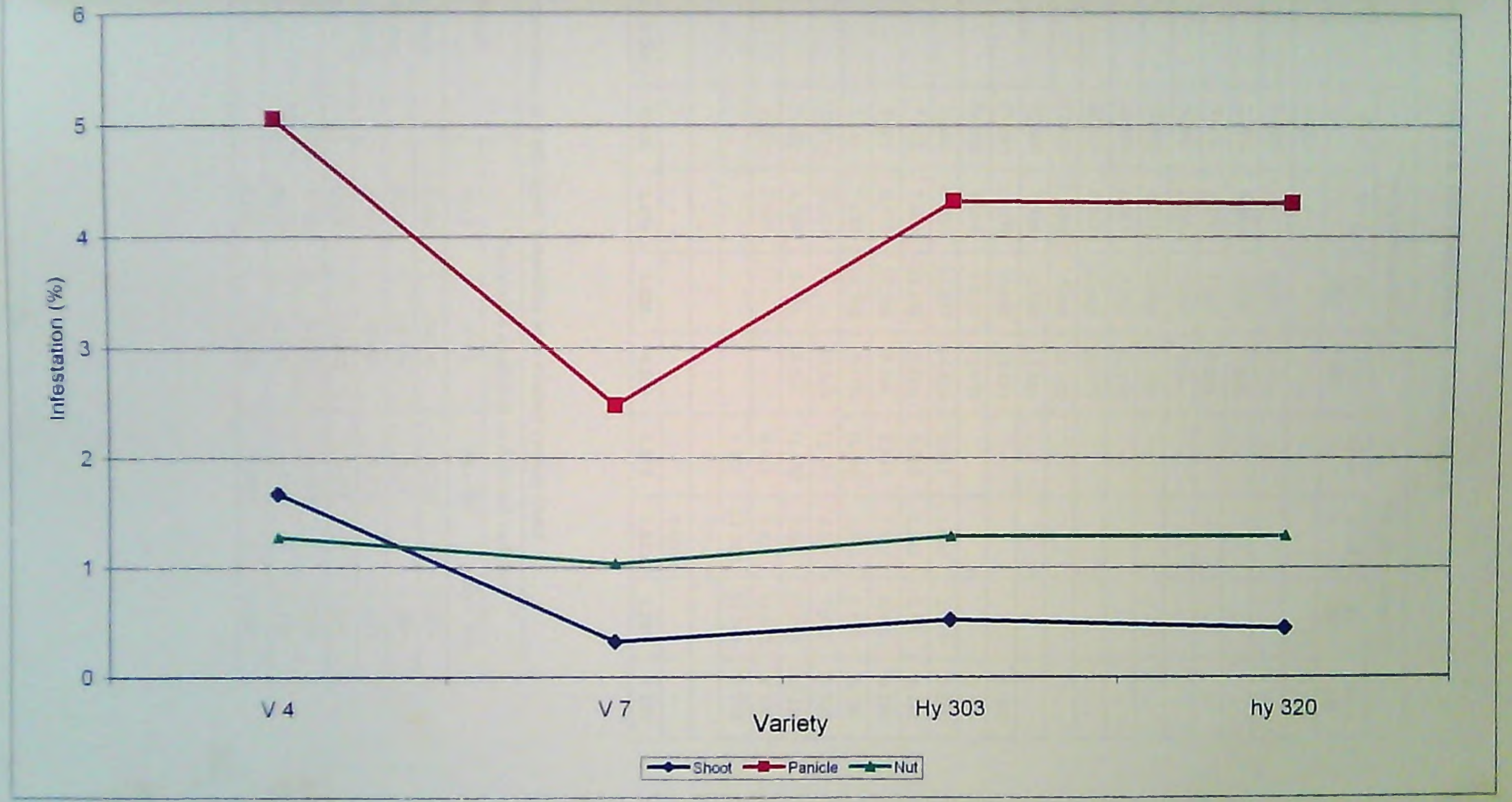


Table 16: TMB Panicle & Nut infestation on Young Plants

Period	Panicle infestation (%)				Nut infestation (%)			
	V - 4	V - 7	Hy - 303	Hy - 320	V - 4	V - 7	Hy - 303	Hy - 320
Nov II	0.213	-	-	-	-	-	-	—
Nov III	1.620	-	0.511	2.066	-	-	-	—
Nov IV	2.806	0.354	2.605	4.840	-	-	-	-
Dec I	3.639	1.276	6.506	4.810	-	-	-	—
Dec II	8.266	2.256	9.681	9.166	-	--	--	-
Dec III	15.413	3.211	13.345	12.254	—	-	-	-
Dec IV	22.893	6.485	17.893	18.132	-	—	-	--
Dec V	30.119	9.062	21.413	20.779	-	-	-	-
Jan I	32.395	11.098	17.868	23.162	-	-	-	—
Jan II	32.066	9.906	12.089	19.961	-	-	-	-
Jan III	27.260	12.270	10.692	19.414	-	-	-	5.000
Jan IV	14.062	9.334	9.815	12.875	-	-	-	2.500
Feb I	9.129	10.290	11.297	14.539	1.611	1.667	2.024	3.280
Feb II	7.875	7.363	13.142	8.516	3.335	2.222	2.570	4.226
Feb III	9.585	8.976	15.568	9.164	6.845	3.375	4.807	4.398
Feb IV	7.344	7.820	19.380	9.993	10.404	3.872	8.123	8.936
Mar I	10.750	10.015	16.330	10.008	12.131	4.321	9.082	7.333
Mar II	7.202	4.359	9.543	6.524	11.750	7.702	11.354	10.321
Mar III	4.000	1.667	-	-	8.611	8.437	16.667	8.333
Mar IV	-	-	-	-	1.429	11.302	11.167	7.778
Mar V	-	-	-	-	-	7.705	-	-
Apr I	-	-	-	-	-	4.000	-	-
Mean (Sept. to Jul.)	**5.055**	**2.476**	**4.320**	**4.299**	**1.275**	**1.033**	**1.285**	**1.289**

Table. 17 Correlation of TMB shoot infestation with weather (young trees)

Period	Correlation coefficient on different varieties			
	V - 4	V - 7	Hy - 303	Hy - 320
Max. Temperature	0.330	-0.674*	-0.270	0.024
Min. Temperature	-0.351	-0.339	-0.237	-0.456*
Mean Temperature	-0.351	-0.486	-0.319	0.465*
F.N Humidity	0.248	- 0.460	0.474	0.294
A.N Humidity	-0.326	0.235	-0.019	-0.368
Mean Humidity	-0.129	0.391	0.232	-0.135
Sunshine hours	0.193	-0.128	-0.599*	0.026

Table 18 Correlation of TMB Panicle infestation with weather (Young plants)

Period	Correlation coefficient on different varieties			
	V - 4	V - 7	Hy - 303	Hy - 320
Max. Temperature	0.155	0.182	-0.248	0.260
Min. Temperature	-0.435	-0.457	-0.220	-0.538
Mean Temperature	-0.366	- 0.384	-0.378	-0.425
F.N Humidity	0.163	0.221	0.412	0.156
A.N Humidity	-0.420	-0.215	0.069	-0.451
Mean Humidity	-0.226	-0.029	0.260	-0.231
Sunshine hours	0.187	0.371	0.307	0.281

Expt . 7 Assessment of ant population (September, 2005 to July, 2006)

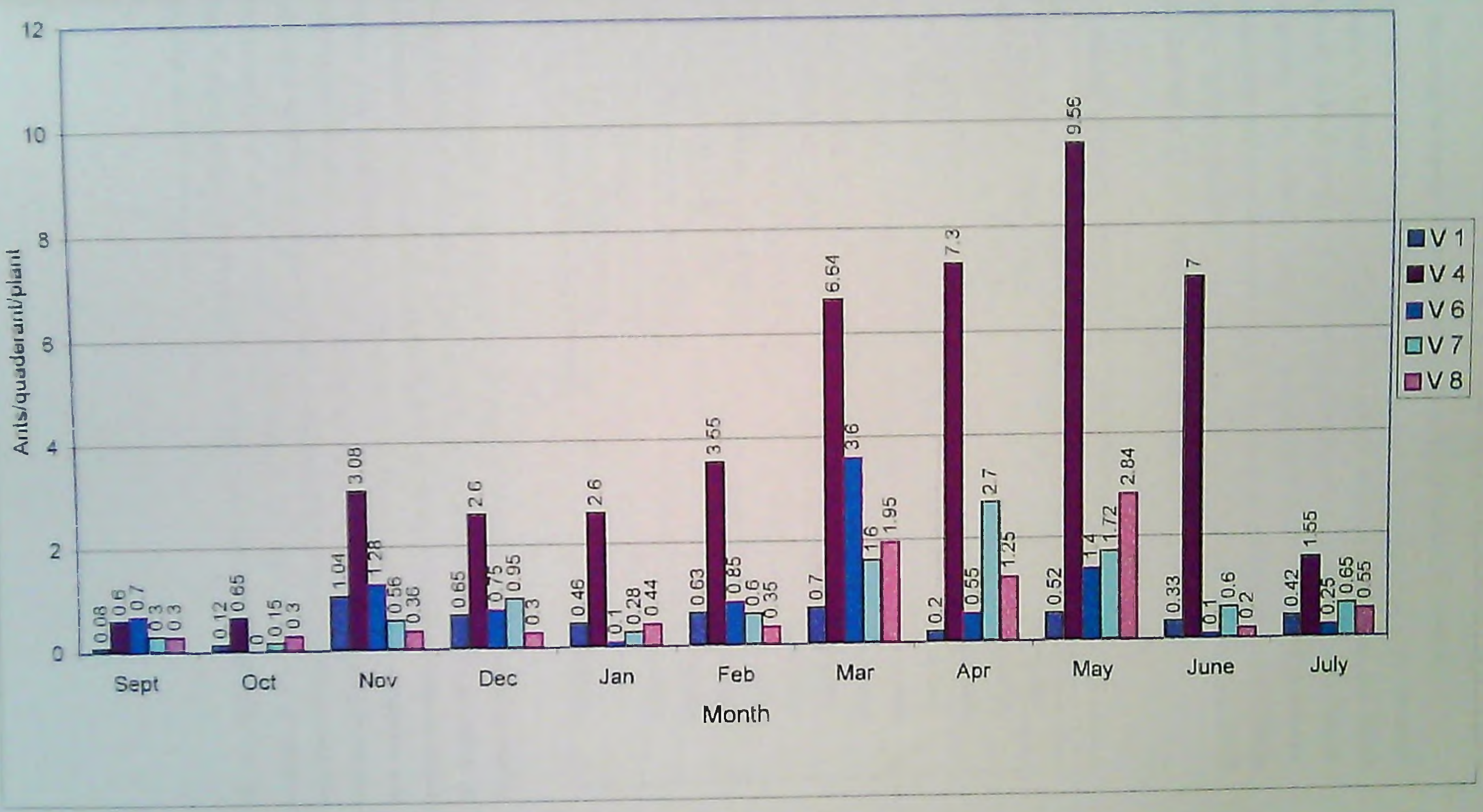
Observations on population of ants were taken at weekly intervals from all the plants of three categories viz. early, middle and late season varieties. In situ count of ant population present in each quadrant ($1 m^2$) was taken ($0.5 m^2$ for young plants of age 6 yrs). The mean number of ants present per quadrant per mature tree, counted at weekly intervals averaged on monthly basis on different categories/varieties is presented in Table 19 and Fig.6.

Table 19. Population of ants (mean no. per quadrant) on mature trees)

Month	V – 1	V – 4	V – 6	V – 7	V – 8	Mean
Sep. 05	0.08	0.60	0.70	0.30	0.30	0.40
Oct. 05	0.12	0.65	0.00	0.15	0.30	0.24
Nov. 05	1.04	3.08	1.28	0.56	0.36	1.26
Dec. 05	0.65	2.60	0.75	0.95	0.30	1.05
Jan. 06	0.46	2.60	0.10	0.28	0.44	0.78
Feb. 06	0.63	3.55	0.85	0.60	0.35	1.20
Mar. 06	0.70	6.64	3.60	1.60	1.95	2.90
Apr. 06	0.20	7.30	0.55	2.70	1.25	2.40
May 06	0.52	9.56	1.40	1.72	2.84	3.21
Jun 06	0.33	7.00	0.10	0.60	0.20	1.65
Jul 06	0.42	1.55	0.25	0.65	0.55	0.68
Mean	**0.47**	**4.10**	**0.87**	**0.92**	**0.80**	

In mature cashew plants, the highest ant population (9.56) was in the month of May in the Variety V–4. In the variety V–1, high population of ants was recorded during November and March with mean no. of 1.04 and 0.70 respectively. In the variety, V– 6, high ant population was during March (3.60) followed by V– 7 (2.70) during April while in the case of V–8, the highest ant population was during May with a mean population of 2.84. Irrespective of the varieties, high population of ants was observed during May and April with mean population of 3.21 and 2.40 respectively. Comparatively high ant population was recorded in Vengurla - 4, the mean number was 4.10 over period.

Fig. 6 : Ants population on mature plants



Expt . 8 Diversity of Spider fauna and assessment of population of Spiders

A survey has been conducted in cashew plantations of Regional Fruit Research Station, Vengurle. Spiders were collected from cashew fields by following the direct observation/hand picking method. Wide mouth test tubes or polythene bags were used to capture the spiders. The collected specimen was preserved in diluted isopropyl alcohol. Collection was made only from the cashew trees. The collected spiders were sent to College of Horticulture, Vellanikkara for their identification upto genus/species level and the list of spider fauna observed at RFRS, Vengurle is given in Table 20.

Table 20: LIST OF SPIDERS IDENTIFIED – RFRS Vengurle

Bottle No.	Name of spider	Family
A	*Peucetia* sp. (adult female)	Oxyopidae
B	1. *Lysomanes* sp. (adult female)	Lysomanidae
	2. *Lysomanes* sp. (adult female)	Lysomanidae
C	*Oxyopes shwetae* Tikader (adult female)	Oxyopidae
D	1. *Thomisus sikkimensis* Tikader (adult female)	Thomissidae
	2. *Thomisus pugilis* Stoliczha (adult female)	Thomissidae
E	*Peucetia* sp. (adult male)	Oxyopidae
F	1. *Argiope anasuja* (Immature)	Agriopidae
	2. *Lysomanes* sp. (Immature)	Agriopidae
	3. *Dieta* sp. (Immature)	Agriopidae
G	1. *Neoscona* sp. (adult female)	Agriopidae
	2. *Neocona* sp. 2 (adult female)	Agriopidae
H	1. *Hyllus* sp. (adult female)	Salticidae
	2. *Plexippus paykulli* (adult female)	Salticidae

The mean number of spiders present per quadrant per mature tree, counted at weekly intervals and averaged on monthly basis on different categories/varieties is presented in Table 21. Irrespective of the varieties, high population of spiders was observed during March and February with mean population of 5.44 and 5.12 respectively. Spider population was present throughout the period and it was high during November to March in all the varieties which coincides with the occurrence of TMB. It was seen that the spider population was low in monsoon season i.e. in the months of June, July at that time occurrence of TMB is negligible. Comparatively high population of spiders was recorded in Vengurla – 8, the mean number was 3.67 over period.

Table 21: Population of spiders (mean no. per quadrant) on mature tree)

Month	V – 1	V – 4	V – 6	V – 7	V – 8	Mean
Sep. 04	2.78	2.65	2.35	2.00	2.60	2.48
Oct. 04	1.86	1.95	2.40	2.25	1.90	2.07
Nov. 04	3.04	2.40	2.48	2.84	3.00	2.75
Dec. 05	3.45	3.95	3.20	3.75	5.45	3.96
Jan. 05	5.56	4.10	3.45	3.28	4.96	4.27
Feb. 05	5.82	4.04	4.60	5.60	5.55	5.12
Mar. 05	4.15	5.40	6.60	5.25	5.80	5.44
Apr. 05	2.85	2.35	3.70	3.00	3.70	3.12
May 05	3.20	3.56	3.60	2.60	3.36	3.26
Jun 05	1.95	2.45	2.00	2.45	2.30	2.23
Jul 05	1.92	1.75	1.75	1.65	1.70	1.75
Mean	**3.33**	**3.15**	**3.28**	**3.15**	**3.67**	

Exit . 9 Assessment of TMB population on alternative host plants

Random survey was conducted in and around the cashew plantation to locate the alternative host plants for TMB population and attack. The following tress/plants present in the locality were observed. TMB population was not observed on any of the plants observed during the period. The plants observed were: Guava *Psidium guajava* Cocoa *Theobroma cacao*, Indian goose berry *Emblica officinalis* and Drumstick *Moringa oleifera*

ANNUAL REPORT OF THE ICAR AD-HOC SCHEME

FORE WARNING TEA MOSQUITO BUG
Helopeltis antonii sign (Miridae : Hemiptera) in Cashew
01-09-2005 to 31-05-2006

NAME OF SUB CENTER – AGRICULTURAL RESEARCH STATION,
CHINTAMANI, KOLAR (DIST).
UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE – 560065.
May –2006.

Research Team:

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NAME OF SUB CENTER – AGRICULTURAL RESEARCH STATION, CHINTAMANI, KOLAR (DIST), UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE – 560065.

The project was implemented at the ARS, Chintamani as one of the sub centers. The experiments as per the technical programme were implemented during the period 2004-2005.

Expt. 1: Seasonal occurrence of TMB population and damage

Objective: To assess the TMB population and the intensity of damage on selected trees at the center over a period of one year (September 2005 to May 2006).

Materials and methods

From the trees available at the center, the following were selected to represent three categories as early, mid and late varieties.

Varieties

Early - Anakkayam-1 (10)

Mid - Kanaka (10)

Late - Chintamani-1 (10) and NDR-1 (3)

No. of trees – 3 per Variety

Observations

Observations were taken as described in earlier report

Results

TMB population

The data on seasonal variations of TMB population at fortnightly intervals during the period from September 2005 to May 2006 at ARS, Chintamani, UAS, Bangalore are presented in Table 1 & Fig. 1

Among the varieties the early variety Anakayam-1 recorded significantly highest TMB population (0.299) followed by NDR-1 (0.159), which is a late variety.

Among seasonal variations, the highest TMB population was observed during I fortnight of April (3.220), 2006 followed by I fortnight of March, 2006 (0.556) and II fortnight of March, 2006 (0.496) which were significantly different.

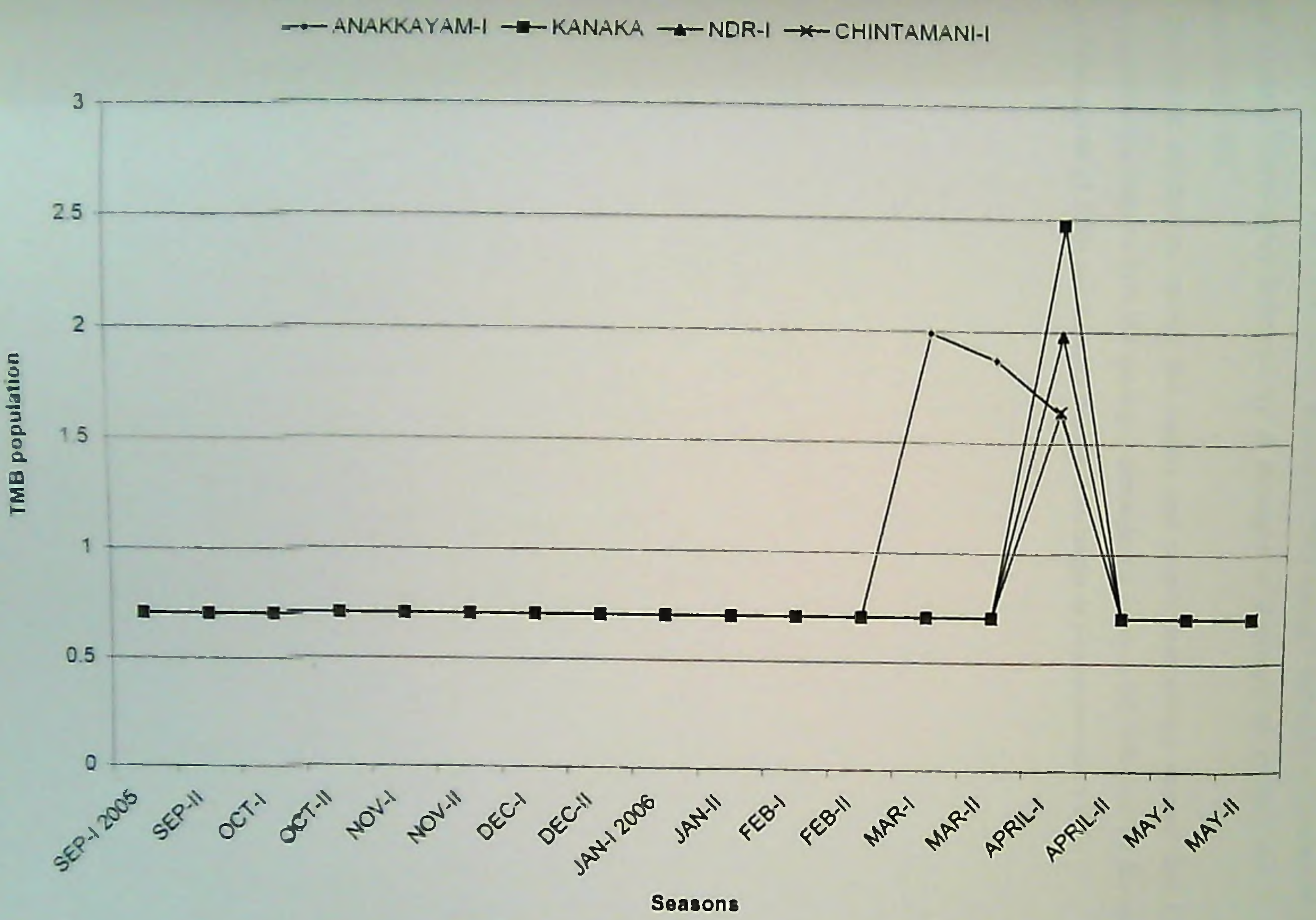
The variety and seasonal interaction showed that Kanaka has showed higher population of TMB 1.072) during I fortnight of April 06 followed by Anakayam-1 during I fortnight of March 06 (0.910), NDR-1 during I fortnight of April 06 (0.906), Anakkayam-1 during II fortnight of March, 06 (0.867), Chintamani-1 during I fortnight of April, 06 (0.780) and Anakkayam-1 during I fortnight of April, 06 (0.775). The remaining combinations of varieties and seasons were on par with each other with significantly low or nil population of TMB.

Table 1. Seasonal occurrence of TMB on different varieties (mean of three replications)

Month/ Fortnight	Anakkayam-1	Kanaka	NDR-1	Chintamani-1	Fortnights
September I 2005	0.0 (0.707)	0.0(0.707)	0.0(0.707)	0.0(0.7070	0.0(0.707)
September II	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0(0.707)
October I	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0(0.707)	0.0 (0.707)
October II	0.0 (0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
November I	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
November II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
December I	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
December II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
January I 2006	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
January II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
February I	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
February II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
March I	0.910(1.990)	0.0 (0.707)	0.0(0.707)	0.0(0.707)	0.556 (1.028)
March II	0.867(1.870)	0.0 (0.707)	0.0(0.707)	0.0 (0.707)	0.496(0.998)
April I	0.775 (1.627)	1.072 (2.473)	0.906 (1.979)	0.780 (1.639)	3.22 (1.930)
April II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
May I	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
May II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0 (0.707)	0.0(0.707)
Varieties	0.299 (0.894)	0.148(0.805)	0.159 (0.812)	0.08 (0.759)	

CD (0.05) for comparing periods, varieties and their interactions is 0.34

Fig. 1 **Seasonal occurrence of TMB on different varieties**



TMB Damage intensity: Shoot infestation

The data on seasonal variations of shoot infestation by TMB on different varieties at fortnightly interval at ARS, Chintamani, UAS, Bangalore, during the period from September 2005 to May 2006 are presented in Table 2.

Shoot infestation was significantly high (0.348) in Chintamani-1 compared to all other varieties. No significant difference was observed in remaining varieties with regard to shoot infestation.

Shoot infestation was significantly highest (2.290) during I fortnight of January 06 compared to all other seasons (fortnights) followed by II fortnight of February 06 (0.296) and II fortnight of September 05 (0.103).

The shoot infestation among the variety and season interactions showed that Chintamani-1 showed significantly highest (20.35) during I fortnight of January 06 followed by Kanaka during II fortnight February 06 (1.590) and Kanaka during II fortnight of September 06 (0.476).

Table 2. Shoot infestation on different varieties (mean of three replications)

Month/ Fortnight	Anakkayam-1	Kanaka	NDR-1	Chintamani-1	Fortnights
September I 2005	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
September II	0.0 (0.707)	0.476 (0.988)	0.0 (0.707)	0.0 (0.707)	0.103 (0.777)
October I	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
October II	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
November I	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
November II	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
December I	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
December II	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
January I 2006	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	20.35 (4.567)	2.29 (1.672)
January II	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
February I	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
February II	0.0 (0.707)	1.59 (1.446)	0.0 (0.707)	0.0 (0.707)	0.296 (0.892)
March I	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
March II	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
April	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
April	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
May I	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
May II	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)	0.0 (0.707)
Varieties	0.0 (0.707)	0.084 (0.764)	0.0 (0.707)	0.348 (0.921)	

CD (0.05) for comparing periods, varieties and their interactions is 0.1

Panicle infestation:

The data on seasonal variations of panicle infestation by TMB on different varieties at fortnightly intervals at ARS, Chintamani, UAS, Bangalore during the period from September 2005 to May 2006are presented in Table 3 & Fig. 2.

Among the varieties significantly highest panicle infestation was recorded on NDR-1 (1.290) followed by Chintamani-1 (1.005), Kanaka (0.949) and Anakkayam-1 (0.192) all are significantly differed.

Among seasons significantly highest panicle infestation was recorded during I fortnight of April 06 (34.71) followed by II fortnight March 06 (4.808), I fortnight March 06 (1.457) and during II fortnight of October 05 (0.869).

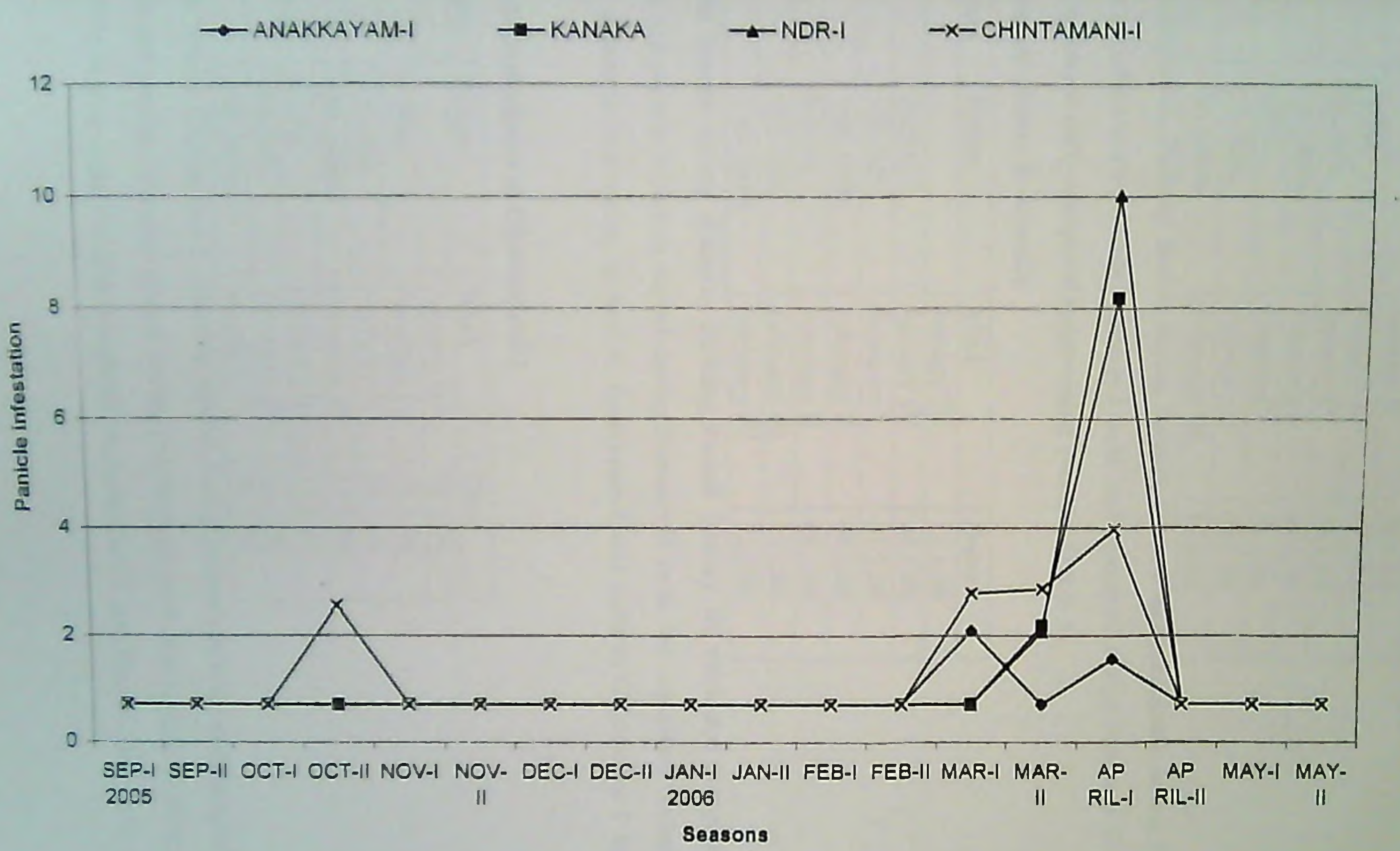
Among different varieties during different seasons significantly higher values 99.90, 66.41 and 15.28 were observed during I fortnight of April 06 on NDR-1, Kanaka and Chintamani-1 respectively. Followed by Chintamani-1, 7.284 during I fortnight of March 06, 6.04 during II fortnight of October 05 on Chintamani-1, on Kanaka during II fortnight of March 06 (4.265), on Anakkayam-1 during I fortnight of March 06 (3.893) and during II fortnight of March 06 on, NDR-1 (3.772) . 1.936 during I fortnight of April 06 on Anakkayam-1 and 1.440 during I fortnight of march 06 on Chintamani-1.

Table 3. Panicle infestation on different varieties (mean of three replications)

Month/ Fortnight	Anakkayam-1	Kanaka	NDR-1	Chintamani-1	Fortnights
September I 2005	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
September II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
October I	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
October II	0.0(0.707)	0.0(0.707)	0.0(0.707)	6.04 (2.559)	0.869 (1.170)
November I	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
November II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
December I	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
December II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
January I 2006	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
January II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
February I	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
February II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
March I	3.893(2.096)	0.0(0.707)	1.440(1.393)	7.284(2.790)	1.457 (1.339)
March II	0.0 (0.707)	4.265(2.183)	3.772 (2.067)	2.870 (2.870)	4.808(2.304)
April I	1.936(1.561)	66.41(8.180)	99.90(10.02)	15.28 (3.973)	34.71(5.934)
April II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
May I	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
May II	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)	0.0(0.707)
Varieties	0.192(0.832)	0.949(1.204)	1.290 (1.338)	1.005 (1.227)	

CD (0.05) for comparing periods, varieties and their interactions is 0.60

Fig 2 **Panicle infestation on different varieties**



Expt.2. Phenological phases in different varieties at ARS, Chintamani.

The observational trees were monitored at weekly intervals and recorded the various phonological events such as flushing, flowering, nut set etc. as per the method given in earlier report.

Results

Table4: Phenological phases Anakayam -1

Phonological phases	Range	Week	Dates
Bud break	-	January II	10.1.06
Flushing	0-25%	January III	17.1.06
" "	>25-50%	January IV	24.1.06
" "	>50-100%	February I	01.2.06
Panicle initiation	0-25%	February I	01.2.06
" "	>25-50%	February II	08.2.06
" "	>50-100%	February III	15.2.06

In the Anakayam-1, flushing started during January II week and completed during February I week and panicle initiation started during February I week and completed during February III week, all the events in this variety is early compared to remaining varieties (Table 4).

Table5: Phenological phases in Kanaka

Phenological phases	Range	Week	Dates
Bud break	-	January III	17.1.06
Flushing	0-25%	January IV	24.1.06
" "	>25-50%	February I	01.2.06
" "	>50-100%	February II	08.2.06
Panicle initiation	0-25%	February II	08.2.06
" "	>25-50%	February III	15.2.06
" "	>50-100%	February IV	22.2.06

In the mid season variety Kanaka, flushing started January III week and completed during February II week and panicle initiation started during February II week and completed during February IV week, all the events in this variety is next to Anakayam-1 and early to Chintamani-1 and NDR-1 (Table5)

Table6: Phenological phases in Chintamani-1

Phenological phases	Range	Week	Dates
Bud break	-	January IV	24.1.06
Flushing	0-25%	February I	01.2.06
" "	>25-50%	February II	08.2.06
" "	>50-100%	February III	15.2.06
Panicle initiation	0-25%	February III	15.2.06
" "	>25-50%	February IV	22.2.06
" "	>50-100%	March I	01.3.06

In the late variety Chintamani-1, flushing started during January IV week and completed during February III week and panicle initiation started during February III week and completed during March I week, all the events in this variety is late compared to Anakayam-1 and Kanaka and early to NDR-1 (Table6).

Table7: Phenological phases in NDR-1

Phenological phases	Range	Week	Dates
Bud break	-	February I	01.2.06
Flushing	0-25%	February II	08.2.06
" "	>25-50%	February III	15.2.06
" "	>50-100%	February IV	22.2.06
Panicle initiation	0-25%	February IV	22.2.06
" "	>25-50%	March I	01.3.06
" "	>50-100%	March II	08.3.06

In the late variety NDR-1, flushing started February I week and completed during February IV week and panicle initiation started during February IV week and completed during March II week, all the events in this variety is late compared to all the varieties (Table7).

Expt.3. Weather data at the ARS, Chintamani.

Objective:

To record the weather parameters prevailing in the experimental sites and to assess the influence of weather parameters on pest population build up.

Materials and methods

Weekly data on weather parameters *viz.*, maximum temperature, minimum temperature, forenoon relative humidity, afternoon relative humidity, amount of rainfall (mm), rainy days and sunshine hours were recorded with the facilities already available at the center. The mean weekly weather data for the period from September 2005 to May 2006 are presented in Table 8.

During October-November (post monsoon period) the maximum temperature was in the range of 23.50 to 28.80^0. The forenoon and afternoon relative humidity ranged from 80.20 to 91.10 per cent and 50.00 to 84.00 per cent respectively. The rainfall received during the period ranged from 0 to 76.40 mm. The number of rainy days varied from 0 to 5days.The mean sunshine hours ranged between 2.00 to 9.20.

During December to February (winter season) the maximum temperature was in the range of 24.10 to 31.50^0 C. The forenoon and afternoon relative humidity ranged from 50.20 to 90.20 per cent and 20.00 to 66.70 per cent respectively. The rainfall received during the period ranged from 0 to 7.40 mm. The number of rainy days varied from 0 to 3 days. The mean sunshine hours ranged between 4.20 to 10.60.

During March-May (summer season) the maximum and minimum temperatures were in the range of 29.00 to 36.00^0 C and 17.60 to22.00^0 C respectively. The forenoon and afternoon relative humidity ranged from 64.20 to 86.00per cent and 25.00to 48.00 per cent respectively. The rainfall received during the period ranged from 0 to 29.60 mm. The number of rainy days varied from 0 to 3days.

During June-August (rainy season) the maximum and minimum temperatures were in the range of 30.80 to 36.30^0 C and 17.60 to21.50^0 C respectively. The forenoon and afternoon relative humidity

ranged from 73.00 to 88.00per cent and 25.00to 48.00 per cent respectively. The rainfall received during the period ranged from 0 to 29.60 mm. The number of rainy days varied from 0 to 3days.

Table 8. Mean weekly weather data from September 2005 to May 2006

Month/week	Max.temp	Min.temp	FN RH (%)	AN RH (%)	RF (mm)	No. Of rainy days	Sun shine hrs/day
Sept 1	28.00	18.60	86.50	65.50	64.40	5	3.9
Sept 2	27.40	18.70	82.10	61.10	1.2	1	3.8
Sept 3	28.50	18.60	82.80	50.20	0.0	0	7.5
Sept 4	29.70	19.90	85.40	51.50	8.8	2	7.6
Oct 1	28.80	19.80	84.00	63.00	17	2	5.0
Oct 2	27.70	19.60	82.40	65.50	17.1	2	2.1
Oct 3	28.50	19.30	87.70	61.10	47.80	3	6.9
Oct 4	25.30	18.90	91.10	73.00	76.40	5	2.1
Nov 1	25.20	19.10	89.80	84.10	78.30	5	3.5
Nov 2	24.50	18.60	90.20	80.70	1.40	1	2.0
Nov 3	25.70	16.50	80.20	51.00	0	0	9.2
Nov 4	23.50	17.20	88.20	77.40	35	4	2.6
Dec 1	24.50	15.00	90.10	66.70	7.4	3	5.7
Dec 2	24.10	14.40	83.40	57.80	0	0	4.2
Dec 3	24.90	15.50	87.40	64.20	0	0	3.5
Dec 4	24.50	09.50	87.30	51.10	0	0	9.0
Jan 1	25.20	13.20	85.70	53.80	0	0	7.5
Jan 2	27.20	14.50	83.00	43.40	0	0	8.8
Jan 3	29.10	12.50	74.70	35.00	0	0	10.3
Jan 4	28.00	12.40	77.20	36.00	0	0	9.1
Feb 1	27.90	10.60	76.00	27.20	0	0	9.4
Feb 2	30.30	10.20	50.20	20.00	0	0	10.6
Feb 3	31.50	11.90	62.40	22.80	0	0	10.2
Feb 4	31.30	16.70	79.40	37.50	0	0	8.1
Mar 1	30.40	18.70	86.00	45.40	54.20	3	8.1
Mar 2	30.00	18.90	81.10	47.20	0	0	7.9
Mar 3	32.40	16.60	65.00	35.40	0	0	9.5
Mar 4	33.70	13.40	64.20	27.80	0	0	9.1
Apr 1	34.00	21.50	70.50	32.70	0	0	7.2
Apr 2	34.70	21.20	76.10	38.80	0	0	8.7
Apr 3	32.20	19.90	70.20	46.20	5	1	8.2
Apr 4	36.00	21.50	62.80	31.40	2.2	1	9.6
May 1	35.70	22.00	68.80	41.20	12.6	2	8.6
May 2	35.00	21.50	68.50	39.50	2.2	1	7.9
May 3	31.20	20.80	70.20	50.20	30.2	2	6.6
May 4	29.00	21.00	74.70	63.50	0	0	4.3

Expt.4. Correlations of TMB population and damage with weather

Table 9. Correlation with weather – Anakayam-1

	Temperature ^{O}C		Relative humidity %		Rainfall Amount (mm)	No. of rainy days	Sun shine hours
	Max.	Min.	FN	AN			
Population	0.258	-0.030	-0.150	-0.242	0.028	-0.119	0.274
Shoot	-	-	-	-	-	-	-
Panicle	0.273	0.256	0.045	-0.168	0.079	-0.075	0.164

In the Anakayam-1 TMB population showed –ve correlation with weather parameters like minimum temperatures, forenoon and after noon relative humidity and number of rainy days. However, maximum temperature, rainfall amount and sunshine hours showed +ve correlation.

In the Anakayam-1 panicle infestation showed –ve correlation with weather parameters like after noon relative humidity and number of rainy days. However, maximum temperature, minimum temperatures, forenoon relative humidity, rainfall amount and sunshine hours showed +ve correlation. (Table 9).

Table 10.Correlation with weather – Chintamani-1

	Temperature ^{O}C		Relative humidity %		Rainfall Amount (mm)	No. of rainy days	Sun shine hours
	Max.	Min.	FN	AN			
Population	0.375	0.307	-0.144	-0.222	-0.182	-0.240	0.112
Shoot	-0.201	-0.228	0.174	-0.018	-0.191	-0.243	0.140
Panicle	0.393	0.263	-0.102	-0.219	0.165	-0.029	0.153

In the Chintamani-1 TMB population showed –ve correlation with weather parameters like forenoon relative and after noon relative humidity number of rainy days and Rainfall amount. However, maximum temperature, minimum temperature and sunshine hours showed +ve correlation.

In the Chintamani-1 shoot infestation showed –ve correlation with weather parameters like maximum and minimum temperature, after noon relative humidity, rainfall amount and number of rainy days. However, after noon relative humidity and sunshine hours showed +ve correlation (Table 10).

In the Chintamani-1 panicle infestation showed –ve correlation with weather parameters like fore noon and after noon relative humidity, and number of rainy days. However, maximum, minimum, rainfall amount and sunshine hours showed +ve correlation (Table 10).

Table 11.Correlation with weather – Kanaka

	Temperature ^{O}C		Relative humidity %		Rainfall Amount (mm)	No. of rainy days	Sun shine hours
	Max.	Min.	FN	AN			
Population	0.446	0.307	-0.272	-0.150	0.047	-0.039	0.147
Shoot	0.160	-0.148	-0.143	-0.291	-0.217	-0.243	0.262
Panicle	0.427	0.273	-0.218	-0.277	-0.216	-0.286	0.164

In the Kanaka TMB population showed –ve correlation with weather parameters like forenoon relative and after noon relative humidity and number of rainy days. However, maximum and minimum temperature, rainfall amount and sunshine hours showed +ve correlation.

In the Kanaka shoot infestation showed –ve correlation with weather parameters like minimum temperature, fore noon and after noon relative humidity, rainfall amount and number of rainy days. However, maximum temperature and sunshine hours showed +ve correlation (Table 10).

In the Kanaka panicle infestation showed –ve correlation with weather parameters like fore noon and after noon relative humidity, amount of rainfall and number of rainy days. However, maximum and minimum temperatures and sunshine hours showed +ve correlation (Table 11).

Table 12.Correlation with weather – NDR-1

	Temperature ^{O}C		Relative humidity %		Rainfall Amount (mm)	No. of rainy days	Sun shine hours
	Max.	Min.	FN	AN			
Population	0.375	0.307	-0.144	-0.222	-0.182	-0.240	0.112
Shoot	-	-	-	-	-	-	-
Panicle	0.422	0.291	-0.189	-0.269	-0.194	-0.271	0.160

* Significant at 5% level

In the NDR-1 TMB population showed –ve correlation with weather parameters like forenoon relative and after noon relative humidity, rainfall amount and number of rainy days. However, maximum and minimum temperature and sunshine hours showed +ve correlation.

In the NDR-1 panicle infestation showed –ve correlation with weather parameters like fore noon and after noon, relative humidity, rainfall amount and number of rainy days. However, maximum and minimum temperatures and sunshine hours showed +ve correlation. (Table 12).

FINAL CONSOLIDATED RESULTS , 2003 to 2006

1. CASHEW RESEARCH STATION, MADAKKATHARA

2. REGIONAL AGRL. RESEARCH STATION, PILICODE

3. REGIONAL FRUIT RESEARCH STATION, VENGURLE

CRS, Madakkathara

RESULTS 2003-06

1. TMB Population as influenced by the varieties for three years (2003-06)

a. Anakkayam-1

The mean TMB population over three years for each variety was examined separately. In the case of the early variety Anakkayam-1, TMB occurrence was in two peaks for all the three years, the first peak was during December 4th week and the second peak in January 3rd week. The year 2005-06 recorded a relatively high population starting from December 3rd week with a gradual increase and the highest peak was during January 3rd week whereas the high population was during December 4th week (52 nd week) during 2003-04 and 2004-05 (Table 13 & Fig 1).

b. Madakkathara-1

In the year 2004-05, Madakkathara-1 recorded a very low population, where as the year 2003-04 recorded the peak population during 51 and 52nd standard weeks. During 2005-06, there were two definite peaks in population during the highest in January 3rd week followed by December 4th week (Table 14 & Fig. 2).

c. Kanaka

In the mid season variety kanaka no TMB population was recorded in 2003-04. In 2004-05 there were two peaks uniformly in January 1st week and 3rd week. In the year 2005-06, highest peak was during January 3rd week and another low peak was during 52nd week. The population was found to persist at low level upto February 4th week during 2005-06 (Table 15 & Fig 3).

d. Madakkathara-2

During 2003-04, a very low TMB population occurred during December 4th week and continued upto 2nd week of January. During 2004-05 also population was very low in Madakkathara-2, the two peaks were during 1st and 3rd week of January. However, in 2005-06, population was high and the peak was in January 3rd week. A low population persisted during the other periods from 46th week to 8th week. This is the late season variety (Table 16 & Fig 4).

Table 13 Mean TMB population inAnakkayam-1

Anakkayam				
Std. week	Months	2003-04	2004-05	2005-06
46	Nov-3rd	0.00	0.00	0.00
47	4th	0.00	0.00	0.00
48	5th	0.00	0.00	0.25
49	Dec-1st	0.25	0.00	0.00
50	2nd	0.00	0.00	1.00
51	3rd	0.00	1.00	1.25
52	4th	2.56	2.50	3.25
1	Jan-1st	0.00	0.00	4.50
2	2nd	0.00	0.25	4.00
3	3rd	0.00	1.25	7.25
4	4th	0.00	0.50	0.25
5	Feb-1st	0.25	0.50	0.25
6	2nd	0.00	0.50	0.25
7	3rd	0.00	0.00	0.75
8	4th	0.00	0.00	0.00
9	Mar-1st	0.00	0.00	0.00
10	2nd	0.00	0.00	0.00
11	3rd	0.00	0.00	0.00
12	4th	0.00	0.00	0.00

Table 15 Mean TMB population in Kanaka

Kanaka				
Std. week	Months	03-04	04-05	05-06
46	Nov-3rd	0.00	0.00	0.00
47	4th	0.00	0.00	0.00
48	5th	0.00	0.00	0.00
49	Dec-1st	0.00	0.00	0.00
50	2nd	0.00	0.00	0.00
51	3rd	0.00	0.00	0.50
52	4th	0.00	0.00	1.00
1	Jan-1st	0.00	0.75	0.75
2	2nd	0.00	0.00	1.00
3	3rd	0.00	0.75	2.50
4	4th	0.00	0.25	0.75
5	Feb-1st	0.00	0.00	0.25
6	2nd	0.00	0.00	0.50
7	3rd	0.00	0.00	0.25
8	4th	0.00	0.00	0.75
9	Mar-1st	0.00	0.00	0.00
10	2nd	0.00	0.00	0.00
11	3rd	0.00	0.00	0.00
12	4th	0.00	0.00	0.00

Table 14. Mean TMB population in Madakkathara-1

Table 16 . Mean TMB population in Madakkathara-2

Madakkathara-1

Std. week	Months	2003-04	2004-05	2005-06
46	Nov-3rd	0.00	0.00	0.00
47	4th	0.00	0.25	0.00
48	5th	0.00	0.25	0.00
49	Dec-1st	0.00	0.50	0.50
50	2nd	0.00	0.00	1.25
51	3rd	4.38	0.00	0.00
52	4th	4.25	0.50	6.25
1	Jan-1st	0.56	0.25	2.00
2	2nd	0.00	0.00	2.25
3	3rd	0.00	0.75	7.25
4	4th	0.00	0.00	4.25
5	Feb-1st	0.00	0.00	0.25
6	2nd	0.00	0.00	0.50
7	3rd	0.00	0.00	0.25
8	4th	0.00	0.00	0.00
9	Mar-1st	0.00	0.00	0.00
10	2nd	0.00	0.00	0.00
11	3rd	0.00	0.00	0.00
12	4th	0.00	0.00	0.00

Madakkathara-2

Std. week	Months	2003-04	2004-05	2005-06
46	Nov-3rd	0.00	0.00	0.00
47	4th	0.00	0.00	0.50
48	5th	0.00	0.00	1.00
49	Dec-1st	0.00	0.00	0.00
50	2nd	0.00	0.25	1.00
51	3rd	0.00	0.50	0.50
52	4th	1.50	0.00	2.00
1	Jan-1st	0.50	0.75	1.75
2	2nd	0.75	0.00	1.50
3	3rd	0.00	1.00	4.50
4	4th	0.00	0.00	0.75
5	Feb-1st	0.00	0.00	2.00
6	2nd	0.00	0.00	2.00
7	3rd	0.00	0.00	1.00
8	4th	0.00	0.00	0.75
9	Mar-1st	0.00	0.00	0.00
10	2nd	0.00	0.00	0.00
11	3rd	0.00	0.00	0.00
12	4th	0.00	0.00	0.00

Fig. 1 TMB Population in Anakkayam-1 for three years - CRS Madakkathara

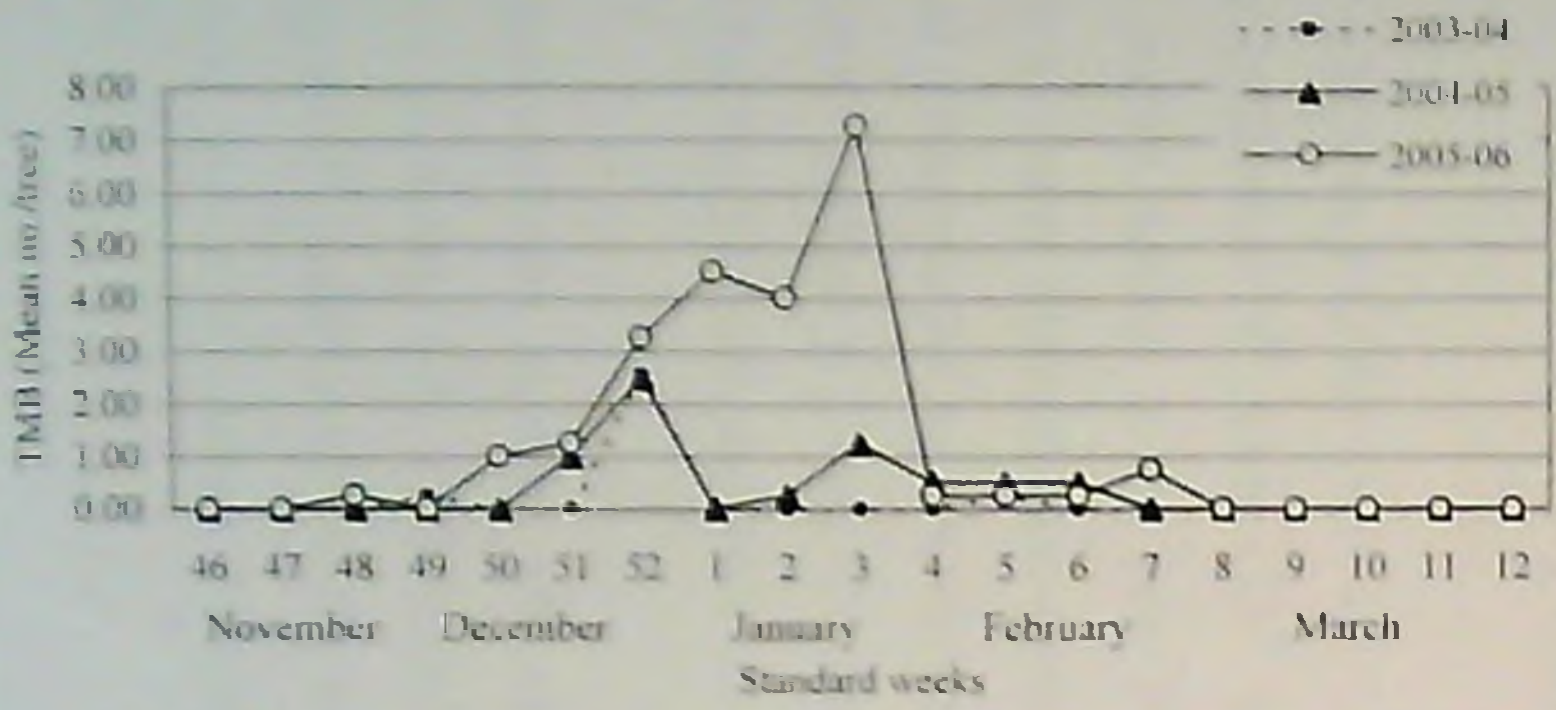


Fig. 3 TMB Population in Kanaka for three years - CRS Madakkathara

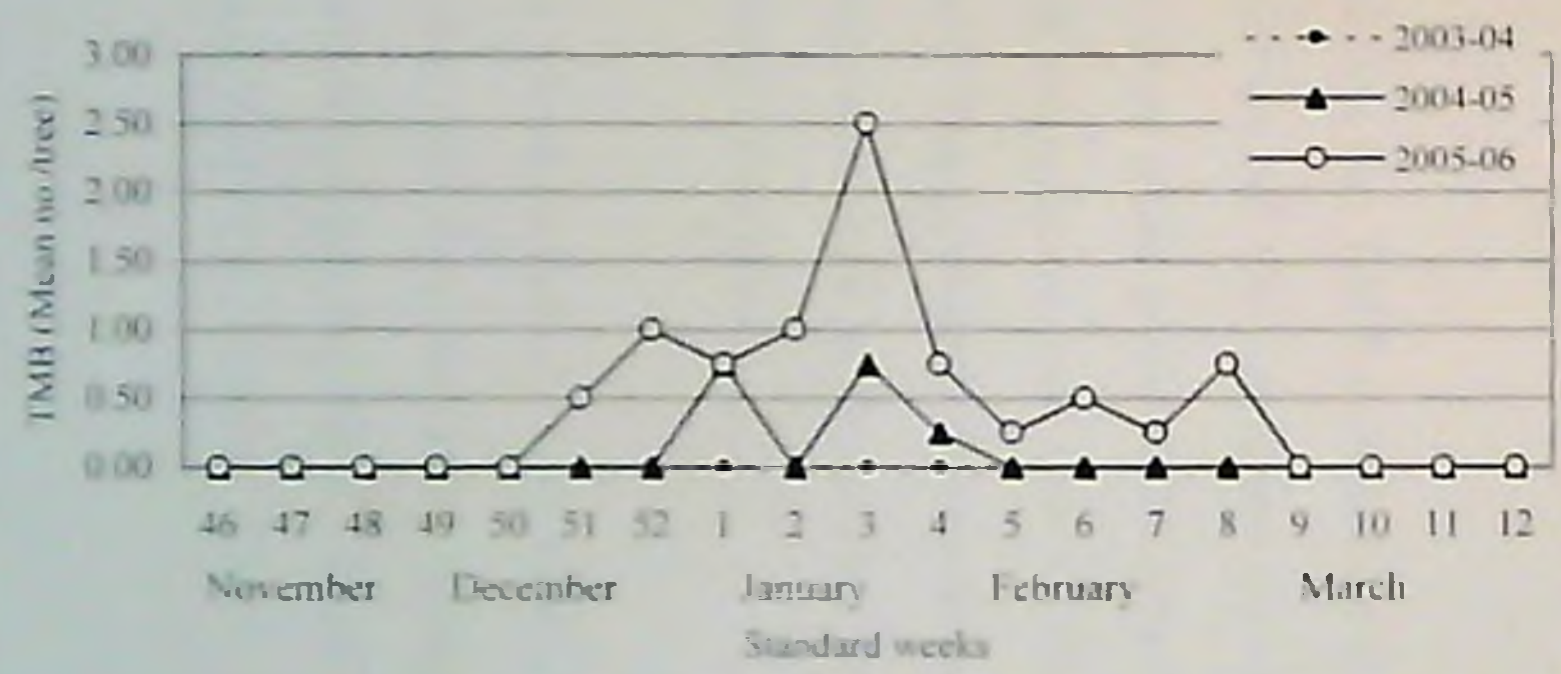


Fig 2 **TMB Population in Madakkathara-1 for three years - CRS Madakkathara**

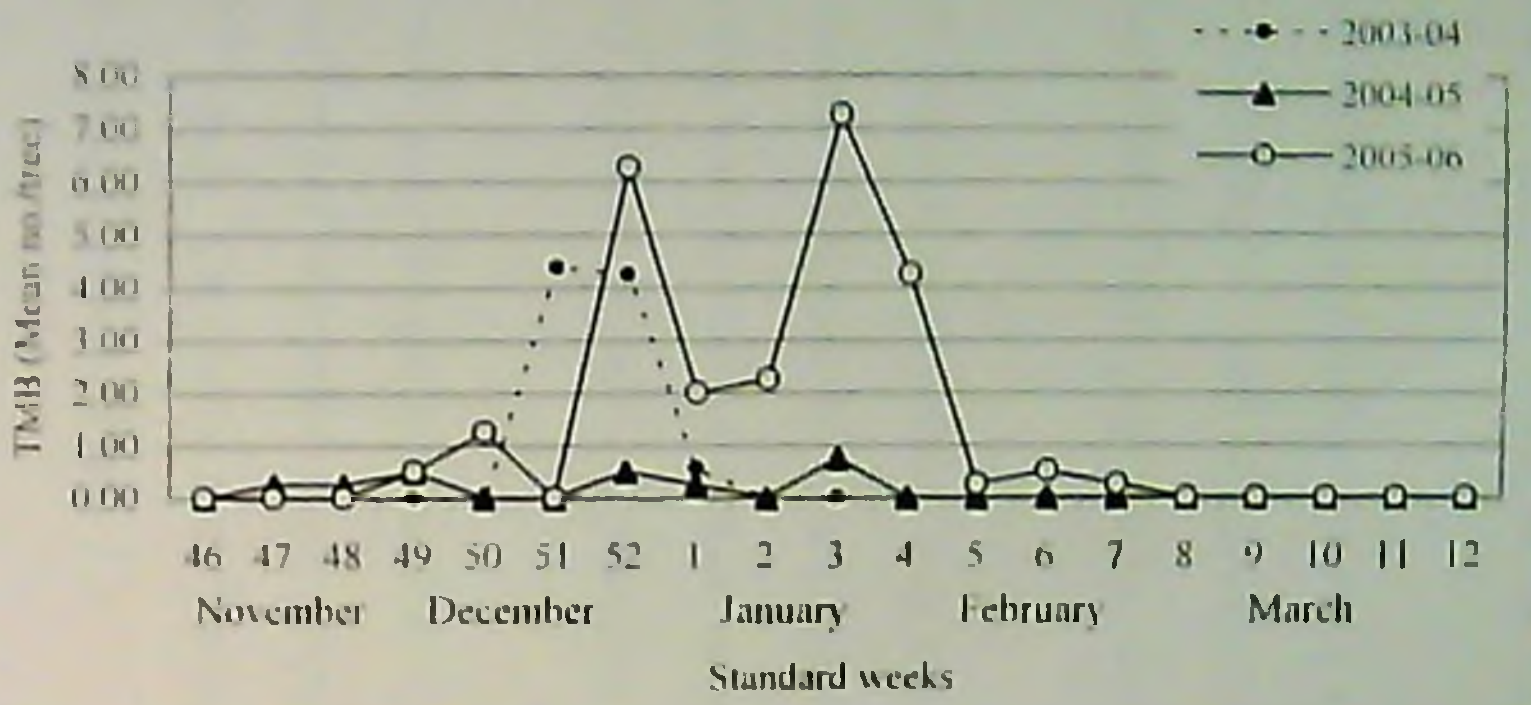
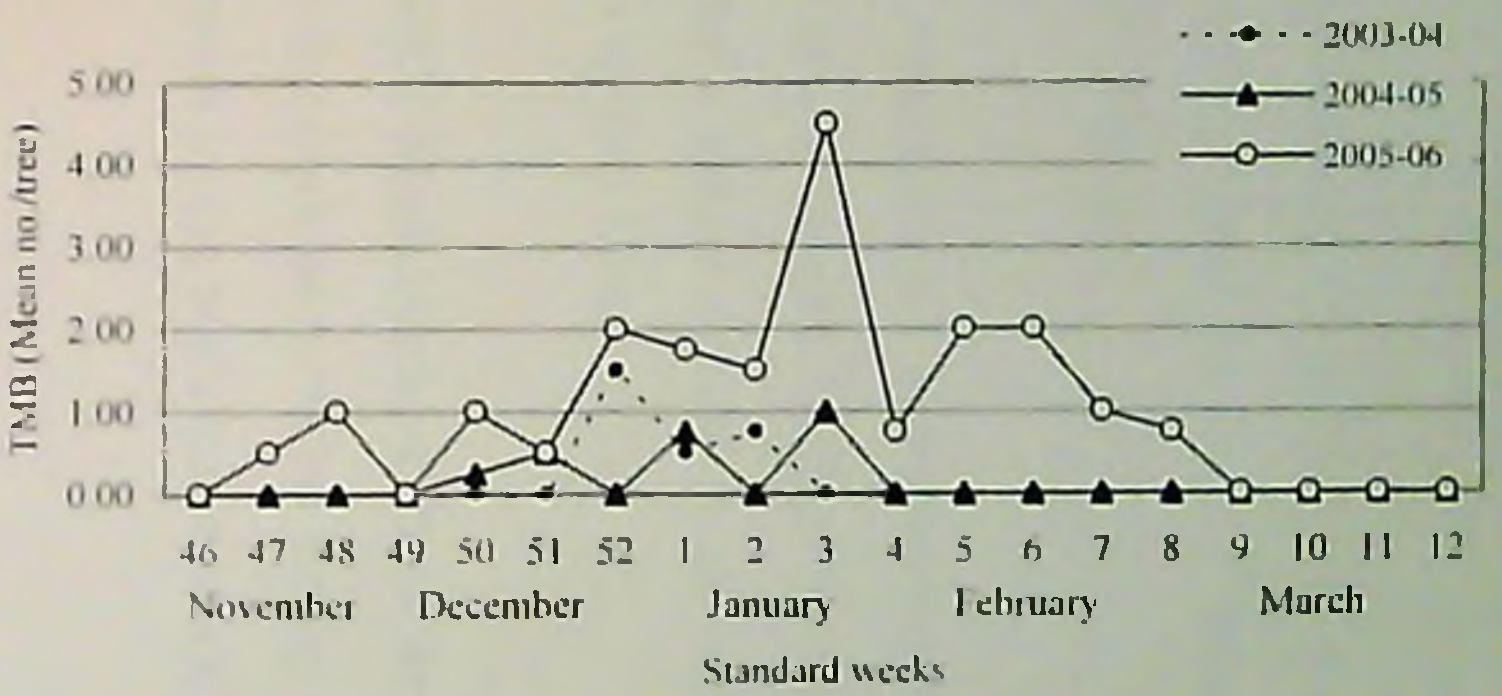


Fig 4 **TMB Population in Madakkathara-2 for three years - CRS Madakkathara**



2. TMB population over three years

TMB population recorded on all the four varieties for each year are presented in Fig. 9 to 11).

2003-04

In 2003-04, the highest population was in Madkkathara-1 during 51 & 52 week. It was followed by Anakkayam-1 and Madakkathara-2 with a single peak during 52nd week. Kanaka was free from TMB population during 2003-04 (Fig.5).

2004-05

In 2004-05, the highest population was in the variety Anakkayam-1 and attained the peak in 52nd standard week. The second low peak was during Jan. 3 rd week. Unlike during 2003-04, a low population was found to occur continuously for a longer period in all the varieties. During 2004-05 also the lowest population was in the variety Kanaka (Fig. 6).

2005-06

The year 2005-06 was the peak year for TMB at the CRS, Madakkathara. Both Anakkayam-1 and Madakkathara-1 recorded high population with the peak occurrence during 52nd week and January 3rd week. Similarly a corresponding increase in the population was observed in Madakkathara-2 and Kanaka (Fig. 7).

CONCLUSION

The three years data (2003-04 to 2005-06) revealed that the TMB population attained the first peak during December 4th week (52nd standard week) on all the varieties throughout the three year study period. Except in the year 2003-04, one more peak population was in January 3rd week. In general under Madakkathara conditions TMB population was low in the first two years of study and moderate during the third year (2005-06). The population was found to occur from the month of November at a very low intensity and attained peak in December and January and persisted till February which was more or less fluctuating throughout.

Among the varieties studied, the early varieties Anakkayam-1 and Madakkathara-1 always recorded a comparatively high population. The mid and late varieties recorded a low population during the 1st peak in 52nd week and it was relatively high during 2nd peak in January 3rd week. Kanaka, the mid season hybrid variety recorded the lowest TMB population throughout (Table 7)

Fig. 5 TMB population (Mean No.)on different varieties (2003-04)

Fig. 6 TMB population (Mean No.)on different varieties (2004-05)

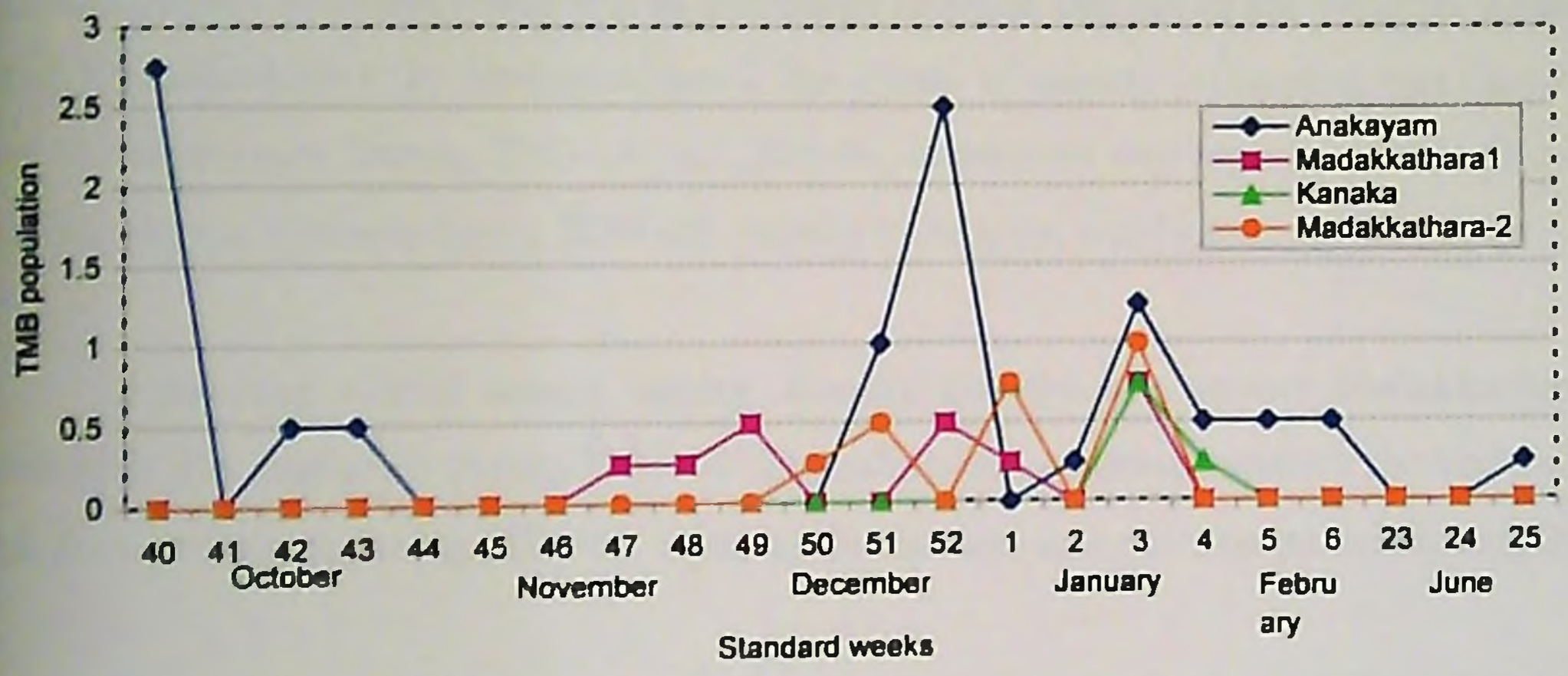


Fig. 7 TMB population (Mean No.)on different varieties (2005-06)

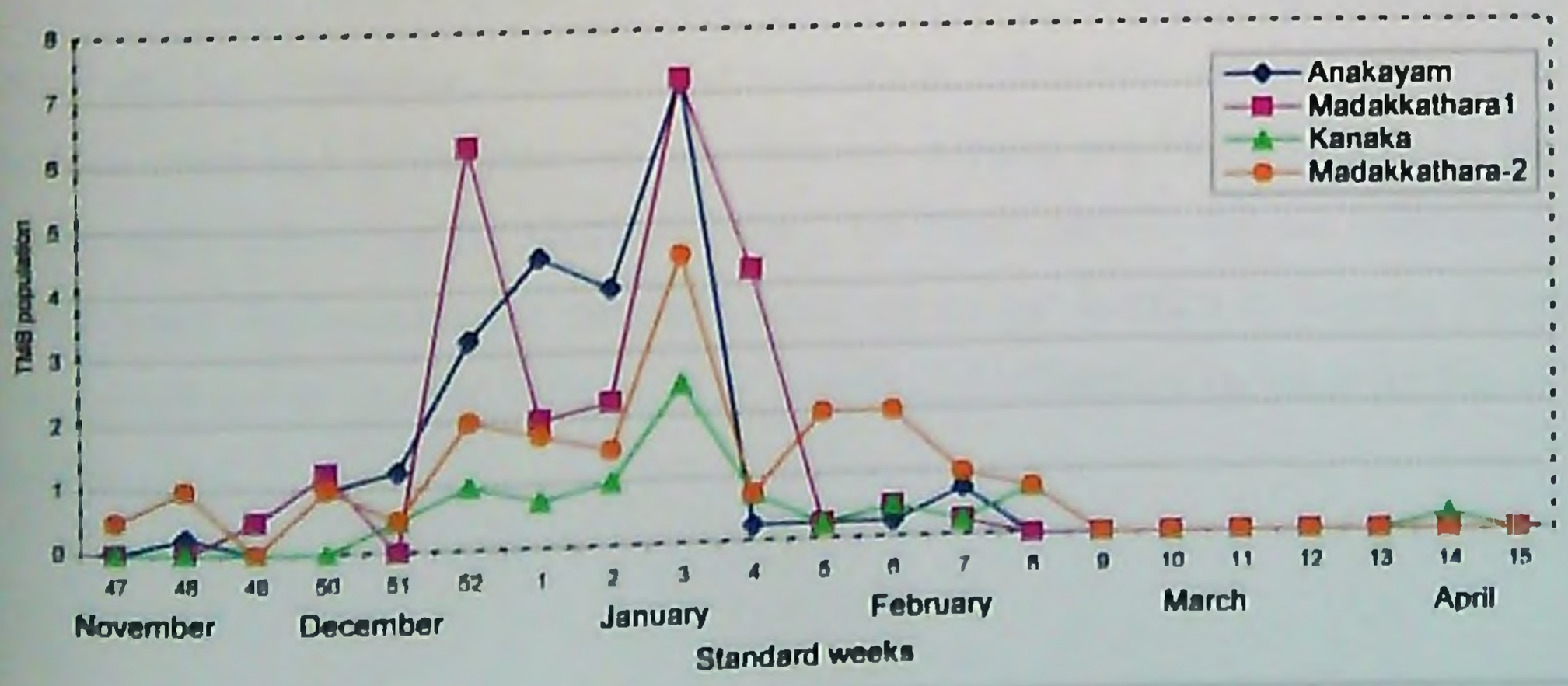


Table. 17. Over all mean TMB population in four varieties over three years (2003-06)

(Mean of 52 observations per year)

Varieties	TMB mean no.		
	2003-04	2004-05	2005-06
Anakkayam	0.058	0.202	0.447
Madakkathara-1	0.173	0.048	0.446
Kanaka	0.000	0.034	0.149
Madakkathara-2	0.053	0.048	0.284
Mean	**0.071**	**0.083**	**0.332**

3. TMB infestation as influenced by different varieties over three years (2003- 2006)

The overall mean per cent infestation on shoot, panicle and nut on four varieties over a period of three years is presented in table 18 and figures 8 to 10. In 2003-04, infestation was high in the early variety, Madakkathara-1, followed by Anakkayam -1. In both the varieties infestation was more in the case of panicle as compared to shoot. During the year 2004-05 and 2005-06, panicle infestation was low as compared to shoot and nut in the varieties Anakkayam-1 and Madakkathara-1. In Madakkathara-1, the extent of panicle infestation was found to vary over the three years. During 2003-04 and 2005-06, infestation was high on panicle as compared to shoot and nut whereas during 2004-05, panicle infestation was low.

In the case of mid season variety, Kanaka and the late variety Madakkathara-2, the infestation was negligible during 2003-04. The infestation on these varieties showed a relatively high damage on nuts during 2004-05, whereas the damage was more on panicle during 2005-06.

CONCLUSION

In general, panicle infestation was low in the early variety Anakkayam-1, as compared to shoot and nut infestation. On the other hand shoot infestation was less and panicle and nut infestation were high in the mid and late varieties, Kanaka and Madakkathara-2. However in the other early season variety Madakkathara-1, the shoot, panicle and nut infestation varied in different years. Madakkathara-1 showed a relatively longer duration of flushing, flowering and nut set, as compared to other varieties. The intensity of infestation varied according to varieties as well as years.

Fig. 8 Varietal influence on TMB infestation (2003-04)

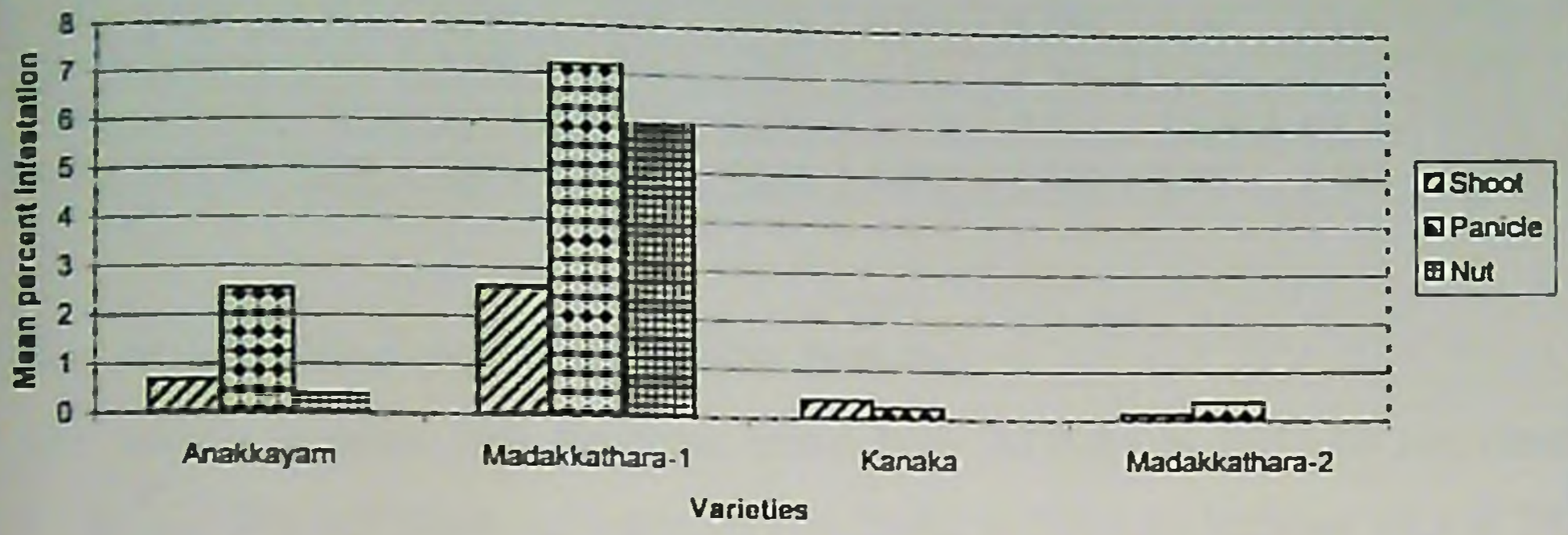


Fig. 9 Varietal influence on TMB infestation (2004-05)

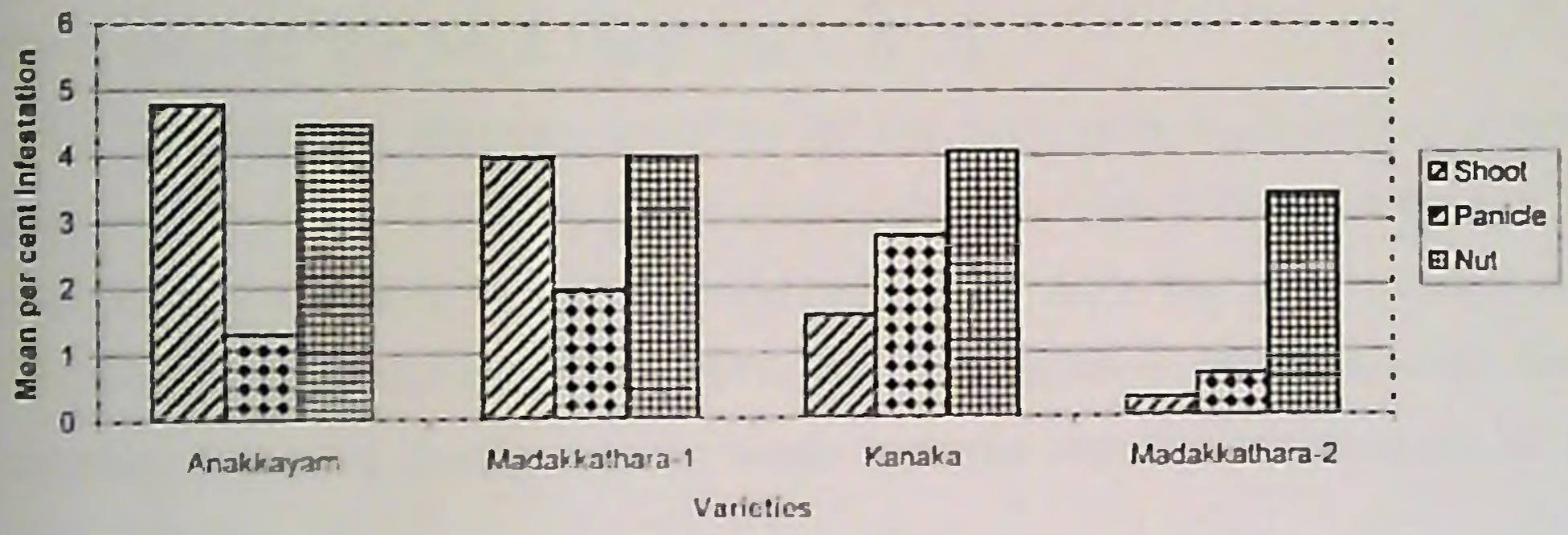


Fig. 10 Varietal influence on TMB infestation (2005-06)

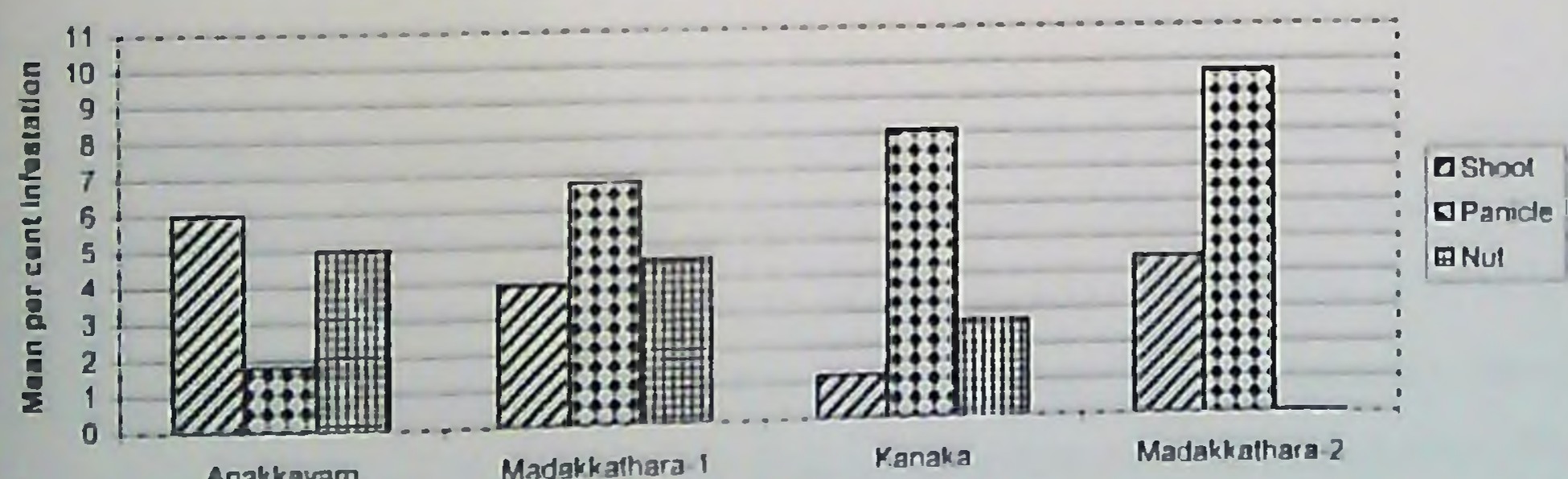


Table. 18 Varietals influence on TMB infestation over three years

Years	Varieties											
	Anakkayam-1			Madakkathara-1			Kanaka			Madakkathara-2		
	Shoot	Panicle	Nut	Shoot	Panicle	Nut	Shoot	Panicle	Nut	Shoot	Panicle	Nut
2003-04	0.682	2.536	0.383	2.615	7.188	5.978	0.388	0.235	0.00	0.125	0.381	0.00
2004-05	4.765	1.303	4.463	3.966	1.941	3.988	1.569	2.780	4.065	0.278	0.640	3.406
2005-06	5.998	1.797	4.994	3.914	6.749	4.571	1.194	8.097	2.676	4.418	9.696	0.036
Mean	3.815	1.879	3.280	3.498	5.293	4.846	1.050	3.704	2.247	1.607	3.572	1.147

4. Weather data for three years (2003-04 to 2005-06).

The weekly weather data for three years from 2003-04 to 2005-06 are presented in figures 11 to 16. The minimum temperature was found to fluctuate between 22 and 24^{0}C from the 42nd standard week. The minimum temperature reached below 20 ^{0}C during most of the weeks of December, January and February months with an up and down trend. The maximum temperature fluctuated between 30 and 32^{0}C up to February 2nd week and after that it increased gradually to above 32 ^{0}C in Feb. & March (Fig. 11 & 12).

The forenoon and afternoon humidity for the three years fluctuated considerably. As compared to 2003-04 and 2004-05, forenoon humidity was high (>75 %) in the year 2005-06 during the flushing and early flowering period (upto December). The A.N. humidity during the period showed a gradual decrease from > 65% to < 35%. However, after December, the FN and A.N. humidity fluctuated greatly over the weeks and were more or less same for all the three years (Fig. 13 & 14).

The wind speed was relatively low during the flushing and panicle initiation stage during 2005-06 as compared to 2003-04 and 2004-05. (Fig. 15 & 16).

5. Correlation Analysis

The data on TMB population recorded at weekly intervals for the three consecutive years from September 2003 to July 2006 was correlated with the weather variables such as minimum temperature, maximum temperature, forenoon relative humidity, afternoon relative humidity, , brightness, wind speed, rainfall and rainy days. The weather data was taken as the cumulative mean of previous fourteen days from the date of recording of TMB population. The highest TMB population recorded at each week irrespective of the varieties was taken for the analysis. The result is presented in table 19. A highly significant negative correlation was observed for

Fig. 11 **Minimum temperature (°C) for three years - CRS Madakkathara**

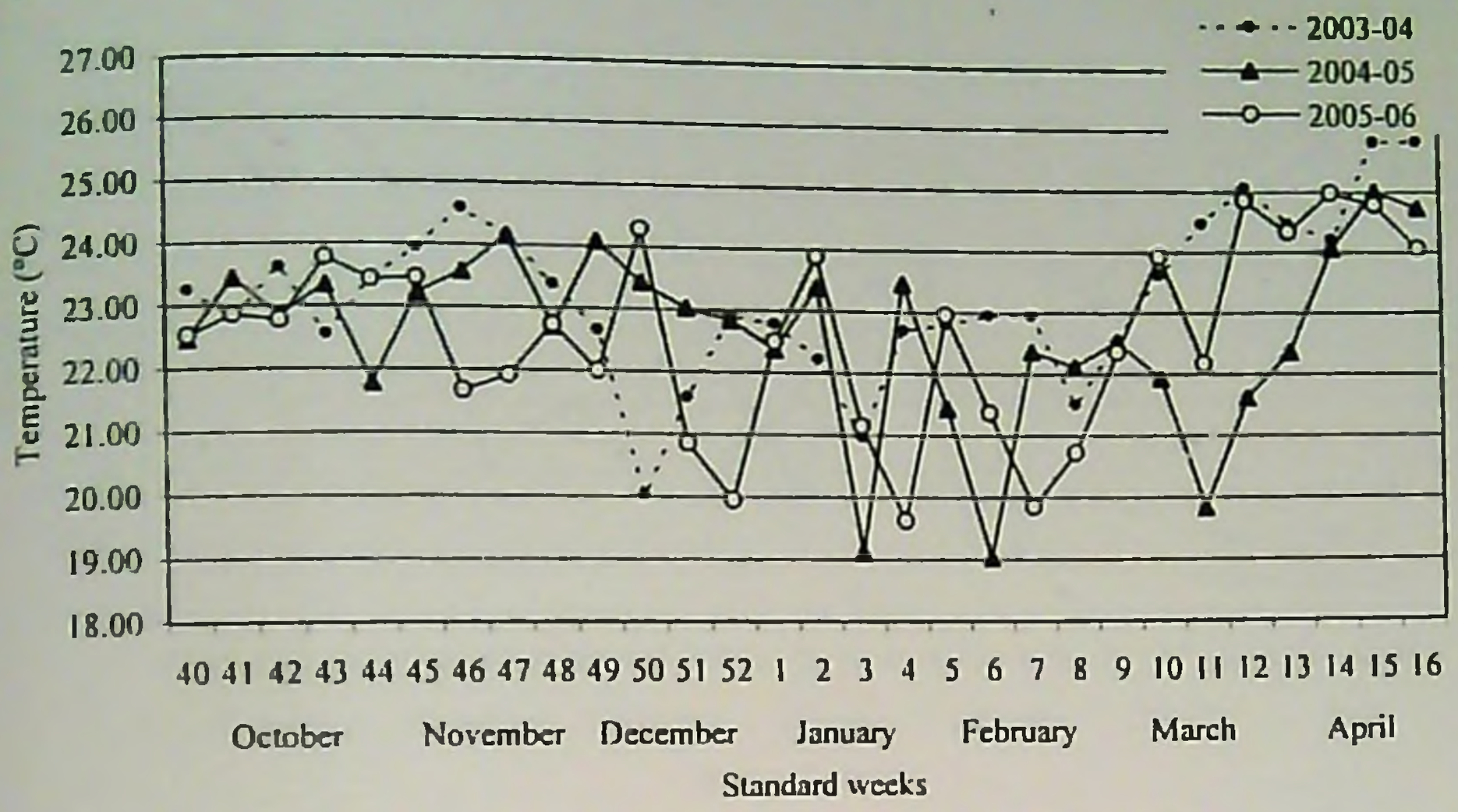


Fig. 12 **Maximum temperature (°C) for three years - CRS Madakkathara**

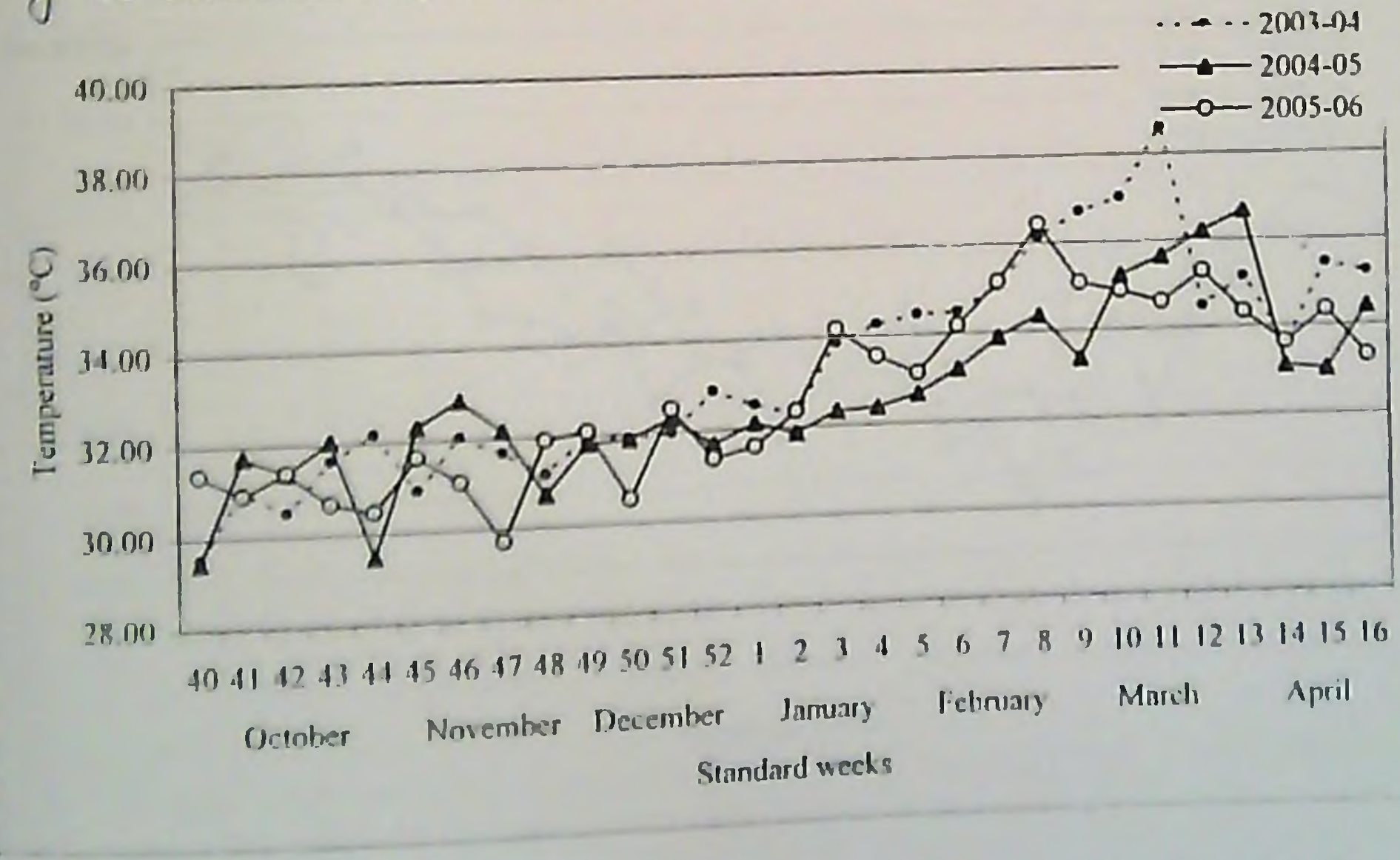


Fig 13 **Forenoon humidity for three years - CRS Madakkathara**

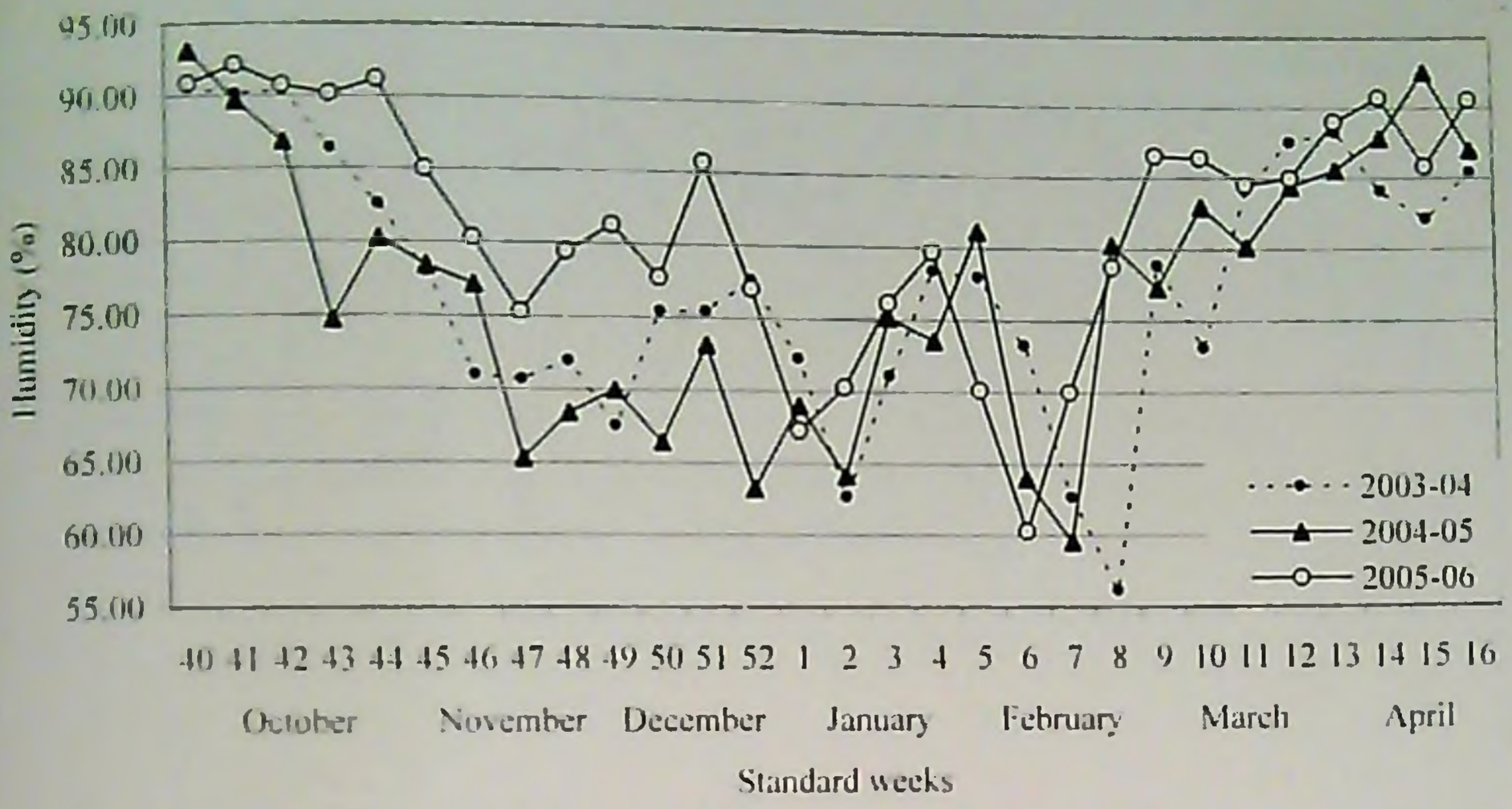


Fig 14 **Afternoon humidity for three years - CRS Madakkathara**

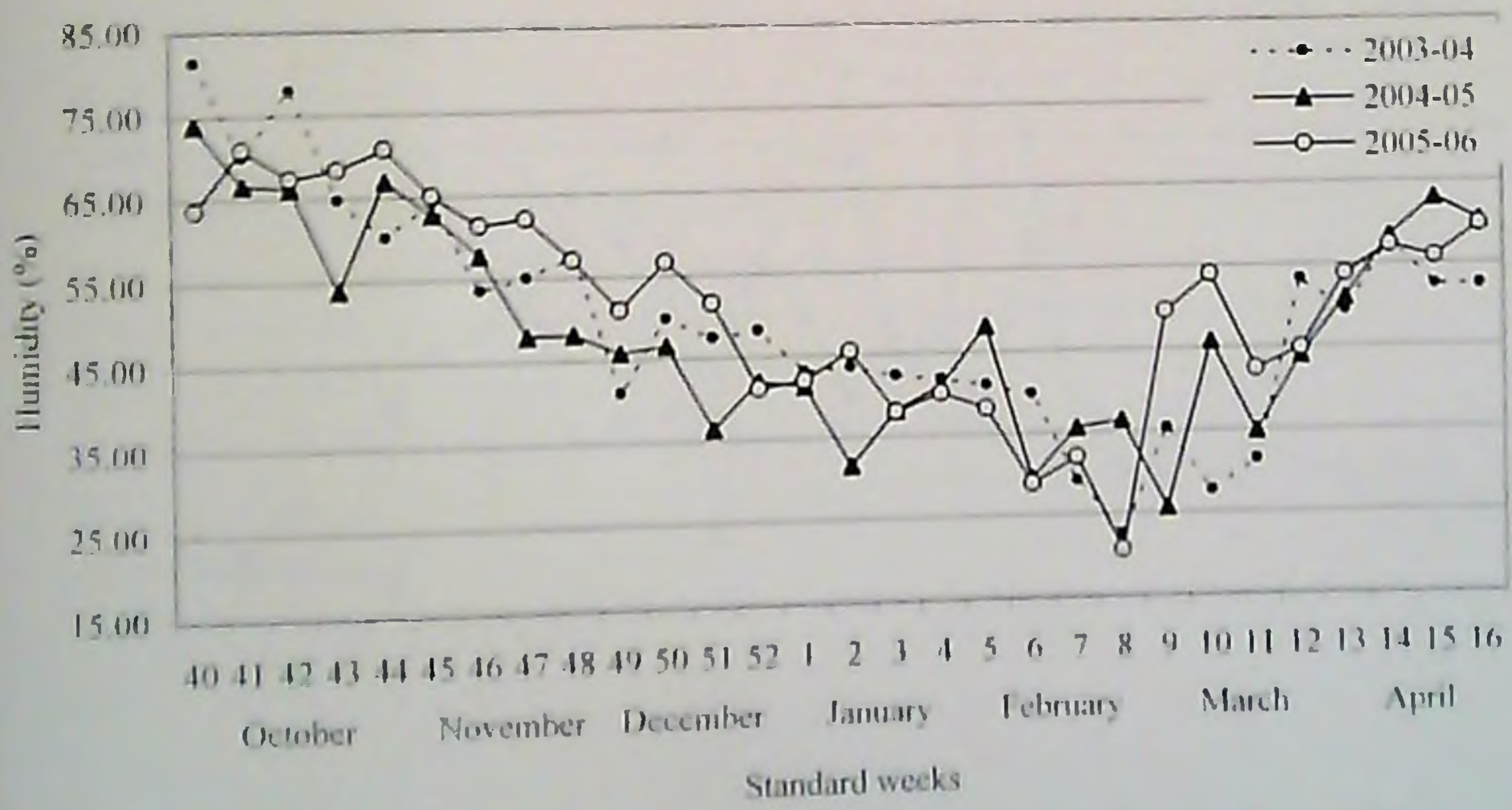


Fig - 15 **Brightness for three years - CRS Madakkathara**

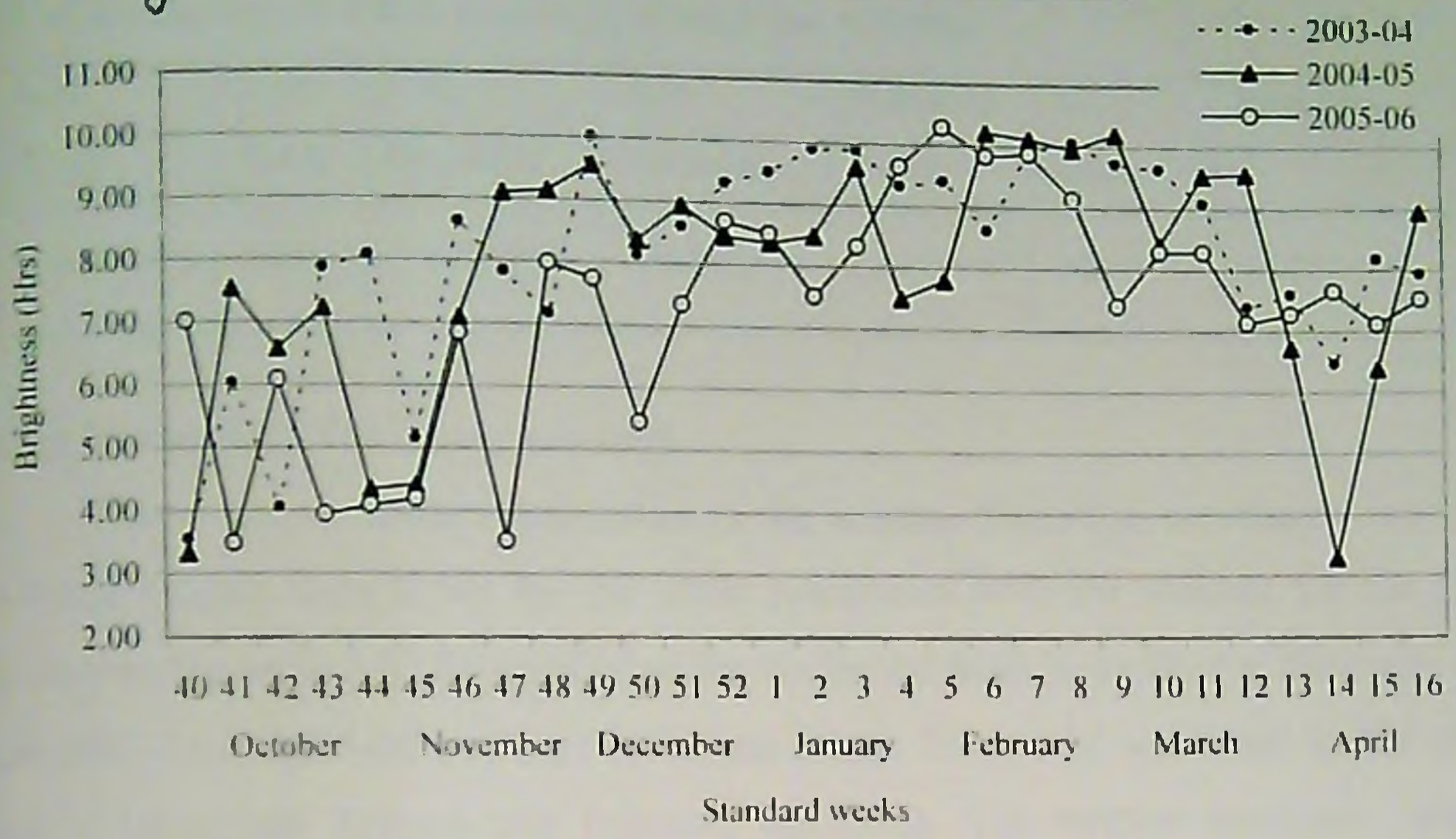
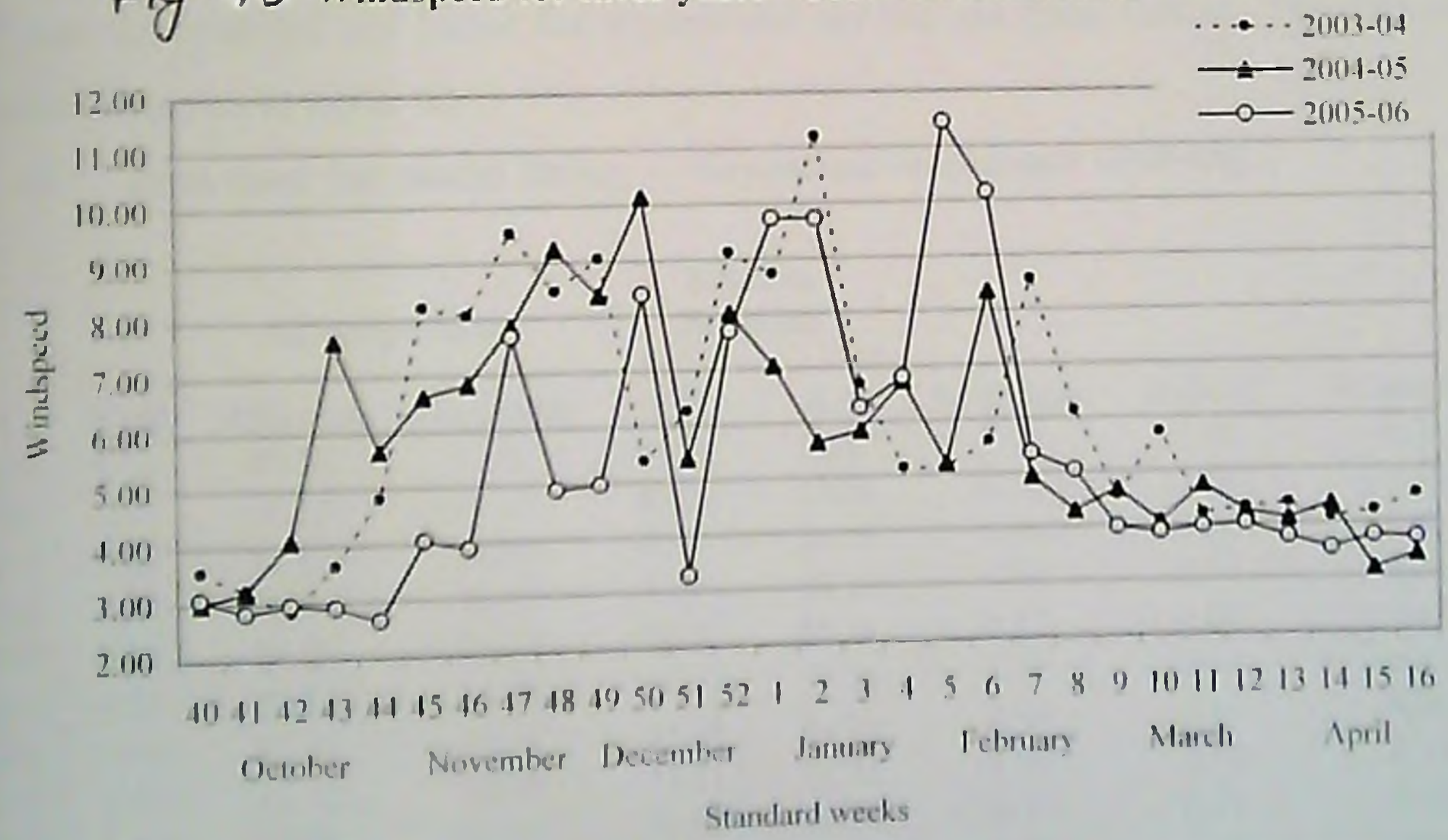


Fig - 16 **Windspeed for three years - CRS Madakkathara**



the weather variables such as minimum temperature, forenoon relative humidity, afternoon relative humidity and rainfall. A significant positive correlation was observed with bright sunshine hours and wind speed.

Table 19 Correlation of TMB population with the weather

	Min. Temp	Max. Temp	F.N Humidity	A.N Humidity	Sunshine hours	Wind speed	Rainfall	Rainy days
TMB	**– 0.337(**)**	**0.054**	**– 0.337(**)**	**– 0.295(**)**	**0.251(**)**	**.420 (**)**	**–0.231 (**)**	**–0.286 (**)**

6. Weather Modeling (Non-linear models)

There was no linear relationship in the weather factors in correlation analysis. So the non-linear models were fitted for the TMB population with the weather for the previous fourteen days as lag period. TMB population for the period from November to February of each year from 2003-04 to 2005-06 was used for model fitting. The model was fitted for the month of November – December, January and February separately. The weather variables used in the model and the equation substituted with the values are as given below. During November – December the rainfall and rainy days were also found influencing. During January and February rainfall was not received and hence the models did not include these factors. The data used for the models are given in table 20.

Table 20 Data used for model fixing (November-December 2003-06)

		Air temperature		Relative Humidity					
Date	**TMB**	**Minimum**	**Maximum**	**F.N**	**A.N**	**Brightness**	**Rainfall**	**Windspeed**	**Rain day**
05/11/03	0.00	23.00	31.91	84.50	62.57	7.98	2.66	4.24	0.29
10/11/03	0.00	23.26	31.69	80.36	61.93	6.78	1.83	5.44	0.21
14/11/03	0.00	23.82	31.60	79.21	60.79	6.96	1.54	7.21	0.14
22/11/03	0.00	24.28	31.55	73.79	58.93	7.55	0.01	8.57	0.00
28/11/03	0.00	24.26	31.82	70.00	53.14	8.22	0.00	8.41	0.00
06/12/03	0.06	23.75	31.46	70.43	53.14	7.93	0.14	9.41	0.00
12/12/03	0.00	22.49	31.54	69.29	48.14	8.59	0.14	8.96	0.00
20/12/03	4.38	21.11	32.09	75.21	47.21	8.85	0.00	6.13	0.00
27/12/03	4.50	20.99	32.29	78.50	48.79	8.50	0.00	5.29	0.00
03/11/04	0.00	23.00	30.85	77.36	59.36	6.34	7.69	6.76	0.29
10/11/04	0.00	22.29	30.82	78.36	63.71	5.26	9.14	6.24	0.29
17/11/04	0.00	22.88	32.27	78.57	61.57	5.26	4.17	6.66	0.14
23/11/04	0.25	23.79	32.66	72.79	55.71	6.79	0.60	6.88	0.07
30/11/04	0.25	23.79	32.11	68.71	49.00	9.02	0.00	8.24	0.00
05/12/04	0.50	23.26	31.20	68.50	48.86	8.99	0.00	8.89	0.00
12/12/04	0.25	23.44	31.28	68.93	45.50	9.36	0.00	8.52	0.00

21/12/04	0.50	23.43	31.97	67.86	41.57	8.92	0.00	8.52	0.0
28/12/04	2.50	23.15	32.07	68.79	40.43	8.71	0.00	7.21	0.0
02/11/05	0.00	23.49	30.71	90.79	71.00	3.89	4.11	2.79	0.3
07/11/05	0.00	23.49	30.60	90.07	71.00	3.81	2.58	2.94	0.14
14/11/05	0.00	23.45	30.95	87.71	69.86	3.76	0.93	3.39	0.07
21/11/05	0.00	21.93	31.53	80.43	59.07	6.10	0.59	3.89	0.07
28/11/05	1.00	21.91	30.76	76.57	57.79	5.88	0.00	6.42	0.0
06/12/05	0.50	23.11	30.73	80.79	62.79	5.71	0.06	6.58	0.0
12/12/05	1.25	22.23	31.44	81.79	56.79	6.76	0.23	4.64	0.0
19/12/05	1.25	22.77	31.46	77.14	51.50	6.91	0.17	6.44	0.0
26/12/05	6.25	22.09	32.14	81.29	50.43	7.55	0.00	5.84	0.0

January **2003-06**

		Air temperature		Relative Humidity			
Date	**TMB**	**Minimum**	**Maximum**	**F.N**	**A.N**	**Brightness**	**Wind speed**
01/01/04	0.94	22.35	32.44	75.57	47.43	8.96	8.09
08/01/04	0.75	23.09	32.70	75.36	45.43	9.41	9.27
17/01/04	0.00	22.17	32.49	67.57	42.86	9.72	9.84
24/01/04	0.00	21.51	33.43	68.64	41.86	9.77	7.58
05/01/05	0.75	22.78	31.80	68.50	42.93	8.13	7.21
12/01/05	0.25	23.26	31.98	67.14	39.29	7.95	6.66
19/01/05	0.75	21.72	32.10	67.57	33.86	9.11	5.96
25/01/05	0.50	20.94	32.33	71.50	36.86	9.04	6.34
02/01/06	4.50	20.56	31.81	81.43	44.43	8.41	6.52
09/01/06	4.00	21.60	31.36	70.57	42.21	8.21	9.16
16/01/06	7.25	23.29	32.11	69.36	44.57	7.99	9.49
23/01/06	4.25	21.90	33.51	74.29	38.93	8.48	7.61
30/01/06	2.00	20.27	33.86	76.86	38.14	9.04	6.75

February **2003-06**

		Airtemperature		RelativeHumidity			
Date	**TMB**	**Minimum**	**Maximum**	**F.N**	**A.N**	**Brightness**	**Windspeed**
03/02/04	0.25	22.66	34.14	78.79	41.86	9.39	5.36
07/02/04	0.00	22.68	34.47	77.14	41.64	9.49	4.99
14/02/04	0.00	22.94	34.56	74.71	39.64	9.10	5.81
27/02/04	0.00	21.98	35.69	57.36	24.36	10.09	7.18
02/02/05	0.50	22.57	32.57	76.14	43.79	7.64	5.84
09/02/05	0.00	20.96	32.77	76.93	42.50	8.31	5.68
17/02/05	0.00	19.94	33.19	62.07	30.71	10.06	7.23
24/02/05	0.00	21.77	34.04	67.86	34.64	10.09	5.11
06/02/06	2.00	21.81	33.32	72.93	40.36	10.01	9.50
13/02/06	1.00	22.20	33.70	65.07	33.29	10.06	10.56
20/02/06	0.75	20.44	34.77	65.86	29.36	9.82	7.42

The weather variables used in the models and the equation substituted are given below

$Y = \text{Constant} + a_1 x_1^2 + a_2 x_2^2 + a3\, x_3^2 + a_4 x_4^2 + a_5 x_5^2 + a_6 x_6^2 + a_7 x_7^2 + a_8 x_8^2$ where a_1, a_2, a_3, a_4 --- etc are the coefficients to be estimated and x_1, x2, x3, x4... etc are weather parameters

RESULTS

The observed and predicted values obtained in the non-linear models are presented in table 21. The variance explained in the above non-linear models was more than 72 % for all the three periods (November- December, January and February). The predictability of the model was highest (79.03 %) during the month of November- December (Fig. 17 to 19).

CONCLUSION

It is to be presumed that the weather variables prevailed during the November-December period were more influencing in TMB build up. The influence of weather variables when considered individually were non significant and hence the most influencing or critical weather variable on TMB population could not be assessed. The prediction model prepared based on the present three year study revealed the influence of more than one weather parameter in the population build up of TMB. The TMB population at CRS, Madakkathara was low to moderate and only one year (2005-06) has got a moderate population. The study has to be continued to get the population data at least for a minimum of five years to have a confirmative result on the influence of weather on TMB population and for getting prediction models.

November - December	Variance explained
$Y = -16.7524 - 0.01003\ x_1^2 + 0.012335\ x_2^2 + 0.002837\ x_3^2 - 0.00241 x_4^2 - 0.0021\ x_5^2 + 0.024306\ x_6^2 + 0.036141\ x_7^2 - 14.1434\ x_8^2$	79.028 %
January	
$Y = 7.463347 - 0.01602\ x_1^2 + 0.008064\ x_2^2 + 0.001009 x_3^2 - 0.00142\ x_4^2 - 0.17641\ x_5^2 + 0.076383\ x_6^2$	72.523 %
February	
$Y = -4.70092 - 0.00557\ x_1^2 + 0.004041\ x_2^2 + 6.4 \times 10^{-6}\ x_3^2 + 0.001236 x_4^2 + 0.00297\ x_5^2 + .022697 x_6^2$	77.142%

Where Y= Predicted TMB population

X_1 = Minimum temperature (cumulative 14 days before)
X_2 = Maximum temperature ,,
X_3 = Forenoon Relative humidity
X_4 = Afternoon Relative humidity ,,
X_5 = Sunshine hours
X6 = Rainfall
X7 = Wind speed
X8 = Rainy days

Table : 21 Observed and predicted values during different periods

Nov-Dec 2003-06			January 2003-06			February 2003-06		
Period	Predictd	observed	Period	Predictd	observed	Period	Predictd	observed
C:1	0.842654	0.00	C:1	1.349759	0.94	C:1	0.267034	0.25
C:2	-0.31822	0.00	C:2	1.266288	0.75	C:2	0.249417	0.00
C:3	0.309597	0.00	C:3	0.819724	0.00	C:3	0.18803	0.00
C:4	-0.78234	0.00	C:4	-1.13159	0.00	C:4	-0.01771	0.00
C:5	-0.66615	0.00	C:5	1.747075	0.75	C:5	0.101311	0.50
C:6	0.126935	0.06	C:6	1.622493	0.25	C:6	0.400307	0.00
C:7	1.213099	0.00	C:7	-0.74769	0.75	C:7	0.214934	0.00
C:8	3.339153	4.38	C:8	0.759789	0.50	C:8	-0.25112	0.00
C:9	4.294459	4.50	C:9	3.507173	4.50	C:9	1.530409	2.00
C:10	0.007881	0.00	C:10	4.939357	4.00	C:10	1.3735	1.00
C:11	-0.16656	0.00	C:11	4.733704	7.25	C:11	0.488111	0.75
C:12	0.893239	0.00	C:12	3.983392	4.25	C:12	-0.04423	0.00
C:13	-0.18053	0.25	C:13	3.090526	2.00			
C:14	0.173433	0.25						
C:15	0.067159	0.50						
C:16	0.728494	0.25						
C:17	1.702165	0.50						
C:18	1.758078	2.50						
C:19	-0.58006	0.00						
C:20	0.270161	0.00						
C:21	-0.06494	0.00						
C:22	1.025409	0.00						
C:23	0.098534	1.00						
C:24	0.036668	0.50						
C:25	2.359906	1.25						
C:26	2.137673	1.25						
C:27	4.814097	6.25						

Fig 17 **Model fit for NOV-DEC (CRS)**

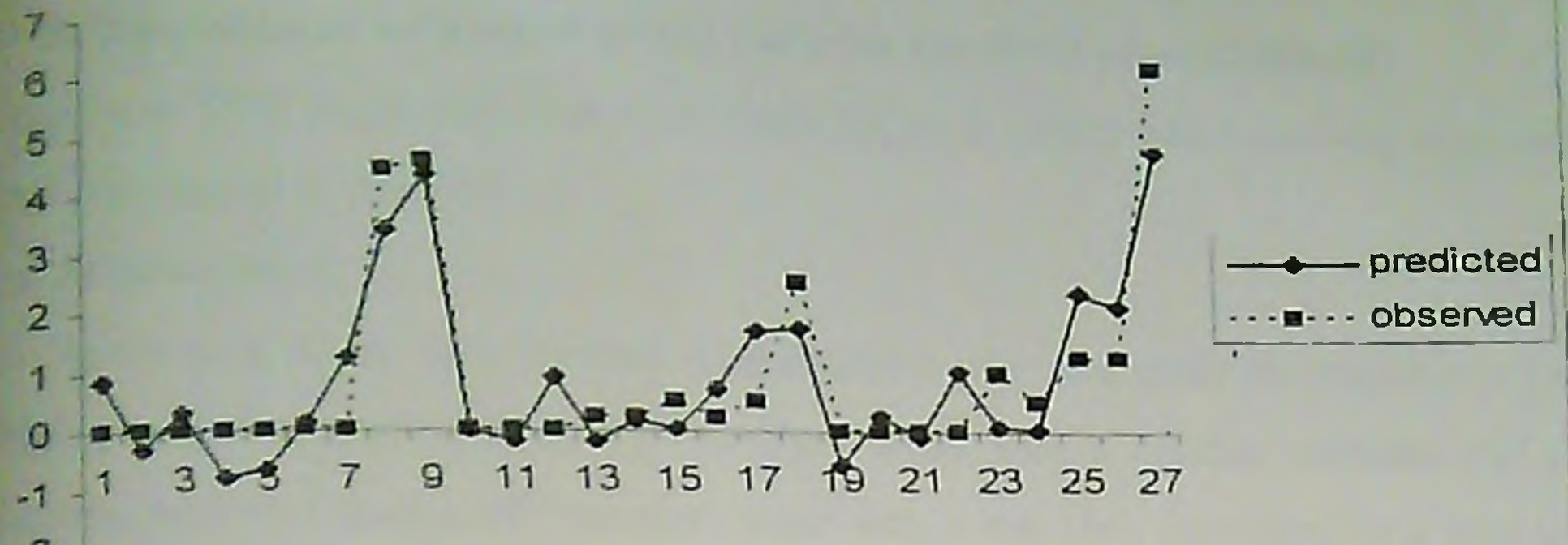


Fig 18 **Model fit for JAN (CRS)**

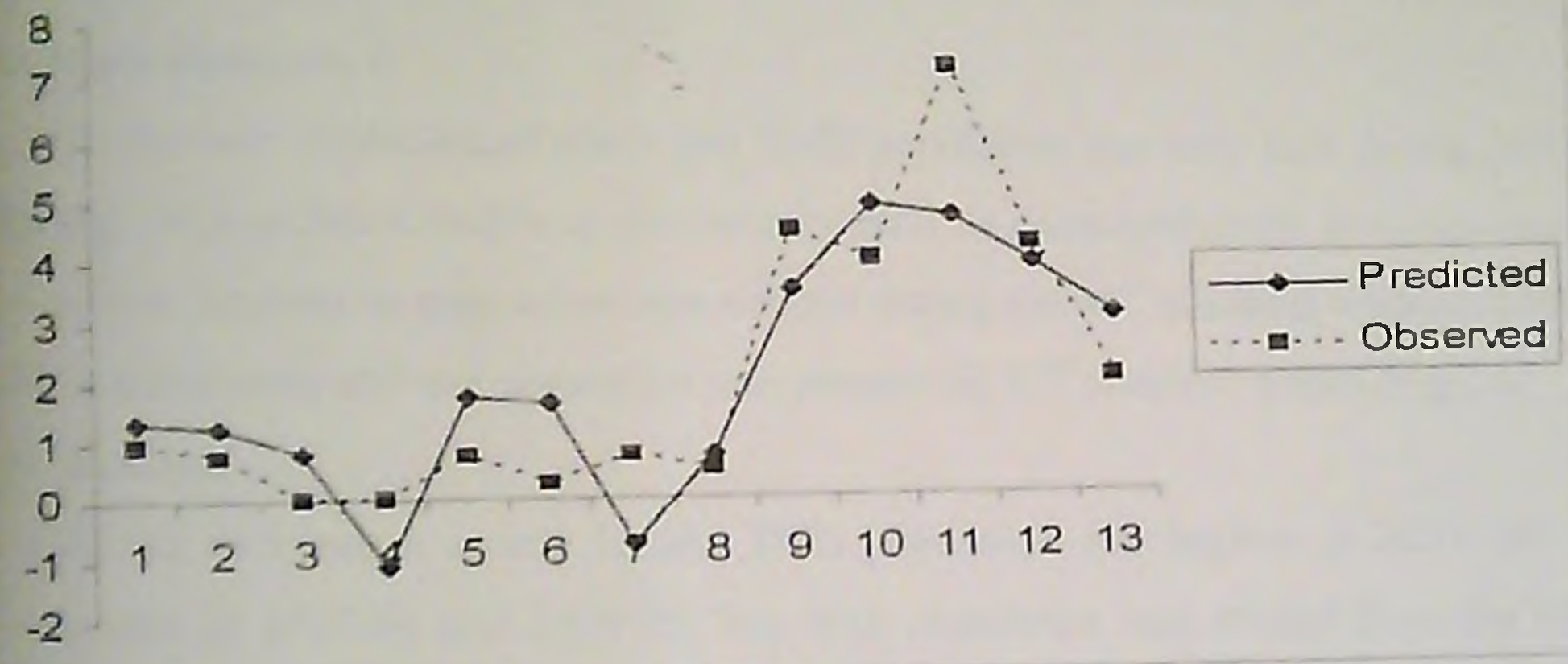
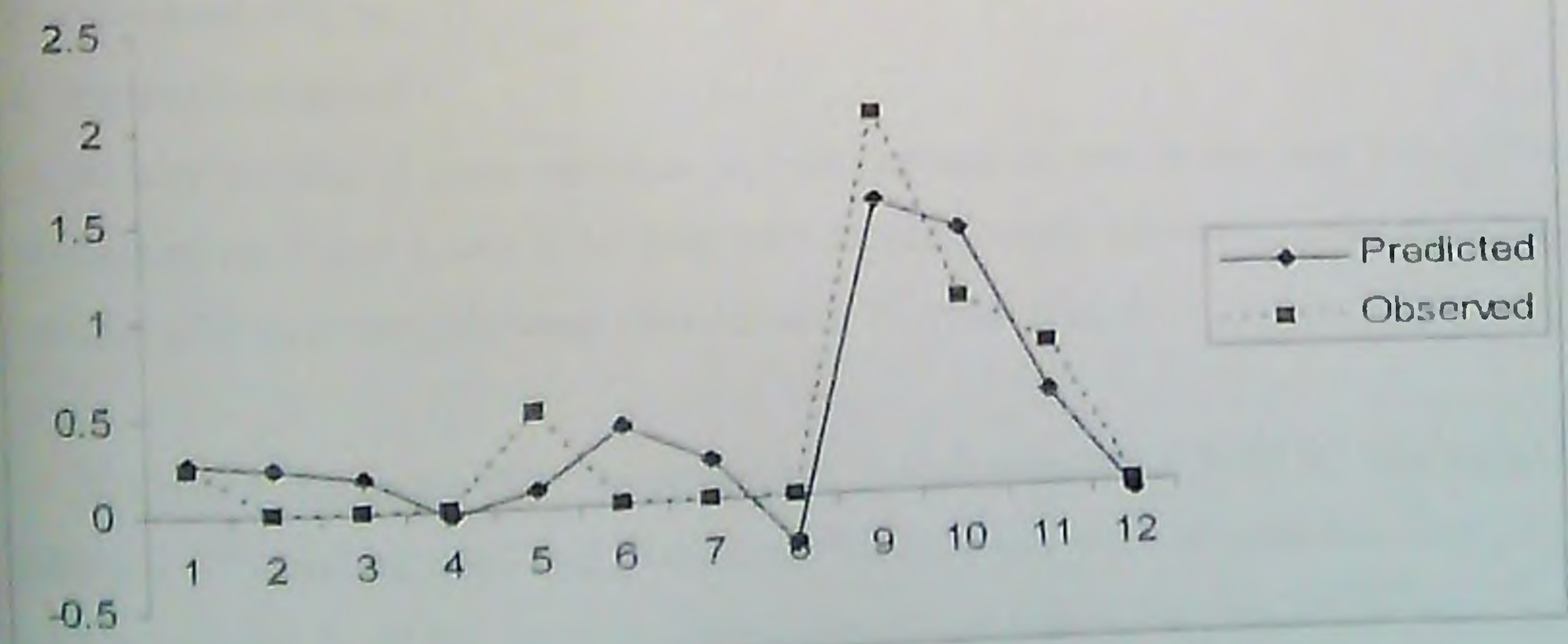


Fig 19 **Model fit for FEB (CRS)**



RESULTS: 2003- 06 (RARS, PILICODE)

TMB Population as influenced by the varieties for three years (2003-06)

The mean TMB population over three years for each variety was examined separately and represented in Fig 20to 23.

a. Anakkayam-1

In the case of the early variety Anakkayam-1, the year 2005-06 recorded a very high population starting from 41st standard week with a gradual increase and the highest peak was during 49th standard week which was then decreased to a very low level and the population was present till 15th standard week. In the year 2004-05 Anakkayam-1 recorded the lowest population whereas the population was moderate in 2003-04 (Fig.20).

b. Madakkathara-1

In the case of Madakkathara-1 also TMB population was very high during 2005-06 and the population builds up started very early as compared to the previous years. A sudden increase in population was noticed during the 40th standard week in 2005-06. A continuous and low population was present till 22nd standard weeks (Fig.21).

c. Kanaka

In the mid season variety kanaka TMB population was highest in 2005- 06 as compared to 2003-04 and 2004-05. The high population was started from the 48th standard week in 2005-06 which persisted till 7th standard week after that population was decreased. The population was found to persist continuously throughout the year at a low level (Fig 22).

d. Madakkathara-2

Similar to that of other varieties highest population was in the year 2005-06 in Madakkathara-2 and it was > 10 from 48th standard week. However, population was reduced after to a very low level after January 3rd week (Fig.23).

In general, under the Pilicode conditions a high population build up was noticed after the 47th standard week and it continued till February end (8th standard week) for all the varieties. In all the varieties highest population was in the year 2005-06

Fig. 20 TMB Population in Anakkayam-1 for three years-RARS, Pilicode

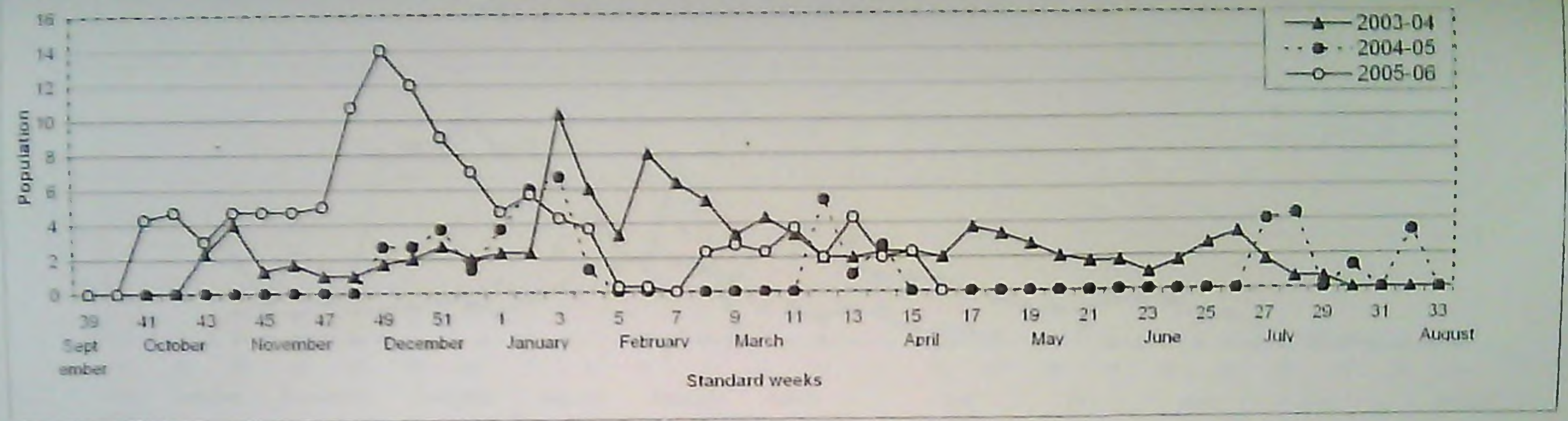


Fig. 21 TMB Population in Madakkathara-1 for three years-RARS, Pilicode

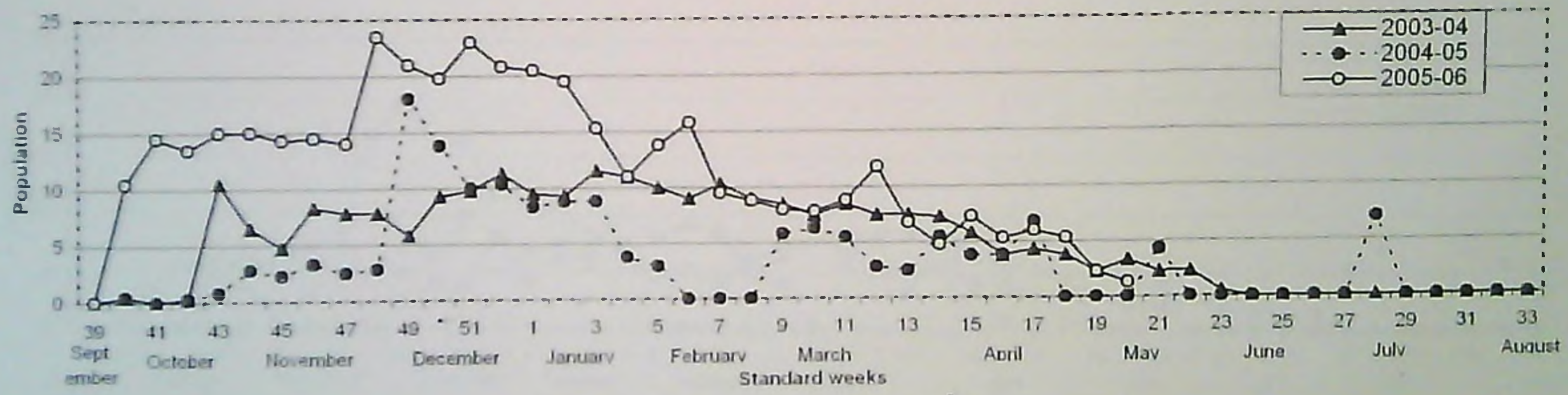


Fig. 22 TMB Population in Kanaka for three years-RARS, Pilicode

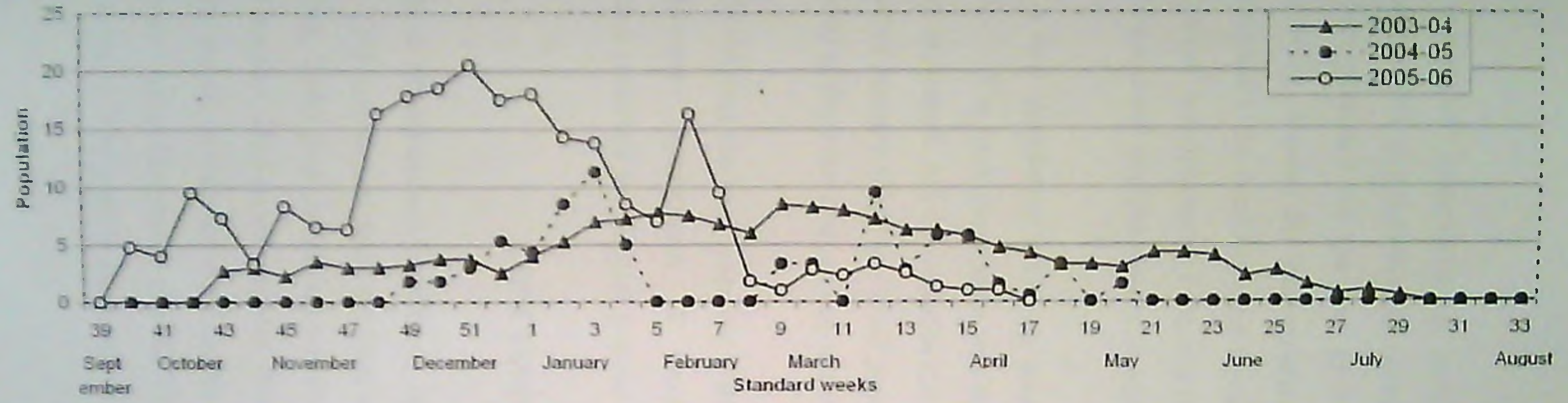
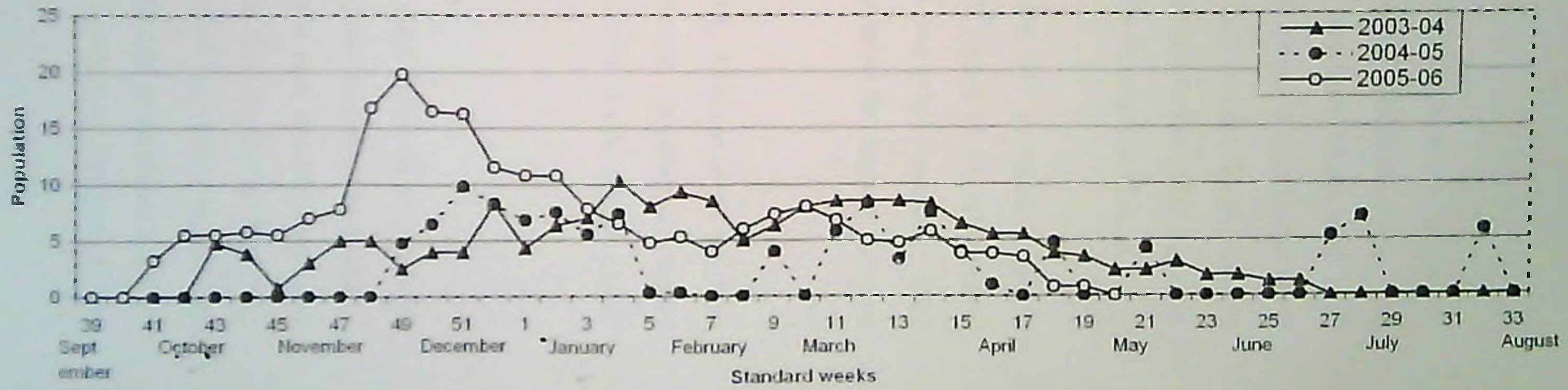


Fig. 23 TMB Population in Madakkathara-2 for three years-RARS, Pilicode



2. TMB population over three years

TMB population recorded on all the four varieties for each year are depicted in Fig. 24 to 26 .

)

2003-04

In 2003-04, the highest population was in Madkkathara-1 throughout the period. A sudden increase in the population was observed from the 43rd standard week. The high population persisted till the end of February (8th standard week) and then decreased gradually. Among the four varieties the lowest population was in the early variety Anakkayam-1. In Anakkayam-1 there were two peaks in population , one in January third week and another in February third week whereas in the other varieties the population persisted continuously with small fluctuations throughout (Fig.24).

2004-05

In 2004-05, a low population build up was noticed in the 44th standard week in Madakkathara- 1. The high population was started from 49th week in Madakkathara-1, after that it decreased. All the varieties showed more or less same population after the third week of January (Fig.25). TMB population was present throughout the year and it fluctuated at short intervals of one to two weeks.

2005-06

The year 2005-06 was the peak year for TMB at the RARS, Pilicode in all the four varieties. However Anakkayam -1 recorded the lowest population, while Madakkathara-1 recorded the highest population throughout the period of three year study Fig.26)

CONCLUSION

Unlike under Madakkathara conditions, the three year data (2003-04 to 2005-06) revealed that the TMB population was very high at Pilicode and the location was found to be the hot spot area. TMB population was present throughout the year though it was low after the regular season. During the regular flowering season the population build up started early in the month of October itself during 2003-04 and 2005-06 while in 2004-05 the peak occurrence was in December. So the TMB occurrence and population build up varied in different years. The weekly fluctuations in the mean number of TMB on all the

Fig. 24 TMB Population RARS, Pilicode (2003-04)

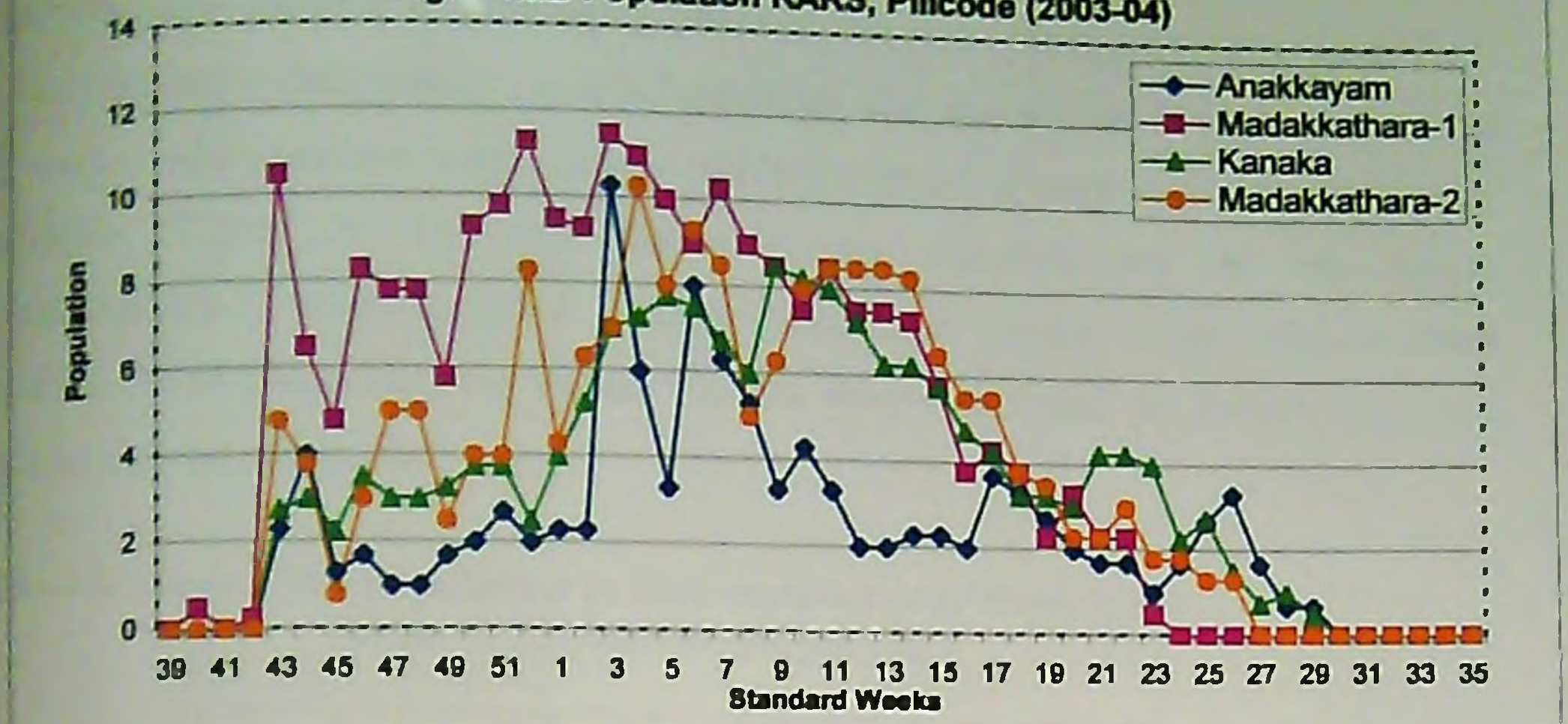


Fig. 25 . TMB Population RARS, Pilicode (2004-05)

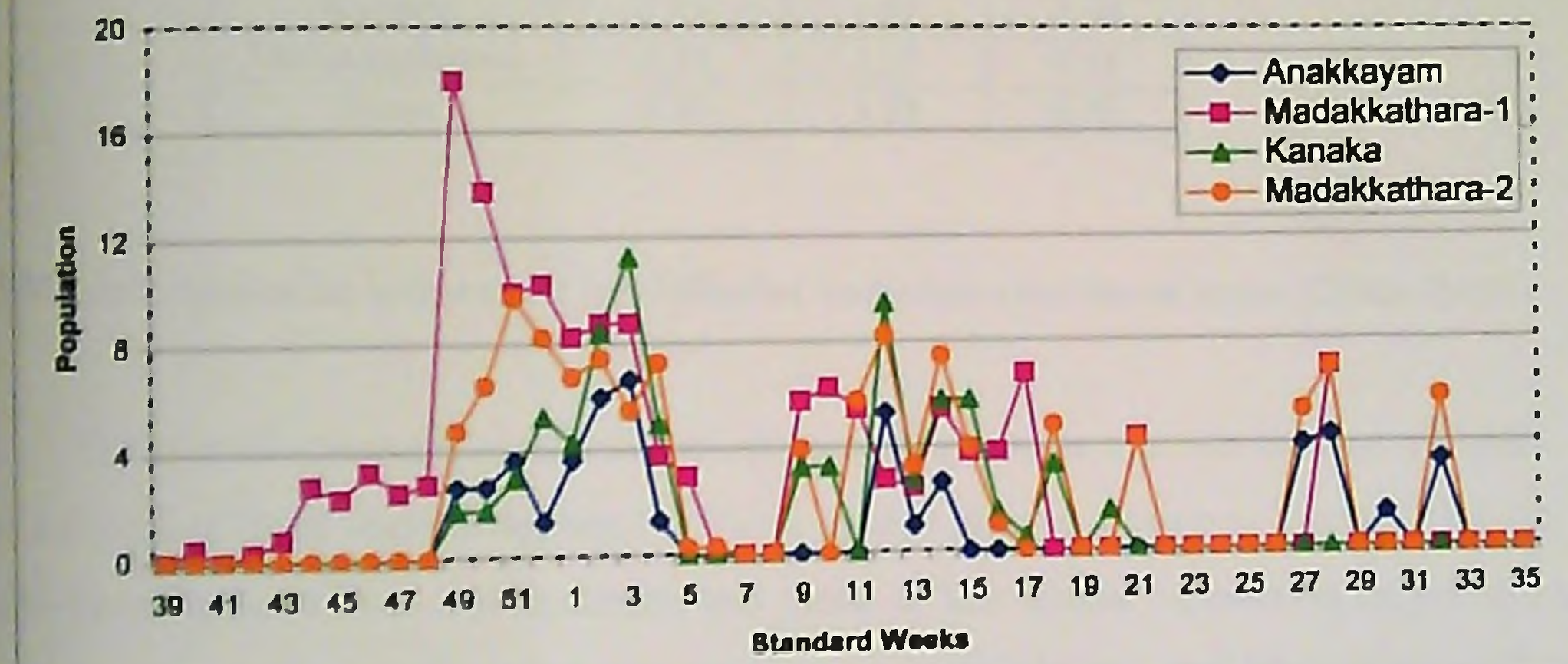
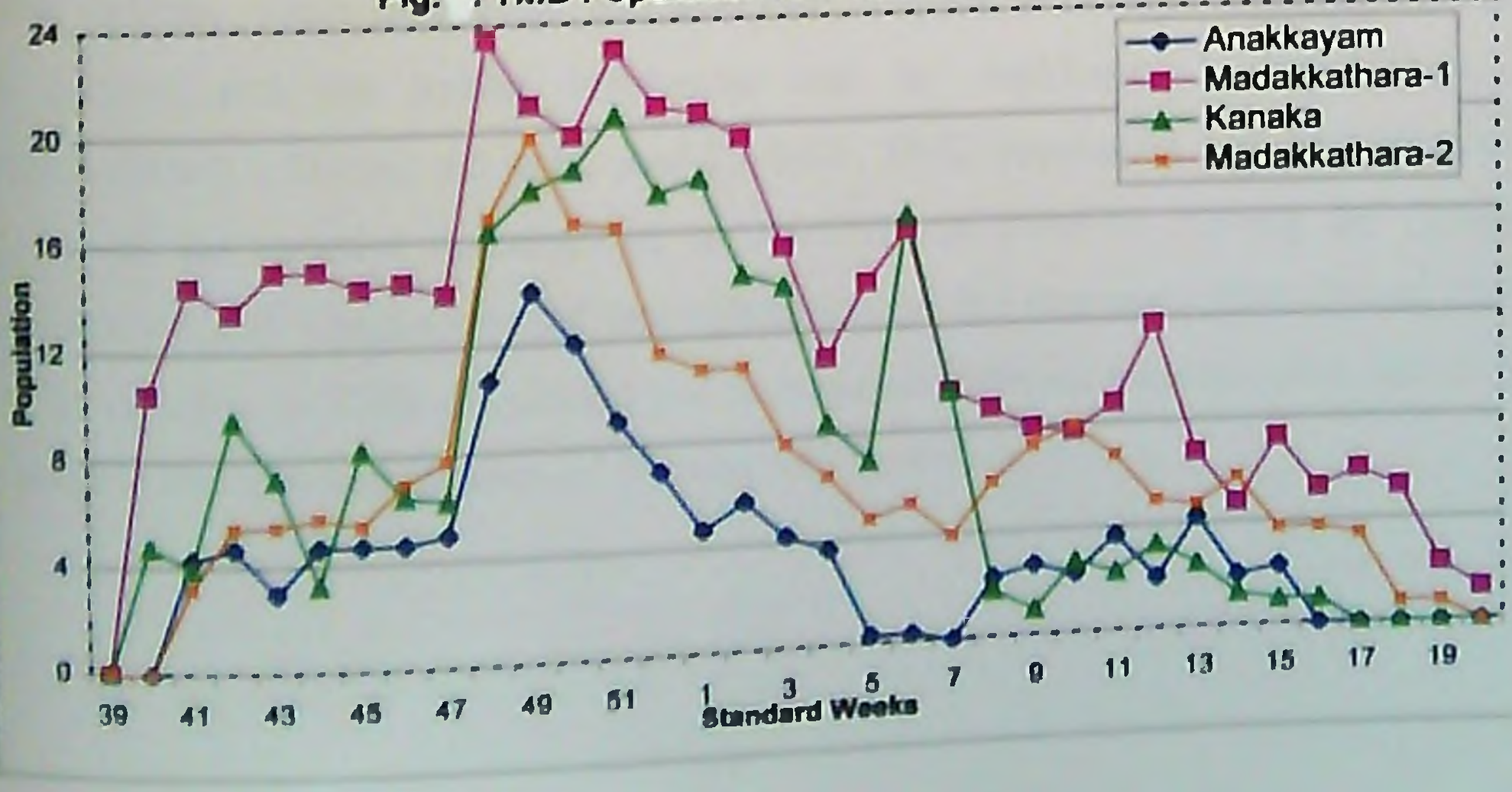


Fig. 26 . TMB Population RARS, Pilicode (2005-06)



varieties may be due to the availability or non availability of highly succulent plant parts during the active flushing and flowering phase of the crop. Among the varieties studied, the early variety Anakkayam-1 recorded relatively low population throughout the three year period while another early variety Madakkathara-1 always recorded the highest population (Table 22). The mid season variety (Kanaka) and the late variety (Madakkaathara-2) also recorded a high population unlike under Madakkathara condition. At Madakkathara the variety Kanaka always recorded the lowest population followed by Madakkathara-2.

Table 22. Mean TMB population in four varieties over three years
(Mean of 52 observations per year)

Varieties	TMB mean no.		
	2003-04	2004-05	2005-06
Anakkayam-1	2.15	0.96	3.36
Madakkathara-1	4.57	2.97	11.06
Kanaka	3.31	1.51	6.60
Madakkathara-2	3.59	2.27	6.15
Mean	**3.41**	**1.93**	**6.79**

3. TMB infestation as influenced by different varieties over three years (2003- 2006)

The overall mean per cent infestation on shoot, panicle and nut on four varieties over a period of three years is depicted in Table 23 and Figures 27 to 29. During 2003-04 all the varieties have shown moderate and more or less similar infestation on shoot and panicle. However, nut infestation was very low in Anakkayam-1 and Madakkathara-2 as compared to Kanaka and Madakkathara -1. During 2004-05 infestation was very low in all the varieties, when population was also low. Unlike in 2003-04 varietals influence was noticed and the lowest infestation was in Anakkayam-1 and highest in Madakkathara-1. During the peak year 2005-06, TMB population and infestation was high on all the varieties as compared to 2003-04 and 2004-05. Among the varieties Anakkayam-1 and Kanaka showed less infestation for the two years 2004-05 and 2005-06. The variation in TMB population and damage on different varieties were due to the variation in the time and duration of flushing and flowering.

Fig 27 Varietal influence on TMB infestation (2003-04). RARS, Pilicode

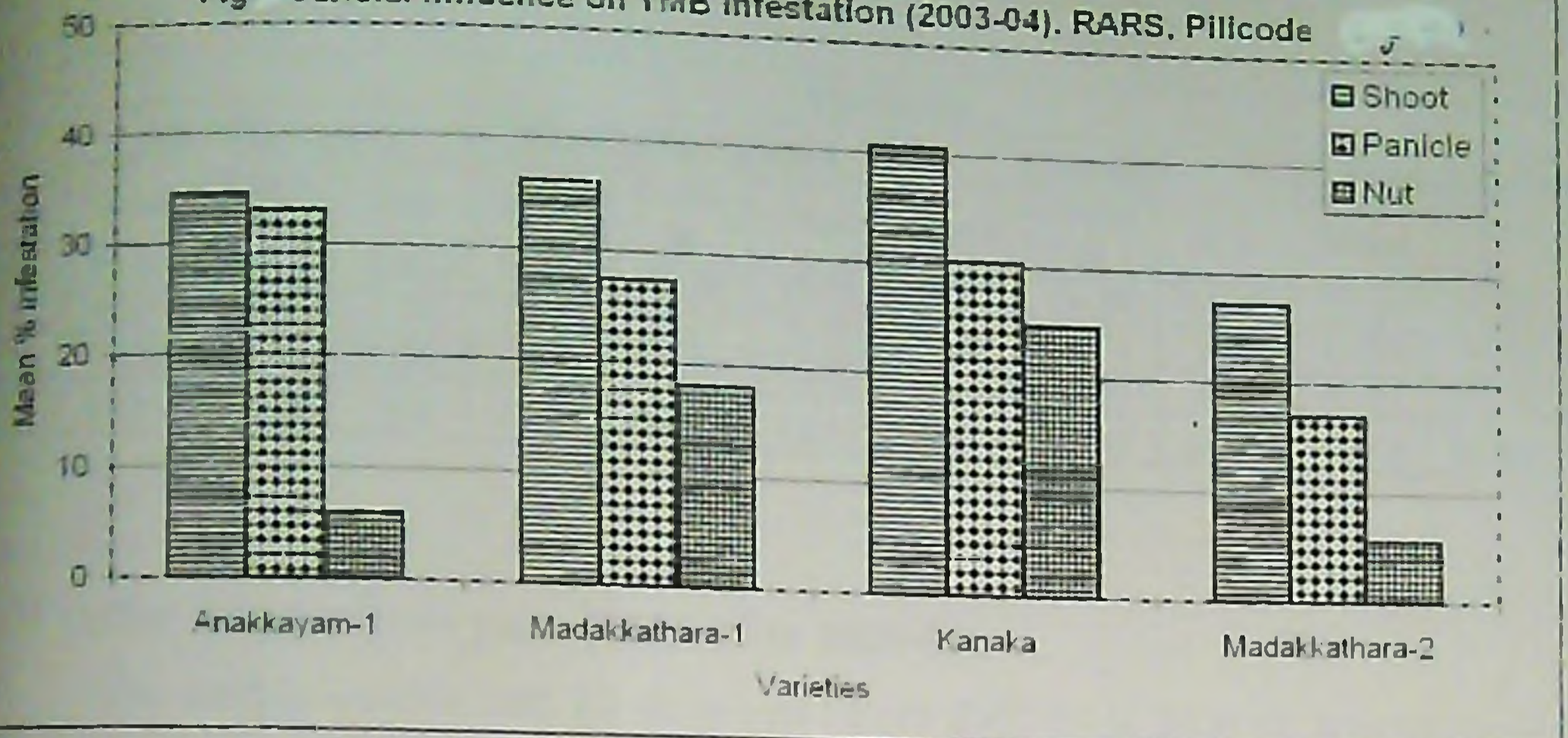


Fig. 28 Varietal influence on TMB infestation (2004-05) RARS, Pilicode

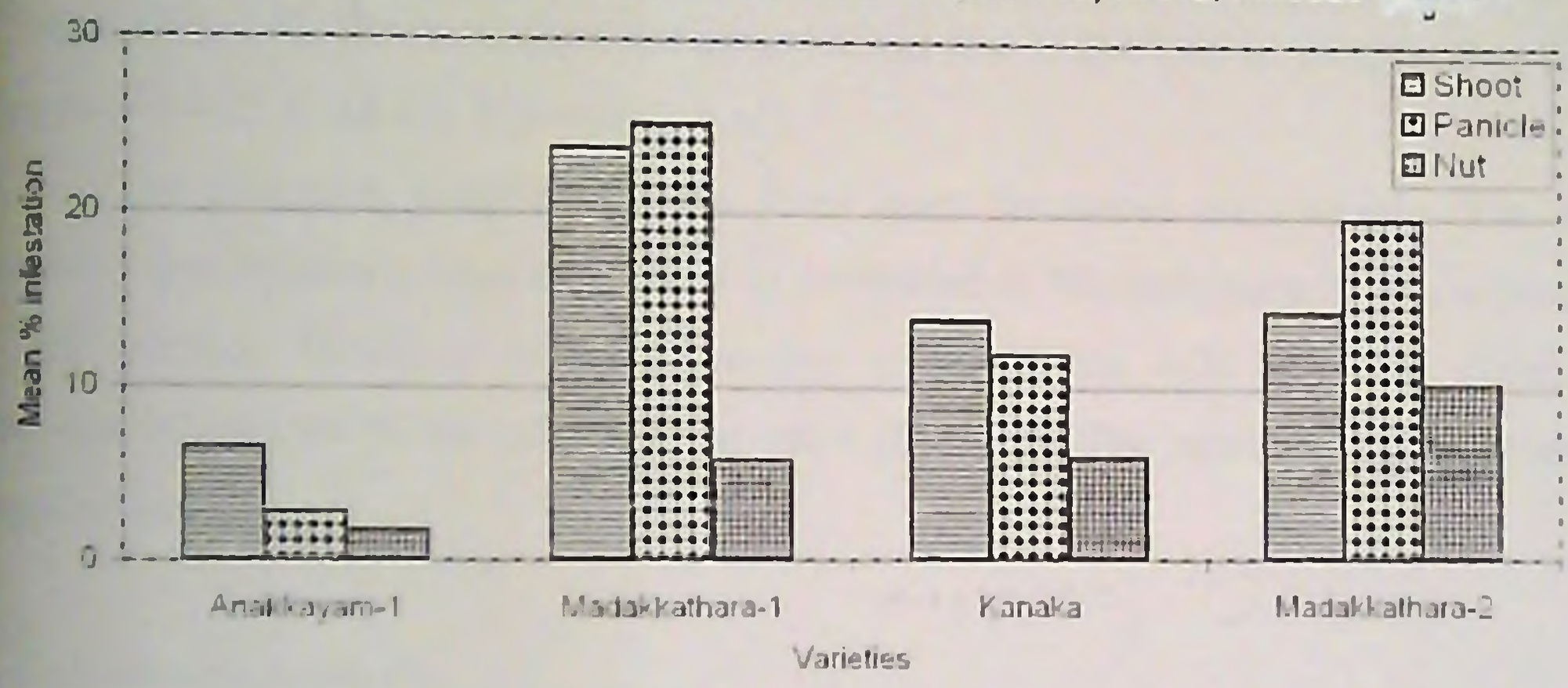


Fig 29 Varietal influence on TMB infestation (2005-06) RARS, Pilicode

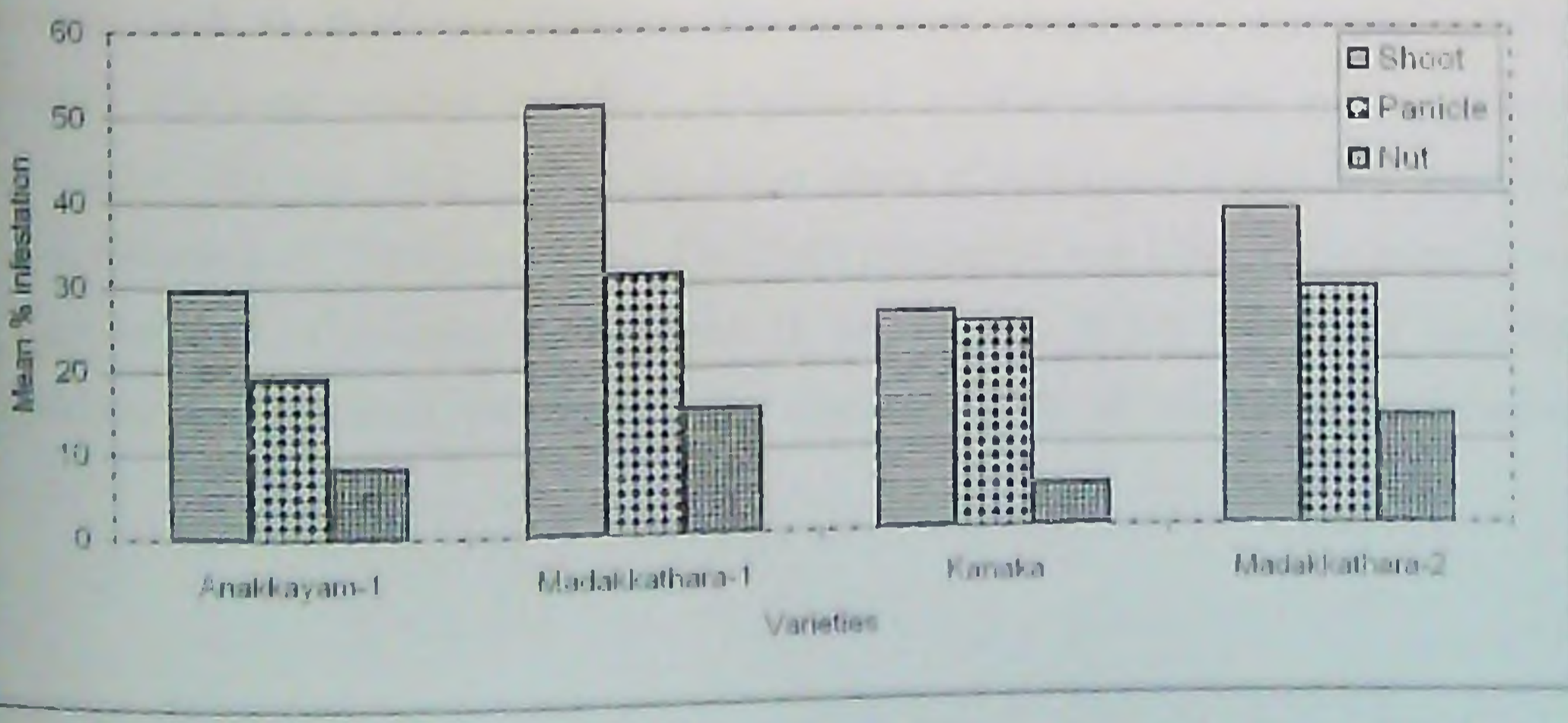


Table. 23 Varietals influence on TMB infestation over three years

Years	Varieties											
	Anakkayam-1			Madakkathara-1			Kanaka			Madakkathara-2		
	Shoot	Panicle	Nut	Shoot	Panicle	Nut	Shoot	Panicle	Nut	Shoot	Panicle	Nut
2003-04	34.50	33.05	5.92	36.09	27.38	18.09	40.62	30.29	24.67	27.14	17.00	5.65
2004-05	6.52	2.78	1.74	23.81	25.23	5.77	14.03	12.03	5.96	14.55	19.95	10.31
2005-06	29.74	19.08	8.53	51.27	31.18	14.91	26.26	24.84	5.11	38.21	28.78	13.13
Mean	**23.59**	**18.30**	**5.4**	**37.06**	**27.93**	**12.92**	**26.97**	**22.39**	**11.91**	**26.63**	**21.91**	**9.70**

4. Weather data for three years (2003-04 to 2005-06).

The weekly weather data for three years from 2003-04 to 2005-06 are represented in figures 30 to 33. The minimum temperature was found to fluctuate between 21 and 24^{0}C from the 36th to 46th standard week which was then reduced to less than 21 ^{0}C upto 8th week (Fig. 30). The maximum temperature was low in 2005-06 as compared to 2003-04 and 2004-05 at RARS, Pilicode (Fig 31).

The afternoon humidity for the three years fluctuated considerably. The A.N. humidity was relatively high at Pilicode as compared to Madakkathara. It was around 70 % till October. However during November to March the A.N. humidity fluctuated between 50 and 60 % for all the three years (Fig. 32). The intensity of brightness is depicted in Fig. 33

5. Correlation Analysis

The data on mean TMB population recorded at weekly intervals for the three consecutive years from September 2003 to July 2006 was correlated with the weather variables such as minimum temperature, maximum temperature, forenoon relative humidity, afternoon relative humidity, , brightness, wind speed, rainfall and rainy days. The weather data was taken as the cumulative mean of previous fourteen days from the date of recording of TMB population. The TMB population was taken as the mean value of four varieties. The result is presented in table 24. A highly significant negative correlation was observed for the weather variables such as minimum temperature,

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Fig 30 **Minimum temperature (°C) for three years - RARS Pilicode**

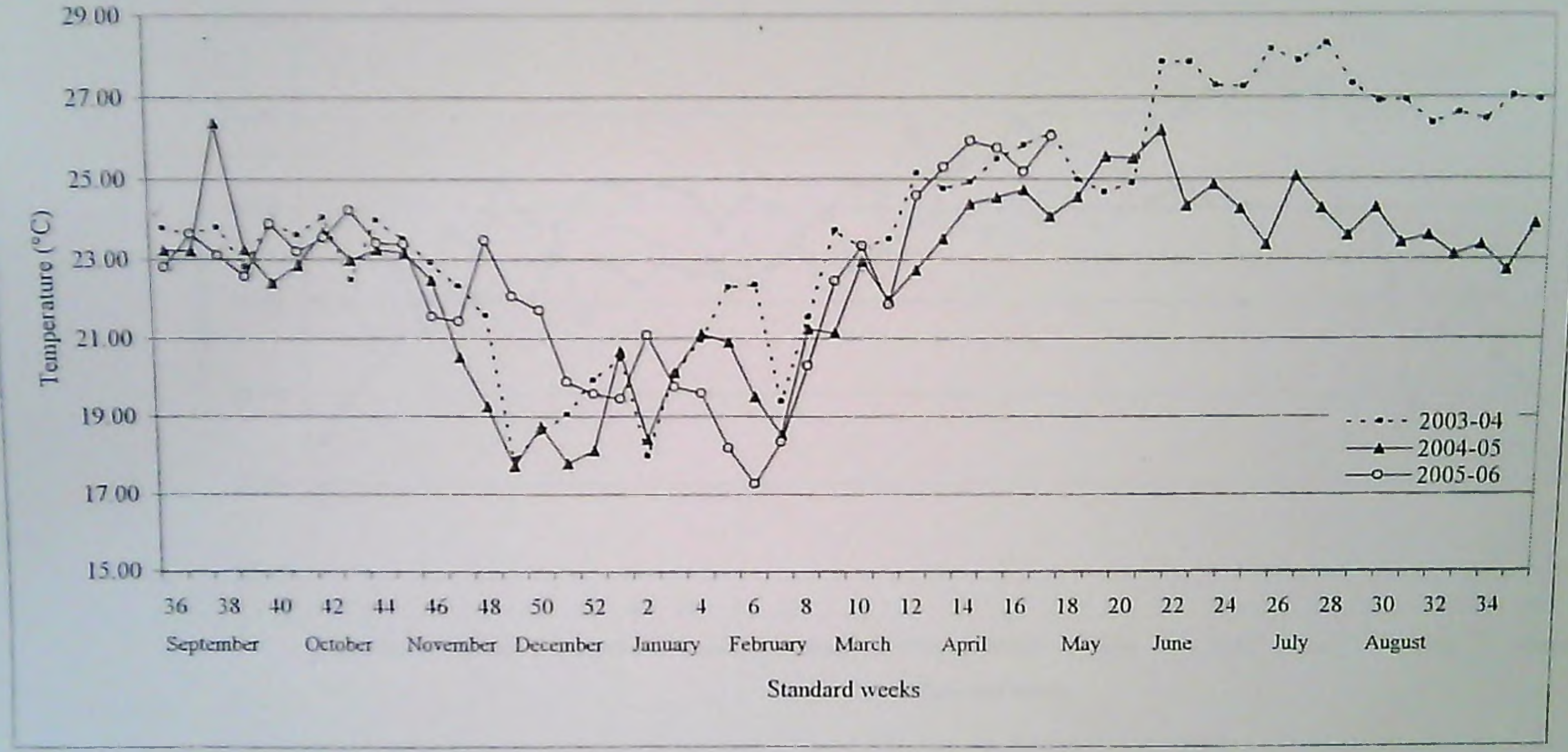


Fig 31 **Maximum temperature (°C) for three years - RARS Pilicode**

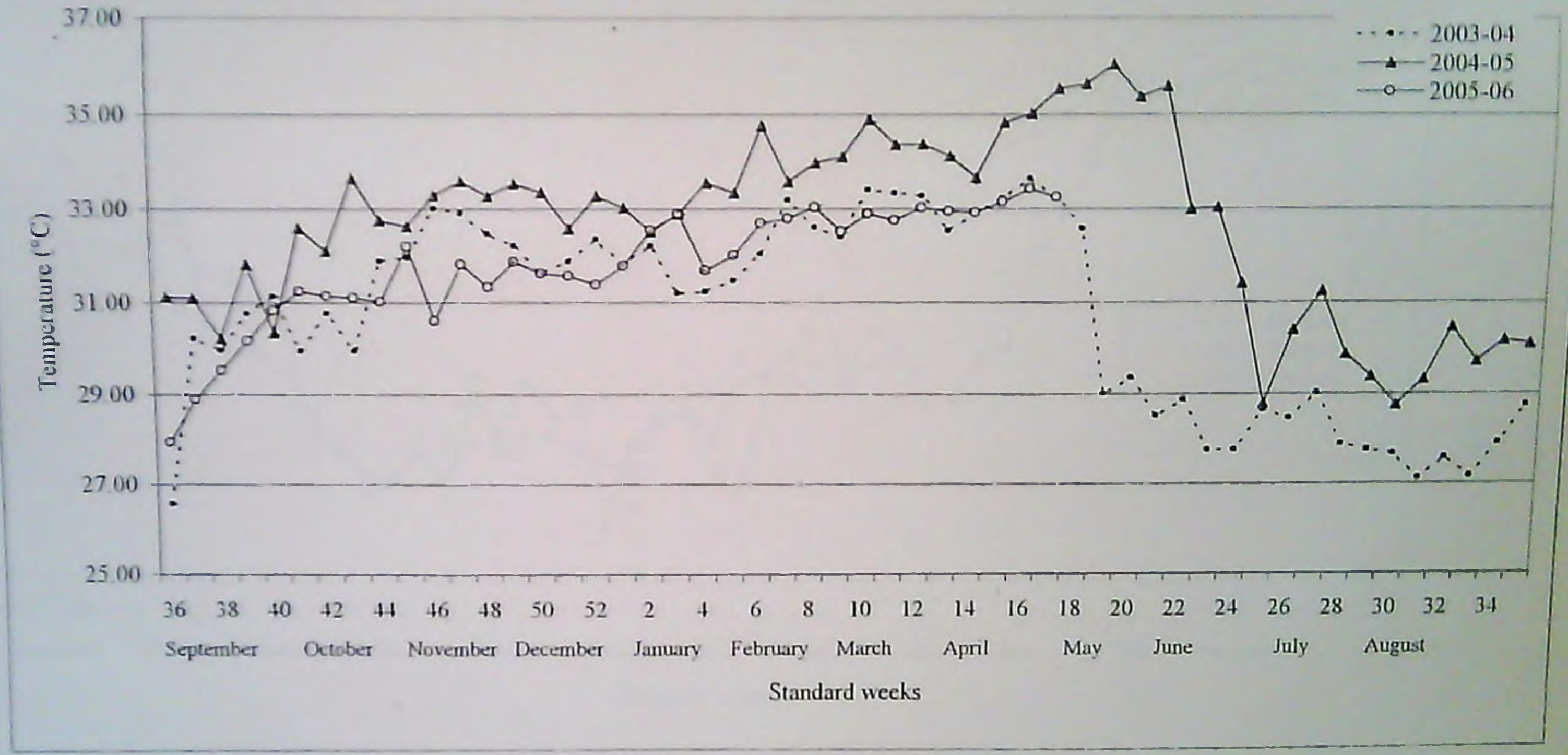


Fig 32 **Afternoon humidity for three years - RARS Pilicode**

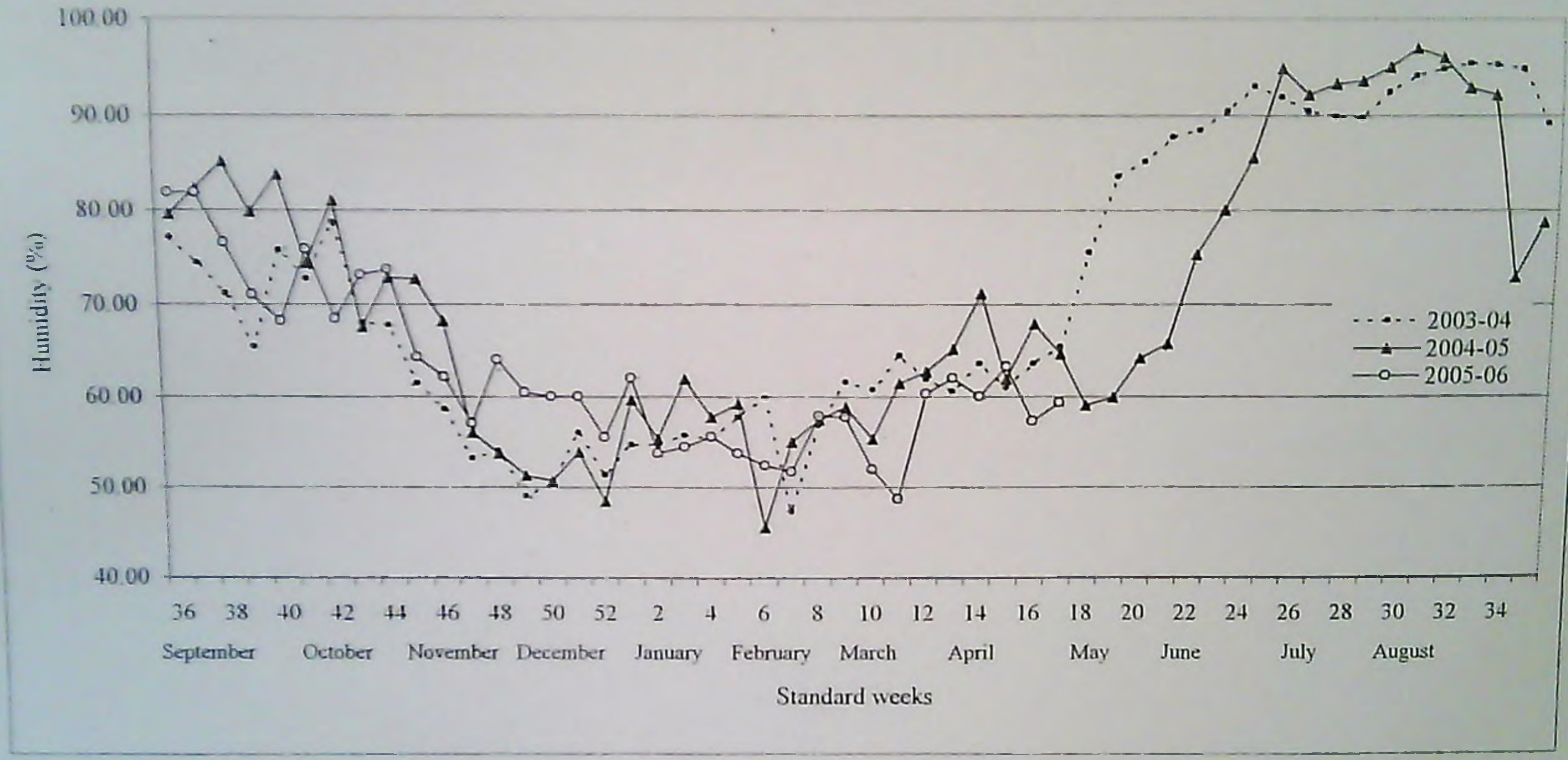
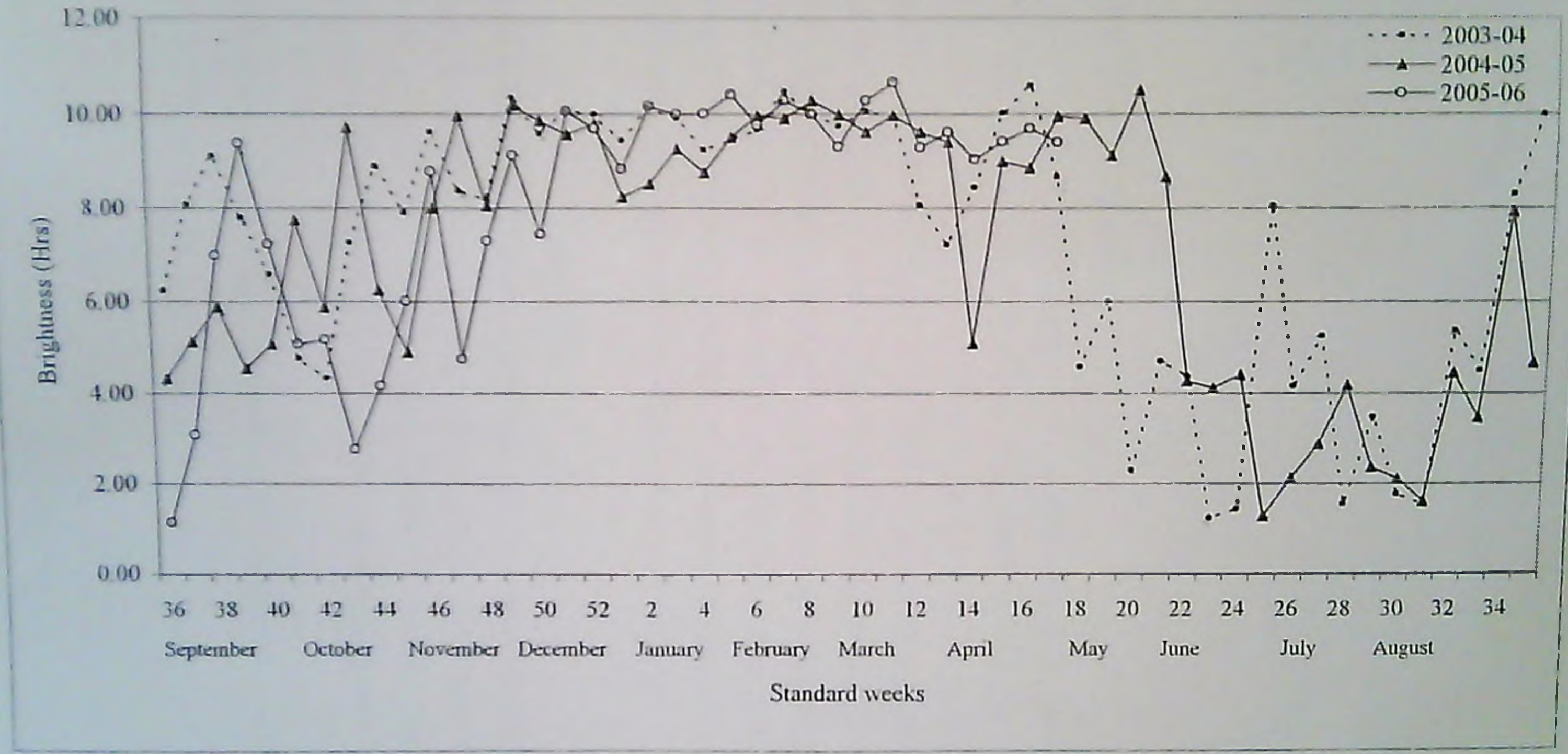


Fig · 33 **Brightness for three years - RARS Pilicode**



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forenoon relative humidity, afternoon relative humidity, rainy days and rainfall. A significant positive correlation was observed with bright sunshine hours.

Table. 24 Correlation of TMB population with the weather variables

	Min. Temp	Max. Temp	F.N Humidity	A.N Humidity	Sunshine hours	Wind speed	Rainfall	Rainy days
TMB	**– 0.490 (**)**	**0.215 (*)**	**– 0.320 (**)**	**– 0.538 (**)**	**. 0.410 (**)**	**– 0.083**	**– 0.383 (**)**	**– 0.510 (**)**

6. Weather Modeling (Non-linear models)

There was no linear relationship in the weather factors in correlation analysis. So the non-linear models were fitted for the TMB population with the weather for the previous fourteen days as lag period. TMB population for the period from November to February of each year from 2003-04 to 2005-06 was used for model fitting. The model was fitted for the month of October to July separately. The weather variables used in the model and the equation substituted with the values are as given below. During October to November and April to July the rainfall and rainy days were also found influencing. During December to March rainfall was not received and hence the models did not include these factors. The data used for the models are given in table 25.

RESULTS

The variance explained in the above non-linear models were more than 92 % for the months of October, November, December and February and during the other periods it was more than 75 % except in March. Similar to that of Madakkathara, the predictability of the model was highest (94.566 %) during the month of December.

The observed and predicted values obtained in the non-linear models are presented in Figures 34 to 42.

Table 25 Data used for model fixing (October - July 2003-06)

October Date	TMB	TEMPERATURE (°C) Minimum	Maximum	RELATIVE HUMIDITY (%) AN	FN	Brightness	Wind speed	Rainfall	Rainy days
10/10/03	0.13	23.44	30.99	72.93	93.86	6.70	1.86	6.02	0.43
17/10/03	0.00	23.69	30.52	74.14	93.93	5.34	1.47	8.22	0.57
23/10/03	0.06	23.72	29.99	76.21	93.14	4.25	0.96	7.79	0.43
28/10/03	5.09	23.26	30.14	73.36	93.00	5.24	0.95	6.28	0.36
04/10/04	0.13	23.89	31.18	81.36	98.79	4.71	1.63	9.45	0.43
11/10/04	0.00	22.48	31.26	79.71	100.00	6.29	1.38	16.41	0.50
18/10/04	0.08	22.62	31.66	78.86	100.00	6.29	1.09	11.84	0.43
26/10/04	0.20	23.56	32.44	77.93	100.00	6.62	1.16	5.59	0.50
07/10/05	3.83	23.21	30.39	69.71	90.64	8.41	1.88	0.44	0.21
14/10/05	6.51	23.49	31.09	71.93	92.14	6.29	2.08	1.51	0.21
21/10/05	8.30	23.35	31.24	71.64	93.57	5.14	2.09	8.70	0.43
31/10/05	7.70	23.92	31.22	72.14	94.36	4.69	1.27	6.69	0.43

November Date	TMB	TEMPERATURE (°C) Minimum	Maximum	RELATIVE HUMIDITY (%) AN	FN	Brightness	Wind speed	Rainfall	Rainy days
03/11/03	4.33	23.16	30.47	71.00	93.43	6.60	1.07	5.96	0.21
10/11/03	2.29	23.69	31.76	67.64	92.79	8.26	1.41	0.59	0.14
17/11/03	4.13	23.43	32.44	61.29	91.64	8.92	1.21	1.66	0.21
24/11/03	4.20	22.92	32.82	55.43	90.64	8.91	1.11	1.07	0.07
30/11/03	4.20	22.12	32.89	54.50	91.14	8.39	1.24	0.00	0.00
01/11/04	0.70	23.44	33.15	72.29	100.00	7.94	0.94	3.60	0.50
10/11/04	0.58	23.16	32.91	71.14	100.00	6.06	1.04	10.22	0.57
18/11/04	0.83	22.72	32.96	69.71	100.00	6.41	0.71	3.91	0.64
24/11/04	0.63	21.70	33.33	63.71	100.00	8.48	0.73	1.36	0.29
30/11/04	0.70	20.80	33.55	57.57	100.00	9.09	0.70	0.00	0.07
04/11/05	7.20	23.91	31.08	73.43	94.57	3.56	0.84	1.03	0.43
11/11/05	8.20	23.36	31.35	70.50	94.71	4.70	0.82	4.89	0.50
18/11/05	8.18	22.76	31.29	65.86	92.50	6.95	0.99	7.39	0.29
25/11/05	8.28	21.54	31.36	59.57	90.14	6.86	0.78	3.66	0.21

December Date	TMB	TEMPERATURE (°C) Minimum	Maximum	RELATIVE HUMIDITY (%) AN	FN	Brightness	Wind speed
05/12/03	3.31	21.55	32.53	53.57	91.36	8.38	1.19
12/12/03	4.76	19.39	32.20	51.57	89.93	9.26	1.31
22/12/03	5.06	18.79	31.74	52.79	88.79	9.85	1.61
30/12/03	6.03	19.37	31.91	55.07	91.71	10.02	1.69
07/12/04	6.82	19.52	33.45	55.07	100.00	8.94	0.74
13/12/04	6.19	18.03	33.40	50.86	100.00	9.59	0.94
21/12/04	6.62	17.72	33.10	50.64	100.00	9.84	1.06
30/12/04	6.31	17.89	33.01	49.86	100.00	9.76	1.25
06/12/05	16.83	23.51	31.45	64.43	92.86	5.90	1.16
15/12/05	18.15	22.15	31.62	61.50	93.64	8.00	1.28
23/12/05	16.70	20.74	31.68	59.86	93.07	8.76	1.08
30/12/05	17.20	19.74	31.59	59.50	89.93	9.85	1.56

January Date	TMB	TEMPERATURE (°C) Minimum	Maximum	RELATIVE HUMIDITY (%) AN	FN	Brightness	Windspeed
05/01/04	5.03	19.76	32.21	52.21	92.14	9.81	1.67
15/01/04	5.79	19.23	32.01	54.71	92.00	9.77	1.50
22/01/04	8.95	19.03	31.70	55.21	91.79	10.01	1.64
28/01/04	8.64	20.37	31.25	55.36	90.07	9.57	2.01
06/01/05	5.77	19.71	33.07	54.79	100.00	9.00	1.51
13/01/05	7.70	19.51	32.73	57.43	100.00	8.31	1.73
20/01/05	8.07	18.93	32.65	57.21	100.00	8.99	1.93
27/01/05	4.36	20.35	33.24	58.64	100.00	9.58	1.90
06/01/06	14.20	19.22	31.49	58.07	88.93	9.75	1.60
13/01/06	13.50	20.12	32.01	56.50	91.71	9.43	1.41
20/01/06	12.58	21.09	32.50	55.86	92.64	9.48	1.49
27/01/06	10.30	19.91	32.30	55.57	92.36	9.98	1.74

February Date	TMB	TEMPERATURE (°C) Minimum	Maximum	RELATIVE HUMIDITY (%) AN	FN	Brightness	Wind speed
04/02/04	7.26	21.72	31.31	56.07	87.21	9.36	2.44
12/02/04	8.45	22.33	31.75	58.79	88.21	9.54	2.45
20/02/04	7.96	20.87	32.61	53.57	90.00	10.06	2.24
26/02/04	6.33	20.46	32.89	52.07	89.00	10.24	2.49
03/02/05	0.83	20.77	33.40	58.36	100.00	9.01	1.80
10/02/05	0.08	20.94	33.55	56.93	100.00	9.07	2.09
17/02/05	0.00	18.97	34.19	49.64	100.00	10.08	2.14
24/02/05	0.00	19.04	34.04	52.50	100.00	10.14	2.59
03/02/06	7.43	18.74	31.99	53.93	92.29	10.22	1.84
10/02/06	6.48	18.11	32.36	53.36	92.14	10.10	1.75
17/02/06	9.43	17.33	32.75	50.21	91.14	10.04	1.55
24/02/06	5.75	18.95	32.61	54.14	91.00	10.09	1.60

March Date	TMB	TEMPERATURE (°C) Minimum	Maximum	RELATIVE HUMIDITY (%) AN	FN	Brightness	Wind speed
03/03/04	6.65	22.44	32.45	59.07	89.36	9.86	2.66
09/03/04	7.01	23.15	32.71	61.79	89.93	9.86	2.59
16/03/04	7.08	23.31	33.23	62.14	90.29	9.97	2.70
23/03/04	6.31	23.90	33.36	61.64	88.79	9.79	2.82
29/03/04	6.06	24.51	33.02	62.64	89.29	8.45	2.54
03/03/05	3.28	21.30	33.93	59.14	99.71	9.96	2.87
10/03/05	2.40	21.89	34.41	56.93	99.50	9.79	2.72
17/03/05	2.83	22.24	34.63	57.50	99.79	9.81	3.05
23/03/05	6.48	22.32	34.51	60.93	100.00	9.89	3.09
31/03/05	2.40	23.01	34.30	64.07	100.00	9.50	3.14
01/03/06	4.73	20.26	32.64	56.64	90.86	10.02	2.03
08/03/06	4.75	21.73	32.97	55.79	88.79	9.78	2.24
15/03/06	5.23	22.99	32.80	53.29	85.00	9.96	2.27
22/03/06	5.40	22.43	32.79	50.07	81.36	10.39	2.54
29/03/06	5.53	24.09	33.02	57.50	83.21	9.76	2.71

April Date	TMB	TEMPERATURE (°C) Minimum	Maximum	RELATIVE HUMIDITY (%) AN	FN	Drightness	Windspeed	Rainfall	Rainy days
05/04/04	6.04	25.04	33.08	61.79	88.50	7.52	2.41	2.39	0.43
12/04/04	5.09	24.99	32.89	61.57	87.07	8.34	2.42	4.76	0.50
20/04/04	4.01	25.55	32.98	63.00	84.50	9.79	2.35	3.07	0.14
29/04/04	4.44	25.90	33.47	64.36	85.64	9.59	2.51	0.70	0.14
07/04/05	5.37	23.59	34.19	65.07	99.93	8.31	3.36	1.90	0.00
13/04/05	3.40	24.19	33.96	67.07	99.93	7.06	2.98	1.97	0.21
20/04/05	1.58	24.66	34.37	67.21	99.93	7.94	2.84	1.31	0.21
27/04/05	1.83	24.45	35.23	65.50	99.93	9.10	2.84	0.16	0.00
05/04/06	4.60	25.38	32.94	62.14	86.43	9.16	2.70	0.00	0.00
12/04/06	3.48	25.84	32.89	61.57	84.71	9.11	2.65	0.00	0.00
20/04/06	3.60	25.95	33.17	59.93	80.86	9.60	2.67	0.00	0.00
28/04/06	2.53	25.36	33.34	58.93	80.50	9.81	3.39	0.00	0.00

May Date	TMB	TEMPERATURE (°C) Minimum	Maximum	RELATIVE HUMIDITY (%) AN	FN	Brightness	Wind speed	Rainfall	Rainy days
04/05/04	3.54	25.87	33.53	65.71	85.79	8.58	2.84	0.76	0.21
10/05/04	2.94	26.03	31.93	73.93	85.93	5.17	3.50	37.67	0.57
17/05/04	2.65	23.64	29.90	84.07	86.86	3.69	2.73	39.76	0.79
23/05/04	2.64	24.74	29.19	85.07	86.86	4.79	1.52	26.73	0.79
30/05/04	2.81	28.06	28.75	86.79	88.93	3.80	1.22	23.79	0.93
04/05/05	2.03	24.31	35.39	64.07	100.00	9.21	2.92	1.03	0.14
12/05/05	0.00	24.76	35.73	59.64	100.00	10.04	3.26	0.00	0.14
18/05/05	0.38	25.18	35.66	60.29	100.00	9.79	3.29	0.00	0.00
25/05/05	2.14	26.03	35.88	63.29	99.86	9.64	3.25	0.00	0.00
31/05/05	0.00	25.68	34.92	67.07	99.86	8.21	3.26	6.67	0.00
06/05/06	2.38	25.52	33.53	61.21	82.79	9.06	4.05	1.64	0.14
15/05/06	1.53	25.62	33.59	62.29	82.93	9.04	3.21	1.71	0.21
22/05/06	0.78	25.73	33.11	61.86	85.36	8.59	2.91	2.23	0.36
30/05/06	0.33	24.64	31.17	76.14	93.64	4.80	2.99	40.29	0.86

June - July Date	TMB	TEMPERATURE (°C) Minimum	Maximum	RELATIVE HUMIDITY (%) AN	FN	Brightness	Windspeed	Rainfall	Rainy days
03/06/04	1.83	27.86	28.64	87.86	89.79	4.36	1.30	27.82	0.86
10/06/04	1.43	27.62	28.38	89.07	90.86	3.41	1.86	36.12	0.86
18/06/04	1.68	27.26	27.74	91.71	93.00	1.33	2.54	47.64	1.00
28/06/04	1.53	27.93	28.41	91.57	93.00	5.28	2.43	11.69	0.86
02/07/04	0.61	28.01	28.54	91.14	92.50	6.09	1.67	12.51	0.86
12/07/04	0.42	27.98	28.66	90.21	91.93	4.53	1.69	9.22	0.64
19/07/04	0.29	27.44	28.13	90.21	91.79	3.56	1.62	11.42	0.64
29/07/04	0.00	26.87	27.65	93.14	94.36	2.21	1.42	24.58	1.00
15/06/05	0.00	24.58	32.81	80.43	100.00	4.69	1.98	8.10	0.64
21/06/05	0.00	24.26	31.09	86.71	100.00	3.42	2.26	21.79	0.71
30/06/05	0.00	24.24	29.73	92.86	100.00	2.01	3.06	50.73	0.86
05/07/05	2.33	24.26	30.25	92.57	100.00	2.57	2.97	44.53	1.00
10/07/05	4.58	24.63	30.86	92.64	100.00	2.63	3.39	21.32	1.00
15/07/05	0.00	23.88	30.31	93.93	100.00	3.26	2.08	25.55	1.00
21/07/05	0.33	24.02	29.88	93.79	100.00	3.41	1.44	19.46	0.93
29/07/05	0.00	23.98	29.21	95.64	100.00	2.49	1.22	22.26	0.93

The weather variables used in the models and the equation substituted are given below

Y= Constant + $a_1 x_1^2 + a_2 x_2^2 + a_3 x_3^2 + a_4 x_4^2 + a_5 x_5^2 + a_6 x_6^2 + a_7 x_7^2 + a_8 x_8^2$ where a_1, a_2, a_3, a_4 —etc are the coefficients to be estimated and x_1, x_2, x_3, x_4— etc are weather parameters.

	Variance explained %
October $Y = -7.99847 + 0.04746\ x_1^2 - 0.01532\ x_2^2 - 0.01162\ x_3^2 + 0.00809\ x_4^2 - 0.14406\ x_5^2 + 0.37355\ x_6^2 + 0.01658\ x_7^2 - 31.4268\ x_8^2$	92.091
November $Y = 35.8047 + 0.00548\ x_1^2 + 0.00793\ x_2^2 + 0.00076\ x_3^2 - 0.00433\ x_4^2 - 0.05205\ x_5^2 - 3.77462\ x_6^2 + 0.01006\ x_7^2 - 5.77618\ x_8^2$	92.062
December $Y = 60.7937 - 0.00084\ x_1^2 - 0.10902\ x_2^2 + 0.00874\ x_3^2 + 0.00326\ x_4^2 + 0.15904\ x_5^2 - 3.89004\ x_6^2$	94.566
January $Y = 21.2148 + 0.00432\ x_1^2 + 0.01632\ x_2^2 + 0.00973\ x_3^2 - 0.00482\ x_4^2 - 0.17192\ x_5^2 - 1.1475\ x_6^2$	75.831
February $Y = 45.5252 - 0.00767\ x_1^2 - 0.00765\ x_2^2 + 6.7 \times 10^{-5}\ x_3^2 - 0.00327\ x_4^2 + 0.00629\ x_5^2 - 0.31714\ x_6^2$	92.736
March $Y = 4.63645 + 0.00952\ x_1^2 - 0.01423\ x_2^2 + 0.00198\ x_3^2 - 0.00034\ x_4^2 + 0.08214\ x_5^2 - 0.05744\ x_6^2$	65.183
April $Y = 100.204 - 0.09621\ x_1^2 - 0.0328\ x_2^2 + 0.00236\ x_3^2 - 0.00119 x_4^2 + 0.07426 x_5^2 - 0.54749\ x_6^2 .0.2446\ x_7^2 + 15.4113\ x_8^2$	81.815
May $Y = -38.2892 + 0.00034\ x_1^2 + 0.04163\ x_2^2 + 0.00282\ x_3^2 - 0.00236 x_4^2 - 0.00837 x_5^2 - 0.04413\ x_6^2 .0.0005\ x_7^2 + 4.9457\ x_8^2$	77.020
June-July $Y = 15.0081 - 0.00878\ x_1^2 + 0.01512\ x_2^2 + 0.00069\ x_3^2 - 0.00324\ x_4^2 - 0.02649 x_5^2 + 0.37047\ x_6^2 - 0.00071\ x_7^2 + 2.91006\ x_8^2$	85.086

Where Y= Predicted TMB population

X_1 = Minimum temperature (cumulative 14 days before)

X_2 = Maximum temperature "

X_3 = Afternoon Relative humidity

X_4 = Forenoon Relative humidity "

X_5 = Sunshine hours

X6 = Wind speed

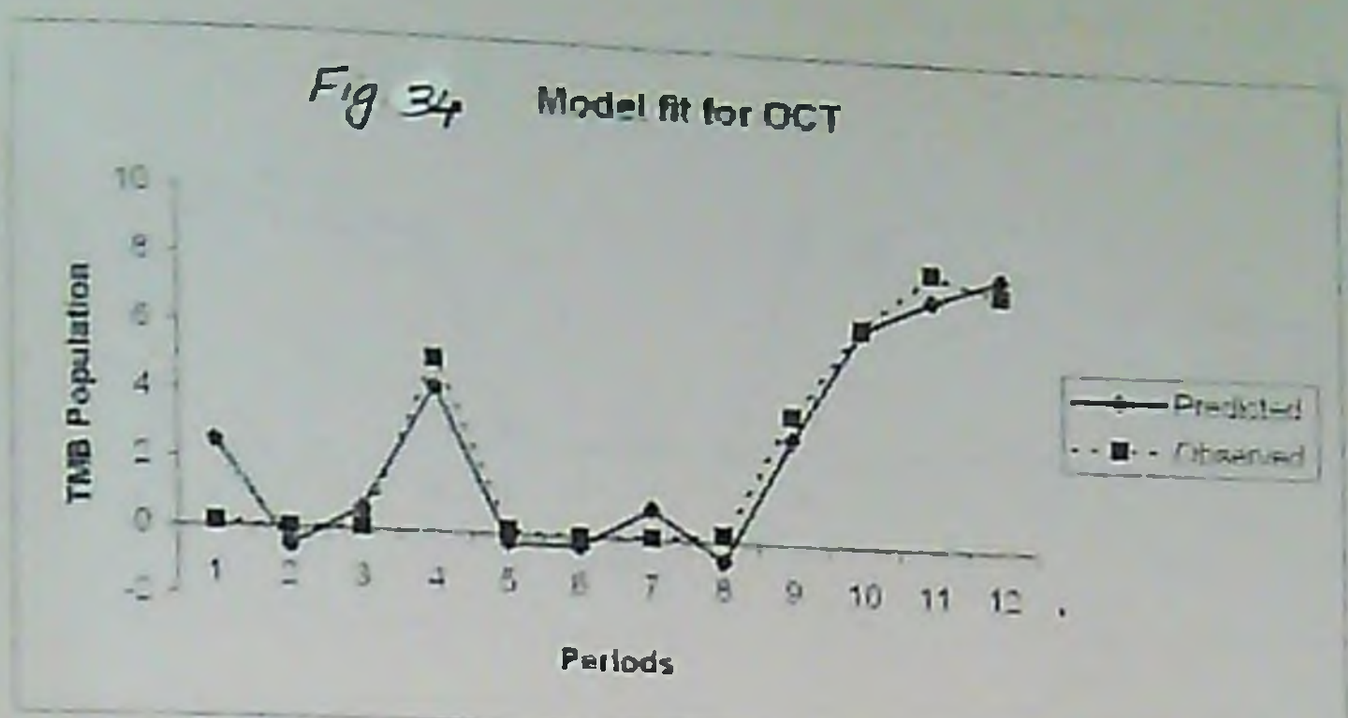
X7 = Rainfall

X8 = Rainy days

Predicted Values (new.sta)

	Predictd VAR1	observed
C1	2.514934	0.13
C2	-0.53164	0.00
C3	0.628726	0.08
C4	4.253829	5.09
C5	-0.21723	0.13
C6	-0.27618	0.00
C7	0.918818	0.08
C8	-0.56484	0.20
C9	3.137195	3.83
C10	6.487387	6.51
C11	7.453665	8.30
C12	8.207826	7.70

Fig 34 Model fit for OCT



Predicted Values (new.sta)

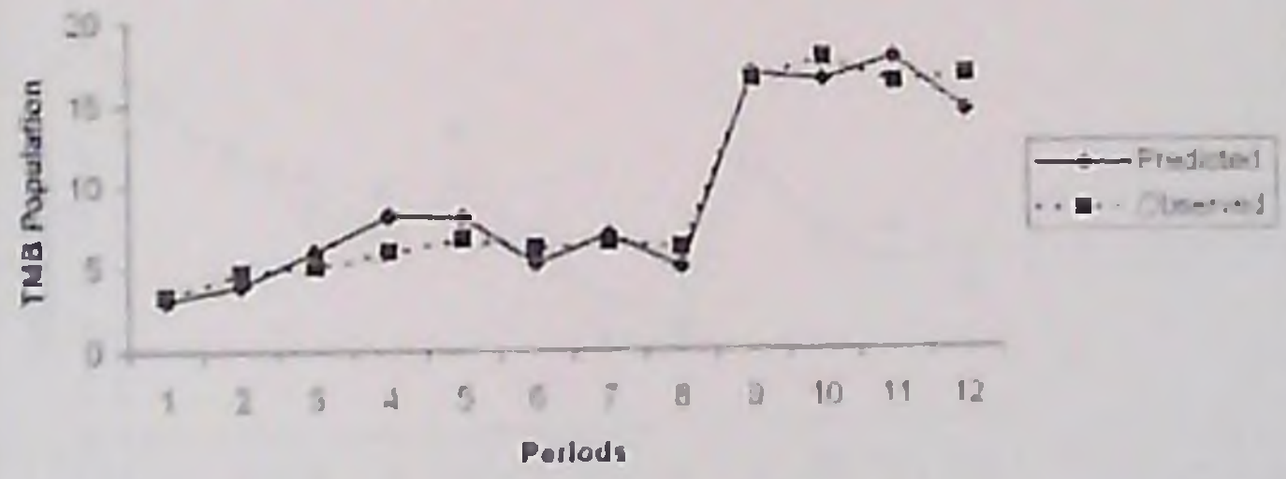
	Predictd VAR1	observed
C1	5.696472	4.33
C2	1.996479	2.29
C3	3.825949	4.13
C4	5.26571	4.20
C5	3.917657	4.20
C6	0.317766	0.70
C7	1.151013	0.58
C8	1.4097	0.83
C9	0.846753	0.63
C10	0.201266	0.70
C11	7.642344	7.20
C12	6.687857	8.20
C13	8.609294	8.18
C14	8.844241	8.28

Fig 35 Model fit for NOV

Predicted Values (new.sta)

	Predictd VAR1	observed
C1	3.027765	3.31
C2	3.973096	4.76
C3	6.033377	5.06
C4	8.183926	6.03
C5	8.15947	5.82
C6	5.30368	6.19
C7	7.069514	6.82
C8	5.09741	6.31
C9	17.14256	16.83
C10	16.82607	18.15
C11	18.24354	16.70
C12	14.91209	17.20

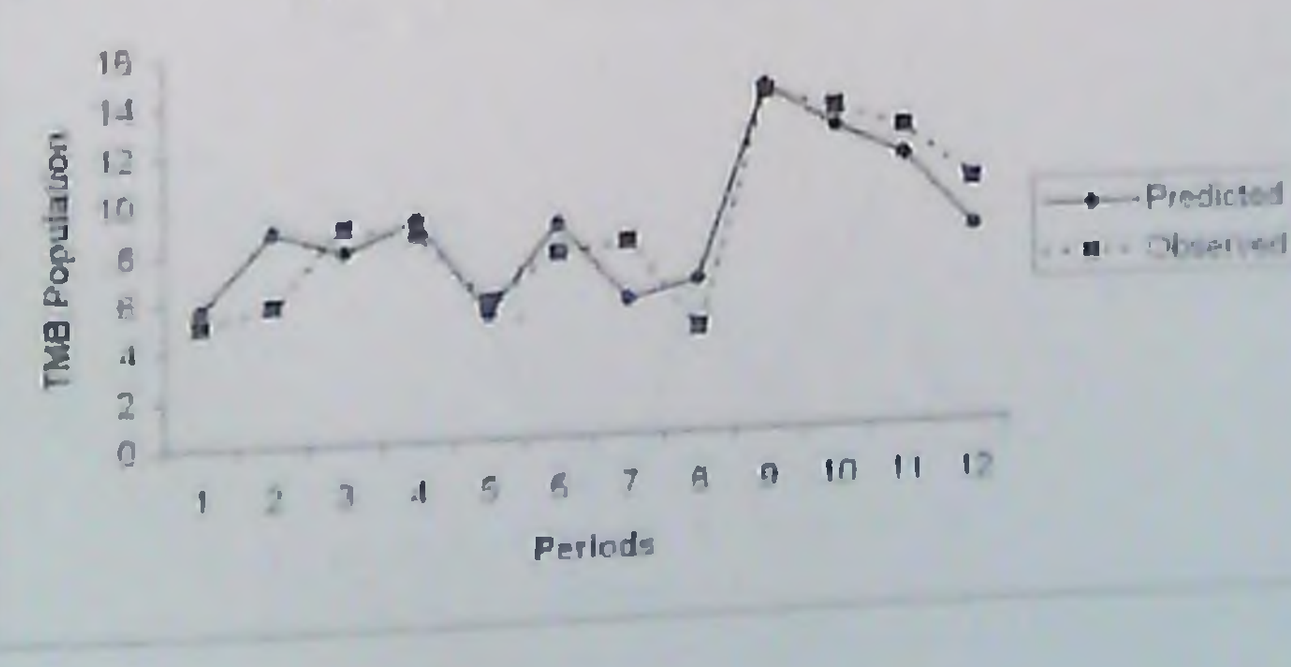
Fig 36 Model fit for DEC



Predicted Values (new.sta)

	Predictd VAR1	observed
C1	5.716275	5.03
C2	8.895132	5.79
C3	7.969856	8.95
C4	9.272167	8.64
C5	5.217768	5.77
C6	8.944304	7.70
C7	5.665978	8.07
C8	6.402309	4.36
C9	14.42215	14.20
C10	12.67297	13.50
C11	11.3823	12.58
C12	8.30629	10.30

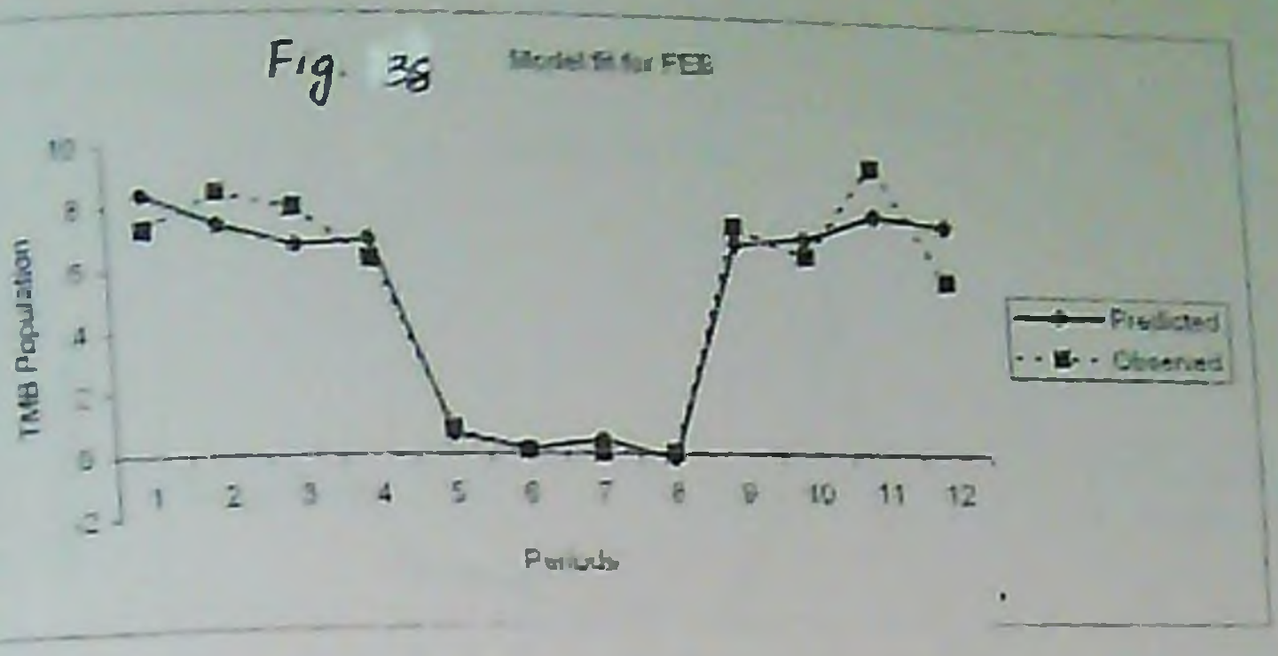
Fig 37 Model fit for JAN



Predicted Values (new.sta)

	Predictd	observed
	VAR1	
C1	8.379821	7.26
C2	7.411035	8.45
C3	6.772124	7.96
C4	6.977959	6.33
C5	0.690771	0.83
C6	0.155239	0.08
C7	0.425118	0.00
C8	-0.15962	0.00
C9	6.901489	7.43
C10	7.058964	6.48
C11	7.888612	9.43
C12	7.548285	5.75

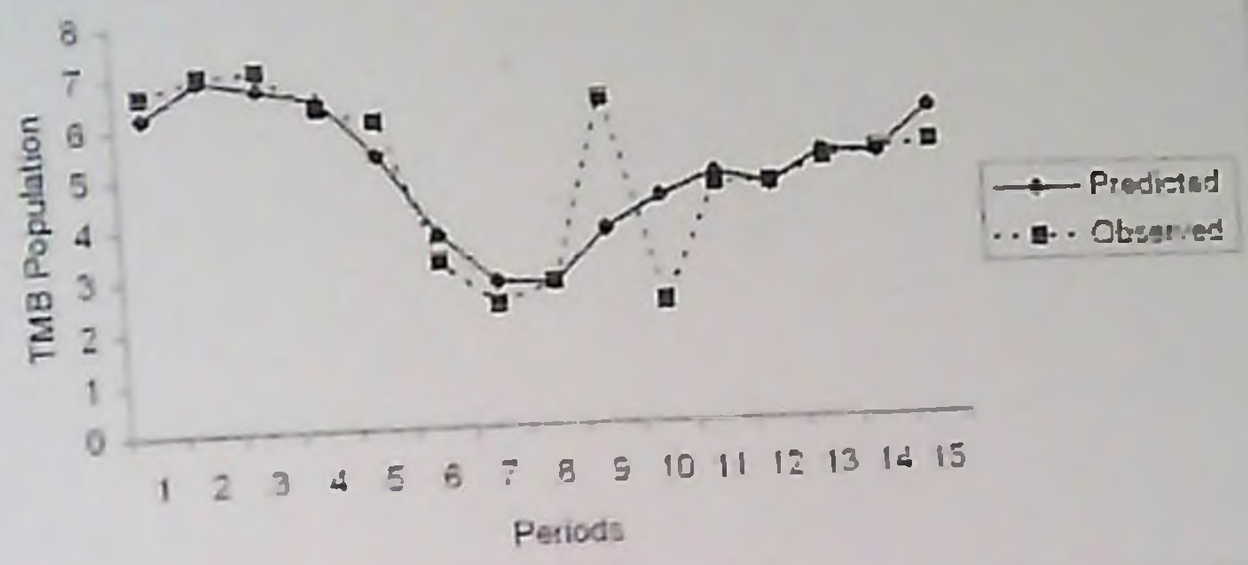
Fig. 38 Model fit for FEB



Predicted Values (new.sta)

	Predictd	observed
	VAR1	
C1	6.211797	6.65
C2	6.918609	7.01
C3	6.71627	7.08
C4	6.486349	6.31
C5	5.383922	6.06
C6	3.758018	3.28
C7	2.84525	2.40
C8	2.802764	2.83
C9	3.85928	6.48
C10	4.506099	2.40
C11	4.944189	4.73
C12	4.705704	4.75
C13	5.368216	5.23
C14	5.334701	5.40
C15	6.238833	5.53

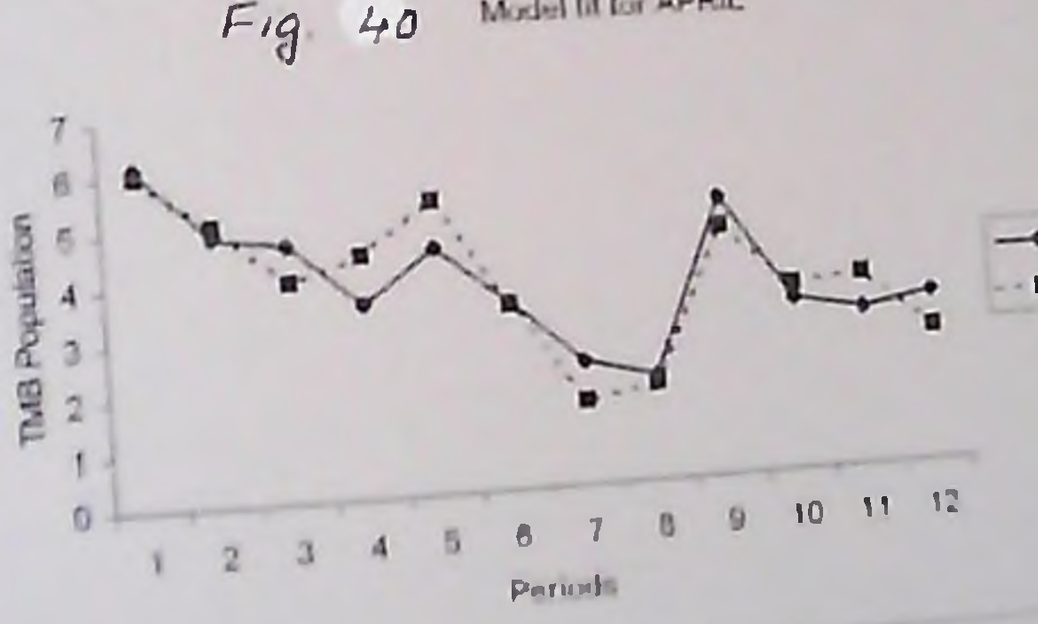
Fig. 39 Model fit for March



Predicted Values (new sta)

	Predictd	observed
	VAR1	
C1	6.176044	6.04
C2	4.862988	5.09
C3	4.696028	4.01
C4	3.547811	4.44
C5	4.497344	5.37
C6	3.448912	3.40
C7	2.285884	1.58
C8	1.956533	1.83
C9	5.135196	4.60
C10	3.19037	3.48
C11	2.962884	3.60
C12	3.182507	2.53

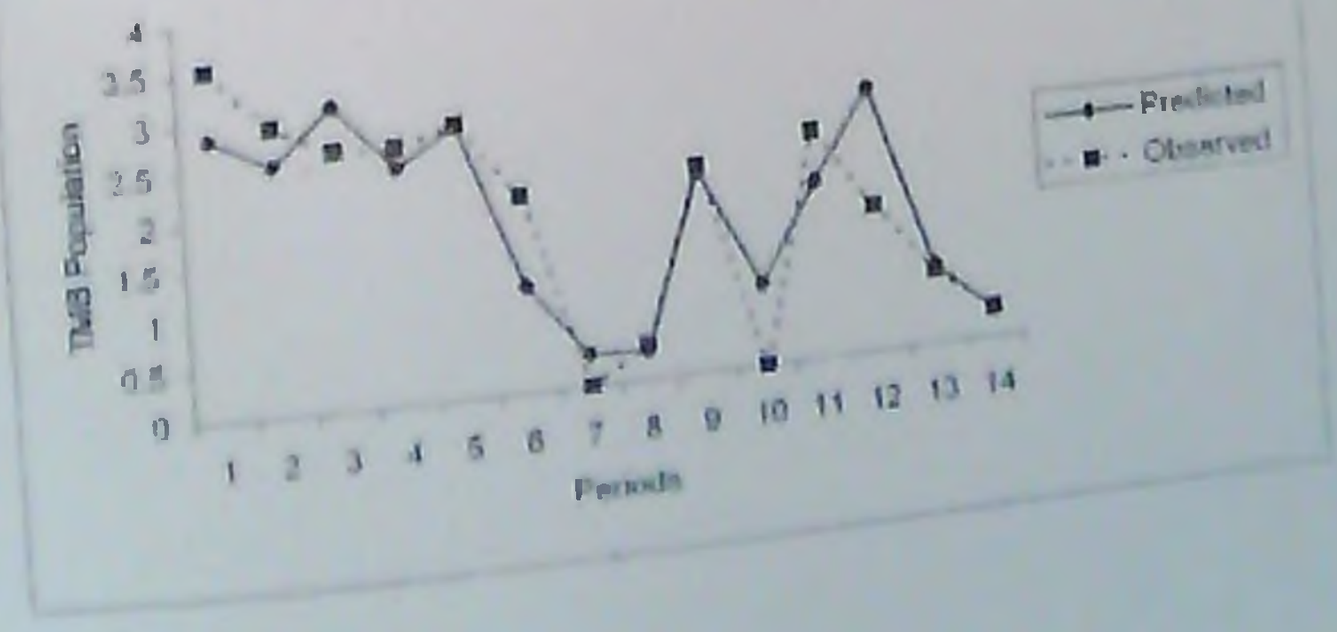
Fig. 40 Model fit for APRIL



Predicted Values (new sta)

	Predictd	observed
	VAR1	
C1	2.838837	3.54
C2	2.544461	2.04
C3	3.104143	2.65
C4	2.424519	2.64
C5	2.799302	2.81
C6	1.068826	2.03
C7	0.32954	0.00
C8	0.296284	0.38
C9	2.068012	2.14
C10	0.84958	0.00
C11	1.847821	2.38
C12	2.74585	1.53
C13	0.834563	0.76
C14	0.300772	0.33

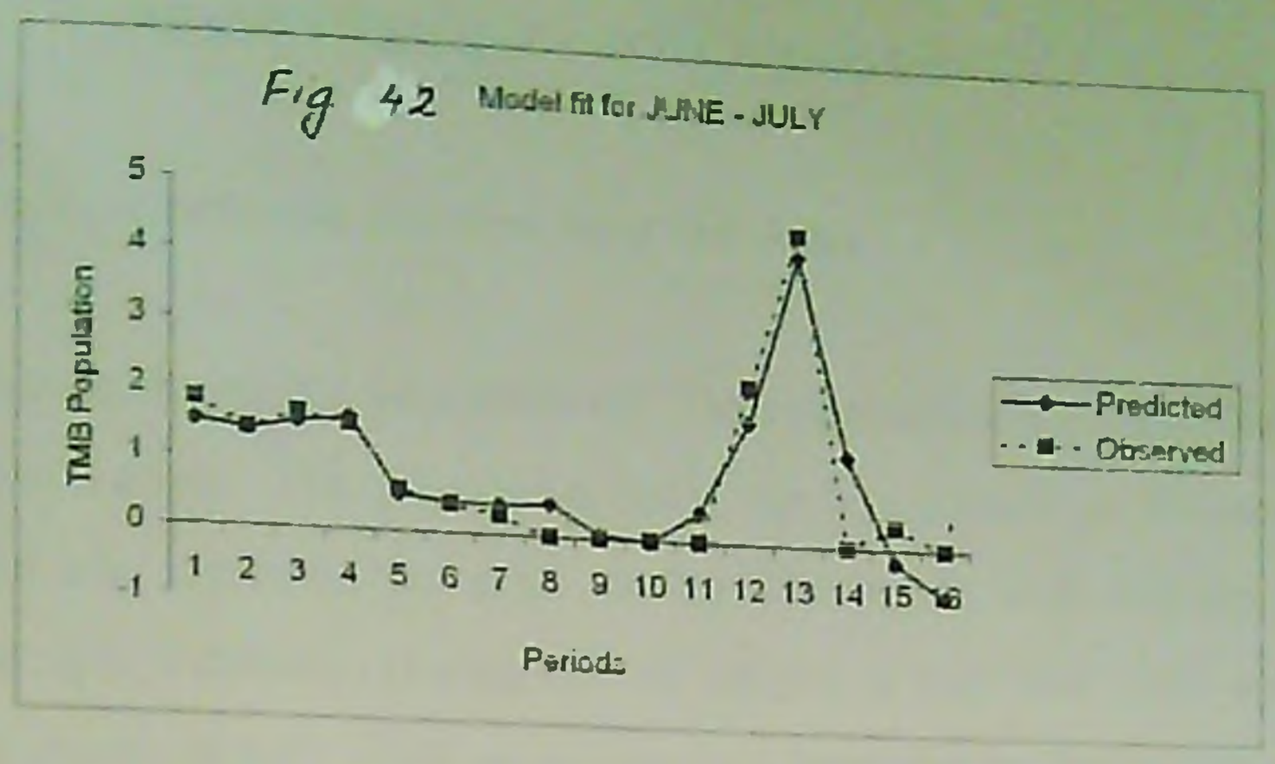
Fig. 41 Model fit for MAY



Predicted Values (new.sta)

	Predicid VAR1	observed
C.1	1.524299	1.83
C.2	1.401563	1.43
C.3	1.54447	1.68
C.4	1.624537	1.53
C.5	0.53374	0.61
C.6	0.44513	0.42
C.7	0.432614	0.29
C.8	0.474603	0.00
C.9	0.068322	0.00
C.10	-0.01697	0.00
C.11	0.432907	0.00
C.12	1.795239	2.33
C.13	4.264983	4.58
C.14	1.356503	0.00
C.15	-0.18849	0.33
C.16	-0.67845	0.00

Fig 42 Model fit for JUNE - JULY



RESULTS 2003-06 (RFRS, VENGURLE)

TMB population on different varieties over the years

At RFRS, Vengurle, during the year 2003-04, TMB population was recorded only on V-1, an early season variety. The population build up was started in November and increased gradually and attained the peak during December and January. A low population persisted upto February. During the off season, a very low TMB population was recorded in the month of July. TMB population was recorded on five varieties for the two years, 2004-05 and 2005-06. The results are depicted in Figures 43 to 49. TMB population was extremely low for all the varieties. Comparatively high population was recorded in the variety V-4 in 2005-06.

The mean per cent infestation was also low at Vengurle and it was less than 10 % on shoot and panicle (Figures 50 to 51). Infestation on shoot and panicle was high during 2004-05 as compared to 2003-04 and 2005-06.

Weather at RFRS,VENGURLE for three years

The weather data for three years at the RFRS, Vengurle are depicted in Figures 52 to 56. During 2003-04, the minimum temperature was in the range of 22 to 25^0 C during the period from September to November 2nd fortnight which was then decreased from Nov. 3rd week upto February last week and the values ranged from 16 to < 20^0 C. Similar was the case in 2004-05 except that the low temperature of < 20^{0}C persisted till March last week in 2005. During 2005-06 the variation in minimum temperature was more during the period from November to February and it ranged from 14 to 21 ^{0}C.

The F N. relative humidity during the first two year period (2003-04 & 2004-05) was less than 91 % during the regular flushing and flowering season and the variation was also less which ranged from > 70 to 91 % all through the year. However during 2005-06, the F N. relative humidity reached 92 % in two weeks. The A N. relative humidity at Vengurle over the years was in the range of 44 to 78 % (2003-04), 47 to 81% (2004-05) and 42 to 85 % (2005-06).

Fig. 43 TMB population on different varieties-2004-05

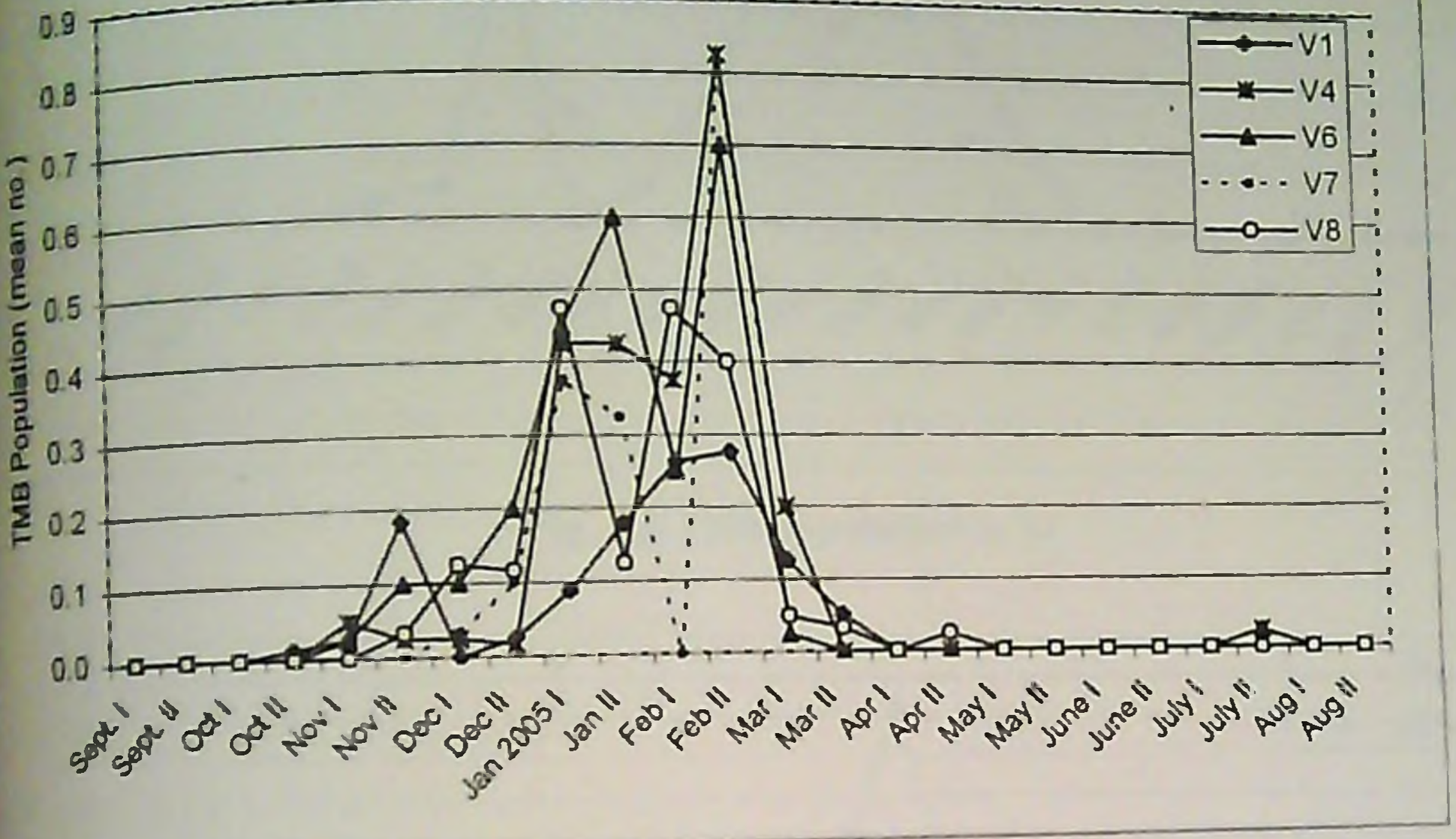


Fig. 44 TMB population on different varieties-2005-06

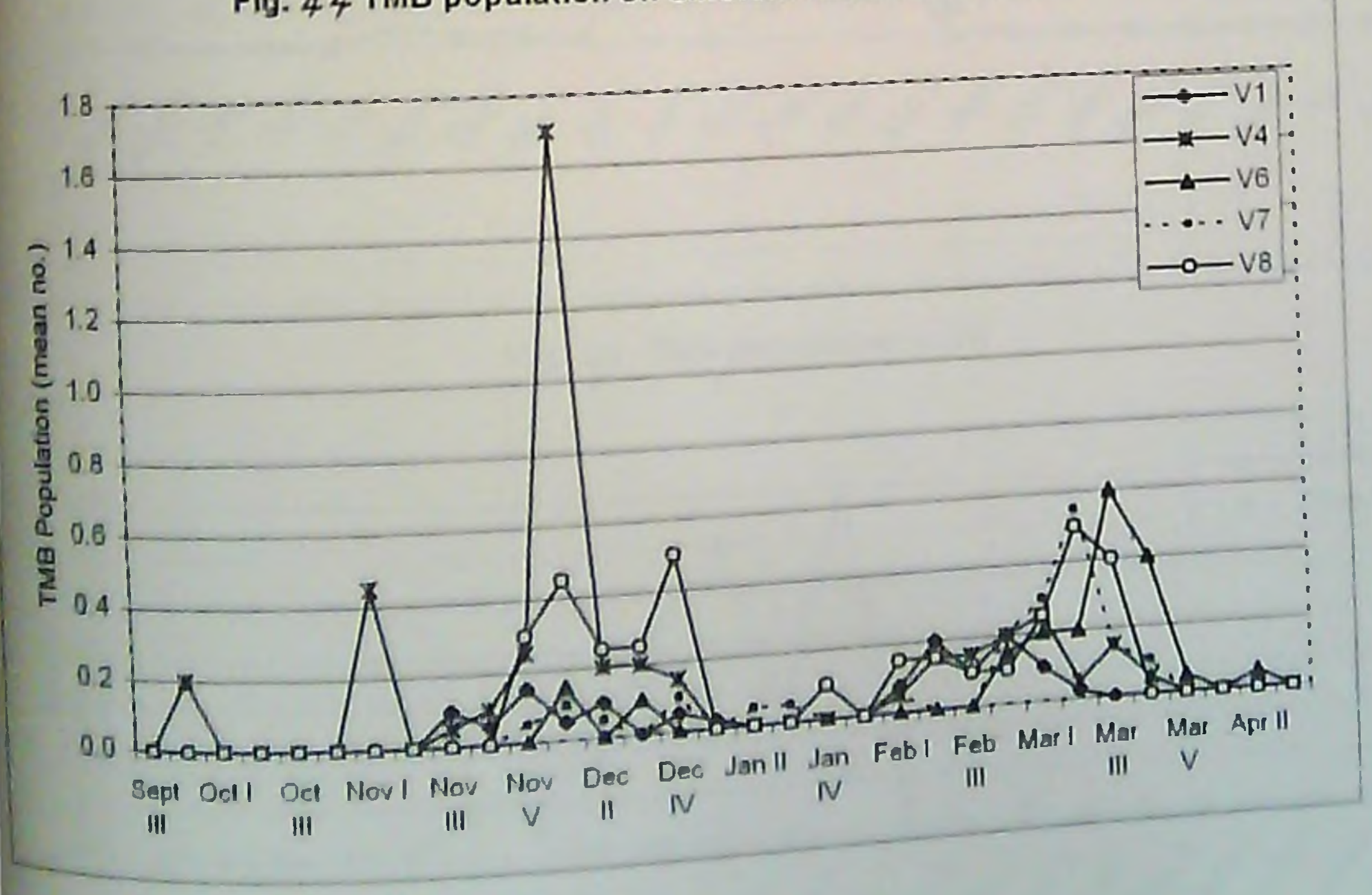


Fig. 45 TMB population in V1

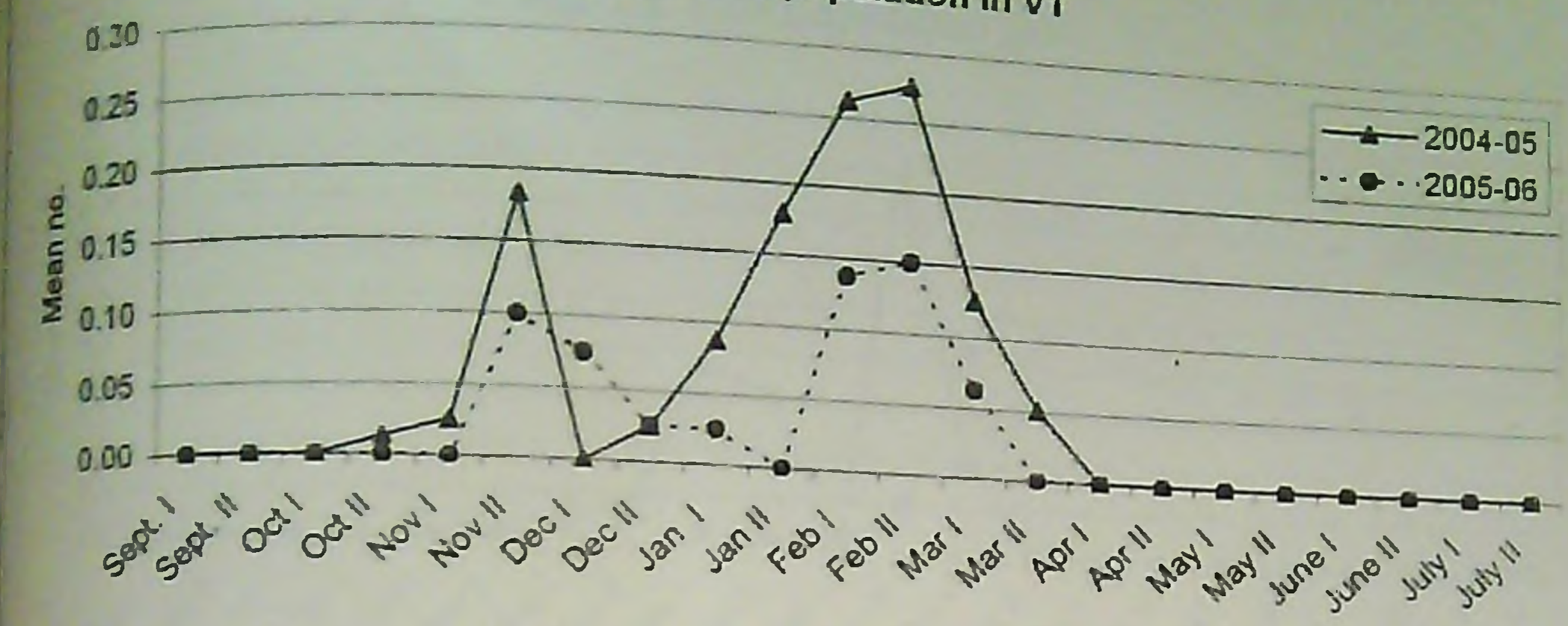


Fig. 46 TMB population in V4

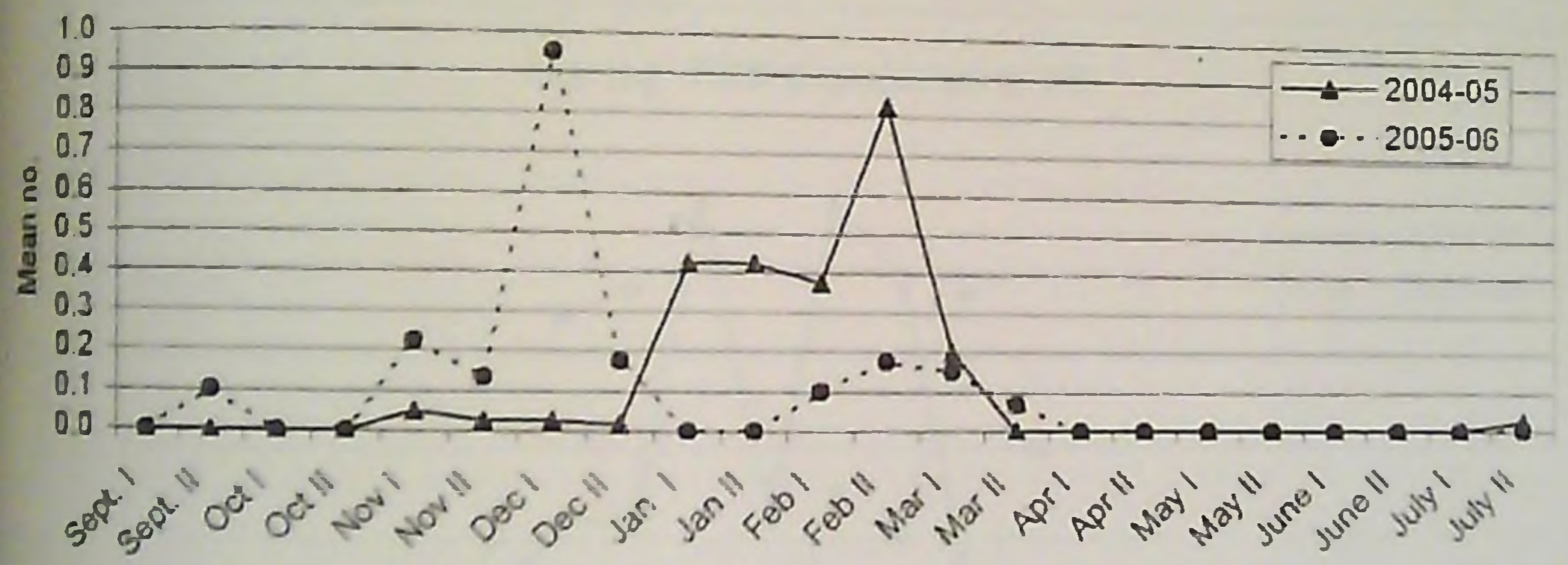


Fig. 47 TMB population in V6

Fig. 48 TMB population in V7

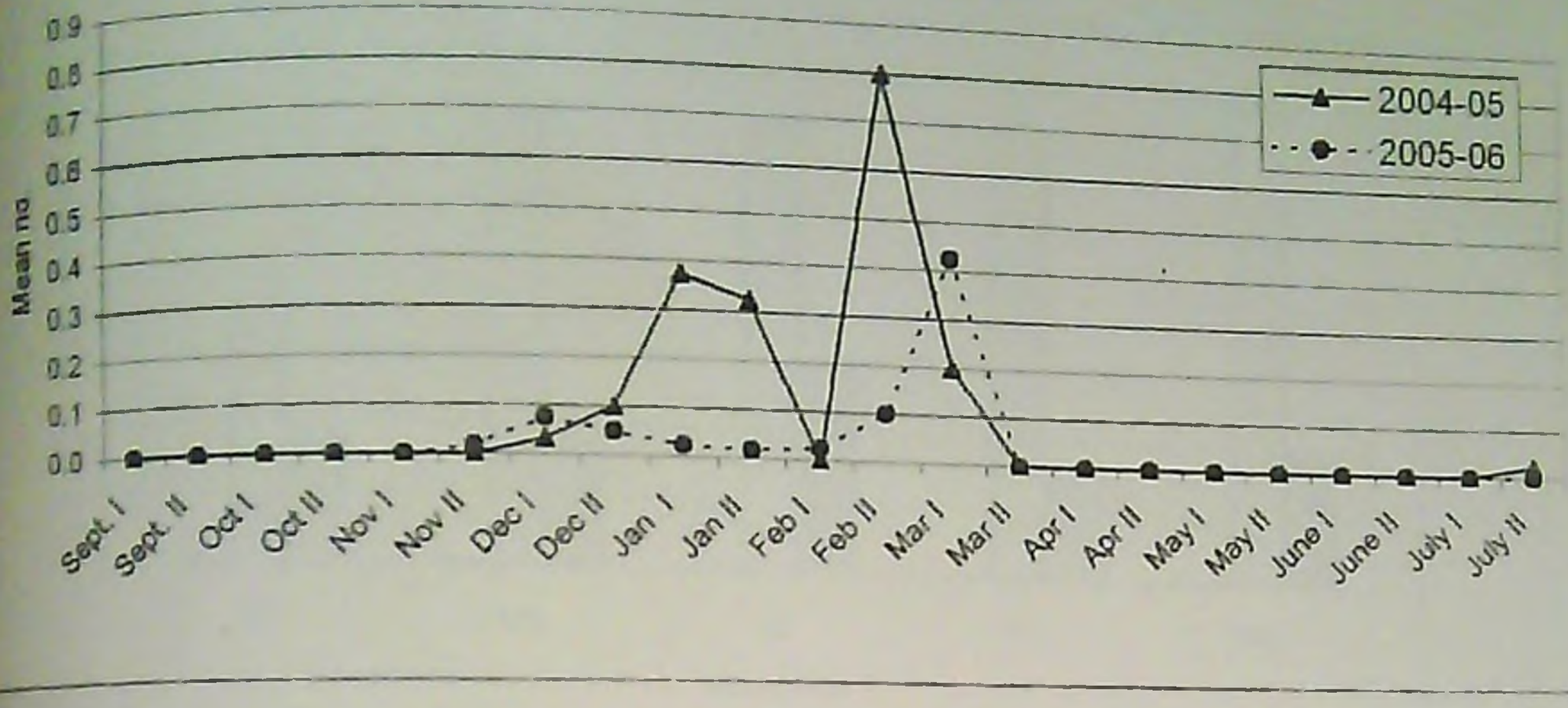


Fig. 49 TMB population in V8

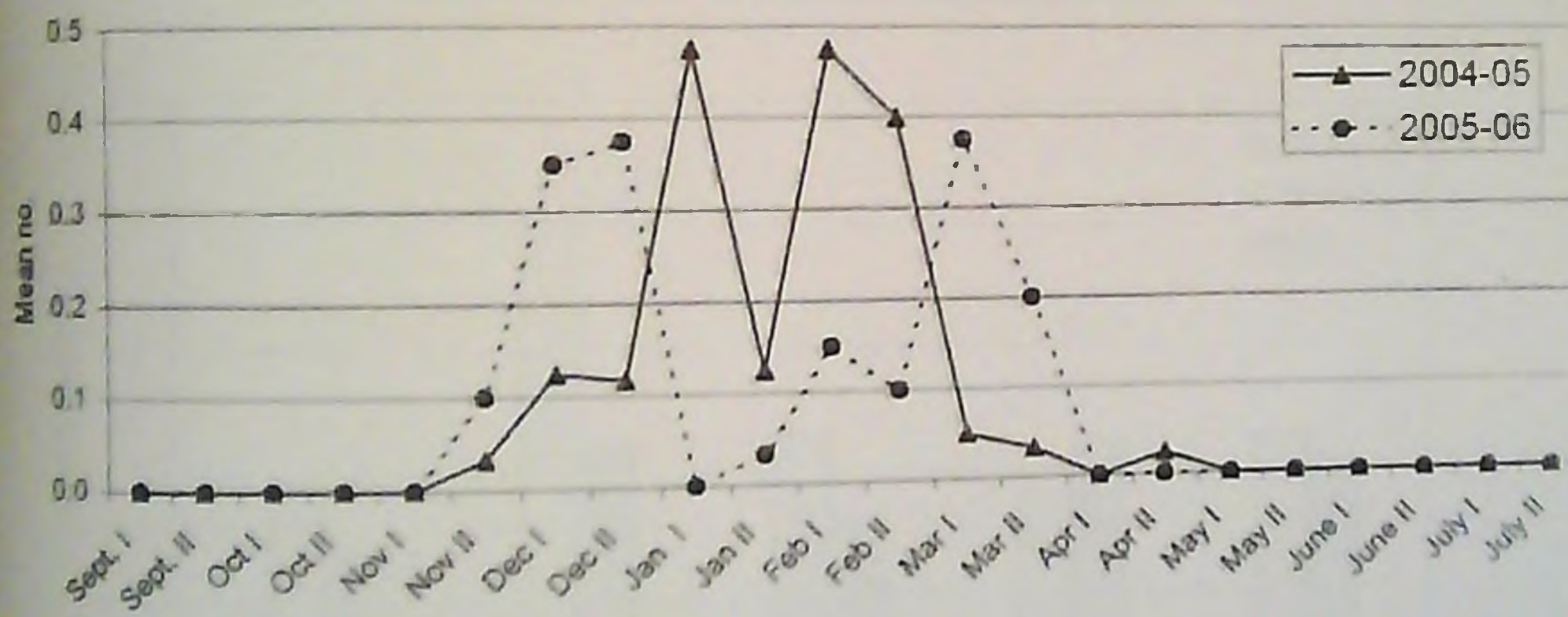


Fig. 50 Varietal influence on TMB infestation (2004-05)

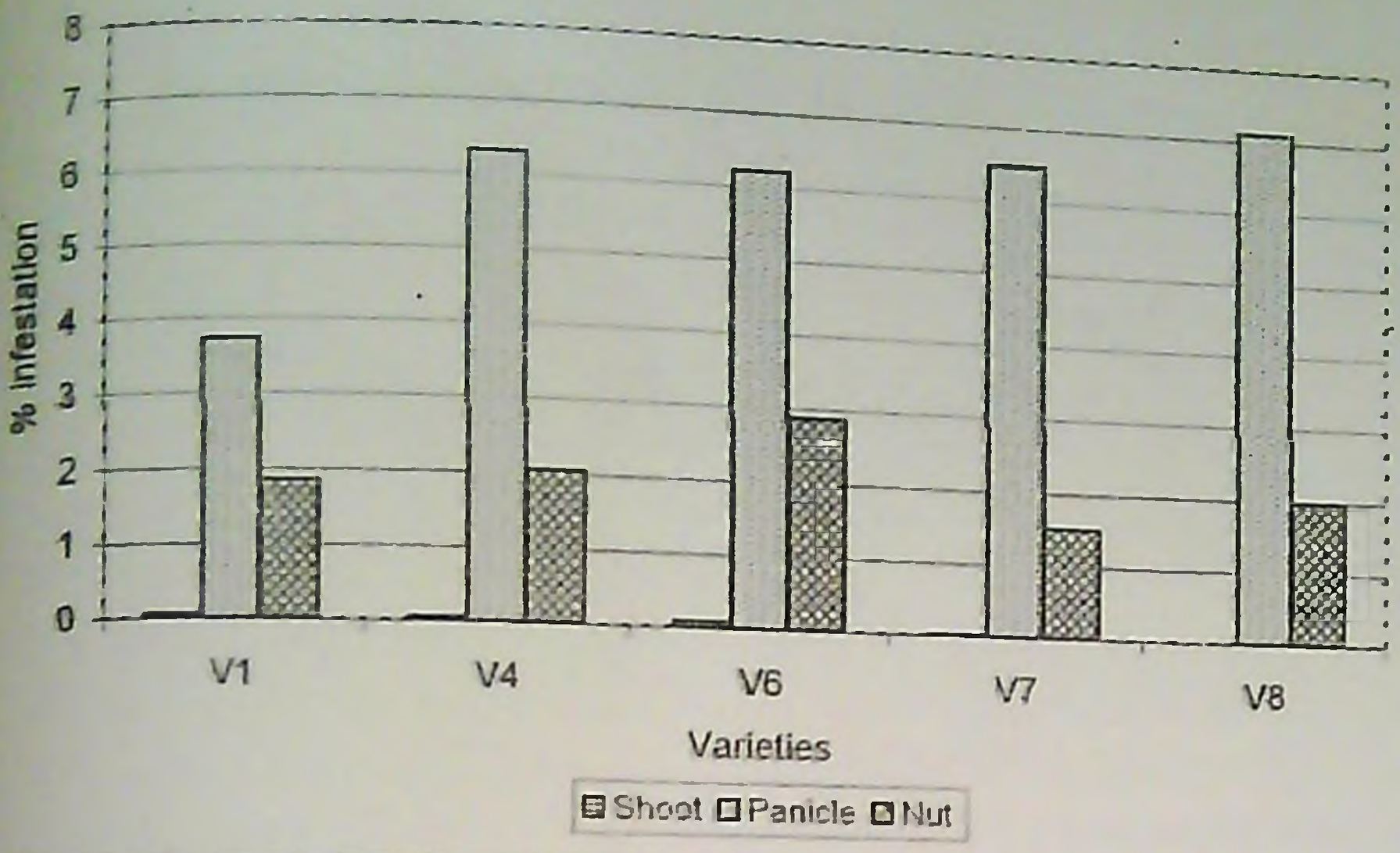


Fig. 51 Varietal influence on TMB infestation (2005-06)

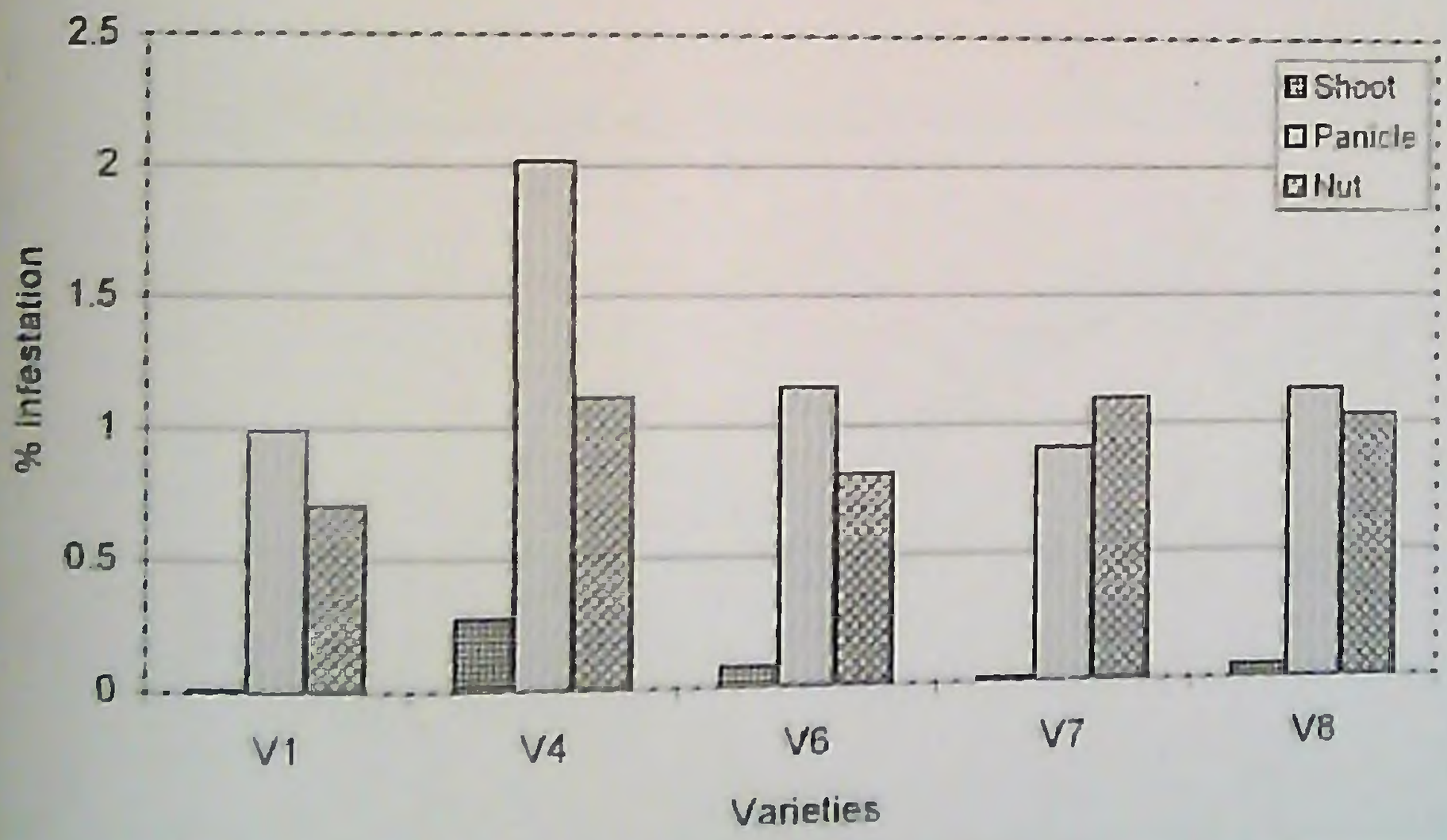


Fig. 52 Maximum temperature (^{0}C) for three years - RFRS, Vengurle

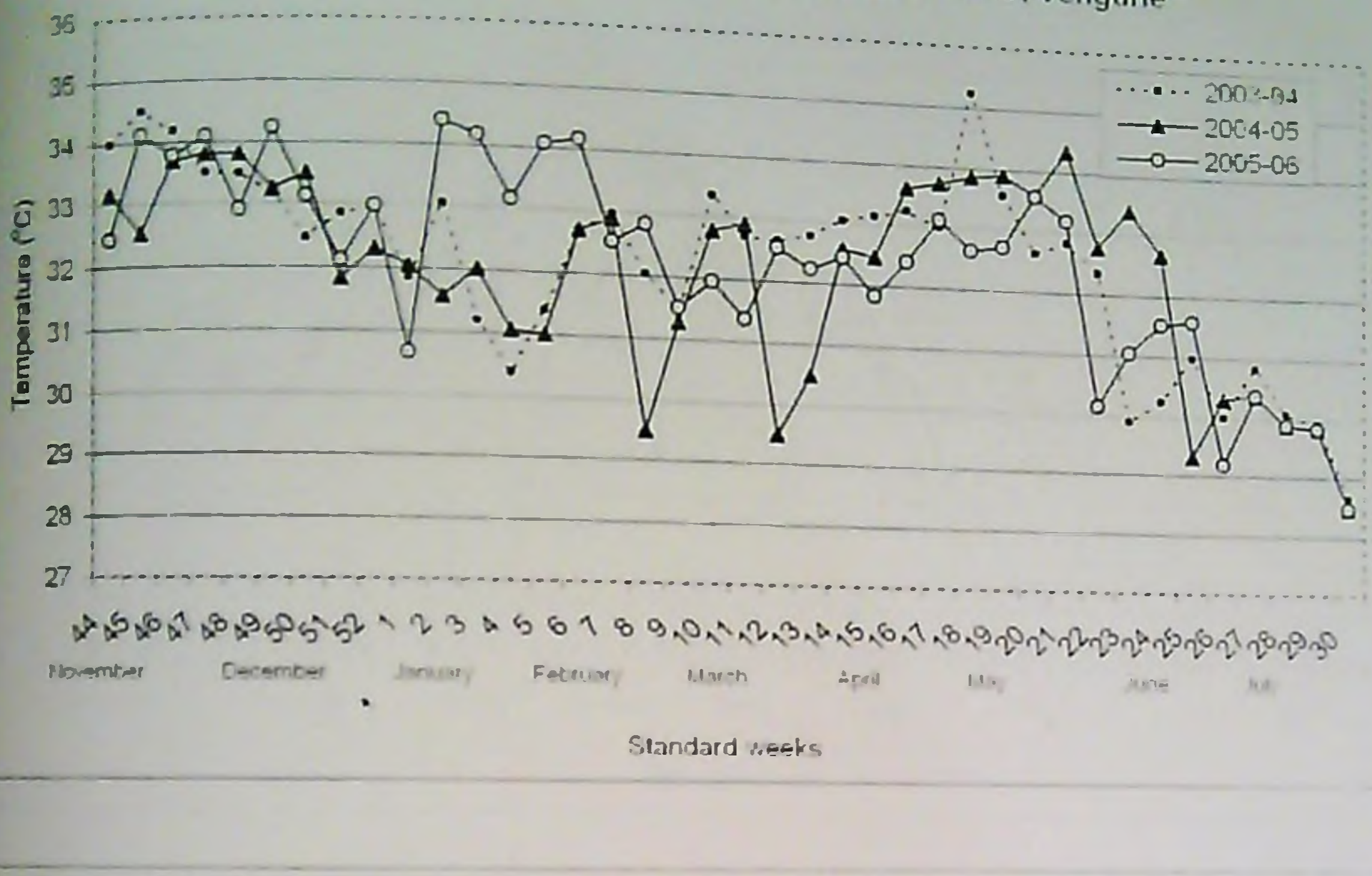


Fig. 53 Minimum temperature (^{0}C) for three years - RFRS, Vengurle

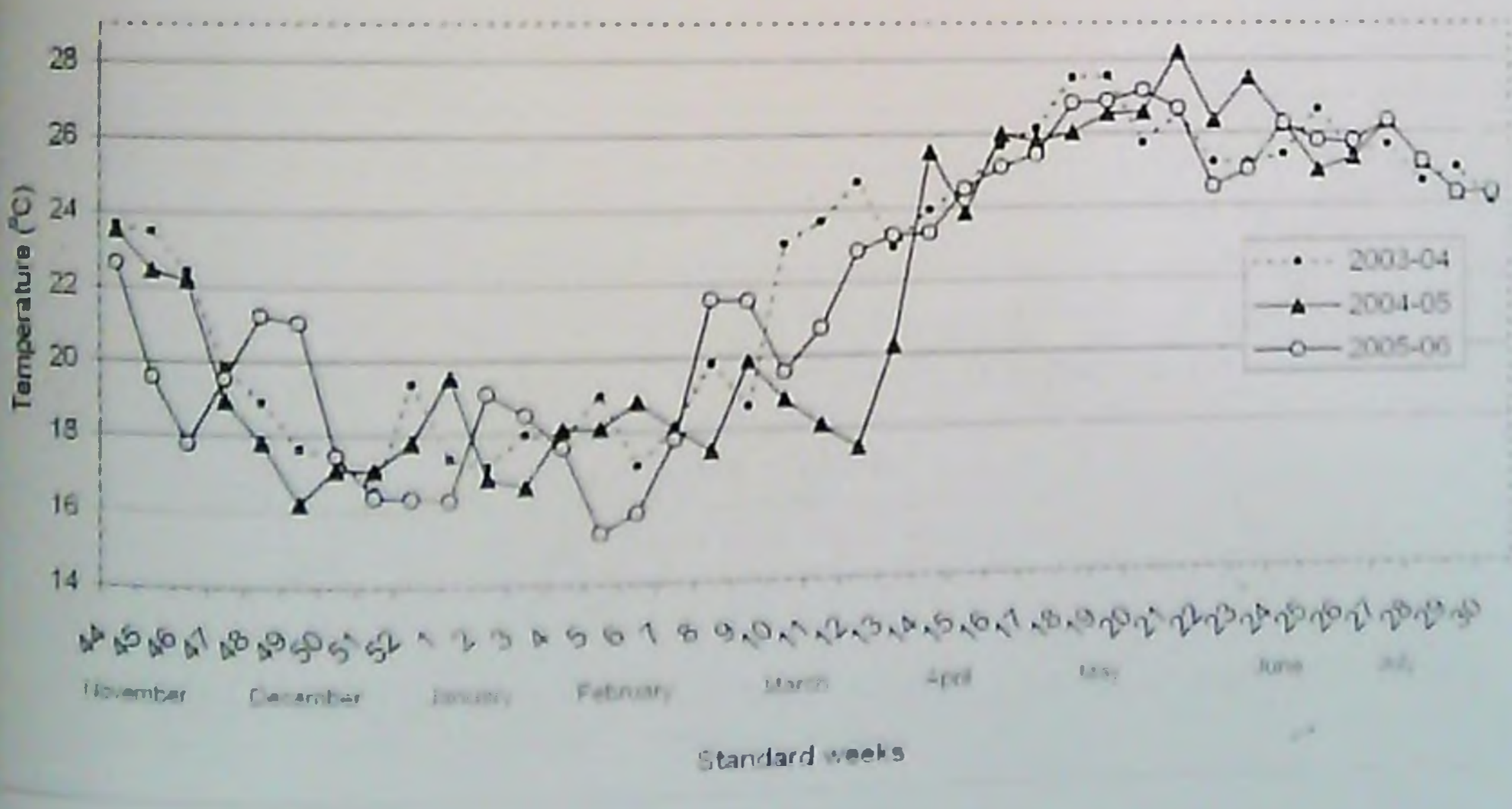


Fig. 54 Forenoon humidity for three years - RFRS, Vengurle

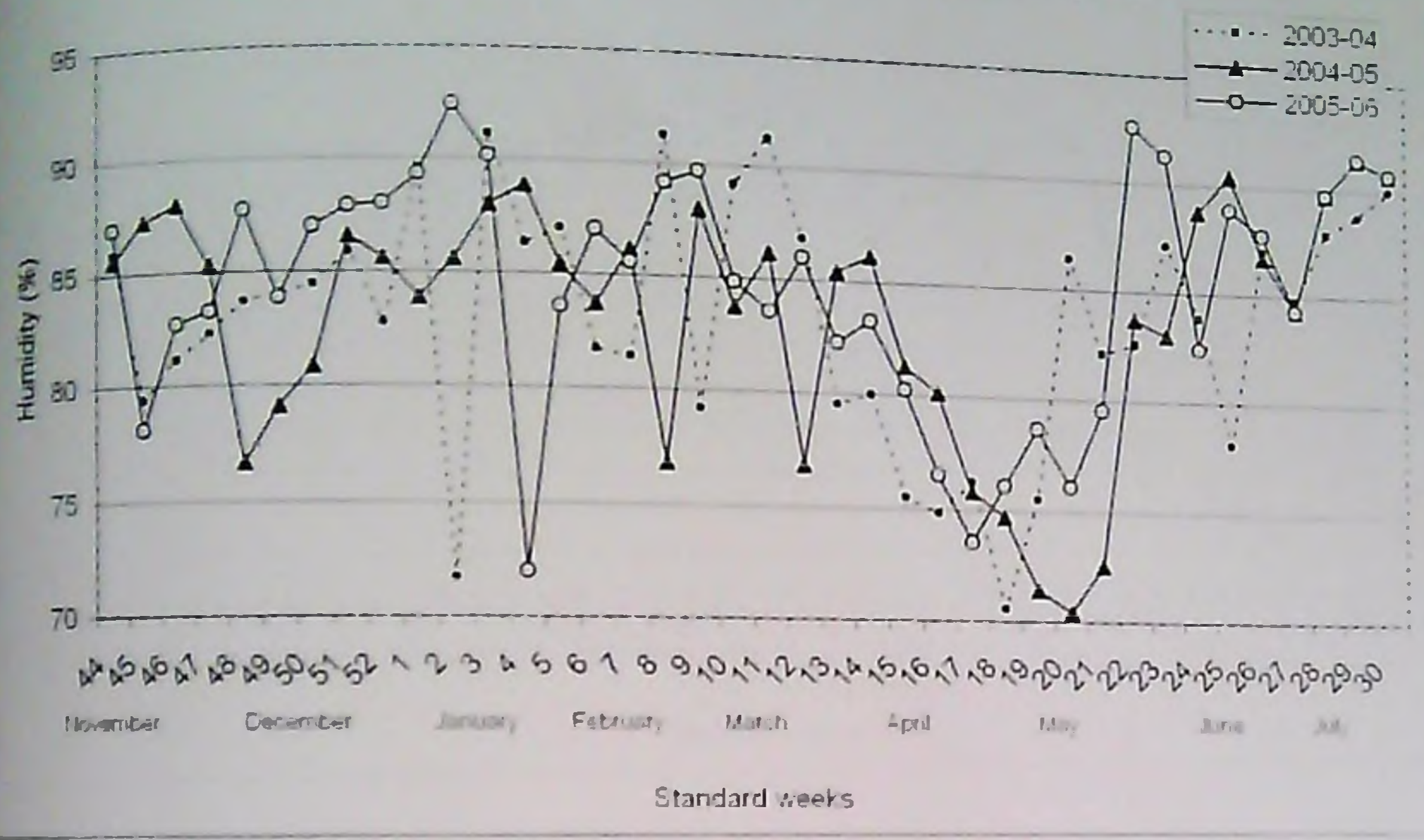


Fig. 55 Afternoon humidity for three years - RFRS, Vengurle

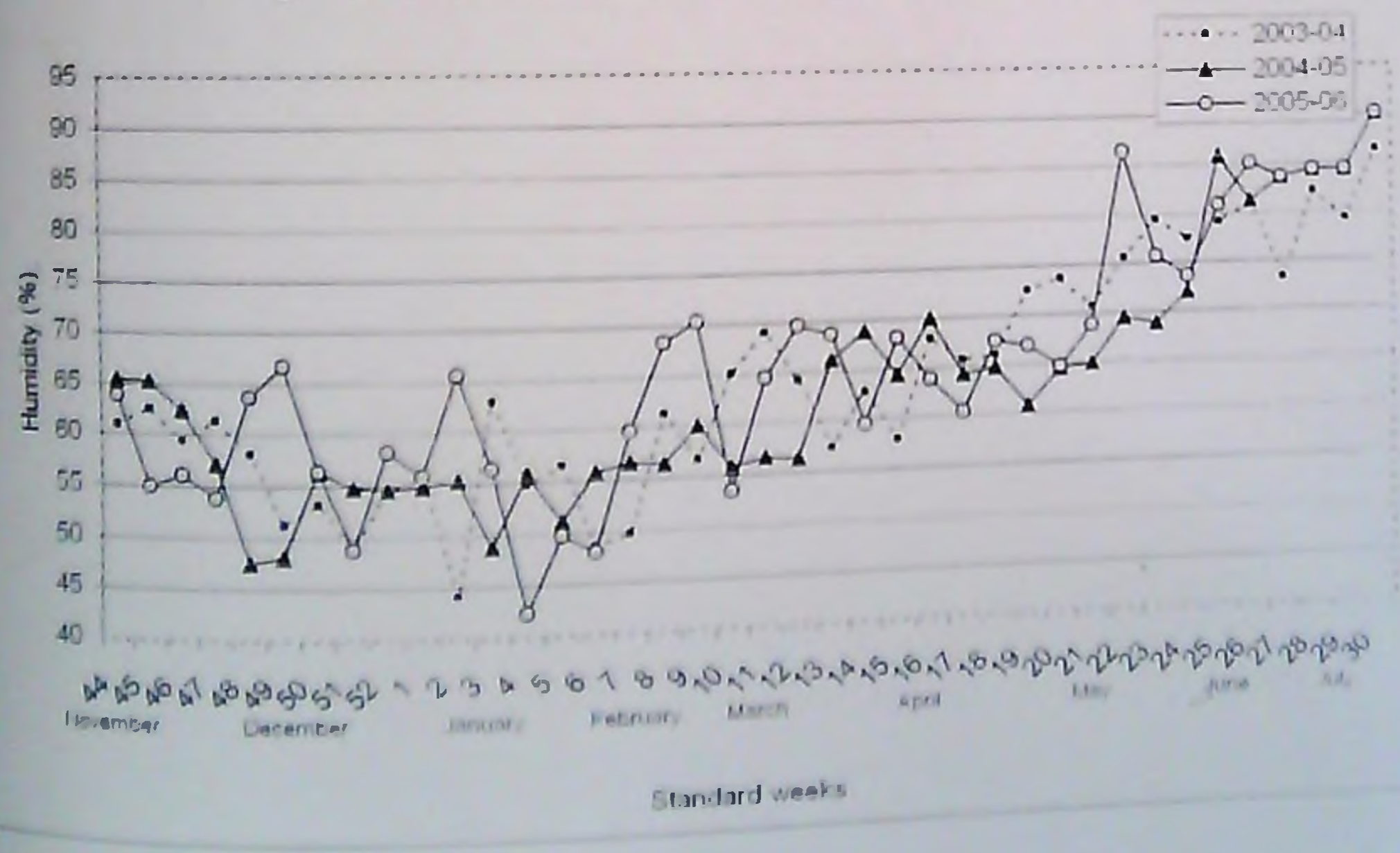
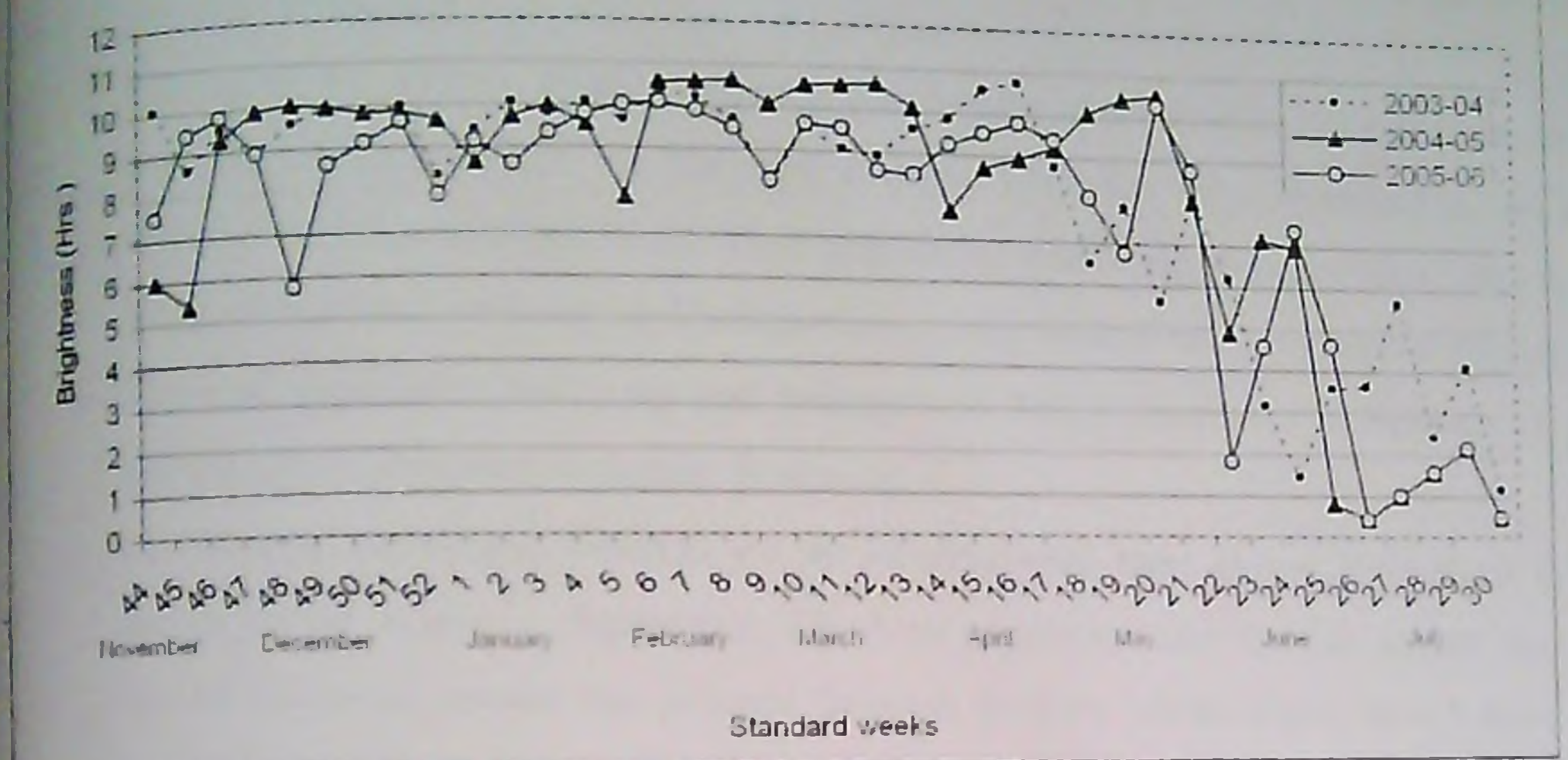


Fig. 56 Brightness for three years - RFRS. Vengurle



DISCUSSION

- TMB population and damage was found to vary in different agro- ecological situations as affected by weather conditions prevailed in the locality, varietal variation, age of the trees and crop phenology.
- Among all the centres, TMB population was highest at the RARS, Pilicode throughout the period of study and thus the hot spot area for TMB has been identified as the RARS, Pilicode. In the present study the TMB population was found to be low in Chintamani and Vengurle centres , moderate at Madakkathara centre while it was very high at Pilicode.
- The peak population builds up and damage was during December to February at all the centres which coincided with peak flowering.
- At Pilicode, population survived on the observational trees almost throughout the year except during August – September. The high population and damage caused during the regular flowering season has induced frequent flushing which might have helped in the survival of TMB during the off season. Some of the observation trees were young and were in the active vegetative growth, which also contributed to the high infestation at Pilicode.
- As compared to Pilicode, the initial population at Madakkathara on mature trees was totally absent or negligible during early phase of the crop in, September, October and November. On the other hand, the young trees (3-4 years) at Madakkathara centre, has recorded the TMB population throughout the year at moderate intensity, the peak population being in the months of December and February. However, TMB population was totally absent during March and August. During March the maximum temperature was above 35°C, which could be lethal high and also flushing intensity was found to be low. During the month of March, the pest population was completely absent even in the young trees
- Young trees acted as the perennial source of food supply for TMB population which survived throughout the year except during the adverse situation in March and August. The continuous and heavy rainfall and maximum number of rainy days occurred during June-July months might have led to a zero population in August. The trees were also in dormant stage with no new flushes. A continuous carry over population at low intensity could be noticed on post harvest flushes as well as on monsoon flushes in young trees at all the

centres. In a plantation with the trees of different age groups, TMB population was present almost throughout the year on young trees at a moderate to heavy intensity.

- At low population intensity, TMB occurrence on mature trees was confined on isolated trees showing patchy/ scattered distribution.
- The occurrence of TMB was found to be directly related to the availability of tender plant parts and hence surveillance and monitoring during the off season should be done selectively
- At all the centres, the correlation analysis revealed a highly significant negative correlation existed between the TMB population and the weather factors such as minimum temperature, relative humidity, rainfall and the number of rainy days. TMB population was found to be positively correlated with sunshine hours.
- In the partial correlation analysis the influence of weather variables when considered individually was not significant and hence the most influencing or critical weather variable on TMB population build up could not be identified. The prediction model prepared based on the present three year study revealed the influence of more than one weather parameter in the population build up of TMB.
- The spiders and ants were found to be present in cashew ecosystem throughout the year at all the four centres. At Madakkathara, altogether, 31 spider species under 9 families and 23 genera have been collected from cashew trees and identified. The preliminary feeding trials could confirm the feeding of about nine species of spiders on TMB. Few spiders fed only on TMB adult while some others could feed both on nymphs and adults.
- Ants were found to be abundant in the cashew ecosystem throughout the year. A number of species have been identified of which three species have been found to be predatory on TMB. Ants such as *Crematogaster* sp., *Oecophylla smaragdina* and *Tetraponera* sp. were reported to be predatory on TMB.
- The impact of natural enemies, both parasitoids and predators, could not be quantified in the present study. Egg parasitoids were not obtained and thus egg parasitism could not be assessed.
- The population of ants and spiders (all species) has been recorded by all the centres. However, the relationships of ants with TMB and their impact as predators of TMB have to be studied in detail separately.

TECHNICAL SUMMARY

The present project envisaged the detailed and systematic studies to analyze the factors responsible for the triggering of tea mosquito bug infestation and to forewarn its population build up. Intensive monitoring programme has been undertaken to record the tea mosquito population at weekly intervals under different geographical situations of major cashew growing states in the West Coast. Along with the tea mosquito bug population, the weather data of the experimental area has also been recorded to study their interrelationships so as to ascertain the critical weather factors and to study their influence on TMB population build up and damage during the regular season. The project was implemented at the following four centre as per the approved technical programme.

Lead centre: 1. College of Horticulture, Kerala Agrl. University,Vellanikkara. For the lead center, field experiments were conducted at the Cashew Research Station, Madakkathara.

Sub centers:

ii). Regional Agricultural Research Station, Pilicode (Kerala)

iii). Regional Fruit Research Station, Vengurle (Maharashtra)

iv). Agricultural Research Station, Chintamani (Karnataka)

The research work has been conducted for three years (From September 2003 to August 2006) as per the approved technical programme. Monitoring of tea mosquito bug (*Helopeltis antonii* Sign) population was done at weekly intervals round the year. Cashew varieties under three categories such as early, mid and late season were included for the studies. Monitoring was done by visual estimation of crop damage and *in situ* count of TMB population at weekly intervals. The summary of results generated from four centres and the major findings are presented below:

1. TMB population

TMB population and damage was found to vary at the four different centres

The highest population was at the **RARS, Pilicode**, situated at the northern end of Kerala and can be considered as the hot spot area for TMB. At Pilicode ,TMB population build up started very early in the month of October i e during the early flushing stage itself at a moderate intensity on all the four varieties, throughout the three years of study. The population

persisted at a moderate to high intensity continuously throughout the year though it was low after the regular flowering season. The peak population was during December and January coinciding with the flowering and nut formation stage. Among the three years of study at Pilicode, the population was highest during 2005-06 and lowest in 2004-05 (Fig. 1 to 3).

Among the four varieties studied, the early variety, Anakkayam -1 recorded the lowest population in all the three years, while the population was always highest in the variety Madakkathara-1 though it was also an early season variety. During the peak year 2005-06, all the varieties showed corresponding increase in the population.

However, the situation was different at the **CRS, Madakkathara, Thrissur**, located in the central Kerala, where the TMB population was negligible during the beginning of the season i.e. during the flushing and early flowering period. A moderate TMB population was recorded only during the period from December to February every year. The peak population was during the last two weeks in December and the third week of January and it was same for all the varieties throughout the three year period. During the other periods and off season TMB population was not observed on older trees at Madakkathara condition. During the three year study period at Madakkathara, TMB population was comparatively high during the year 2005-06. The same trend was observed at Pilicode also.

At Madakkathara, among the four varieties studied, high population was in the early varieties Anakkayam-1 and Madakathara-1. At Madakkathara, the mid season hybrid variety Kanaka has recorded the lowest population throughout the period of study. At Pilicode location, lowest population was in Anakkayam-1 (Fig. 1 to 3).

At RFRS, Vengurle, during the year 2003-04, TMB population was recorded only on V - 1, an early season variety. The population build up was started in November and increased gradually and attained the peak during December and the first two weeks in January. A low population persisted upto February during the regular season. During the off season, a very low TMB population was recorded in the month of July (Fig. 4, 5)

Fig. 1 TMB population in CRS, Madakkathara & RARS, Pilicode (2003-04)

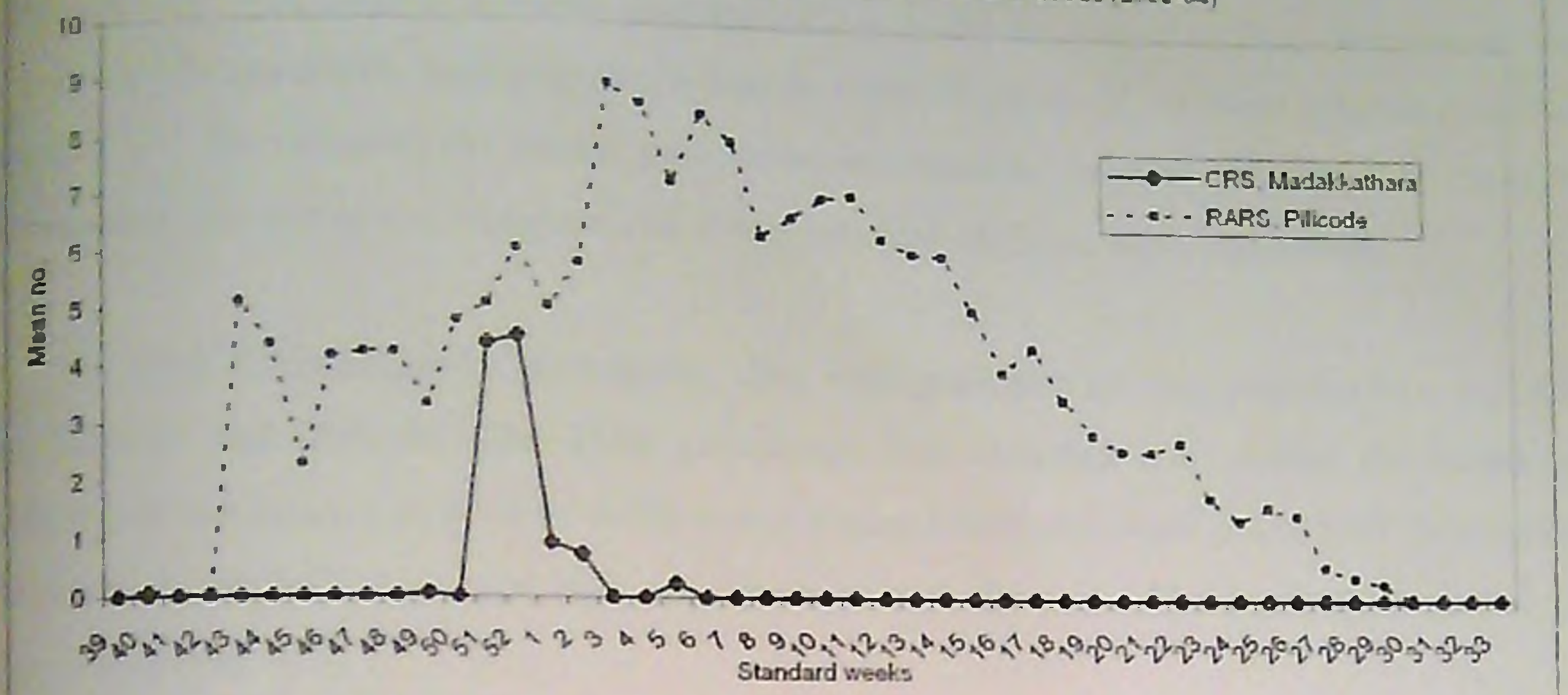


Fig. 2 TMB population in CRS, Madakkathara & RARS, Pilicode (2004-05)

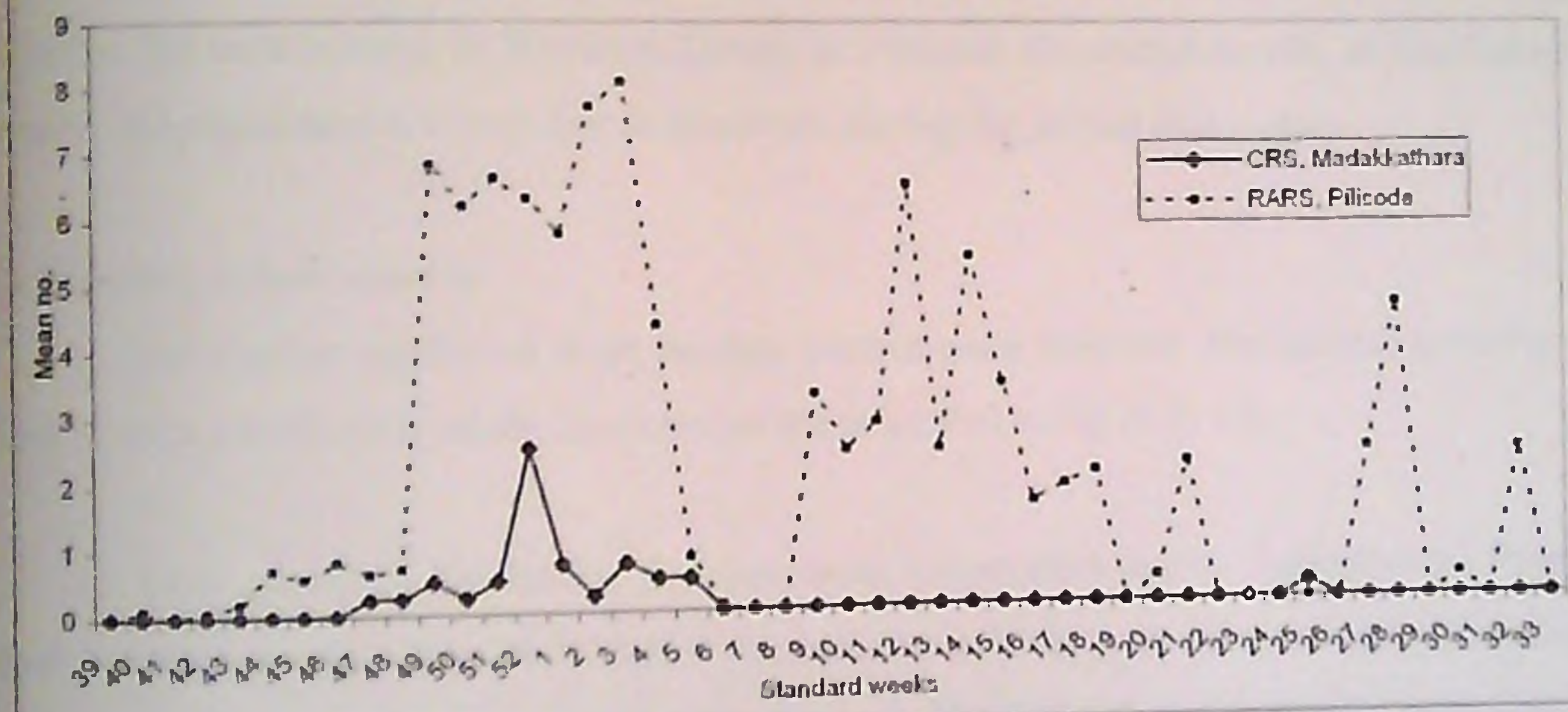
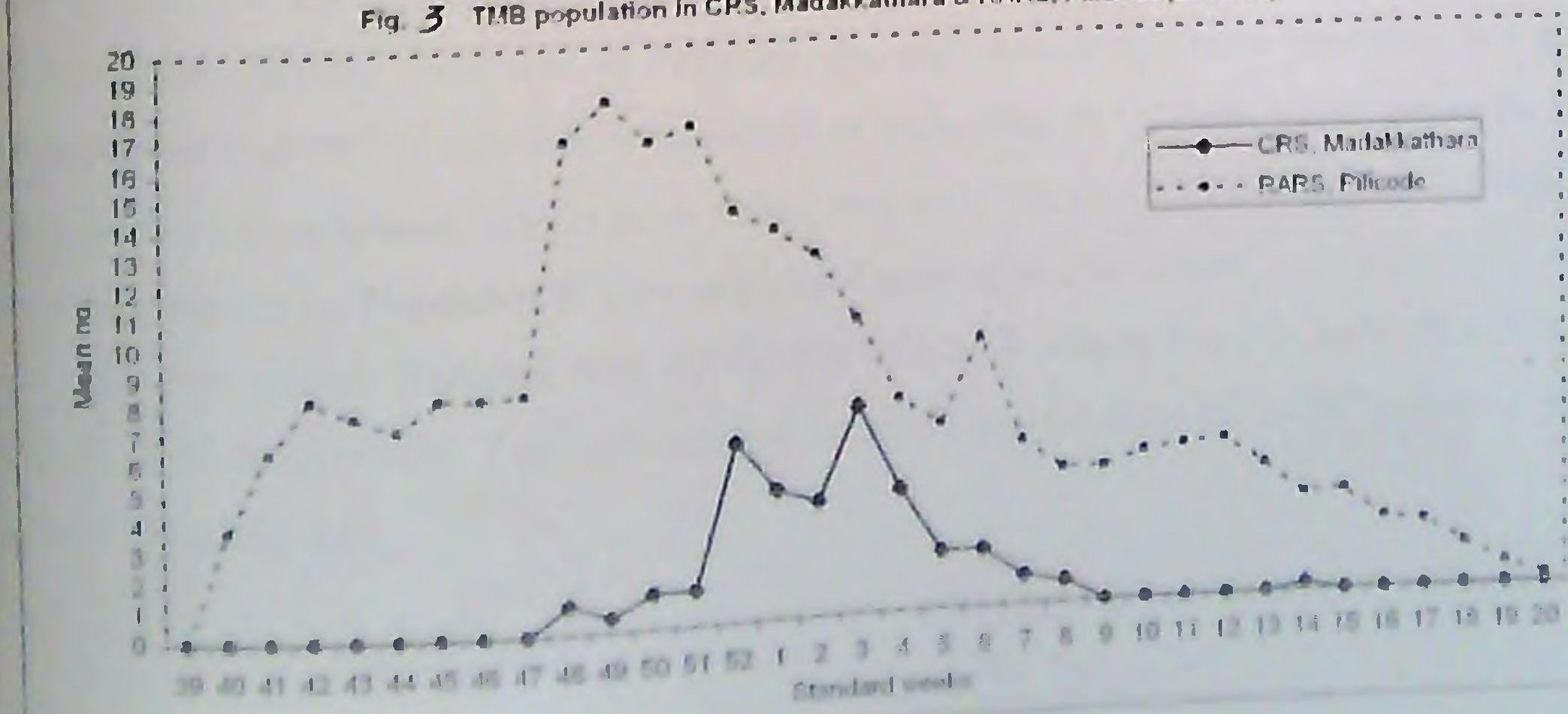


Fig. 3 TMB population in CRS, Madakkathara & RARS, Pilicode (2005-06)



At Vengurle. TMB population was recorded on five varieties for the two years. 2004-05 and 2005-06. The results revealed that population build up was extremely low for all the varieties. Comparatively high population was in 2004-05 on all the varieties. The early season variety V-1 has recorded the lowest population as compared to other varieties. The mean % Infestation was also low at Vengurle and it was less than 10 % on shoot and panicle.

At **ARS, Chintamani in Karnataka**, data were generated for two years on four varieties in 2004-05 and 2005-06. The TMB population was recorded only during the month of December and January in 2004-05 while it was during March and April in 2005-06. Among the varieties Anakkayam-1 showed high population in both the years. The population was low at this centre (Fig. 4, 5).

The results generated for three years at four centres revealed that the hot spot area for TMB in the west coast is in Northern Kerala at Pilicode. In central Kerala, at Madakkathara centre, the population was only low to moderate during the period under study.

2. Weather at four centres

The weather conditions at all the four centres were different. The relative humidity and temperature variations at all the four centres are presented in Fig (6 to 13).

At **Chintamani** in Karnataka, the maximum temperature during September to February first fortnight was less than 28 ^{0}C and it reached above 30 ^{0}C only after February 2nd fortnight upto June. The minimum temperature was also low. The F.N and A.N humidity were also low. During 2005-06, the mmimum temperature ranged from 16 to less than 20^0 C during September to November. During December to February the minimum temperature was very low and it ranged from 9 to 16 ^{0} C after that it increased to more than 18 ^{0}C from March onwards. So at Chintamani the minimum temperature range was only 10 to 16^{0}C during the flushing and flowering season i e. December to February, the lowest of all the centres.

The F.N. relative humidity from September to March ranged from 73 to 93 % (2004-05). and 50 to 85 % (2005-06). The A.N. relative humidity ranged from 25 to 88 % (2004-05) and 20 to 84 % (2005-06).

Fig. 4 TMB population in RFRS, Vengurle & ARS, Chintamani (2004-05)

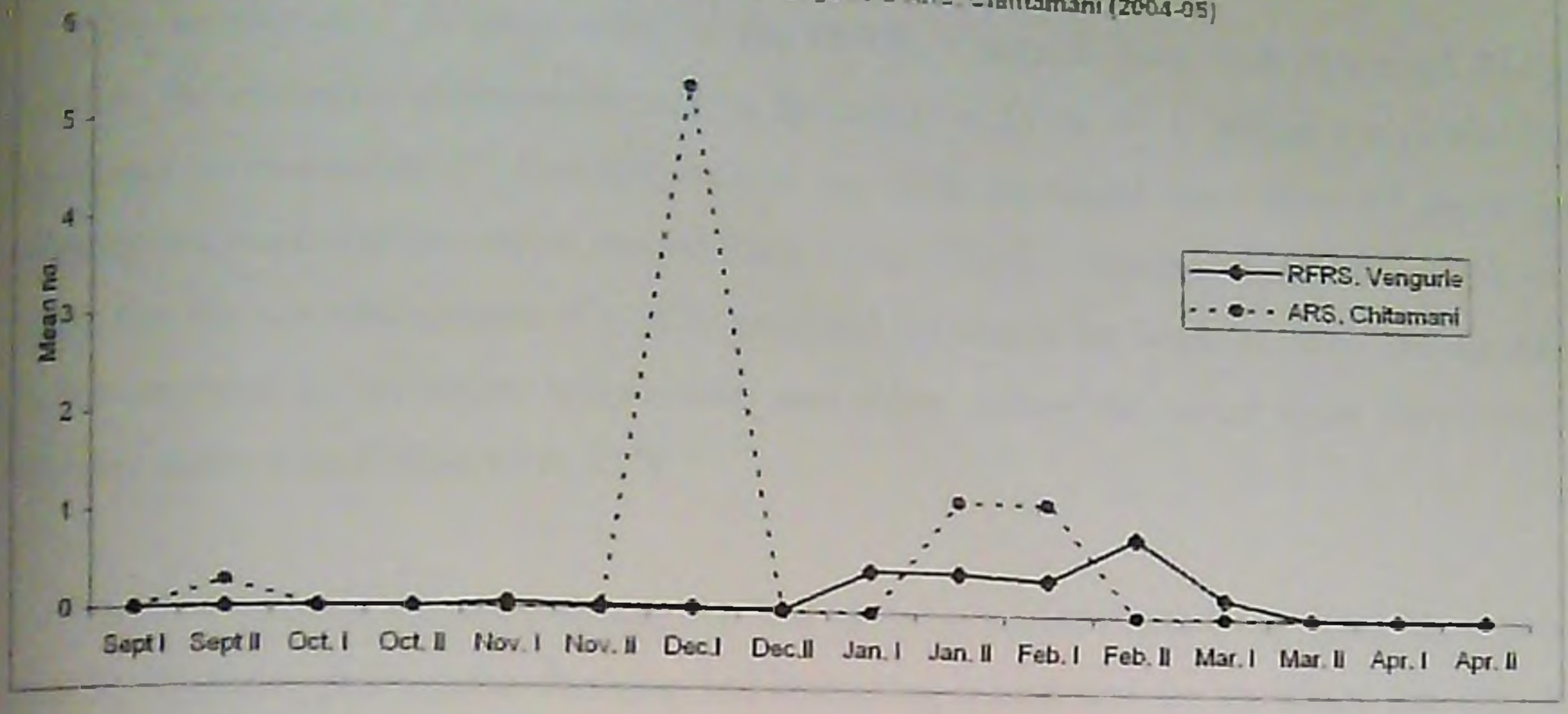
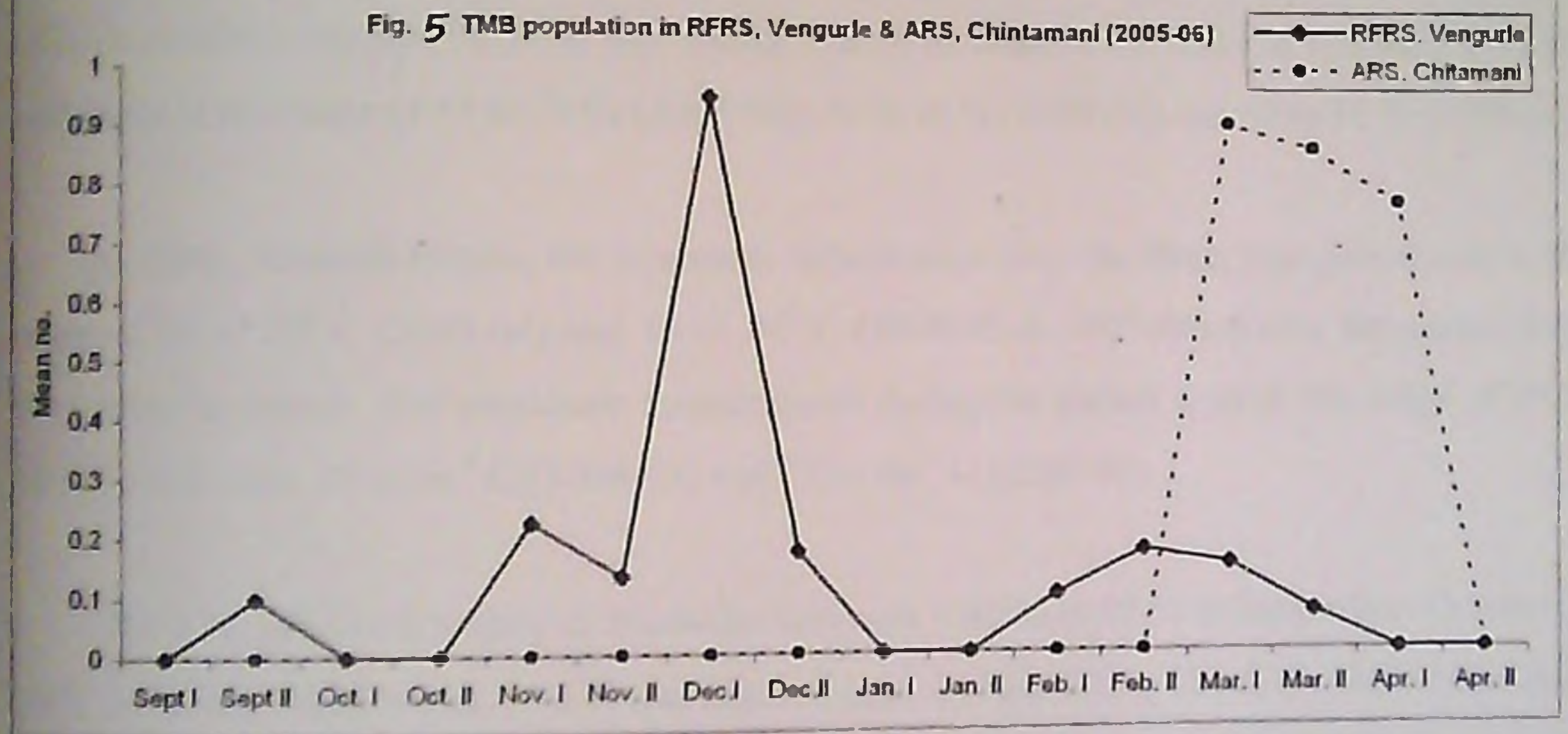


Fig. 5 TMB population in RFRS, Vengurle & ARS, Chintamani (2005-06)



The weather data for three years at the **RFRS, Vengurle** have been examined. During 2003-04, the minimum temperature was in the range of 22 to 25^0 C during the period from September to November 2nd fortnight which was then decreased from Nov. 3rd week upto February last week and the values ranged from 16 to < 20^0 C. Similar was the case in 2004-05 except that the low temperature of < 20^{0}C persisted till March last week in 2005. During 2005-06 the variation in minimum temperature was more during the period from November to February and it ranged from 14 to 21 ^{0}C.

The F.N. relative humidity during the first two year period (2003-04 & 2004-05) was less than 91 % during the regular flushing and flowering season and the variation was also less which ranged from > 70 to 91 % all through the year. However during 2005-06, the F.N. relative humidity reached 92 % in two weeks. The A.N. relative humidity at Vengurle over the years was in the range of 44 to 78 % (2003-04); 47 to 81% (2004-05) and 42 to 85 % (2005-06).

At CRS, Madakkathara, the minimum temperature over the three year period was in the range of 20 to 25^0 C (2003-04) and 19 to 24^0 C (2004-05 & 2005-06) during the period from September to March. The maximum temperatures during the period were in the range of 29 to 38 ^{0} C (2003-04), 29 to 36 ^{0} C (2004-05) and 27 to 36 ^{0} C (2005-06).

The F.N. relative humidity at Madakkathara was > 80 % to 92 % in September- October of 2003 and 2004, while it was > 90 % and reached upto 94 % in 2005. The A.N. relative humidity was in the range of > 60 to 81 % (2003), 54 to 74 % (2004) and 62 to 87 % (2005). The relative humidity was reduced from November to February, the F.N humidity ranging from 56 to 78 % (2003-04), 59 to 81 % (2004-05) and 60 to 85 % (2005-06). The A.N. humidity during the period was 23 to 64 % (2003-04), 29 to 63% (2004-05) and 20 to 65 % (2005-06).

The hot spot area for TMB has been identified as the **RARS, Pilicode**. The weather prevailed at Pilicode has been examined critically and the details are as follows

Fig.6 Minimum tempeature in four centres (2004-05)

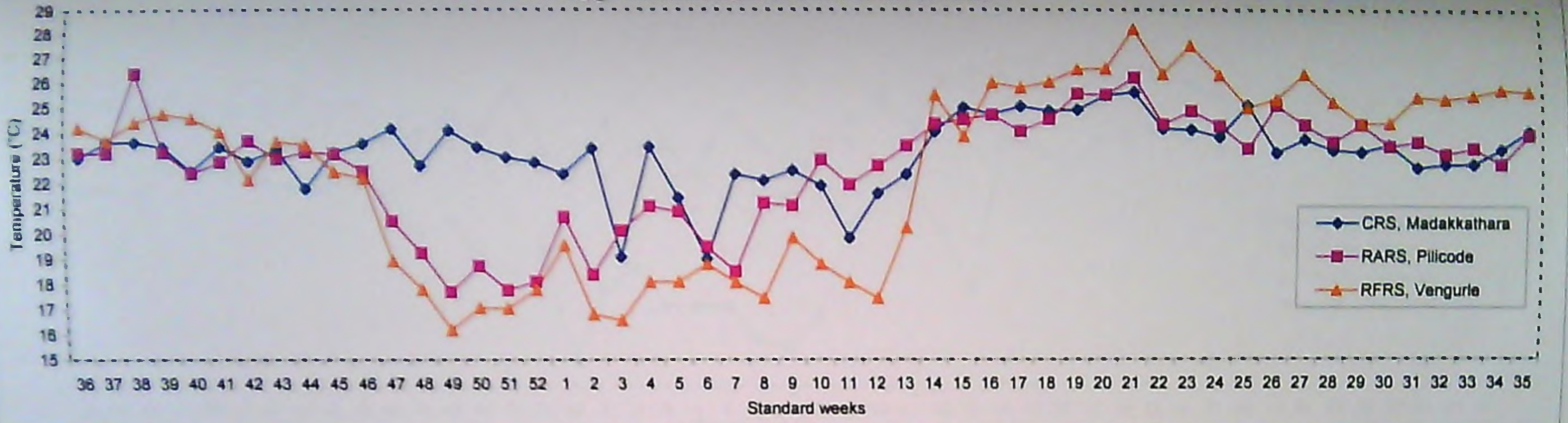


Fig.7 Maximum temperature in four centres (2004-05)

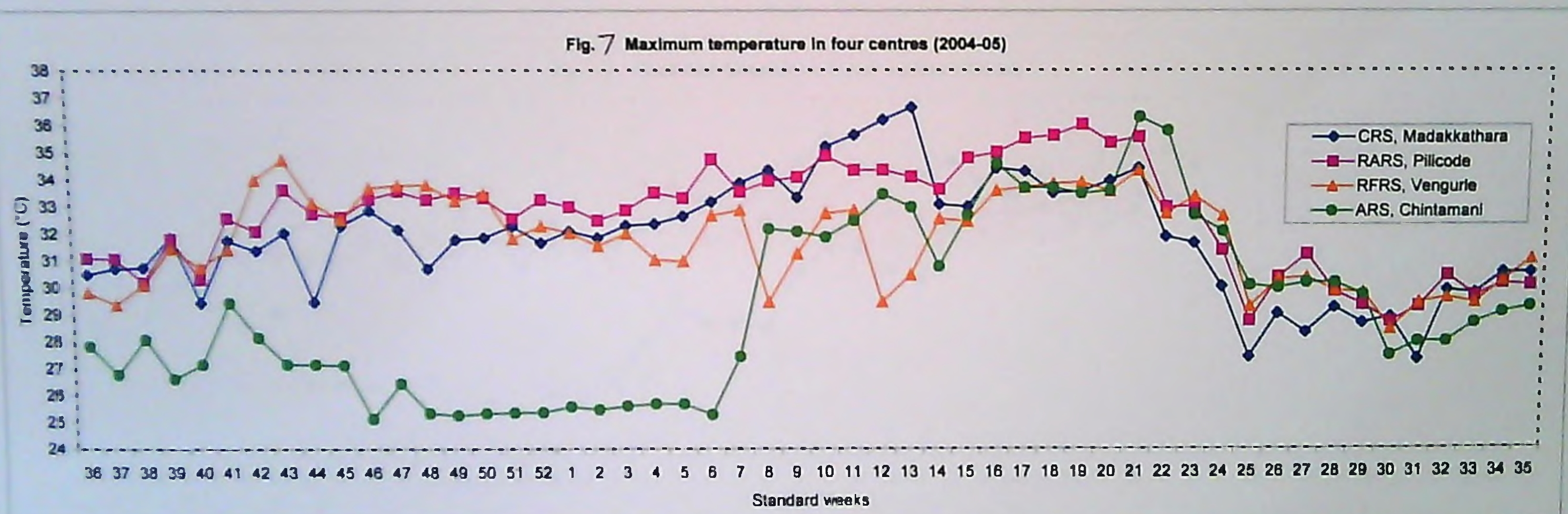


Fig. 8 Minimum temperature in four centres (2005-06)

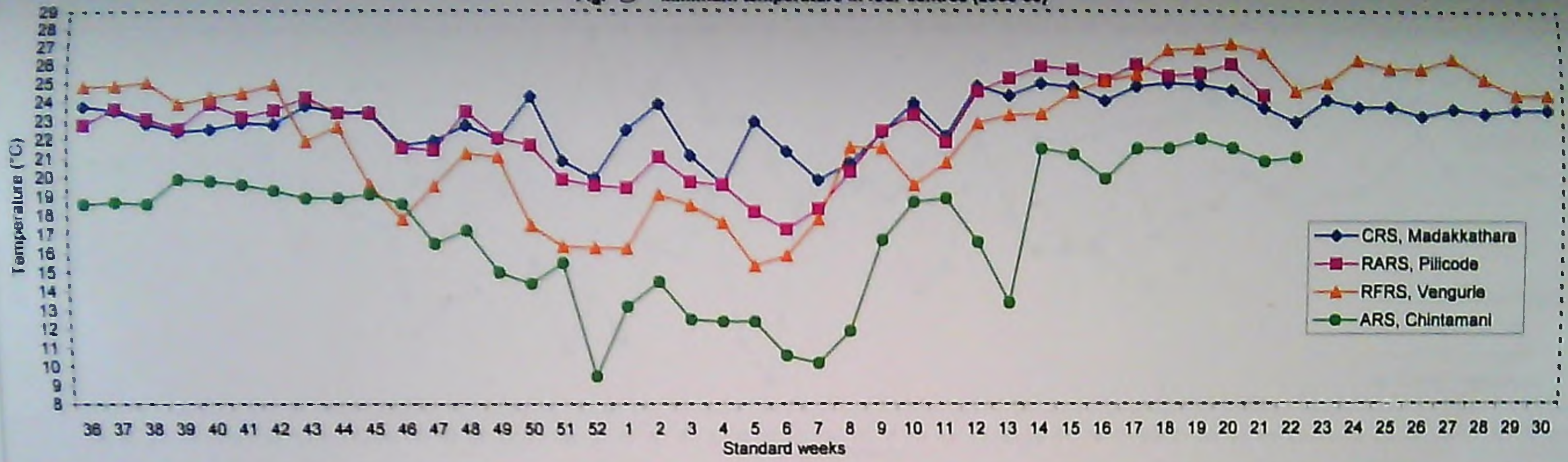


Fig. 9 Maximum temperature in four centres (2005-06)

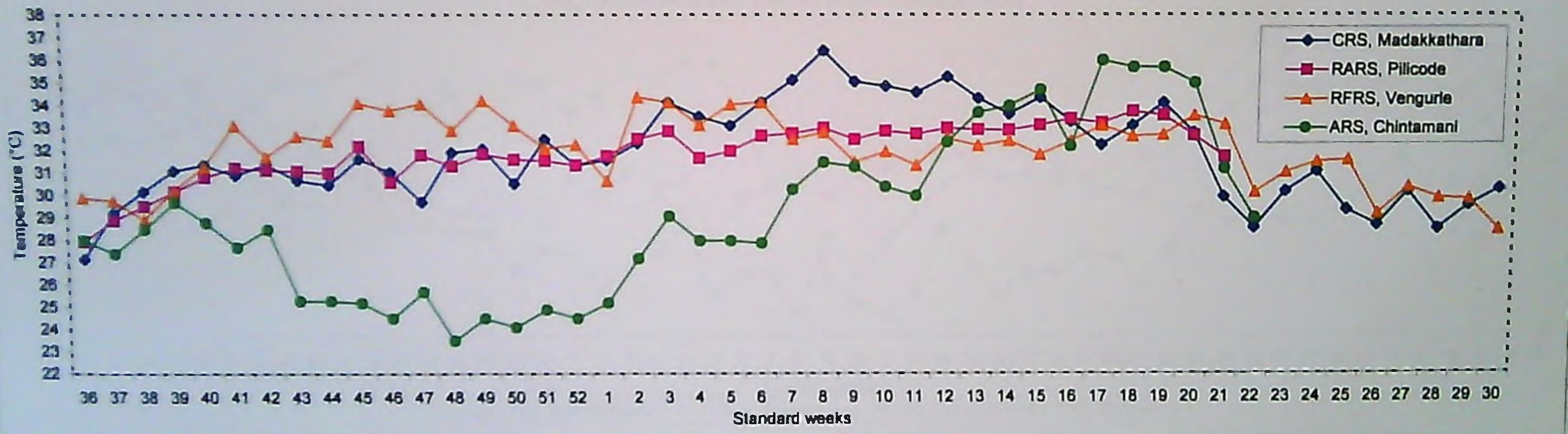


Fig.10 Forenoon relative humidity in four centres (2004-05)

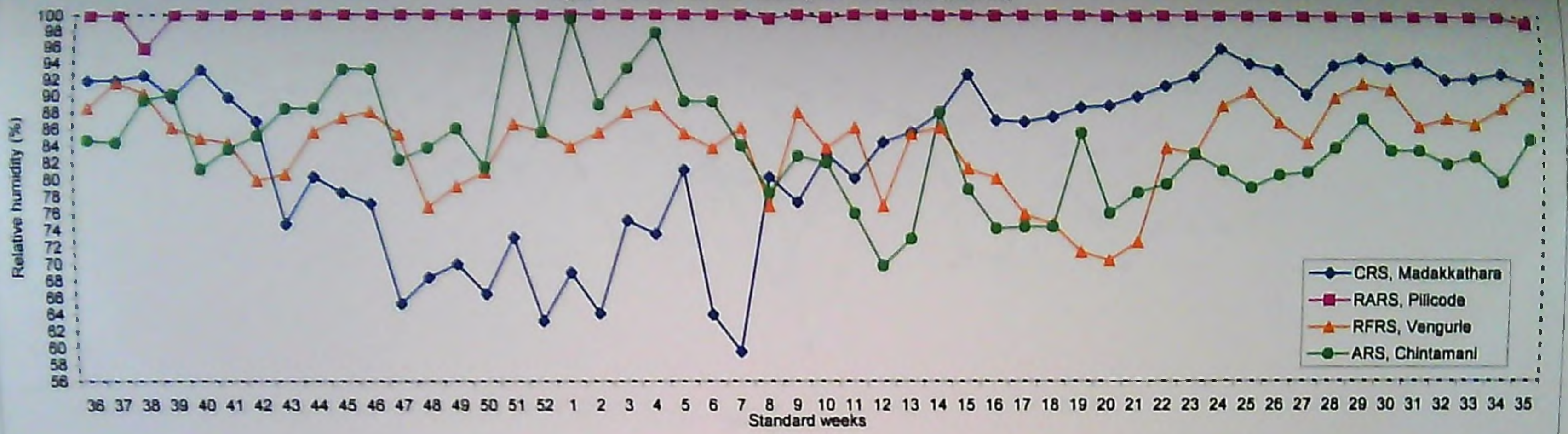


Fig.// Afternoon relative humidity in four centres (2004-05)

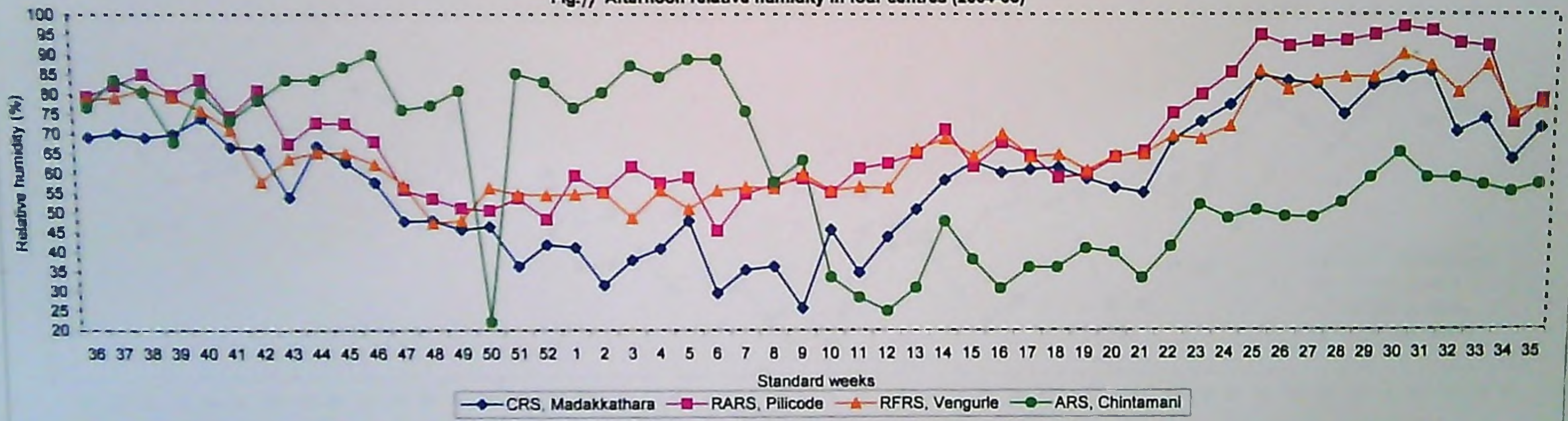


Fig. 12 Forenoon relative humidity in four centres (2005-06)

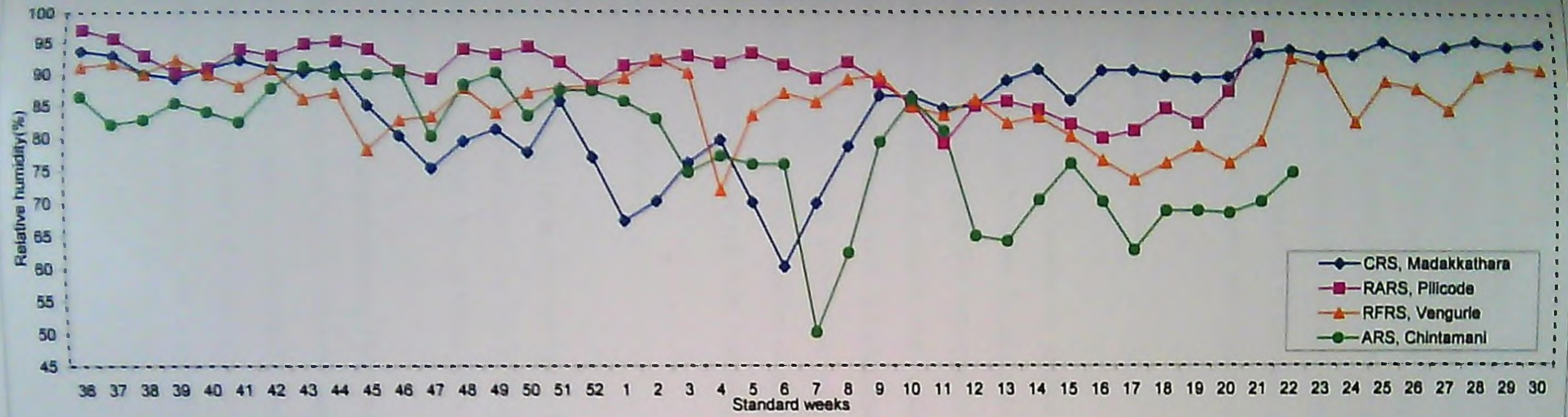
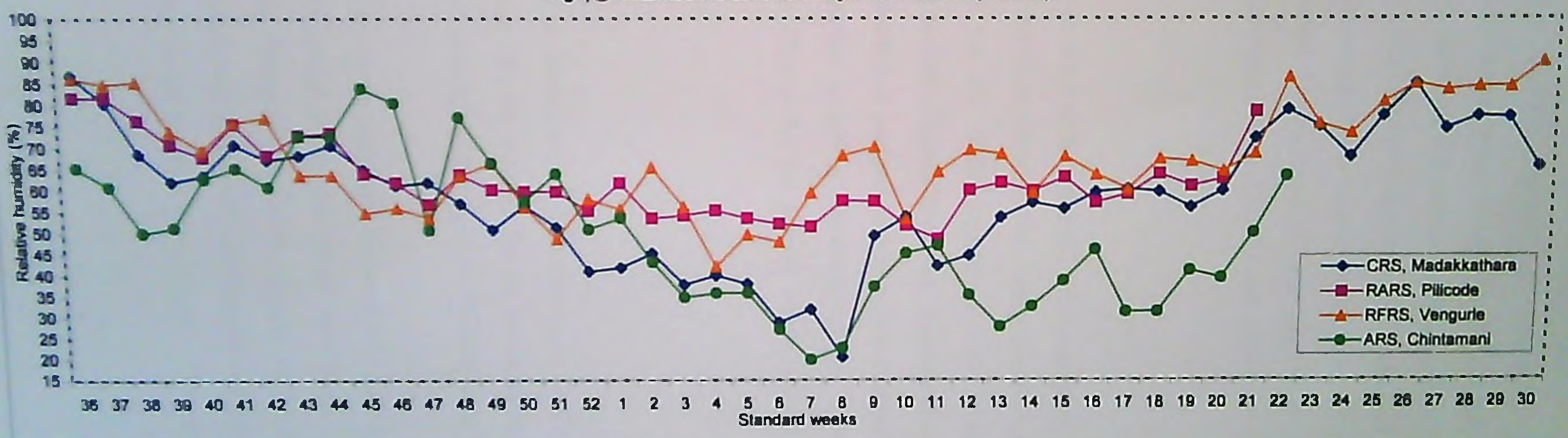


Fig. 13 Afternoon relative humidity in four centres (2005-06)



The minimum temperature during the flushing and flowering season from October to March over the three years study period was in the range of 18 to 25 ^{0} C (2003-04); 17 to 26 ^{0} C (2004-05) and 17 to 25 ^{0} C (2005-06). The maximum temperature ranges were 30 to 33 ^{0} C (2003-04); 30 to 35^{0} C (2004-05) and 28 to 33 ^{0} C (2005-06). However, for most of the weeks in 2005-06 the maximum temperature was only 31 to 32 ^{0} C. The relative humidity at Pilicode was high. The F.N. relative humidity recorded during the flowering season was in the range of 89 to 100 % and it was more than 92 % for most of the period. During the peak year 2005-06 the A.N. humidity during December and January was high as compared to 2003-04 and 2004-05.

3. Correlation Analysis

Simple bivariate correlation analysis has been done to find out the relationship of TMB population and the weather factors prevailed at the three centres. The results revealed that a highly significant negative correlation existed for the TMB population with minimum temperature, relative humidity and rainfall at the RARS, Pilicode and CRS, Madakkathara. At RFRS, Vengurle and ARS, Chintamani, the correlation analysis did not give a significant relationship for TMB population with the weather variables. However, at the Vengurle condition, a significant negative correlation was obtained for the panicle infestation with the minimum temperature and A.N. humidity.

4. Weather modeling

There was no linear relationship in the weather factors in correlation analysis. So the non-linear models were fitted for the TMB population with the weather for the previous fourteen days as lag period. The models were prepared separately for RARS, Pilicode and CRS, Madakkathara.

For CRS, **Madakkathara.** TMB population for the period from November to February of each year from 2003-04 to 2005-06 was used for model fitting. The model was fitted for the month of November – December, January and February separately. During November – December the rainfall and rainy days were also found influencing. During January and February rainfall was not received and hence the models did not include these factors. The variance

explained in the non-linear models was more than 72 % for all the three periods (November-December, January and February). The predictability of the model was highest (79.03 %) during the month of November- December. It is to be presumed that the weather variables prevailed during the November-December period is more influencing in TMB build up.

For **RARS, Pilicode**, the weather modeling was done as done for Madakkathara. There was no linear relationship in the weather factors in correlation analysis. So the non-linear models were fitted for the TMB population with the weather for the previous fourteen days as lag period. TMB population for the period from November to July of each year from 2003-04 to 2005-06 was used for model fitting. The model was fitted for the month of October to July separately. During October to November and April to July the rainfall and rainy days were also found influencing. During December to March rainfall was not received and hence the models did not include these factors. The variance explained in the non-linear models were more than 92 % for the months of October, November, December and February and during the other periods it was more than 75 % except in March. Similar to that of Madakkathara, the predictability of the model was highest (94.57 %) during the month of December. So it is to be presumed that the weather variables prevailed during October, November, December and February months are more influencing in TMB build up.

CONCLUSION

Intensive monitoring and surveillance was undertaken on tea mosquito population build up throughout the year at four different centres in the West Coast.

- Among the four centres, TMB population was highest at RARS, Pilicode throughout the period of study and thus the hot spot area for TMB has been identified as the RARS, Pilicode. At Pilicode, minimum temperature, F.N. humidity and A. N. humidity were in the optimum range. Unlike in other centres, the weather was almost steady without many fluctuations at the RARS, Pilicode. In the other two centres in Vengurle and Chintamani where the TMB population was lowest the weather fluctuation was more in short intervals and the minimum temperature and relative humidity were very low or high according to locations.

- At CRS, Madakkathara, TMB population was low to moderate and only one year (2005-06) has got a moderate population as compared to Pilicode. At CRS, Madakkathara, though the minimum temperature was favorable, the relative humidity was very low during the flushing and flowering season along with a high wind speed. At Madakkathara the relative humidity was low as compared to RARS, Pilicode throughout the three years of study. During the peak year 2005-06, the relative humidity during December and January was high as compared to 2003-04 and 2004-05 at Pilicode and Madakkathara.

- In the partial correlation analysis the influence of weather variables when considered individually was not significant and hence the most influencing or critical weather variable on TMB population build up could not be identified. The prediction model prepared based on the present three year study revealed the influence of more than one weather parameter in the population build up of TMB.

The study has to be continued to get the population data at least for a minimum of five years to have a confirmative result. The weather relationships on TMB population build up will have to be examined and analysed further with the data generated in subsequent years for making forwarning models.

7-5-07

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