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Effect of weather parameters on mango hoppers population

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Abstract
The present research was carried out to study the correlation between weather parameters and mango hoppers during 2015-16 and 2016-17. The correlation between mango hopper population and different weather parameters during 2015-16 was found to be non-significant except evaporation which was negatively significant (r=0.576) only in IIA (Indo-Israel Project- Alphonso). The correlation between mango hopper population and different meteorological parameters during year 2016-17 was found to be non-significant except minimum temperature and wind speed. The correlation between minimum temperature and hopper population in IIA (Indo-Israel Project- Alphonso) and IIPA (Indo-Israel Project-Pruned Alphonso) indicated that as the temperature decreases population of hopper decreases, which showed the values of -0.791 (r=0.602) and -0.744 (r=0.602), respectively. In PaSA (Pangari Block-Sprayed Alphonso) and PaUSA (Pangari Block-Unsprayed Alphonso) results revealed that as wind speed increases the population of hopper decreases and showed values of 0.529 (r=0.514) and 0.595 (r=0.514), respectively.

Keywords: Mango hoppers, weather parameters, hopper population, alphonso

Introduction
Mango (*Mangifera indica* Lin.) is the main fruit of Asia and this fruit has developed its own importance all over the world. It is the national fruit of Indian and since long it is the choicest fruit in India. This fruit has been under cultivation in Indian sub-continent over 4000 years and has been the favorite of the kings and commoners because of its nutritive value, taste, attractive fragrance and health promoting qualities. In many parts of the country mango serves as staple food for several months during the year because of its fine quality and taste as raw fruit. It is now recognized as one of the best fruits in the world market; hence it is called as the 'King of the fruits'. It occupies relatively the same position in the tropical region as is enjoyed by apple in temperate region.

In consideration of area, production and productivity of various states, Andhra Pradesh stands at the top considering the area (31.57 M ha) under mango cultivation. The other important mango growing states are Karnataka, Telangana, Bihar, Tamil Nadu, Maharashtra, West Bengal, Gujarat, Madhya Pradesh, Orissa and Kerala (Anonymous, 2015)[2].

In Maharashtra, the area under mango cultivation is 0.485 M ha with a total production of over 1.212 MT of mango fruits and productivity is 2.5 MT per ha. Konkan is the major mango producing region on the West Coast of Maharashtra, occupies an area of 0.182 M ha which comprises five mango growing districts *viz.*, Thane, Palghar, Raigad, Ratnagiri and Sindhudurg and is emerging as one of the largest mango growing belts in the country. Konkan region accounts for about 10 per cent of the total area under mango cultivation in the country, out of which almost 90 per cent area is covered by a single cultivar Alphonso, which is locally called as '*Hapus*' (Anonymous, 2014) [1].

The reasons for low productivity of 'Alphonso' variety in Konkan region are high incidence of pests and diseases due to hot and humid climate. Among the insect-pests, mango hopper is the number one serious and destructive pest of mango. Apart from causing menace in various states of India, the hopper pest has been found prevalent in most of the tropical and sub-tropical countries in South East Asia. Damage is caused by the nymphs and adults by sucking sap from tender leaves, inflorescence as a consequence of which inflorescence and fruit if any set, fall prematurely. Mango hoppers secrete honey dew which facilitates the development of sooty mold on the leaves, twigs and inflorescence.

Due to sooty mold the photosynthetic adversely activity is hampered and ultimately fruit setting is also affected.

Many researchers had worked on seasonal incidence and influence of weather parameters on the development of the hoppers, but still there is vast scope. Hence there is need to carry out detailed study to determine the effect of some abiotic factors on hopper population in different sites as well as different stages in mango plant.

In view of this, the present investigations were undertaken for the management of mango hoppers by studying correlation between weather parameters and hopper population.

Materials and Methods

The field observation on mango hopper population to study population fluctuations were undertaken under different Dapoli locations.

Methods of Recording Observations

For recording population of mango hoppers, five plants per location were selected and ten panicles per tree were tagged location wise. The total numbers of mango hoppers (nymphs and adults) per panicle were counted at weekly interval and at different phenological stages on different mango varieties. Data thus collected were averaged to number of hoppers per panicle and analyzed statistically.

Statistical Analysis

The data on weather parameters *viz.*, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours, wind speed and evaporation were collected from Pangari Block, Central Experimental Station, Wakawali as well as from Department of Agronomy, College of Agriculture, Dapoli. The correlation between average mango hopper population and various weather parameters was worked out by the Pearson's correlation coefficient.

Results and Discussion

The results pertaining to the correlation coefficients of different meteorological parameters *viz.*, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours, wind speed and evaporation with mean mango hoppers population at different locations *viz*., IIA (Indo-Israel Project- Alphonso), IIPA (Indo-Israel Project- Pruned Alphonso), PaSA (Pangari Sprayed Alphonso) and PaUSA (Pangari Unsprayed Alphonso) during years 2015-2016 and 2016-17 are presented in Table 1 and 2. The results on correlation between mango hopper population and different weather parameters during 2015-16 revealed that, all the meteorological parameters like maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours and wind speed found to be non-significant except evaporation which was negatively significant (r=0.576) only in IIA (Indo-Israel Project- Alphonso).

The correlation between mango hopper population and different meteorological parameters during year 2016-17 indicated that, among the various meteorological parameters, maximum temperature, morning relative humidity, evening relative humidity, sunshine hours and evaporation was found to be non-significant except minimum temperature and wind speed.

The results revealed that minimum temperature showed negatively significant correlation in IIA (Indo-Israel Project- Alphonso) and IIPA (Indo-Israel Project- Pruned Alphonso) while, wind speed showed positively significant correlation with hopper population in PaSA (Pangari Block-Sprayed Alphonso) and PaUSA (Pangari Block-Unsprayed Alphonso). The correlation between minimum temperature and hopper population in IIA (Indo-Israel Project- Alphonso) and IIPA (Indo-Israel Project- Pruned Alphonso) indicated that as temperature decreases population of hopper decreases, which showed the values of -0.791 (r=0.602) and -0.744 (r=0.602), respectively. In PaSA (Pangari Block-Sprayed Alphonso) and PaUSA (Pangari Block-Unsprayed Alphonso) results revealed that as wind speed increases the population of hopper decreases and showed values of 0.529 (r=0.514) and 0.595 (r=0.514), respectively. This might be due to the location of the orchards. Both the orchards of Pangari block were situated on hills and that might be the reason of positive correlation with wind speed. The other orchards are on plain topography.

The results of the present findings are corroborative with the earlier results. Vijaya Lakshmi *et al.* (2010)[4] revealed the significant negative influence of relative humidity and positive influence of maximum temperature, evaporation and wind speed on the population of mango hoppers. Weather based pest forewarning models developed in seven varieties of mango for mango hoppers explained the variation in mango hopper population by 25 to 49 per cent with linear models as compared to 28 to 71 per cent obtained with non-linear models.

Table 1: Correlation coefficient of mean hoppers population and weather parameters in 2015-16

Location codes	Weather parameters							r values
	Tmax	Tmin	RH-I	RH-II	Wind speed	BSS	Epan	
IAA	-0.154	-0.107	0.295	-0.082	-0.394	0.074	-0.629*	0.576
IIPA	-0.305	0.236	0.221	0.288	0.097	0.109	-0.274	0.576
PaSA	0.225	0.112	-0.313	0.025	0.423	0.297	0.179	0.632
PaUSA	0.335	0.165	-0.341	0.096	0.562	0.306	0.321	0.632

* Correlation is significant at the 0.05 level

Table 2: Correlation coefficient of mean hoppers population and weather parameters in 2016-17

Location codes	Weather parameters							r values
	Tmax	Tmin	RH-I	RH-II	Wind speed	BSS	Epan	
IAA	-0.222	-0.791*	0.418	-0.123	-0.457	-0.206	-0.497	0.602
IIPA	0.038	-0.744*	-0.030	0.089	-0.300	-0.131	-0.344	0.602
PaSA	0.107	0.493	-0.280	-0.079	0.529*	0.281	-0.159	0.514
PaUSA	0.167	0.371	-0.196	-0.156	0.595*	0.447	-0.114	0.514

* Correlation is significant at the 0.05 level

Zagade and Chavan (2013) [5] recorded the peak incidence of the mango hopper during 2nd SMW. They further reported the significant negative correlation with maximum temperature, minimum temperature and afternoon relative humidity.
Chaudhari *et al.* (2017) [3] reported that maximum temperature, morning RH, evaporation and sunshine hours influenced the hopper infestation positively but not significant whereas minimum temperature, afternoon RH, rainfall and wind speed showed non-significant negative correlation.

Conclusion

The correlation between mango hopper population and different meteorological parameters during year 2016-17 indicated that the minimum temperature showed negatively significant correlation in IIA (Indo-Israel Project- Alphonso) and IIPA (Indo-Israel Project- Pruned Alphonso) while, wind speed showed positively significant correlation with hopper population in PaSA (Pangari Bloch-Sprayed Alphonso) and PaUSA (Pangari Block-Unsprayed Alphonso). The correlation between minimum temperature and hopper population in IIA (Indo-Israel Project- Alphonso) and IIPA (Indo-Israel Project- Pruned Alphonso) indicated that as temperature decreases population of hopper decreases, which showed the values of -0.791 (r=0.602) and -0.744 (r=0.602), respectively. In PaSA (Pangari Block-Sprayed Alphonso) and PaUSA (Pangari Block-Unsprayed Alphonso) results revealed that as wind speed increases the population of hopper decreases and showed values of 0.529 (r=0.514) and 0.595 (r=0.514), respectively.

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