Pakistan J. Sci. Ind. Res., Vol. 24, No. 4, August 1981

SOOTY MOLD ON MANGO PLANTS AND ITS RELATIONSHIP WITH LEAFHOPPERS AND CLIMATIC FACTORS IN KARACHI-PAKISTAN DURING 1978-79

Mubarik Ahmed, Manzoor Ahmed, M.A. Baluch and Rukhsana Naheed

Leafhopper Ecology Research Project, Department of Zoology, University of Karachi, Pakistan*

(Received July 9, 1980)

Fungal infestation or sooty mold of mango has become serious problem in recent years in Karachi. In view of its increasing economie significance, a study of its relationship with mango leafhoppers, and several environmental variables was made from May 1978 to May 1979 in Karachi. Statistical analysis based on data obtained in these studies on 10 randomly picked up mango plants in Karachi University Campus showed that the growth of sooty mold is significantly related with the population of mango leafhoppers and minimum week temperatures, but highly significantly related with maximum day temperatures, The fungal growth is at its peak during May and June, at minimum temperature between 25–30°, and maximum temperature around 35°.

INTRODUCTION

Mango leafhoppers *Amritodus atkinsoni* and *Idioscopus clypealis* (Idiocerinae: Cicadellidae) are distributed far and wide in India and Pakistan, and practically in all mango growing areas of the subcontinent [1]. Apart from sucking the nutrients from the leaves, the leafhoppers are also responsible for a large-scale growth of fungal complex on the leaves known as sooty mold. Haq and Akmal [2] discussed the various ways in which the mango leafhoppers could destroy the mango orchards. Ahmed and Ahmed [3] demonstrated that the mango leafhoppers affected the growth of plants, destroyed the chlorophyll of foliage, and caused heavy infestation of leaves by fungi. Haq [1] also showed that the leafhoppers were responsible for fungal growth on leaves, which interfered in their normal process of photosynthesis.

The information on the development of sooty mold of mango and particularly its relationship with leafhoppers and environmental factors was not available. The present study deals with the intensity of fungal infestation and its relationship with leafhopper population, temperature, maximum and minimum of day of sampling as well as maximum and minimum temperatures recorded within sampling week, mean of maximum and minimum relative humidity within the sampling week, all analysed statistically. Mealy bugs and scale insects were relatively insignificant during the period of present study. Their relationship with fungal infestation was therefore, not studied.

MATERIAL AND METHODS

The fungal infestation on mango foliage *(Mangifera indica)* was studied on plants in the Campus of Karachi University from May 1978 to May 1979. Out of more than 200 trees, 10 trees were picked up randomly, for assessment of fungal infestation, and sampling of mango leafhoppers. The estimation of fungal growth was made by visual examination of total leaves on 4 branches, on four sides of the mango plant, from where mango leafhoppers were also collected. As the leafhopper sampling varied from lower to middle and upper leaves [4], the observation of fungus also varied accordingly. With regard to the extent of fungal growth, the leaves were divided into 4 levels i.e. O-with no fungus at all, 1-with 33% leaf surface covered with fungus, 2-with 2/3 part covered, and 3-with the entire leaf covered with fungus. The number of leaves on all the four branches, falling into each category of fungal growth were separately recorded and the index of infestation was calculated as below:

$$\text{Infestation index} = \frac{0 \times n \text{ leaves} + 1 \times n \text{ leaves} + 2 \times n \text{ leaves} + 3 \times n \text{ leaves}}{\text{Total leaves}}$$

*Research financed by a grant No. FG - Pa - 319, PK - SEA 154 under PL 480 program of U.S. Department of Agriculture.

Temperature and humidity were recorded daily, and leafhopper counts alongwith infestation index of sooty mold on weekly basis. The correlation between various environmental variables was calculated by using the formula:

$$r = \frac{\epsilon xy - \frac{(\epsilon x)(\epsilon y)}{N}}{\sqrt{\left(\epsilon x^2 - \frac{(\epsilon x)^2}{N}\right)\left(\epsilon y^2 - \frac{(\epsilon y)^2}{N}\right)}}$$

The population of leafhoppers as estimated has been stated by Ahmed *et al.* [2].

RESULTS AND DISCUSSION

I. *Fungi and Sooty Mold.* Ghafoor and Khan [5] menttioned nine species of fungi on mango leaves, fruit or branches in Malir (Karachi). During the present study following 15 species of fungi were identified in the sooty mold of mango, these are listed below:

1. *Alternaria alternata;* 2. *Alternaria tenuissima;* 3. *Cladosporium cladosporioides;* 4. *Cladosporium* sp. 5. *Helminthosporium hawaiiensis;* 6. *Fusarium semitectum;* 7. *Fusarium moniliform;* 8. *Aspergillus niger;* 9. *Aspergillus flavus;* 10. *Botryodiplodia mangiferae;* 11. *Botryodiplodia ribis;* 12. *Botryodiplodia theobromae;* 13. *Curvularia lunata;* 14. *Capnodium mangiferae;* 15. *Capnodium ramosum.*

II. *Fungal Infestation and Leafhoppers.* As the sooty mold of mango is dependant on the honey dew excreted by mango leafhoppers, it is expected that the more the population of leafhoppers, the more the honey dew, and so the more the fungal growth. The population of mango hoppers and index of fungal infestation with weeks of the years, have been give in Fig. 1. It would appear that the maximum growth of fungus took place from late May to July, which appeared to follow the large-scale appearance of mango hoppers from March to May. As the torrential rains also affect the population of leafhoppers, the low index of fungal infestation during November and December could be accordingly explained. Further from the index of 100 % fungal infestation, it would appear that for a major part of the year, almost 50 to 75% of the foliage of mango re-

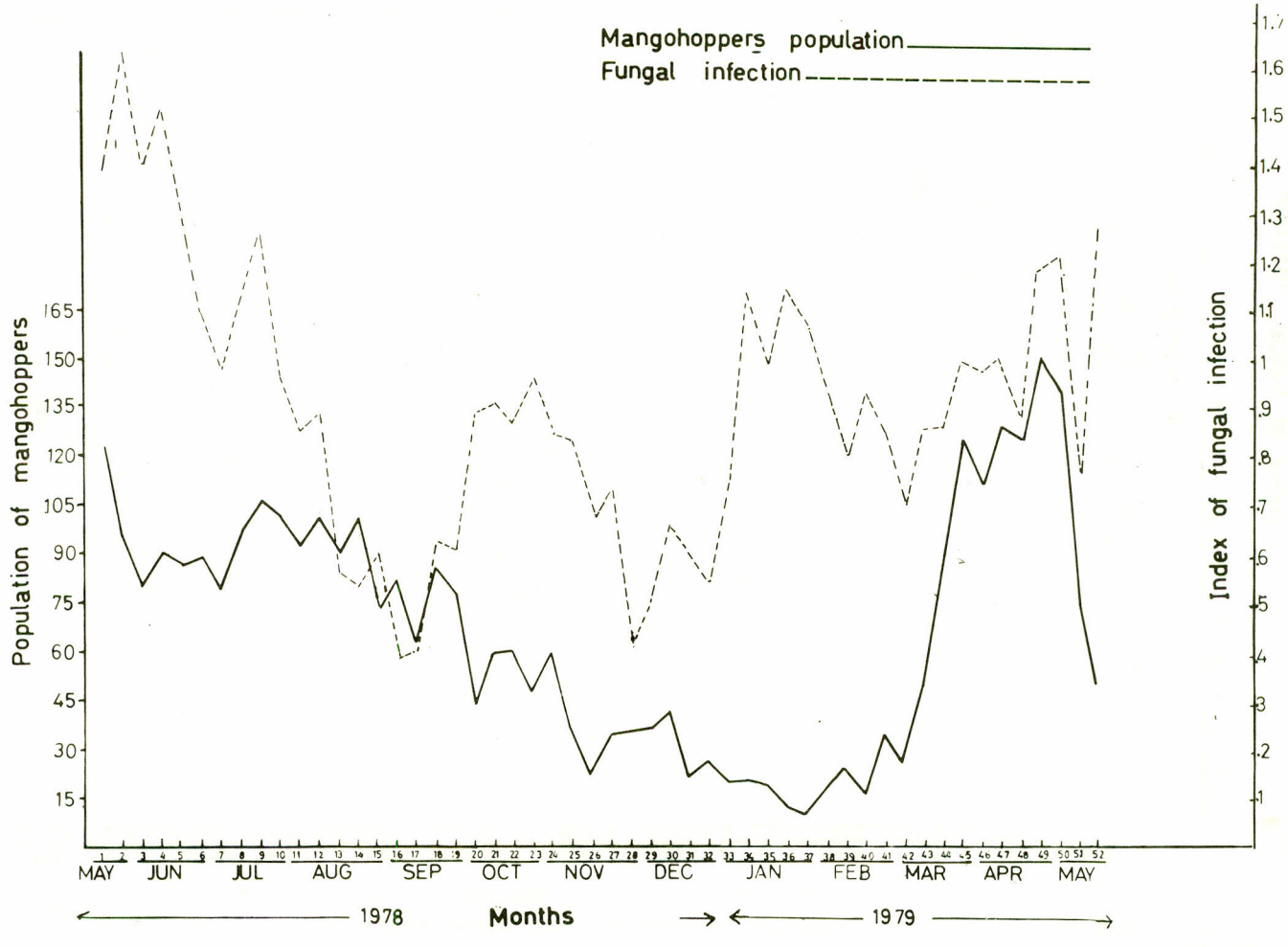

Fig. 1. Population of mango leafhopper and fungal infestation during 52 weeks at Karachi (1978-79).

mained covered by sooty mold, which could undoubtedly be extremely harmful for the healthy growth of the plants. From the Table 1, it would also appear that the 'r' value of 0.33386 of correlation between leafhopper population and fungal infestation is significant at $p < 0.02$.

III. *Fungal Infestation and Environmental Variables.* Table 1 shows the index of fungal infestation with minimum and maximum day temperature, minimum and maximum week temperatures and relative humidity. The relationship of fungal infestation with and minimum realtive humidities and with temperature and rainfall during the 52 weeks study between 1978–79 is shown in Fig. 2 and 3.

The correlation of fungal infestation with minimum and maximum day temperature differ in significance. The values of r = 0.2836 at minimum day temperature and 0.3807 at maximum day temperature are significant and highly significant respectively at $p < 0.05$ and 0.01 respectively. The maximum fungal growth was recorded during the periods of minimum day temperature between 25° and 30°, and maximum day temperature around 35°. This would also explain the second peak of fungal growth seen in December, 1978 and January, 1979 (Fig. 1), when the leafhopper population was minimum, but the maximum day temperature (Fig. 3) was around 35°. The long period of high excretory activity of honey dew by leafhoppers must have deposited so much honey dew on the leaves, that even absence of leafhoppers later on had not resulted in decrease of fungal infestation. Maximum day temperature is highly correlated with fungal growth, but the initial base is always provided by the presence of leafhoppers.

The minimum week temperature has significant correlation with fungus, however the maximum week temperature appears to have no significant bearing on the growth of fungus. Similarly the relative humidity, both minimum and maximum also appear to have no correlation with fungal growth. The rainfall as seen in Fig. 3, decreased the fungal infestation by washing off the mycelia from the leaves on one hand, and as observed by Ahmed *et al.* [4] induced

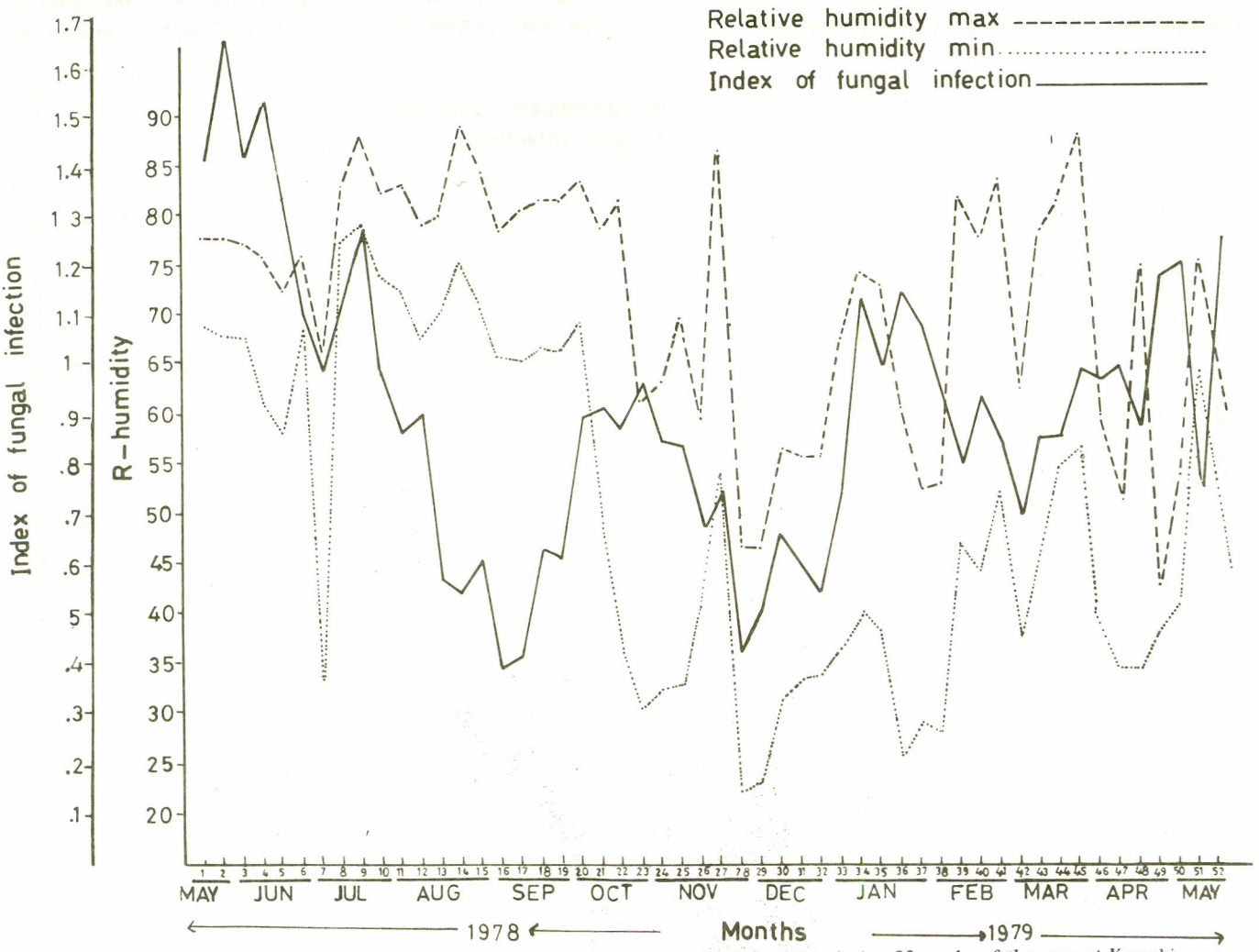

Fig. 2. Fungal infestation of mango and maximum and minimum relative humidities during 52 weeks of the year at Karachi (1978-79).

Table 1. Correlation matrix of index of fungal infestation, environmental variables and population of mangohoppers.

	Index of fungal infestation	Population of mango hoppers	Minimum day temperature	Maximum day temperature	Minimum week temperature	Maximum week temperature	Minimum humidity
Population of mango hoppers	.33386						
Minimum day temperature	.2556	.6928					
Maximum day temperature	.3807	.62516	.4500				
Minimum week temperature	.2836	.73880	.9384	.4922			
Maximum week temperature	.0922	.5408	.5931	.7645	.6395		
Minimum humidity	.137	.46821	.7813	.0835	.7429	.2833	
Maximum humidity	.044	.1779	.5371	−.051	.5573	.1776	.7909

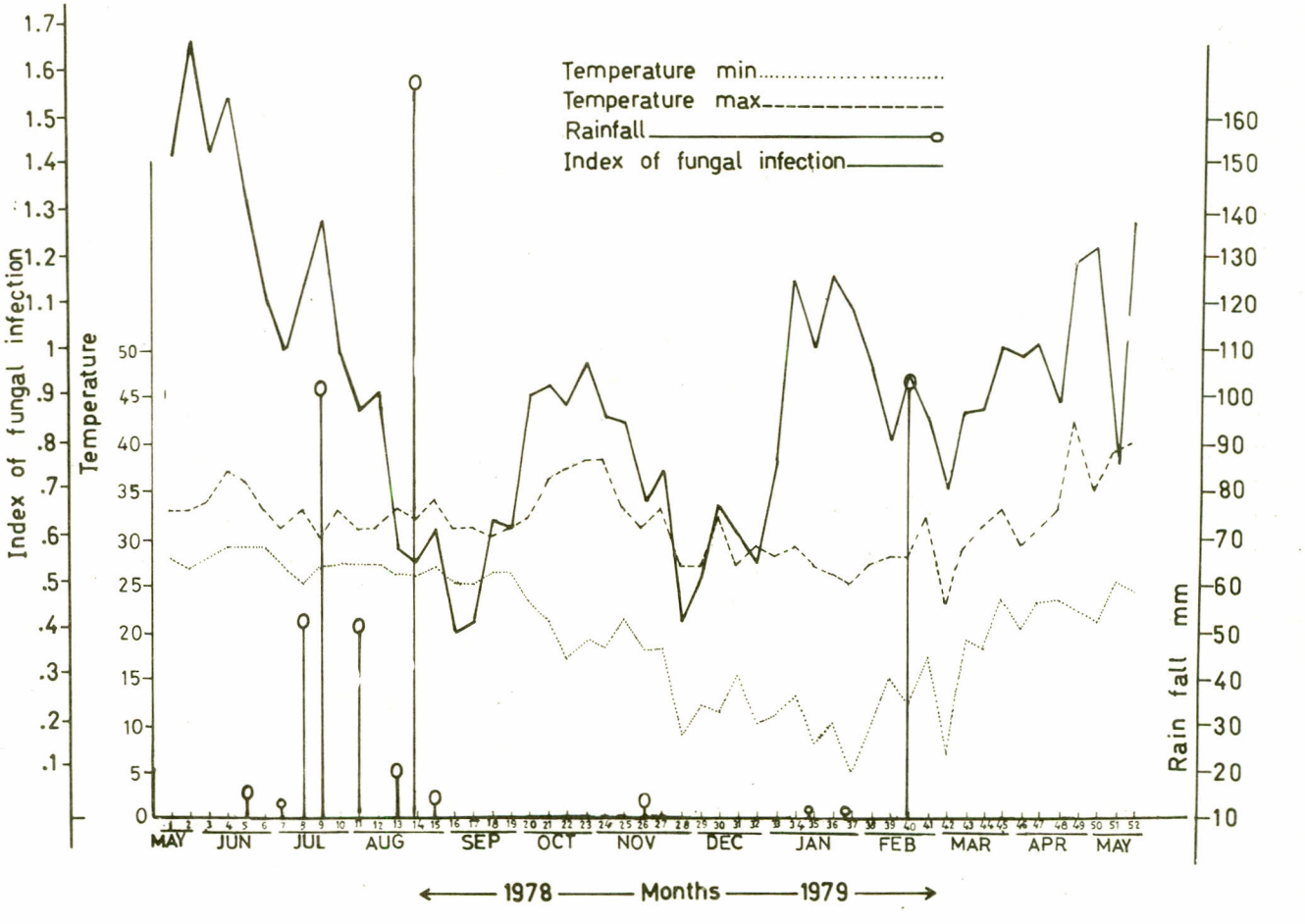

Fig. 3. Fungal infestation of mango, rainfall and maximum and minimum temperatures during 52 weeks of a year at Karachi (1978-79).

the appearance of nymphs, thus increasing the population of mango leafhoppers.

As seen in Table 1, the correlations between seven environmental variables and fungal infestation as well as within themselves are non-significant as well as significant to very highly significant. As these are not independent of each other in the environment, the overall situation of heavy population of mango leafhoppers, which provided the initial substratum of honey dew for fungal growth, and the temperature which was helpfull for the luxurient growth of fungus, were the cumulative net effect of all the factors discussed here. To avoid large-scale fungal growth, control

measures should be adopted soon after the rains in October and November, when leafhopper population would be at its lowest, and the fungus also considerably washed off by rains. The second control operation should be adopted immediately after first rain in February, March when the fruit would have set, and the first nymphal hatching of mango hoppers expected.

REFERENCES

1. K.A. Haq, Ayub Agri. Res. Inst. Faisalabad, p. 24 (1964).
2. K.A. Haq and M. Akmal, Punj. Fruit J., 197 (1960) .
3. M. Ahmed and M. Ahmed, Pakistan J. Sci. Ind. Res., 23, 48 (1980).
4. M. Ahmed, M.A. Baluch, M. Ahmed and S.S. Shaukat. (in press) (1980).
5. A. Ghafoor and S.A.J. Khan, Deptt. of Plant Protection, Govt. of Pakistan. p. 83 (1976).