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Pilot Sample Survey on the Incidence and Yield Loss Due to Eriophyid Mite on Coconut in Alappuzha District

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Abstract

Eriophyid mite has become a major pest of coconut since 1998. An estimate of its incidence and the resulting loss in yield is sought by many agencies. To understand the extent of losses incurred by the farmers due to this pest and also to evolve a suitable procedure of estimation, a pilot sample survey was conducted in Alappuzha district, which is one of the three most severely mite affected districts.

A stratified multistage random sampling design was followed for the present study with three geographical regions viz ., Coastal , Kuttanad and Midland as strata. In the first stage, 29 panchayats (40%) were selected. A total of 85 key plots (each from a separate ward) were selected as second stage unit to estimate the geographical distribution of mite infestation. A cluster of at least 500 bearing palms belonging to the key plot or plots adjacent to it were scored visually for mite infestation. For yield estimation, a second sample of 15 panchayats was drawn out of the first sample of 29 panchayats and 20 bearing palms from each of the key plot were selected for detailed yield observations. The field study was carried out during 10-22 January 2000.

By adopting the regression estimates as employed in double sampling , the per cent incidence of mite in the district was worked out to be 82.4% of the bearing palms. Out of the forecasted production of 366.31 million nuts in Alappuzha district , only 164.25 million nuts would be of normal quality. One quarter of the nuts produced (90.25 million) would be severely damaged and have no practical use and another 52.83 million moderately damaged nuts would not have any buyers in the market . The loss in terms of copra was estimated to be 1962 tonnes (30.94%) and loss of husk was 41.74%.

The sampling design and estimation procedure followed in this study could be employed for crop loss assessment under similar situations.

Introduction

The coconut farmers of Kerala and Tamil Nadu had suffered heavy financial loss due to the outbreak of eriophyid mite since 1998. Though some ad -hoc measures were taken by the government to control the pest, a comprehensive programming is yet to be worked out. To decide upon the priorities, an assessment of yield loss due to the pest and percent incidence is essential. The Coconut Development Board and an expert Committee constituted by the Government of India have already made preliminary assessment of mite incidence through snap observations at different locations, which is based on the visual observations from the ground. No estimate is available on the yield loss. Periodic harvests make it necessary to monitor the crop at least for one year to obtain the annual yield loss. The adoption of different plant protection measures by farmers during the course of such an investigation will also add to the complexities (George *et al*., 1999). In other words, continuous monitoring will be rewarding only with control-plots. An approach of this kind involves large amount of resources besides time consuming. Procedures are therefore to be formulated to assess the economic impact of the pest in a large area say, District or State, at any given point of time . Keeping this in view , a pilot study was conducted in Alappuzha district, which together with Ernakulam and Trichur constitute the most severely affected districts in Kerala. The specific objectives of the study were follows:

(i) To estimate the severity and geographical distribution of m infestation in the district.

(ii) To estimate the production l due to might infestation in term number of nuts and copra yield.

Methodology

Location of the study

Alappuzha district is a sandy strip land intercepted by many rivers backwaters. It has a flat seacoast of km length. A large share of area district belongs to lowland region. T topography of the rest of the belongs to Midland (Edanad). Coc is grown throughout the district occupies 47% of its total geograph area of1414sq. Km. Alappuzha famous for manufacturing coir and products. The incidence of mites is reported from almost all the coco growing areas in the district. T intensity is however expected to v from place to place. The field study w carried out during January 10-22, 20 coinciding with the first round spraying under the comprehens scheme of mite control implemented the Department Agricultu Government of Kerala.

Sampling design

The district has thre distin geographical regions viz., coas Kuttanad and Midland. Consideri these regions as strata, a stratifi multistage random sampling design w followed for the present study. The

panchayats and 4 municipalities of the district constituted the stage units. First, the panchayaths were arranged serially in respective strata by using the district map and 29 panchayats(40%) were selected at random : 17(which includes one municipality) from Coastal, 4 from Kuttanad and 8 from Midland. On consultation with the Agricultural Officer of the selected panchayat, three wards were selected and a key plot was identified. The geographical location of the key plot and address of the contact person in the locality were collected from the Agriculture Office (Krishibhavan). A cluster of at least 500 bearing palms belongings to the key plot or plots adjacent to it were scored visually for mite infestation. Two investigators were employed to cover each location.

A second sample of 15 panchayaths was drawn from the aforesaid sample to record detailed observation at the crown by employing palm climbers. Based on proportional allocation, 9 panchayaths were selected from coastal, 2 from Kuttanad and from Edanad. In and around the key plot, 20 palms were selected systematically, for recording the yield, witch is also classified for severity of infestation. The selected palms were numbered so as to monitor at a later date. A group of 5 to 8 climbers and supervisors per day were engaged for data collection. On completion of the data collection from one location the team moved to the next location. For estimating the reduction in copra and husk yield, a sample of 102 nuts was collected randomly from sample holdings.

Observations recorded

At the time of visual scoring for mite incidence, palms were classified as Free (no nuts were seen infested), Moderate (only a few infested nuts are seen on the crown) or Severe (more number of infested and damaged nuts are seen on the crown). Number of palms that have not started yielding (including seedlings) and palms without any nut on the crown were also enumerated. A total of 61, 106 palms were observed in the survey.

Trained climbers of CPCRI were employed for counting the number of nuts at different stages on the crown of selected palms and grading the nuts for mite-damage. Usually, the symptoms of mite infestation can be seen in nuts which are above first size (more than 3 months old). Some of the infested nuts may grow on par with normal nuts, while some may become deformed and barren. After 7 months of growth, there will not be any further visible change in mite infested nut. Hence the stages of nut development were classified as (i) more than 7 months old nuts-Stage -1., (ii) 3 to 7 months old nuts -Stage -2 and (iii) buttons-Stage-3. The nuts belonging to stage-1were further graded according to the severity of infestation: (i) Free., (ii) Grade-1 (less than half the portion of the nuts exhibit the symptom of mite - damage (iii) Grade-2 (more than half the portion of the nut is damaged and may also be deformed and (iv) Grade-3 (defomed nuts which are apparently barren). No such classification is meaningful with nuts belonging to stage-2 but only infested or free, as their further growth and development cannot be predicted. No visible symptom will be available with buttons. The yield forecasting equation developed at CPCRI (RS), Kayangulam was used for obtaining the annual yield of 868 palms observed in present study.

Results and Discussion

Geographical distribution of mite infection

Mite infection was observed at all the 80 locations sampled. The region -wise details on the number of palms enumerated, number of pre-bearing palms, bearing palms without any nut on the crown and per cent bearing palms which are free of mite and moderately/ severely infested were given in *Table 1.* About one fourth of the palms in the district are in pre- bearing stage. Among the yielding palms, 5 to 23% palms were found to be devoid of nuts on the crown. Only the palms bearing fruits were classified for mite infestation. The per cent palms infested ranges from 14% (ward No. 10 of Alappuzha. near the seacoast) to 98% (ward No. 1 of Thykkattusseri, lies on the side of Vembanattu lake). Both these

Table 1. Classification of palms in the regions for mite infestation

Region	Total No. of palms observed	Pre-bearing palms (%)	Number of yielding palms	Palms without any nut (%)	Palms bearing nuts	Per cent bearing palms of mite infestation category		
						Free	Moderate	Severe
Coastal	36462	27.45	26455	12.20	23228	37.62	41.24	21.14
Knttanad	5563	16.16	4664	5.40	4412	42.91	38.64	18.45
Midland	19081	24.39	14427	14.41	12348	64.57	31.45	3.98

panchayats belong to the Coastal zone. The infestation is more severe in coastal panchayats nearer to Ernakulam district : it was less in panchayats in midland (more than 60% palms are free except in Vallikunnu). The infestation of mite and occurrence of palms without nuts in the area are seem to be independent for non-significant correlation (-0.138).

Compared to Midland, the variation between locations for infestation of mite was more in Coastal and Kuttanad regions. Stratification of panchayats based on the intensity of mite incidence in the Coastal region coincided with the respective taluk boundaries; the incidence is more in Shertalai taluk (81%) compared to Ambalappuzha (48%) and Karthikapalli (57%) taluks. In Kuttanad region the Neelmperur panchayat located in the east of the district has fewer incidence.

The weighted averages over strata (regions), with weights as proportion of panchayaths selected in each stratum, are now the district estimates; and were obtained as 46.6, 37.8 and 15.5% for the respective mite infestation categories - Free, Moderate and Severe. It may be noted here that the number of panchayaths may not be a true indicator of number of palms or area under coconut in that stratum. The available data on number of bearing palms from a previous survey (CPCRI. 1985), was therefore used to construct new strata weights. Another set of strata weights was also considered by adjusting for the current estimates of per cent bearing palms without nuts. To account for the within stratum variation in coastal region, panchayaths of that stratum were grouped on taluk-basis. *Table 2* describes the calculations. The estimated values were same with these two kinds of strata weights considered.

It was noticed during the survey that visual scoring for mite infestation may sometimes leads to misclassificati However, classification of palms on basis of observations at the crown employing palm-climbers) is impracti when large area has to be covered alternative is to draw a second sam from the palms that were already sco visually and again classify by employ palm-climbers. The regressi estimators may then be developed this double sampling plan. T observations recorded for yi estimation on selected palms were us in the present study to construct t regression estimates. Out of panchayaths selected for yie estimation, 13 panchayaths we common for both the rounds of t survey. It may be noted here that, thou same key plot was used in both t rounds, palm wise observations were n distinguishable. Hence regressi estimates were worked out usi estimates for panchayaths as obtain from the two rounds of the survey. T regression equation fitted through orig after eliminating the two outliers w found to be the best; the correspondi regression coefficient was 0.3922. T construct the regression estimator, t estimate (of free palms) based on visu observation was considered as t auxiliary variable (X) and the accura

Table 3. Procedure of combined regression estiamtion of per cent free palms (figures in the parenthesis are number of panchayaths in the sample)

	Coastal	Kuttanad	Edanad
Estimate from first sample-visual scoring (X)	0.376 (17)	0.429 (4)	0.646 (8)
Estimate from the second sample - visual scroing (x)	0.232 (7)	0.447 (2)	0.648 (4)
Estimate based on observation on the crown from the second sample (y)	0.099	0.155	0.258
Strata Weights (CPCRI, 1985)	0.772	0.067	0.211
Regression estimate for the stratum	0.156	0.148	0.257

Table 2. District level estimates of mite infestation based on visual scores

Region/ Taluks	Strata weights constructed (per cent bearing palms)		Per cent bearing palms of mite infestaion category		
	As in CPCRI (1985)	Corrected for the current estimates of % palms without nuts	Free	Mode-rate	Severe
Coastal					
Shertalai	0.403301	0.394708	18.99	43.74	37.27
Amabalappuzha	0.098778	0.099586	51.16	35.35	13.49
Karthikapalli	0.219522	0.226065	43.27	44.56	12.18
Kuttanad	0.067325	0.072887	42.91	38.64	18.45
Midland	0.211074	0.206753	64.57	31.45	3.98
District estimates					
Based on weights *without correction*			38.73	40.16	21.12
Based on *corrected* weights			38.85	40.18	20.97

measurement (Y) as the estimate based on climbers' observations. The strata weights were taken from *Table 2*. First the values of X, x and y (for definition, see *Table 3*) were multiplied by the respective strata weights and summed. Denoting the averages by M_X, M_x and M_y the combined regression estimate is then $My + 0.3922^* (M_x - M_X)$. Accordingly the per cent of free palms in the district was obtained as 17.6%. In other words, 82.4% of the bearing palms in the district were mite infected.

Estimation of Yield Loss

The annual yield of a palm can be predicted based on the number of nuts of all stages on the crown (CPCRI, 1996). But for an infested palm the same prediction equation may not hold well because of (possible) abnormal nut fall at one or other stages of growth. Nevertheless, in the absence of any other procedure, the same prediction equation is used to obtain the yield of palms. However, the usefulness of expressing the yield loss as the difference between yield of free- and infested-palms was found to be impractical, as irrespective of the region, the predicted yield of free palms is low compared to the infested ones. Subsequently, a different approach based on the forecasted yield for the district, was adopted for estimating the yield loss. The secondary data on number of bearing palms, per cent distribution of palms among the three strata and the current estimates of per cent palms classified for mite infestation etc. were used to obtain the yield forecast. Adopting the strata weights and estimates of mite-free palms as in *Table 3* the forecasted per palm yield for 2000 was worked out to be 50.65 nuts. Accounting for the 12.62% palms of without any nuts, the average yield of bearing palms becomes 44.26 nuts. The district had 87,73,503 bearing palms during 1996-97 (Directorate of Economics and Statistics.) Assuming that the number of bearing palms remains the same, the district forecast for the year 2000 is 388.32 million nuts:- an increase of 69.62 million nuts compared to the average annual production for the period 1992-93 to 1996-97. Two points are to be emphasized here - first, the forecasted production includes both normal as well as mite-damaged nuts; and second, few palms were having extremely large values as predicted yield. Data exploring techniques revealed that there are 25 palms yielding more than 138 nuts. Interestingly, all of them were belonging to the affected-category. On removing these extreme values, the predicted per palm yield was obtained as 41.75 nuts and district forecast as 366.31 million nuts.

To obtain an indicator of the economic impact of mite infestation, the per cent distribution of nuts of different grades could be used. It may be noticed from *Table 4* that in the Coastal region, more than 60% of infected nuts are of no use. The damage is less severe in Midland region. Assuming that the frequency of nuts of different grades remains the same around the year, estimates for the number of nuts of different grades were arrived. Using the strata weights as in *Table 3*, the estimates of percent nuts in Normal and Grade I to 3 categories were obtained as 44.84, 16.10, 14.42 and 24.64%. In other words, out of the forecasted production of 366.31 million nuts, less than half (164.25 million) only will be of normal nuts. One-quarter of the nuts produced (90.25 million) will be of no economic value. Again, the 52.82 million Grade 2 nuts though have considerable quantity

Table 4. Per cent distribution of nuts of different grades in an infected palm

	Normal nuts			Mite-damaged nuts (> 7 months)		
	>7 months	3-7 months	Combined	Grade-I	Grade-2	Grade-3
Coastal	34.42	41.93	37.33	36.47	31.24	62.45
Kuttanad	40.66	37.98	39.58	37.81	36.49	26.56
Midland	70.51	60.78	66.78	25.72	32.27	10.99

Table 5. Nut component analysis (Figures in parenthesis denote the range of values)

	Normal nuts	Grade-I	Grade-2
Total weight of nut (kg)	1.89 (0.98-2.77)	1.47 (0.89-2.43)	1.23 (0.62-2.25)
Weight of husk (kg)	1.20 (0.55-1.97)	0.90 (0.40-1.45)	0.74 (0.31-1.40)
Weight husked nut (kg)	0.70 (0.38-1.22)	0.58 (0.35-1.00)	0.49 (0.23-0.91)
Weight of shell (gm)	146.2 (105-225)	115.4 (80-225)	110.0 (50-175)
Weigh of copra (gm)	168.2 (85-265)	141.7 (55-300)	124.3 (40-230)
Oil (g/nut)	103	82	79
No. of samples	30	35	36

of copra, the traders reject such nuts at the time of purchase. The balance of 58.90 million Grade-I nuts too fetches only low price. The economic loss due to mite incidence in this region adds to the miseries of coconut growers as they were already suffering an annual loss of 271 million nuts due to the malady of root (wilt) disease (CPCRI, 1985).

Estimated yield loss in terms copra

Nut samples were collected from farmers' garden belonging to Normal, Grade-1 and Grade-2 categories of nuts for estimating copra content. The Grade-3 nuts are of no economic importance as indicated earlier. Average values of nut components are shown in *Table 5*. Infestation of mite was found to result in reduction in values for all the nut components-lowest for Grade-2 nuts and highest for Normal nuts. The per cent reduction in copra content of Grade-1 and Grade-2 are respectively 15.75% and 26.1%. The total loss of copra in the district is estimated to be 19061.65 tones - The per cent loss is worked out to be 30.94%. In terms of oil, the loss is 31.28%.

The quality of fibre too deteriorated due to mite infestation. About 25-35% reduction in husk weight was noticed : But the husk from nuts of Grade-2 and 3 are not suitable for retting. Considering this, the annual loss of husk was worked out to be 41.74%.

Conclusion

The present study on the incidence and yield loss due to eriophyid mite on coconut in Alappuzha district could effectively employ research methodologies relating to sample survey, data analysis and recording of relevant observations which can be utilized in future under similar circumstances. The stud revealed that : 143.08 million nuts (of the forecasted production of 366 million nuts are of no economic valu In terms of copra the loss is 30.94% an 41.74% loss in total husk production.

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