R. P. F. III

FINAL REPORT

1. Institute Code No. Path.V(131)

2. I. C. A. R. Code No. Pl-84/8-ICI-H_{20}/2710

3. Name and Address of Research Institute/Centre: Central Plantation Crops Research Institute
Kudlu Post, Kasaragod 671 124

4. Project Title: Investigations on tendernut drop in arecanut

5. Name and Designation of Project Leader: R.Chandra Mohanan, Scientist S2(1984-85)
P.S.P.V.Vidyasagar, Scientist SG(1986)
Mariamma Daniel, Scientist SG(1987-90)

6. Name(s) and Designation(s) of Project Associates including Project Leader and work to be done:

Sl. No.	Name and Designation	Time spent	Work done
1.	R.Chandramohanan, Scientist S2	PL 6 months	Technical Programme for 1984-85
2.	P.S.P.V.Vidyasagar, Scientist SG	PL -do-	Technical programme for 1985-86
3.	C.P.Radhakrishnan Nair, Scientist S2	PA 4 months	Technical programme for 1984-85
4.	Mariamma Daniel, Scientist SG	PL 8 months	Technical programme for 1987-90

7. Location of Research Project with complete address (Division/Section/Sub-Centre)

Entomology Section
Central Plantation Crops Research Institute
Regional Station, Vittal 574 243
D.K., Karnataka

8. Date of start

April, 1984

9. Date of termination March, 1990

10. (a) Objectives (Not more than 150 words)

To identify the cause of the tender nut drop and to find out suitable control measures.

(b) Practical Utility including background information (Not more than 150 words) Tendernut drop in arecanut is a serious problem in many parts of Kerala and Karnataka. This occurs mainly from April/May to July months. About 10-20% of palms show this problem irrespective of the management practices. Though physiological nutritional, pathological and entomological reasons are attributed to this malady, no detailed experimental works were undertaken to find out the exact cause of this problem. So this study was taken up to find out the eaxct causes of this problem and to evolve appropriate control measures

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE

KASARAGOD-670 124, KERALA

R P F III

Project No. Path.V(131)

Date of Start: April, 1984

11. Technical Programme:

1. Survey of affected areca gardens to study the different management practices adopted such as irrigation, fertilizer application, plant protection measures, general maintenance of the gardens and to correlate with the tendernut fall (1984-85).
2. Isolation of microorganisms, if any, from the affected nut and testing the pathogenicity (1984-85).
3. Studies on the role of insects, if any (1984-86)
4. Ad-hoc control trial (1984-85)
5. Identification of the insect Biology and host range of the insect (1986)
6. Role of the bug in tendernut fall (1986)
7. Chemical control trial on this insect with seven insecticides(1986-88)
8. Seasonal abundance of this insect in arecanut gardens(1987-90)
9. Alternate host plants of this insect (1989-90)

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
KASARAGOD-670 124, KERALA

R P F III

Project No. Path V(131)

12. Final Report: 1984 —1990 Date of Start: 1984

Survey: The arecanut gardens in Vittal, Puttur, Sullia and Sirsi were surveyed in 1984, 1985, and 1989. At Vittal tendernut fall was seen in 10-20% of palms irrespective of the adoption of recommended management practices or otherwise. Freshly fallen nuts as well as intact ones were examined from the affected and healthy palms to study the symptoms. Sixty-seven per cent of the freshly fallen nuts revealed the presence of one or more pin prick-like punctures on the surface towards the perianth region, leading to dark brown discolouration of the kernel. Only 2% of the intact nuts of the affected palms showed similar symptoms. The affected nuts did not yield any fungi on culturing. Signs of malformation and gummosis in perianth region were noticed in some of the nuts. Perianth ~~calyx~~ mites were not associated with this malady. In 1985, nine more gardens were surveyed in different locations near Vittal. Eight to 98% of the fallen nuts in three gardens showed puncture marks on nut surface.

In 1988, one more survey was conducted in Sullia (6 gardens), Puttur (2 gardens) and Sirsi (11 gardens). Insect infestation ranging from 2 to 72% was noticed in these gardens. In 1989 six more gardens were surveyed and the insect incidence ranged from 0-32.5%.

Role of insects: Since the pin-prick mark on tender nuts suggested the role of an insect, search for the insect was done. In 1985, a pentatomid bug was found in association with the tendernut drop in arecanut. The bug pierces the tendernuts and suck the kernel sap producing characteristic pin-prick marks on the pericarp. The insect was identified by CABIIE, London as Halyomorpha marmorea(F) (Pentatomidae : Hemiptera). Laboratory studies on the role of the insect proved that feeding by the nymphs and adults of this bug caused the tendernut drop in arecanut during April-July months.

..2/-

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The most preferred site for piercing the nut by the insect is near the perianth region, though feeding sites were noticed on the middle and lower portions of the nut also.

Biology studies: The life history of the bug in the laboratory was studied in detail. The eggs hatch in 3.5 to 5.0 days. There are five nymphal instars with a duration of 3-4, 6-7, 6-7, 7-8 and 9-10 days respectively. The total life cycle from egg to adult stage was completed in 36-41 days. The longevity of male insect was 24 days and that of female insect was 40 days.

Field studies on biology: During field surveys in infested gardens in June-July months, all stages of the insect from 3rd instar to adult were collected from areca inflorescences and bunches. Egg masses were collected from mature cacao leaves, pepper leaves and leaflets of young areca palms. Nymphs and adults were collected from leaves and trunk portion of cacao trees, leaves of pepper and leaflets of arecanut in April, May, June, July and November months. Under laboratory conditions the insect did not feed on cacao shoots or cherelles but completed their life cycle on areca inflorescence.

Alternate host plants: Adults and nymphs of this insect were found feeding on the leaves and fruits of cowpea, bitter gourd, okra and chilly in field conditions. Tender bitter gourds and leaves were severely damaged by these insects.

Seasonal abundance: The seasonal abundance of the insect as evident from the damage on arecanut was studied in 1988 and 1989 from the arecanut plots at CPCRI Regional Station, Vittal. The data are given in Table 1.

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Table 1. Seasonal incidence of Halyomorpha marmorea on arecanut

Month	Total nuts collected	Insect damaged nuts	Percentage attack
June 1988	2872	837	29.14
July "	1900	322	16.95
August "	358	25	6.98
October "	94	-	-
March '89	115	15	13.0
May "	193	46	23.8
June "	4324	917	21.2
July "	2350	640	27.2

Fallen tendernuts from the base of many palms were examined separately for each palm to see the number of insect damaged nuts. The insect incidence for each palm ranged from 0-62.9%.

Chemical control: From a preliminary field trial laid out in three private gardens in 1984, it was observed that endosulfan was the most effective followed by Streptocycline + endosulfan, dithane Z-78 + endosulfan, and dimethoate in reducing the tendernut drop (Table 2).

Table 2. Effect of various treatments on tendernut drop in arecanut-1984

Treatments	Nut setting(%)	Percentage nut drop *		
		Pre-treatment	Post-treatment	
			After Ist spray	After 2nd spray
Dithane Z-78(4g/l)	73.62	8.08	9.29	6.80
Streptocycline(400 ppm)	70.91	8.61	10.96	7.84
Endosulfan(1.6 ml/l)	88.38	9.72	0.97	0.24
Rogor (1.6 ml/l)	86.32	7.92	2.70	1.84

...4/-

Dithane Z-78 + Endosulfan	86.74	9.69	2.0	1.09
Streptocycline + Endosulfan	87.71	9.58	1.34	1.37
Control (Bordeaux mixture alone)	74.02	6.16	11.37	8.44

*Mean of three gardens (Replications)

After the association of an insect with tendernut fall was proved in 1985, an insecticidal trial was laid out in a private arecanut garden at Kumbla, Kasaragod district in 1986. The treatments included seven insecticides and an untreated control. The treatments were replicated thrice with 8 palms per treatment. Three rounds of sprays were given in monthly intervals. The data were analysed statistically and the results are given in Table 3. There was no significant difference between the treatments and the control.

Table 3. Results of the insecticidal trial laid out at Kumbla in 1986

Treatments	Percentage of dropped nuts
Endosulfan	13.85
Quinalphos	22.52
Phosalone	20.41
Fenvalerate	14.71
Methyl parathion	18.74
Monocrotophos	17.15
Dimethoate	19.36
Control	18.49

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Since the 1986 trial could not be continued in the same plot for one more year, a second set of insecticidal trial was taken up in 1987 in another private arecanut garden at Muguli, Karapady Post, Dakshina Kannada district. Seven insecticides and an untreated control were the treatments with three replications. The plot size was 25-35 palms with RBD. The first round of spray was given in early May and the second round of spray was given 45 days after the first round of spray. All dropped nuts from all the plots were collected before treatment and the percentage of insect damaged nuts were determined. Post treatment samples were collected after 7th and 25th day of each spraying. The same experiment was continued for 1988 also.

Two years data were statistically analysed. The results of 1987 showed that endosulfan, methyl parathion, fenvalerate(0.02%), monocrotophos and dimethoate were significantly better than other treatments in the first sampling after the second round of spray (Table 4). But after 25th day sampling there was no significant difference between treatments. The 1988 data did not show any significant difference between insecticides tried and control.

The reduction in percentage of insect damaged nuts for 1987 and 1988 are furnished in Table 5. Fenvalerate (0.02%), methyl parathion and endosulfan (0.05%) gave good reduction in the percentage of infested nuts.

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Table 4. Effect of insecticides on tendernut fall caused by Halymorpha marmorea

Treatment	Pre-treatment	7th day after* 2nd spray
Endosulfan	58.00	26.24
Dimethoate	62.67	33.77
Quinalphos	151.67	43.92
Methyl parathion	57.33	27.92
Monocrotophos	60.00	29.18
Fenvalerate	58.33	28.56
Phosalone	93.67	71.56
Control	84.00	61.84

*Value after arcsine transformation
C.D. (P = 0.5) 25.63

Table 5. Effect of insecticides on percentage of tender nut drop

Treatments	incidence - 1987(%)				incidence 1988(%)			
	Ini-tial	After 1 spray	Before II spray	After II spray	Ini-tial	After I spray	Befo-re II spray	After II spray
Endosulfan	36.1	32.3	17.5	7.6	17.9	22.1	5.7	7.3
Dimethoate	39.3	34.0	2.1	10.3	12.5	10.6	0	14.7
Quinalphos	32.6	27.3	6.4	14.6	18.0	10.5	0	8.6
Methyl parathion	44.6	22.8	8.1	8.5	11.8	7.6	17.5	4.7
Monocrotophos	30.3	18.6	8.9	8.6	10.0	9.7	0.7	8.8
Fenvalerate	47.6	27.5	5.1	11.6	22.6	12.7	1.4	2.3
Phosalone	46.3	25.6	8.2	8.7	36.9	28.0	0	8.5
Control	25.6	27.7	14.7	14.4	28.9	15.9	5.3	11.5

13. Approximate expenditure incurred in the Project: (Give reasons for variation, if any, from original estimated cost)

Rs. 65,380/-(The project was extended upto March,1990)

14. Publications and material (one copy each to be supplied with this proforma)

a) Research papers — Vidyasagar,PSPV and Shama Bhat,K.1986. A petatomiid bug causes tendernut drop in arecanut. Curr.Sci.55:1096-1097.

b) Popular articles

c) Reports

d) Seminars and workshops (Relevant to the Project) in which the Scientists have participated:

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e) Material developed (such as new varieties of crops or breeds of farm animals, implements, products, etc.)

Results of the chemical control trial against the pentatomiid bug which causes tendernut fall in arecanut showed that spraying the bunches with endosulfan (150 ml in 100 litres of water) or methyl parathion (100 ml in 100 litres of water) or fenvalerate (100 ml in 100 litres of water) in late April/early May and 45 days after, would reduce the insect infestation and tendernut fall. Endosulfan is the cheapest followed by methyl parathion and fenvalerate.

15. Details (Nos. etc.) of Field/Laboratory Note books and final material and their location

1. Experimental log book - 1 No.
2. Primary data books -3 Nos.
(Kept in the Entomology Section of CPCRI Regional Station,Vittal).

16. Comments/suggestions of Project Leader regarding possible future line of work that may be taken up arising of this project:

17. Signatures with name of Project Leader and Associates:

Mariamma Daniel - Project Leader(1987-1990)

PSPV Vidyasagar - Project Leader(1986)

R Chandra Mohanan-Project Leader(1984-85)

CP RadhakrishnanaNair-Project associate(1984-85)

18. Signature (with comments, if any) of Head of Division/Section/Station:

PRINCIPAL SCIENTIST
(ENTOMOLOGY)
CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
REGIONAL STATION, KAYANGULAM,
KRISHNAPURAM - 690533, KERALA

19. Signature (with comments, if any) of Director:

Director
CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
P. O. KUDLU, KASARAGOD 670124

b) Vidyasagar, P.S.P.V. 1989. Destructive pest of arecanut. The Hindu 19th July, 1989.

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Indian Cocoa, Arecanut & Spices Journal, Vol. X, No. 2, 27-28

PRELIMINARY OBSERVATIONS ON TENDER NUT DROP IN ARECANUT

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ABSTRACT

Tender nut drop in arecanut reckoned as a serious problem in some parts of Kerala and Karnataka states, generally occurs during April-July. Symptomatology studies revealed the presence of one or more puncture marks on the surface of the affected nuts. Such lesions were found leading to the kernel causing dark brown discolouration. These symptoms were observed on 62 per cent of the freshly fallen nuts collected from 19 gardens during 1984-85. No fungus could be found associated with this malady. When healthy tender nuts were injured by piercing with a fine needle, 80-93 per cent nut drop was observed. Preliminary field control trial using fungicides, insecticides and a bactericide given as spray to the bunches revealed the efficacy of insecticides in reducing tender nut drop. The tender nut drop was the least in the Endosulfan (1.6 ml/l) treated palms.

The symptomatology, absence of any fungus in the affected nuts and the reduction in nut drop in the insecticide-treated plots suggest the possible association of an insect with tender nut drop in arecanut.

INTRODUCTION

Tender nut drop in arecanut (*Areca catechu* L.) has been observed as a serious problem during the last few years in Cannanore and Kasaragod districts of Kerala state and Dakshina Kannada, Kodagu, Chikmagalur and Shimoga districts of Karnataka State. In general, it was observed that the intensity gradually increased from April-May, reached a peak during June-July, decreased thereafter and reached the lowest level during September-October. This may be correlated with the susceptible stages.

Fungi like *Gloeosporium* sp., *Diplodia* sp. and *Colletotrichum gloeosporioides* Penz. have been reported to be frequently isolated from the buttons and a fungus and a bacterium from the fallen tender nuts (Anonymous, 1963; Saraswathy *et. al.* 1977). But the role of these organisms in causing tender nut drop was not established. Attempts have also been made to study the effect of growth regulators, insecticides, fungicides and fertilizers on the malady (Anonymous, 1960 and 1964). Earlier work carried out is inconclusive as to the cause of this malady and control measures. The present investigations were taken up mainly to study the symptomatology of the malady, associated fungi and field control.

Materials and methods

During 1984-85 freshly fallen nuts and intact nuts were collected in June-July from the affected area gardens in Kasaragod and Dakshina Kannada districts. The details on the general maintenance and management practices adopted by the growers were recorded from 10 areca gardens in 1984 and nine gardens in 1985.

Freshly fallen nuts as well as intact nuts from the affected palms were collected randomly and examined. Two hundred nuts (150 fallen + 50 intact) were collected from each of the 10 gardens in 1984. During 1985, 100 freshly fallen nuts were collected and examined from each of the nine gardens visited. Symptoms observed on the sample collected were recorded and grouped based on the symptomatology.

To find out the association of fungi if any, microscopic examination was done on 50 per cent of the samples and the remaining 50 per cent was used for the isolation of fungi. For this, different portions of the husk and kernel were surface sterilized and plated on potato dextrose agar medium. To study the effect of injury on nut drop tender nuts of 3-4 months old were surface sterilized and injured by piercing the fine needle of a syringe up to the kernel and slightly drawing out the contents. Five palms were selected and nuts in one half of the bunch (50 per cent nuts) in each palm were thus injured. The nuts on the other half of each bunch were surface sterilized but not injured. The whole bunch was then covered with a polythene bag.

A preliminary control trial was laid out in three private gardens forming three replications. The treatments were: (1) Dithane Z-78: 0.4% (4g/1), (2) Streptocycline: 0.04% (400 ppm), (3) Rogor : 0.16% (1.6 ml/1), (4) Endosulfan: 0.16% (1.6 ml/1), (5) Dithane Z-78 + Endosulfan, (6) Streptocycline + Endosulfan, and (7) Control (Bordeaux mixture 1%).

Each treatment was given to 10 palms per garden twice at an interval of 25 days as spray to areca bunches. All palms irrespective of the treatments received Bordeaux mixture (1%) spray 15 days prior to the treatments to prevent the incidence of Koleroga caused by *Phytophthora arecae* Peth. The pre-treatment nut drop and nut drop at 12-day-interval after the 1st day 2nd spray and nuts set/palm at the tender nut stage were recorded in each garden.

Results and discussion

Tender nut drop in arecanut was observed irrespective of the management and cultural practices adopted by the growers. Thus the incidence was observed in neglected as well as in well maintained gardens. On close examination of the tender nuts collected from 19 gardens during 1984-85, 62 per cent of the freshly fallen nuts revealed the presence of one or more puncture marks of pin prick size on the surface of the nuts, more usually towards the basal portion or calyx region. This puncture was found leading to the kernel causing dark brown discolouration. There was no other symptoms of infection or decay than the puncture marks on the surface of these nuts. Similar symptoms were observed on two per cent of the intact nuts collected from the affected palms. In some of the nuts the puncture marks did not reach the kernel, but this type of symptom was rare.

The intensity of nut drop varied from garden to garden. Among the dropped nuts collected from 19 gardens the tender nuts with puncture marks varied between gardens, from 8 to 98 per cent with a mean of 62 per cent. Among the rest of nuts 0-52% (mean 20%) and 0-40% (mean 13%) showed the symptoms of mahali and nut splitting respectively, whereas five per cent of the tender nuts were free of any such symptoms.

When tender nuts were punctured with a fine needle of a syringe 80 to 93 per cent nuts dropped within 10 days, whereas the uninjured nuts remained intact.

The results of the field trial laid out in three private gardens are summarised below:

Treatments	Net set (%)	Percentage of nut drop*		
		Pre-treatment	Post-treatment	
			After 1st spray	After 2nd spray
Dithane Z-78 (0.4%)	73.62	8.08	9.39	8.80
Streptocycline (0.04%)	71.60	8.93	10.96	8.51
Rogor (0.16%)	86.72	7.92	2.70	2.24
Endosulfan (0.16%)	88.38	9.89	0.98	0.29
Dithane Z-78 + Endosulfan	86.74	9.69	2.00	1.09
Streptocycline+Endosulfan	87.71	9.58	1.34	1.37
Control (Bordeaux mixture 1% alone)	74.02	6.16	11.37	8.44

*Mean of three gardens.

Of the seven treatments Endosulfan (1.6 ml/1) followed by Streptocycline + Endosulfan, Dithane Z-78 + Endosulfan and Rogor treatments showed a trend towards reduction of tender nut drop in arecanut. Nut drop was the least in Endosulfan-treated palms. The reduction in nut drop in the other two treatments viz. Streptocycline + Endosulfan and Dithane Z-78 + Endosulfan may be presumably due to the presence of Endosulfan in the mixture.

The symptomatology of this malady, failure in the attempts to isolate fungi, if any, and the results of the preliminary field trial suggest the possible association of an insect in causing tender nut drop in arecanut. These preliminary observations call for detailed investigations on the insects associated with this malady and large scale control trails using insecticides after the identification of the causal agent.

ACKNOWLEDGEMENT

We are greatly indebted to Dr. K. Shama Bhat Joint Director, C.P.C.R.I. Regional Station, Vittal for his keen interest and guidance in the above studies. Thanks are due to Mr. Kukra Kuloor for the technical assistance.

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A PENTATOMID BUG CAUSES TENDER NUT DROP IN ARECANUT

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ONE of the serious maladies affecting arecanut cultivation in India is the tender nut drop or button shedding resulting in heavy losses in yield. It has been observed that 10–20% of the palms around this Regional Station show this malady irrespective of the management practices[1]. Several insects, mites and pathogens are reported to be associated with the damage to inflorescence, bunch and tender nut[2–4]. Apart from these, the symptoms of punctures on the pericarp and rotting of kernel are also reported[5]. Though these investigators suspected the punctures to be caused by some insect, they could not locate any. Subsequent studies also revealed the presence of pin-prick like punctures on the surface, but all attempts to isolate fungi or bacteria from the affected tender nuts were more or less negative[5]. The foregoing account clearly shows that there is no report so far on the precise nature of the damage and the causal agent of the tender nut drop in arecanut. Hence we undertook to investigate this malady systematically. For the first time in August 1985, we have identified *Halyomorpha marmorea* F (Pentatomidae: Hemiptera) (figure 1) as the insect responsible for this serious malady. It was observed that the bug pierces the tender nut with its long proboscis and sucks the sap. Feeding continues for several hours. Due to continuous feeding the developing kernel was depleted of the most vital sap leading to the shedding of developing nuts.

Feeding activity is very intense during the morning and evening hours in comparison to hot hours of the noon. Perhaps, this may be one of the reasons why no insect could be located by the earlier workers. We have been able to reproduce the damage symptoms viz pin-prick like marks on the pericap, with necrosis and depletion of the fluid in the kernel under controlled conditions with these Pentatomid bugs over an experimental period of three months. Moreover, these insects have been reared for two generations on a collateral host, cowpea, *Vigna sinensis*.

A survey of the literature has revealed that *H. marmorea* has not been reported hitherto as a pest on any crop in India. Therefore, this is the first record of *H. marmorea* as a serious pest of arecanut causing tender nut fall. Another species of this genus *H. picus* F has been reported as a serious pest of beans in China[6] and *Indigofera arrecta* in Ceylon[7].

Figure 1. An adult bug feeding on tender arecanut.

The authors express their gratitude to Dr M. S. K. Ghauri, Commonwealth Institute of Entomology, London for identifying the insect and to Dr K. V. Ahamed Bavappa, Director, CPCRI, Kasaragod for constant encouragement. PSPVV also records his thanks to Mrs. P. Dakshayani for maintaining the insect culture.

7 June 1986; revised 7 August 1986

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be had with 600 panicles per sq.m. bearing 90 spikelets per panicle but with 80 per cent fertility. In certain situations grain filling could be influ-

crop with 400 tillers, if 250 tillers have three leaves and the others a lower number it means that production of leaves must improve. The fer-

Directorate of Rice Research, Rajendranagar, Hyderabad-500 030.

Dreaded disease of poultry

RANIKHET disease remains a big problem in the poultry industry. Even with enough vaccines, untimely procedures and extraneous stresses afflicted on the birds, cause them to respond less.

Recognition of multiple viral strains also renders the vaccination procedure ineffective. This coupled with infections like coli-salmonellosis, mycoplasmosis and infectious coryza only reduces efficacy. High summer temperatures cause a lowering of antibody titres to vaccines.

The farmer should chalk out his vaccination procedures in such a way that the birds receive them during the first and fourth weeks. Administration of vaccine by intraocular and nasal routes will help. These with a third should be given during the seventh week. The number of vaccines can be reduced only, if antibody titre for Ranikhet disease is monitored. This can be diagonised accurately in a good laboratory. In poor farm hygienic conditions and during summer, drinking water vaccine must be avoided.

D. Gopalakrishna Rao

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Destructive pest of arecanut

ARECANUT is an important commercial crop grown in Kerala and Karnataka. An estimated 1.76 lakh hectares in the country is under arecanut cultivation. In recent years, the crop has been affected by an unknown malady where tender (immature) nuts drop, resulting in economic losses to the farmers.

The dropped nuts have one or more pin prick-like marks on their surface. When cut open, the developing tender edible portion the kernel, shows brown discolouration. Farmers generally incur about 20 per cent of yield losses, as a result.

It has been inferred that the damage is caused by an insect, *Halyomorpha marmorea*, hitherto unknown as a pest of arecanut. The adults are bronze coloured with brown spots and are about 1.75 cm long.

The young stages are black with white spots on the legs. The life cycle lasts about 35 to 40 days. Both the adult and young stages of this Pentatomid bug suck the sap from the endosperm of tender nuts and cause premature shedding. Unlike other pests of arecanut, this one is responsible for direct yield losses.

Dropping is severe during June, July and August, the time of the southwest monsoons. Once the endosperm begins to harden, the insect migrates to other hosts such as cowpea and bitter gourd. Significantly, many arecanut farmers grow cowpea as a vegetable in their kitchen gardens and the adults readily migrate to this crop when the tender arecanut is not available. The following measures of control are recommended.

1. Vegetables like cowpea and bitter gourd should be closely watched for the young stages of the bug, which when noticed should be mechanically removed and destroyed.

2. Whenever abnormal dropping of tender nuts is observed, the fallen nuts ought to be examined for pin prick-like marks on their surface and for the brown, discoloured kernel. If the symptoms are positive, one round of spray with endosulfan 0.05 per cent (15 ml in 10 l of water) or fenvalerate 0.02 per cent (10 ml in 10 l of water) must be given. The spray may be given to the bunches only.

3. In gardens characterised by damage in previous years, the first round of chemical spray may be given just before the onset of monsoon followed by a second round after 30 to 45 days.

Dr. P. S. P. V. Vidyasagar

CPCRI, Kasaragod

Technology for rainfed sugarcane

FIELD experiments on rainfed sugarcane under the aegis of the All India Coordinated Research Project on sugarcane at different research stations of the country — Anakapalle (Andhra Pradesh), Lucknow (Uttar Pradesh), Karnal (Haryana), Jalandhar (Punjab), Pusa (Bihar) and Buralikson (Assam) — showed that repeated hoeings at monthly intervals till the onset of the monsoons produced the highest yield (63 tonnes per hectare). When no labour was available for hoeing, trash mulching @ 3.5 tonnes per hectare soon after one hoeing at 30 days helped produce nearly 59 tonnes cane per hectare.

Trash is chiefly dry cane leaves, available in plenty on farmers' fields after the harvest of mature cane. These, when spread in vacant spaces between cane rows of fresh planting, prevent direct contact of sunrays and soil. Hence evaporational loss of water from soil was checked. Moist soil then kept the temperature at a favourable level for optimum activities of soil microbes, which then decomposed the lower portion of the trash to make manure for cane crop.

Antitranspirants like calcium carbonate used to check transpirational losses of water from cane leaves and Atrazine spray to control weeds did not help. However, skip-furrow irrigation system reduced water consumption by 36 per cent and sustained cane productivity of partially irrigated cane.

There had been no difference in yield with various doses of nitrogen (the recommended one for irrigated conditions and half of this dose) in the northwest zone. However, in the eastern zone higher doses of nitrogen (150 kg N/ha) gave higher yield than the lower doses (75 kg /ha). This is possibly because the eastern sector gets early monsoon rains allowing rainfed cane to utilise applied nitrogen efficiently.

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Powdery mildew of brinjal

FOR the last two years, a disease of brinjal, powdery mildew, has been on the rampage in Dharwad districts and other parts of Karnataka.

The symptoms are apparent on the leaves which seem sprayed by white powder. There is retardation of growth in the leaves and entire plant. Cross-section studies of leaves have indicated a chain like conidia — the asexual spores of the fungus. The growth of infective fungus can be checked by spraying tridemorph @ 0.1 per cent.

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Serious threat to leucaena

SUBABUL *(Leucaena leucocephala)* has almost been free from major pest and diseases. The leucaena species cultivated in India is probably derived from a 'Hawaiin type' gene base except for some local strains. This variety does not have adequate resistance to pest and diseases.

Interestingly, leucaena strains seemed immune to such disorders till the late Seventies. In 1982, it was reported that psyllid (Psyllidae: Homoptera) also known as the 'Jumping plant lice' *(Heteropsylla cubana)* was becoming a major pest on leucaena in the Caribbean. It spread to Hawaii (1984), the Pacific Region (1985) and then to India (1987-88). Psyllid attack was first noticed in the leucaena orchard at the University of Agricultural Sciences (UAS), Bangalore early last year.

It soon covered the entire area — even plants grown in isolated areas like roadsides and farm bunds — causing heavy damage to leucaena meant for forage.

The adults are two to four mm long and are a dullish yellow. Both adults and nymphs suck the sap from the tender growing part of the plant with elongate hair like stylets inserted into the vascular tissue. The affected part begins to turn yellow and wilts.

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ರಸ ಹೀರುವ ಕೀಟ : ಎಳೆ ಅಡಿಕೆಗೆ ಕಾಟ

ಹಸಿರಾದ ಎಳೆ ಅಡಿಕೆ ಕಾಯಿಗಳು ಅಡಿಕೆ ತೋಟಗಳಲ್ಲಿ ಕೆಲವೊಮ್ಮೆ ಬಿದ್ದಿರುವುದನ್ನು ನಾವು ಕಾಣುತ್ತೇವೆ. ಇದು ಅಡಿಕೆ ಬೆಳೆಗಾರರನ್ನು ಬಹು ಕಾಲದಿಂದ ಕಾಡುವ ಒಂದು ಸಮಸ್ಯೆ. ಸಾಧಾರಣ ಜೂನ್, ಜುಲ್ಯಾ ಮತ್ತು ಆಗೋಸ್ತು ತಿಂಗಳುಗಳಲ್ಲಿ ಈ ಪಿಡುಗು ಮತ್ತೂ ಹೆಚ್ಚು. ಈ ಕಾರಣದಿಂದಾಗಿ ಕೆಲವು ತೋಟಗಳಲ್ಲಿ ಅಡಿಕೆಯ ಇಳುವರಿ ಶೇಕಡಾ 20ರಷ್ಟು ಕಡಿಮೆಯಾದ ಉದಾಹರಣೆಗಳೂ ಇವೆ. ಯಾಕಾಗಿ ಹೀಗೆ ಹಸಿರಾದ ಎಳತು ಅಡಿಕೆ ಕಾಯಿಗಳು ಉದುರುತ್ತವೆ ಎಂಬುದು ಈಗ ಸರಿಯಾಗಿ ಪತ್ತೆಹಚ್ಚಿದ ವಿಷಯ. ಇದಕ್ಕೆ ಮುಖ್ಯ ಕಾರಣ 'ಹಾಲಿಯೋಮೋರ್ಫ ಪೂರ್ಣೋರಿಯ' ಎಂದು ಕರೆಯಲ್ಪಡುವ ಒಂದು ಜಾತಿಯ ರಸ ಹೀರುವ

ಎಳೆ ಅಡಿಕೆ ಏಕೆ ಉದುರುತ್ತದೆ ಎಂಬುದು ಈಗ ವಿಜ್ಞಾನಿಗಳಿಗೆ ಮನದಟ್ಟಾಗಿದೆ.

ಟಿ. ಈ ಕೀಟವು ಕಾಣಲು ಚಪ್ಪಟೆಯಾಗಿದ್ದು ನೇರಳೆ ಕಂದು ಬಣ್ಣದಿಂದ ಕೂಡಿರುತ್ತದೆ. ದೇಹದ ಗಾತ್ರ ಸುಮಾರು 1.75 ಸೆ. ಮೀ. ಉದ್ದ ಮತ್ತು 1 ಸೆ. ಮೀ. ಅಗಲ. ಈ ಕೀಟದ ಜೀವನ ಚಕ್ರ 35–40 ದಿವಸಗಳು. ಇವರ ಬಾಯಿಯಲ್ಲಿ ಸೊಳ್ಳೆಗಳಿಗಿರುವಂತೆ ಸೂಜಿ ಯಾಕಾರದ ನಾಲಿಗೆಯಿದೆ. ಈ ನಾಲಿಗೆಯ ಸಹಾಯ ದಿಂದ ಕೀಟವು ಎಳತು ಅಡಿಕೆ ಕಾಯಿಗಳನ್ನು ಕೊರೆತು ಮಾಡಿ ಒಳಗಿನ ರಸವನ್ನು ಹೀರುತ್ತದೆ. ಕೀಟದ ಮರಿ ಹುಳಗಳು ಕಪ್ಪಗಿದ್ದು ಅವುಗಳ ಕಾಲುಗಳಲ್ಲಿ ಬಿಳಿ ಚುಕ್ಕೆಗಳಿರುತ್ತವೆ. ಮರಿ ಹುಳಗಳು ಅಡಿಕೆಯ ರಸವನ್ನು ಹೀರಿ ಬೆಳೆಯುತ್ತವೆ. ಹೀಗೆ ರಸ ಹೀರಲ್ಪಟ್ಟ ಅಡಿಕೆಗಳು 2–3 ದಿವಸಗಳಲ್ಲಿ ಕೆಳಗೆ ಬೀಳುತ್ತವೆ.

ಈ ಕೀಟಗಳ ಉಪಟಳಕ್ಕೆ ತುತ್ತಾದ ಅಡಿಕೆಗಳನ್ನು ಬಹಳ ಸುಲಭದಲ್ಲಿ ಕಂಡು ಹಿಡಿಯಬಹುದು. ಬಿದ್ದಂತಹ ಕೆಲವು ಎಳೆ ಕಾಯಿಗಳನ್ನು ಉದ್ದಕ್ಕೆ ಸೀಳಿ ಅವುಗಳ ಸಿಪ್ಪೆಯ ಒಳ ಮೈಯನ್ನು ಪರೀಕ್ಷಿಸಿದರೆ ಸಣ್ಣ ಸೂಜಿಯಿಂದ ಮಾಡಲ್ಪಟ್ಟಿದೆಯೋ ಎಂಬಂತೆ ಒಂದು ಅಥವಾ ಹೆಚ್ಚು ತೂತು ಮಾಡಿದ ಗುರುತುಗಳನ್ನು ಕಾಣಬಹುದು. ಕಾಯಿಯ ಒಳಗಡೆಯ ತಿರುಳು ರಸವಿಲ್ಲದೆ ಸುಕ್ಕುಗಟ್ಟಿದಂತಿರುತ್ತದೆ.

ಅಡಿಕೆ ಮಾತ್ರವಲ್ಲದೆ ತರಕಾರಿಗಳಾದ ಅಲಸಂಡೆ, ಬೆಂಡೆ, ಹಾಗಲ ಮುಂತಾದುವುಗಳಿಗೂ ಈ ಕೀಟಗಳ ಉಪಟಳವಿರುತ್ತದೆ. ಅಂತಹ ಕಡೆಗಳಲ್ಲಿ ಕೀಟಗಳನ್ನು ಕೈಯಿಂದಲೇ ಸಾಧ್ಯವಾದಷ್ಟು ನಾಶ ಮಾಡುವುದು ಒಳ್ಳೆಯದು.

ಅಡಿಕೆ ತೋಟಗಳಲ್ಲಿ ಈ ಕೀಟದ ಹಾವಳಿಯನ್ನು ತಡೆಗಟ್ಟಲು 'ಏಜೋಸಲ್ಫಾನ್' 1.5 ಮಿ. ಲೀ. ಒಂದು ಲೀಟರ್ ನೀರಿನಲ್ಲಿ ಅಥವಾ 'ಪೆನ್‌ವಲರೇಟ್' 1 ಮಿ.ಲೀ. ಒಂದು ಲೀಟರ್ ನೀರಿನಲ್ಲಿ ಬೆರೆಸಿ 45 ದಿವಸಗಳಿಗೊಮ್ಮೆ ಗೊನೆಗಳಿಗೆ ಸಿಂಪಡಿಸಬೇಕು. ಸಿಂಪಡಿಸುವಾಗ ಬೋರ್ಡೋ ದ್ರಾವಣದೊಂದಿಗೆ ಈ ಕೀಟನಾಶಕಗಳನ್ನು ಮಿಶ್ರ ಮಾಡಬಾರದು.

ಪಿ. ಯಸ್. ಪಿ. ವಿ. ವಿದ್ಯಾಸಾಗರ್ ಮತ್ತು
ಯಸ್. ಕೇಶವ ಭಟ್,
ಸಿಪಿಸಿಆರ್‌ಐ
ಕಾಸರಗೋಡು 670 124

[ಚಿತ್ರಗಳಿಗೆ 19ನೇ ಪುಟ ನೋಡಿ.]

ಯಾವುದೇ ಬೆಳೆಗೆ ಹೊಂದದ NPK ಅಂಶಗಳಿರುವ ಸಂಯುಕ್ತ ಗೊಬ್ಬರ ಕೊಟ್ಟರೆ ಅದಕ್ಕೆ ಬೇಕಾದಷ್ಟು ನೇರಗೊಬ್ಬರ ಪೂರಕವಾಗಿ ಕೊಟ್ಟು ಸಮತೋಲನ ಸಾಧಿಸುವುದು ಆಗತ್ಯ. ಆಯಾ ಬೆಳೆಗೆ ಶಿಫಾರಸು ಮಾಡಿದ ಪೋಷಕಾಂಶಗಳ ಪ್ರಮಾಣ ಎಷ್ಟೆಂದು ತಿಳಿದರೆ ಎಷ್ಟು ಗ್ರಾಂ ರಸಗೊಬ್ಬರ ಕೊಡಬೇಕೆಂಬುದನ್ನು ಕೃಷಿಕನೇ ಲೆಕ್ಕ ಹಾಕಿಕೊಳ್ಳಬಹುದು.

ಅಡಿಕೆ ಮರಪ್ರಾಂತಕ್ಕೆ ವರ್ಷಕ್ಕೆ 100:40:140ರ ಪ್ರಮಾಣದಲ್ಲಿ NPK ಕೊಡಬೇಕೆಂದು ಶಿಫಾರಸು ಮಾಡಿದ್ದಾರೆ. ಅಂದರೆ 100ಗ್ರಾಂ ಸಾರಜನಕ (Nitrogen-N 40ಗ್ರಾಂ ರಂಜಕ (Phosphorous-P) ಹಾಗೂ 140 ಗ್ರಾಂ ಪೊಟ್ಯಾಶ್ (Potash-K).

ಬಳಕೆದಾರ ಬೆಳಕಿಂಡಿ

ನೇರಗೊಬ್ಬರ ಹಾಕುವವರಾದರೆ ಯೂರಿಯಾದ ಮೂಲಕ ಸಾರಜನಕ ಪೂರೈಕೆ ಮಾಡಬಹುದು. ಯೂರಿಯಾದಲ್ಲಿರುವ ಸಾರಜನಕದ ಪ್ರಮಾಣ 46 ಶೇಕಡಾ. ಅಂದರೆ 100ಗ್ರಾಂ ಯೂರಿಯಾದಲ್ಲಿ 46 ಗ್ರಾಂ ಸಾರಜನಕವಿದೆ. 100ಗ್ರಾಂ ಸಾರಜನಕ ಸಿಗಬೇಕಾದರೆ 100×46×100-ಹೀಗೆ ಲೆಕ್ಕ ಮಾಡಬೇಕು. ಅಂದರೆ 217.3, ಸುಮಾರು 220 ಗ್ರಾಂ. ಅದೇ ರೀತಿ ಶಿಲಾರಂಜಕದಲ್ಲಿರುವ ರಂಜಕ 20 ಶೇ. 40 ಗ್ರಾಂ ರಂಜಕ ಸಿಗಬೇಕಾದರೆ 100ನ್ನು 20ರಿಂದ ಭಾಗಿಸಿ; 40ರಿಂದ ಗುಣಿಸಿ. 200ಗ್ರಾಂ. ಮ್ಯೂರಿಯೆಟ್ ಆಫ್ ಪೊಟ್ಯಾಶ್‌ನಲ್ಲಿರುವ ಪೊಟ್ಯಾಶ್ 60 ಶೇ. 140ಗ್ರಾಂ ಪೊಟ್ಯಾಶ್ ಸಿಗಬೇಕಾದರೆ ಸುಮಾರು 250 ಗ್ರಾಂ ಮ್ಯೂ. ಆ. ಪೊಟ್ಯಾಶ್ ಕೊಡಬೇಕು.

ರಸಗೊಬ್ಬರ ಹಾಕುವ ಮುನ್ನ ತೂಕ ಮಾಡಿ ಸೂಕ್ತ ಪ್ರಮಾಣದಲ್ಲಿ ಸಮತೋಲನಗೊಳಿಸುವುದು ಆಗತ್ಯ.

ರಸಗೊಬ್ಬರ ಹಾಕುವ ಮುನ್ನ ಲೆಕ್ಕ ಹಾಕಿ

'ಸುಫಲಾ ಸಿಗಲಿಲ್ಲ. ಡೈ ಅಮೋನಿಯಂ ಫಾಸ್ಫೇಟು ಸ್ಟಾಕಿತ್ತು. ಅದನ್ನೇ ತಂದು ಅಂಗಡಿಯವರು ಬೇಳಿದ ಹಾಗೆ ಅರ್ಧರ್ಧ ಕಿಲೋ ಹಾಕಿಬಿಟ್ಟೆ'. 'ನಾವು ತೂಕ ಮಾಡುವ ಕ್ರಮ ಇಲ್ಲ. ಎರಡೆರಡು ಮುಷ್ಟಿ ಕ್ಯಾಲೀಸ್ ಗೊಬ್ಬರ ಹಾಕಿದರಾಯಿತು.' - ಇಂಥ ಹೇಳಿಕೆಗಳು ಕೃಷಿಕರಿಂದ ಆಗಾಗ ಕೇಳಿ ಬರುತ್ತದೆ.

ಆಯಾಯ ರಸಗೊಬ್ಬರದಲ್ಲಿರುವ ಪೋಷಕಾಂಶಗಳ ಪ್ರಮಾಣ, ಬೆಳೆಗೆ ಈ ಗೊಬ್ಬರದ ಸೂಕ್ತತೆ, ಹಾಕ ಬೇಕಾದ ಪ್ರಮಾಣ-ಇವುಗಳ ಬಗ್ಗೆ ಗಮನ ನೀಡದೆ ಹರಕೆ ಸಲ್ಲಿಸುವಂತೆ ಯಾರೋ ಹೇಳಿದರೆಂದು ಕೃತಕ ಗೊಬ್ಬರ ಸುರಿಯುವ ಬೆಳೆಗಾರರು ಕಡಿಮೆ ಏನಲ್ಲ.

ಯದ್ವಾ ತದ್ವಾ ರಸಗೊಬ್ಬರ ನೀಡಿಕೆಯಿಂದ ಬೆಳೆಗೂ ಹಾನಿ, ಕಿಸೆಗೂ ದಂಡ. ಬೇಕಾದ ಪೋಷಕಾಂಶಗಳ ಪೂರೈಕೆಯಾಗದಿದ್ದರೆ ನಿರೀಕ್ಷಿತ ಪರಿಣಾಮ ಸಿಗದು.

ಸುಫಲಾದಲ್ಲಿರುವ NPK ಯ ಪ್ರಮಾಣ 15:15:15. ಇದನ್ನು ಅಡಿಕೆಗೆ ಸರಿ ಹೊಂದಿಸುವುದು ಹೇಗೆ? ಅಡಿಕೆ ಮರಕ್ಕೆ NPKಗಳಲ್ಲಿ ಕಡಿಮೆ ಬೇಕಾದ ಪೋಷಕಾಂಶ ರಂಜಕ. 40 ಗ್ರಾಂ. 40 ಗ್ರಾಂ ರಂಜಕ ಸಿಗಬೇಕಾದರೆ ಹೆಚ್ಚುಕಮ್ಮಿ 300 ಗ್ರಾಂ ಸುಫಲಾ ಹಾಕಬೇಕು. ಆಗ 45:45:45 NPK ಕೊಟ್ಟಂತಾಯಿತು. ಇನ್ನು 55ಗ್ರಾಂ ಸಾರಜನಕ (120ಗ್ರಾಂ ಯೂರಿಯಾ) ಮತ್ತು 95 ಗ್ರಾಂ ಪೊಟ್ಯಾಶ್ (160 ಗ್ರಾಂ ಮ್ಯೂ. ಆ. ಪೊಟ್ಯಾಶ್) ಹಾಕಿ ಸರಿಪಡಿಸಬಹುದು. ಇದಕ್ಕೆ ಬದಲು ಸುಫಲಾವನ್ನು 500 ಗ್ರಾಂ ಹಾಕಿದರೆ ರಂಜಕ (35ಗ್ರಾಂ) ನಷ್ಟವಾಗುತ್ತದೆ. ಕ್ಯಾಲೀಸ್ 14:6:21 ಗೊಬ್ಬರವಾದರೆ ಅಡಿಕೆ ಮರಕ್ಕೆ 700 ಗ್ರಾಂ ಕೊಟ್ಟರೆ ಸರಿಹೊಂದುತ್ತದೆ.

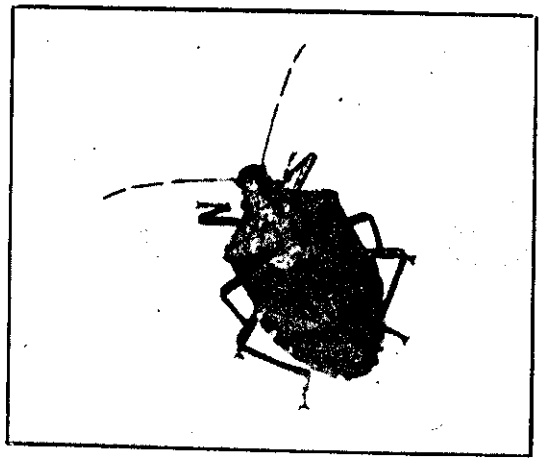
ತೆಂಗಿಗೆ 500:320:1200 NPK ಬೇಕು. ಅಂದರೆ ಯೂರಿಯಾ, 1100ಗ್ರಾಂ, ಶಿಲಾರಂಜಕ 1600 ಗ್ರಾಂ ಮತ್ತು 2000 ಗ್ರಾಂ ಮ್ಯೂ. ಆ. ಪೊಟ್ಯಾಶ್. ಸುಫಲಾ ಹಾಕುವುದಾದರೆ 2100 ಗ್ರಾಂ ಹಾಕಿ

(17ನೇ ಪುಟಕ್ಕೆ)

ಎಳೆ ಅಡಿಕೆಯ ರಸ ಹೀರುವ ಕೀಟ

ಚಿತ್ರ 1

ಚಿತ್ರ 2



ಚಿತ್ರ 3

ಚಿತ್ರ 1: ಎಳೆ ಅಡಿಕೆಯಲ್ಲಿ ಕೀಟ ರಸ ಹೀರಿದ ಜಾಗ
ಚಿತ್ರ 2: ಹಾಲಿಯೋಮೋರ್ಫ ಮಾರ್ಮೋರಿಯಾ ಮರಿ ಎಳೆ ಅಡಿಕೆಯಿಂದ ರಸ ಹೀರುತ್ತಿರುವುದು.
ಚಿತ್ರ 3: ರಸ ಹೀರುವ ಕೀಟ – ತಾಯಿ.

(ಲೇಖನ 7ನೇ ಪುಟದಲ್ಲಿದೆ) ಚಿತ್ರಗಳು: ಸಿಪಿಸಿಆರ್‌ಐ.