Research Article

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Growth and vigour of coconut seedlings raised from eriophyid mite (*Aceria guerreronis* Keifer) infested seed nuts

R. J. Thomas*, R. V. Nair, C.P.R. Nair, C.K. Nampoothiri and Cherian Mathews

Central Plantation Crops Research Institute Regional Station, Kayamkulam
Kerala - 690 533, INDIA

Abstract

Considering the wide spread apprehension regarding suitability of mite infested seed nuts for raising seedlings, a study was undertaken to evaluate the growth and vigour of coconut seedlings raised from mite-infested seed nuts. The maximum values for all the growth characters were recorded in seedlings raised from grade-3 infested seed nuts. However, higher percentage of vigorous seedlings (with Z score of 22 and above) was obtained in seedlings raised from uninfested / grade-0 nuts. The faster germination recorded in grade-3 infested nuts and their subsequent better establishment may be the reasons for the superior performance of seedlings raised. On the basis of the present investigation, it is recommended that mite infested seed nuts should be sorted into lots, depending on severity of infestation, and nursery raised separately for each lot so that competition between seedlings, raised from different grades of mite infested nuts, can be minimized. This will help in obtaining more vigorous seedlings from the mite infested seed nuts.

Key words: Coconut, eriophyid mite, seedling growth, seedling vigour

Introduction

Coconut (*Cocos nucifera* L), a traditional plantation crop, is grown in 93 countries across the world and supports the livelihood of more than 80 million small and marginal farmers. In India, a major coconut producing country, the coconut palm is susceptible to a number of insect and non-insect pests. Of late, eriophyid mite incidence has also become a cause of concern for the coconut farmers throughout India. The occurrence of Eriophyid mite, *Aceria (=Eriophyes) guerreronis* Keifer was reported first in India from Ernakulam District of Kerala by Sathiamma *et al.*, (1998). Subsequently, this pest spread very fast to other regions and its widespread occurrence has been reported from all major coconut growing states of India.

In Kerala, the major coconut growing state in India, it is estimated that more than 50 % of the palms are infested with mites (Khan *et al.*, 2003). The mites occur in large numbers inside the perianth of 2-6 month old nuts. The damage initially appears as a triangular patch close to the perianth. The mites cause damage by sucking the cell contents from the soft meristematic tissues of the buttons (Ramaraju *et al.*, 2000). Feeding injury by large colonies of eriophyid mite results in brownish patches leading to warting and longitudinal fissures on the nut surface. Those nuts that are retained in the bunch develop with different intensities of infestation. Severe infestation leads to poor nut development, reduction in weight of copra, kernel, shell and husk (Nair *et al.*,2003)

Incidence of mite attack has been reported from almost all cultivated varieties of coconut. However, a low incidence has been reported in Kenthali (Ramaraju *et al.*, 2000) and Chowghat Orange Dwarf (Nair, 2000) varieties. Since, mite infestation occurs on nut surface, it leads to development of distorted/malformed nuts showing different intensities of warting and damage. Therefore questions are frequently raised with regard to the suitability of mite-infested nuts for seedling production. Studies in this direction are practically nil or scanty. Considering the wide spread apprehension regarding suitability of mite infested seed nuts for raising

Corresponding author: regijacob@yahoo.com

seedlings, a study was undertaken to evaluate the growth and vigour of coconut seedlings raised from such seed nuts.

Materials and Methods

Mature seed nuts were collected from mother palms of West Coast Tall variety of coconut during January-March of 2002 and 2003 and classified into five categories based on severity of mite infestation on nut surface, as per the index (0-4) developed by Nair *et al.* (2003). Each category viz., grade-0= no damage, grade-1=1-25%, grade-2=26-50%, grade-3=51-75% and grade-4=>75% damage was considered as a treatment.

Nuts were sown during May in nursery beds at a spacing of 30 cm between nuts and 40 cm between rows in a randomized block design with each treatment replicated four times. A spacing of 80 cm was maintained between nursery beds. Twenty nuts were sown for every treatment in each replication and the trial was carried out at CPCRI (RS), Kayangulam during two years, viz., 2002-03 and 2003-04. All routine cultural operations like weeding, irrigation (once in five days) etc., were carried out.

Observations on growth characters like percentage germination, height of seedling (cm), number of leaves per seedling and collar girth (cm) were recorded at monthly intervals from five months (150 days) after sowing. One-year-old seedlings were uprooted and growth characters like fresh weight (kg), percentage of seedlings with split leaves and number of thick roots per seedling were recorded in addition to the above listed characters.

"Z" scores were worked out based on the relationship $Z= -1.24 X_1 + 3.18 X_2 + 2.83 X_3 + 1.00 X_4$, where X_1- collar girth, X_2- number of leaves, X_3- weight of seedlings and X_4- number of thick roots, as suggested by Vijaya Kumar *et al.*,(1991) to distinguish between seedlings which are potentially high or low yielders, based on the observations from one year old seedlings. Data were analysed using analysis of variance technique as per standard methods (Panse and Sukhatme, 1985) to study the treatment, year and interaction (treatment x year) effects. The percentage data was angular transformed before carrying out analysis of variance.

Results and Discussion

The criteria for selecting vigorous one-year old seedling from nursery is based on early germination, number of leaves (> 6), collar girth (> 10 cm) and early splitting (Mulliyar and Pillai, 1989). Vijaya Kumar *et al.*, (1991) reported that characters like collar girth, number of leaves, weight of seedling and number of thick roots contribute maximum in discriminating between seedlings, which are potentially high or low yielders.

Germination

Present studies revealed that the intensity of mite attack on coconut seed nuts significantly affected the germination (Table 1) recorded at five months after sowing. Grade-3 infested seed nuts showed early and highest percentage germination (90) followed by uninfested nuts (grade-0) with 80. This may be due to the fact that the distance to be covered by the germinating shoot tip to emerge out of the husk was significantly less in grade 3 nuts (3.74 ± 0.149 cm) as compared to uninfested (4.62 ± 0.139 cm), grade-1 (4.88 ± 0.114 cm and grade-2 seed nuts (4.67 ± 0.115 cm). But this advantage (though the distance to be covered was only 3.43 ± 0.111 cm) did not favour the over all germination of grade-4 seed nuts due to the possible deleterious effect of severe (100%) infestation on the nut characters including damage to developing kernel (Nair, 2000). The other three treatments (grade-1, grade-2 and grade-4) gave comparable results with germination percentage ranging from 69 to 74.

Table 1. Percentage germination in relation to intensity of Eriophyid mite infestation on seed nuts

Treatments	5 months after sowing		
	2002	2003	Mean
Grade 0	80.00 (67.21)	80.00 (64.31)	80.00 ^{ab} (65.76)
Grade 1	77.50 (61.75)	70.00 (57.67)	73.75 ^{b} (59.71)
Grade 2	72.50 (58.58)	65.00 (53.98)	68.75 ^{b} (56.28)
Grade 3	95.00 (80.66)	85.00 (70.37)	90.00 ^{a} (75.52)
Grade 4	72.50 (59.17)	70.00 (57.14)	71.25 ^{b} (58.16)
Mean	79.50 (65.48)	74.00 (60.69)	76.75 (63.08)
CD (P=0.05)		NS	(11.05)

0= No damage; 1=1-25%; 2=26-50%; 3=51-75%; 4=>75%

Figures in parentheses are angular transformed values

Figures in each column with same superscript are not statistically different at P=0.05

Height of seedling

The effect of mite infestation on seedling height (Table 2) was significant at 12 months after sowing. The maximum seedling height (117.7 cm) was obtained in seedlings of grade-3 infested nuts and the minimum

seedling height (95.2 cm) in seedlings of grade-2 infested nuts. The treatments that gave a higher germination percentage recorded the maximum seedling height. This also can be due to the better establishment of the early-germinated seedlings, as they had the advantage of access to resources like sunlight and space without any competition.

Table 2. Height of seedling (cm) in relation to intensity of Eriophyid mite infestation on seed nuts

Treatments	12 months after sowing		
	2003	2004	Mean
Grade 0	121.82	100.08	110.95ab
Grade 1	117.12	88.83	102.97 bc
Grade 2	108.07	82.34	95.20 c
Grade 3	131.99	103.30	117.65 a
Grade 4	115.89	87.62	101.76 bc
Mean	118.98	92.43	105.71
CD (P=0.05)	8.36		13.22

0= No damage; 1=1-25%; 2=26-50%; 3=51-75%; 4=>75%
Figures in each column with same superscript are not statistically different at P=0.05

Number of leaves, collar girth, per centage seedlings with split leaves, number of thick roots

The seedling characters that were least influenced by intensity of mite infestation are number of leaves per seedling, collar girth, percentage seedlings with split leaves and number of thick roots. With regard to number of leaves produced per seedling (Table 3), the seedlings of grade-3 infested nuts produced the maximum number of leaves (6.38) followed by grade-4 nuts (6.22) and grade-0 nuts (6.09). The minimum numbers of leaves (5.61) were in seedlings of grade-2 infested nuts.

Table 3. Number of leaves per seedling in relation to intensity of Eriophyid mite infestation on seed nuts

Treatments	12 months after sowing		
	2003	2004	Mean
Grade 0	6.08	6.10	6.09
Grade 1	6.17	5.78	5.97
Grade 2	6.04	5.18	5.61
Grade 3	6.56	6.20	6.38
Grade 4	6.36	6.08	6.22
Mean	6.24	5.87	6.05
CD (P=0.05)	0.33		NS

0= No damage; 1=1-25%; 2=26-50%; 3=51-75%; 4=>75%

At 12 months after sowing, the seedlings of grade-3 infested nuts and uninfested nuts had comparable collar girth of 11 cm. The minimum collar girth (9.76 cm) was recorded in the seedlings of grade-2 infested nuts.

Table 4. Collar girth (cm) of seedling in relation to intensity of Eriophyid mite infestation on seed nuts

Treatments	12 months after sowing		
	2003	2004	Mean
Grade 0	11.42	10.63	11.02
Grade 1	11.12	9.15	10.13
Grade 2	10.54	8.98	9.76
Grade3	11.98	9.95	10.96
Grade 4	11.23	9.98	10.61
Mean	11.25	9.74	10.50
CD (P=0.05)	0.62		NS

0= No damage; 1=1-25%; 2=26-50%; 3=51-75%; 4=>75%
Figures in each column with same superscript are not statistically different at P=0.05

The highest percentage of seedlings with split leaves (42.97) was in grade-3 infested nuts (Table 5) followed by grade-0 infested nuts (34.45). The lowest percentage of seedlings with split leaves (26.12) was in grade-2 infested nuts.

Table 5. Percentage of seedlings with split leaves in relation to intensity of Eriophyid mite infestation on seed nuts

Treatments	2003	2004	Mean
Grade 0	36.19	32.71	34.45
	(36.44)	(34.69)	(35.56)
Grade 1	41.94	18.75	30.35
	(40.31)	(22.49)	(31.40)
Grade 2	27.23	25.00	26.12
	(30.97)	(29.67)	(30.32)
Grade 3	51.11	34.82	42.97
	(45.63)	(35.54)	(40.59)
Grade 4	31.24	30.00	30.62
	(33.93)	(32.63)	(33.28)
Mean	37.54	28.26	32.90
	(37.45)	(31.00)	(34.23)
CD (P=0.05)	(5.87)		NS

0= No damage; 1=1-25%; 2=26-50%; 3=51-75%; 4=>75%
Figures in parentheses are angular transformed values

With regard to number of thick roots produced per seedling (Table 6), the maximum value (13.96) was in seedlings of grade-3 infested nuts, followed by grade-0 nuts (13.52).

Table 6. Number of thick roots per seedling in relation to intensity of Eriophyid mite infestation on seed nuts

Treatments	2003	2004	Mean
Grade 0	13.41	13.64	13.52
Grade 1	12.68	12.39	12.53
Grade 2	11.90	12.19	12.04
Grade 3	14.00	13.93	13.96
Grade 4	12.26	13.24	12.75
Mean	12.85	13.08	12.96
CD (P=0.05)	NS		NS

0= No damage; 1=1-25%; 2=26-50%; 3=51-75%; 4=>75%

Here also the minimum value (12.04) was in seedlings of grade-2 seed nuts.

Weight of seedling

Fresh weight of the seedling (Table 7) was significantly and negatively related with the level of infestation. The seedlings of uninfested nuts (grade-0) recorded a significantly superior seedling weight (1.756 kg) compared to other grades of infested nuts. This may be due to the higher seed nut weight recorded in uninfested nuts (Nair *et al.*, 2003) and the gradual negative influence of mite infestation on the weight and size of seed nuts in different treatments. Among the other grades of infestation, grade-3 infested nuts had a higher seedling weight (1.372 kg).

Table 7. Weight of seedling (kg) in relation to intensity of Eriophyid mite infestation on seed nuts

Treatments	2003	2004	Mean
Grade 0	1.639	1.873	1.756 a
Grade 1	1.492	1.110	1.301 b
Grade 2	1.441	0.995	1.218 b
Grade 3	1.590	1.154	1.372 b
Grade 4	1.127	1.113	1.120 b
Mean	1.458	1.249	1.353
CD (P=0.05)	0.161		0.255
CD (T X Y)	0.360		

0= No damage; 1=1-25%; 2=26-50%; 3=51-75%; 4=>75%
T: Treatments, Y: Years
Figures in each column with same superscript are not statistically different at P=0.05

Percentage of seedlings with "Z" score of 22 and above

The percentage of seedlings in each treatment with "Z" score of 22 and above (Table 8) was significant between treatments. Healthy/uninfested nuts produced a higher percentage of seedlings (48.93) with the required Z score, followed by seedlings of grade-3 seed nuts (41.03). Though the other three treatments, grade-1, grade-4 and grade-2 were on par, seedlings of grade-1 seed nuts had the least percentage (28.27) of seedlings with Z value above 22.

Table 8. Percentage of seedlings with "Z" score 22 and above in relation to intensity of Eriophyid mite infestation on seed nuts

Treatments	2003	2004	Mean
Grade 0	60.12 (50.87)	37.74 (37.11)	48.93 a (43.99)
Grade 1	50.28 (45.32)	6.25 (7.50)	28.27 b (26.41)
Grade 2	36.02 (36.28)	7.29 (11.20)	21.67 b (23.74)
Grade 3	55.28 (48.02)	26.78 (27.02)	41.03 ab (37.52)
Grade 4	23.25 (27.98)	21.88 (24.43)	22.57 b (26.21)
Mean	44.99 (41.70)	19.99 (21.45)	32.49 (31.57)
CD (P=0.05)	(8.75)		(13.83)

0= No damage; 1=1-25%; 2=26-50%; 3=51-75%; 4=>75%
Figures in parentheses are angular transformed values
Figures in each column with same superscript are not statistically different at P=0.05

To summarize, the values for all the growth characters in grade-3 and grade-0 (uninfested) nuts were on par. The seedlings of grade-2 infested nuts had significantly inferior values for all the characters observed.

The reason for the superiority of the seedlings of grade-3 infested nuts can be due to its early germination and subsequent better establishment. The laggard seedlings of grade-2 and grade-1 nuts, which germinated subsequently, might have had the disadvantage of intense competition for resources due to the shade created by the early-germinated seedlings. The other possible reason for the better performance of seedlings of grade-3 nuts may be due to the better nutrient availability during the seed nut development phase as compared to grade-2 and grade-1 nuts. For example, in a moderately mite infested bunch; nearly 10-12 mildly (grade-1/grade-2) infested nuts are retained on a single bunch. Contrary to this, in the case of heavily mite-infested bunch, only 3-5 severely infested (grade-3 / grade-4) nuts are retained. Thus, the less number (3-5) of mature grade-3/ grade-4 nuts, which tolerated heavy mite infestation, had access to more nutrients as compared to the more number (10-12) of grade-2/ grade-1 nuts. Though the heavily (grade-3/ grade-4) mite infested nuts had a distorted / malformed appearance, their embryo/ endosperm had more vigour as compared to mildly mite infested (grade-1/ grade-2) seed nuts.

With regard to the influence of year of experimentation, all the growth characters studied, except germination, differed significantly during 2002-03 and 2003-04. The difference with regard to germination was not significant because during the germination phase (June-September), the weather parameters were similar during 2002-03 and 2003-04. The average values for all other growth characters recorded during 2003-04 were inferior to that of 2002-03. The reduction in growth characters during 2003-04 may be due to the impact of severe drought, which prevailed throughout Kerala during that year. The period from September 2003 - April 2004 recorded only 41 rainy days as compared to 54 rainy days recorded during the same period in 2002-03.The treatment x year interaction effect was significant only with regard to weight of the seedling.

Conclusion

Mite infestation significantly affected seedling characters like germination at five months, height and weight of seedling, percentage of seedlings with Z score of above 22.The maximum values for all the growth characters were recorded in seedlings raised from grade-3 infested seed nuts. However, higher percentage of vigorous seedlings (with Z score of 22 and above) was obtained in seedlings raised from uninfested / healthy nuts. The seedlings raised from grade-2 infested nuts recorded the minimum values for all the growth characters studied. The faster germination recorded in grade-3 infested nuts and their subsequent better establishment may be the reasons for their superior performance (higher values for growth characters) of seedlings raised.

On the basis of the present investigation, it is recommended that mite infested seed nuts should be sorted into lots, according to severity of infestation, and nursery raised separately for each lot so that competition between seedlings, raised from different grades of mite infested nuts, can be minimized. This will help in obtaining more vigorous seedlings from mite infested seed nuts.

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