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Effect of weather parameters on the seasonal abundance of peach leaf curl aphid, *Brachycaudus helichrysi* (Kaltenbach) on peach in lower Shiwaliks of Punjab

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Abstract

Peach leaf curl aphid *Brachycaudus helichrysi* (Kaltenbach) is regular and destructive pest of peach in lower Shiwaliks of Punjab causing nearly 50 percent crop loss due to less fruit set and early fruit drop. Keeping in view the economic importance of this pest the present study was conducted from 2013-2015 to determine seasonal incidence and effect of weather parameters on *B. helichrysi* build up. The results revealed that mean aphid population for the year 2013, 2014 and 2015 was 106.1, 123.3 and 127/10 leaves, respectively which showed that over the years the pest incidence has increased. The highest mean aphid population was recorded during March (195.62/10 leaves) followed by February (90.75/10 leaves) and declined in the month of April (64.37/10leaves). The correlation coefficient was positive but significant with maximum temperature T_{max} ($r=0.941^*$ and $r=968^*$) in the month of February and March respectively and significant negative correlation was observed with T_{max} ($r=-0.962$) in April. Similarly minimum temperature showed positive but non significant ($r=0.860$ and $r=0.520$) correlation with aphid population in February and March respectively while negative and significant relation ($r=-950^*$) was observed in April. Rainfall exhibited insignificant negative ($r=-0.782$, $r=-0.504$ and $r=-0.295$) impact on the pest multiplication for these months. The correlation coefficient of mean relative humidity was positive and significant so at lower RH there was decrease in aphid population. There was significant reduction in fruit yield (by 32%) due to aphid incidence. Therefore results depicts that temperature and RH plays important role in the build up of aphid population during different months hence the predictions and forewarning of the aphid population by using weather parameters will be helpful in management of this pest.

Keywords: Management, predictions, relative humidity

Introduction

Peach (*Prunus persica* Batsch), fruit tree of the rose family (Rosaceae) is one of the important stone fruits which is cultivated in temperate climates, as it has chilling requirement that tropical or sub-tropical areas generally cannot satisfy except some part of Jammu & Kashmir, Himachal Pradesh, Punjab, Haryana, Uttarakhand, parts of Uttar Pradesh, Tamil Nadu and North Eastern states [1]. Most of peach cultivars require 500 hours of chilling (0 to 10 °C) and during this period, plants remain dormant [2]. It bears an edible juicy fruit called a peach or a nectarine. In Punjab, it is grown on an area of 1,897 ha with production of 33,852 MT of fruits annually [3]. Moreover the demand for the stone fruits and their processed products has increased because of its high nutritional value (rich in vitamin A, iron and proteins). Peach is generally consumed as fresh, delicious squash and other processed products could be prepared from its varieties, viz. Sharbati, Shan-i-Punjab, Saharanpuri, Prabhat and Florida Red, cultivated in the north Indian plains. In Kandi region of Punjab peach is generally grown in the irrigated areas. In early spring season many insect-pests are affecting the productivity of peach however; Peach leaf curl aphid *B. helichrysi* is one of the most destructive pest in peach orchards. The pest is highly polyphagous infesting about 175 species belonging to 115 genera and 49 plant families in India [4]. This pest damages the crop by sucking sap from leaves, flower buds and newly formed fruits, young leaves curl up and finally turn pale, fruits either do not set or fall off prematurely resulting into poor yield thus causing nearly 50 percent crop loss due to less fruit set and early fruit drop. The extent of infestation generally exceeds 50 percent if the timely measures are not taken [5].

Chandel *et al.* (2001) [6] reported that high incidence of *B. helichrysi* cause significant reduction in leaf area and total chlorophyll content, with marked decrease in fresh and dry leaf weight so considered as destructive insect pest of peach in the country [7, 8].

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Besides peach it also infests nectarines, almonds, apricots, prune and plum. Aphids are greatly affected by weather parameters such as temperature, relative humidity, rainfall etc and these are adapted specifically to the set of environmental and physiographic conditions especially for weather where crops are grown. Therefore, for proper management of aphids, a good understanding of their population dynamics which is been impacted by above weather parameters is critically important [9]. Several studies have indicated that weather plays an important role on the aphid appearance, multiplication and disappearance [4, 10-12]. The population fluctuation mostly depends upon environmental factors so better understanding between environmental factors and insect pest relationship help them to manage the pest population before going to economic injury level and cause increase in yield. Therefore, knowledge about the seasonal population dynamics of pests are the key for preparing management programs. Keeping these points in view, the present investigation was carried out to fulfill the following objectives:

- 1 To study seasonal population dynamics of peach leaf curl aphid
- 2 To study the relationship between aphid population build up and abiotic environmental factors such as temperature, rainfall and relative humidity in peach in lower Shiwalik of Punjab.

Materials and Methods

The studies were carried at Regional Research Station Ballawal Saunkhri which is located in sub-montaneous area comprising Shiwalik foothills in the state of Punjab, known as the *Kandi* region, stretching in a thin belt along the north-eastern border of the state. The field studies were carried out in 5 year old well managed orchards of peach (var. Shan-i-Punjab). All the recommended package of practices was followed except for the routine insecticide application. The experiment was laid out in a randomized block design (RBD) and five peach trees were randomly selected representing one replication. Observations were recorded on number of aphids

population on randomly selected 10 leaves per tree from all geographical directions using hand lens (x 10). Observations on leaves were recorded weekly during the peak infestation period (February to April) of the pest for three years (2013 to 2015). Data on weather parameters viz. temperature in °C (maximum and minimum), percent relative humidity (average) and rainfall in mm were obtained from the meteorological observatory, Regional Research Station, PAU, Ballawal Saunkhri, Balachaur. The seasonal incidence of pest and important weather parameter viz., temperature, relative humidity and rainfall were correlated to find out the influence of abiotic parameters on fluctuation. At harvest, fruit yield in peach orchards was recorded in observation area and was compared with yield where recommended insecticides were applied. The data collected and generated for all the parameters were statistically subjected to correlation and stepwise regression analysis according to the standard methods [13]. Significance level of 5 percent for correlation was determined. SPSS software version 16.0 was used for statistical analysis following the standard procedure.

Result and Discussion

Incidence of peach leaf curl aphid, *B. helichrysi* on peach

The results revealed that pest incidence was increase in three consecutive years from 2013-2015 has increased. The mean monthly pest population for three years was highest during the month of March (195.62) followed by February (90.75) and declined in the month of April (64.37). On the basis of three years observations the activity of pest commenced from February and continued increasing pre and post blooming period with increasing warming of weather, the population started declining after March.

The aphid population was noticed on the plants during the last week of January (5th standard week) with an initial population of 50.1, 82.4 and 72.3 aphids/10 plants in the year 2013, 2014 and 2015 when the minimum and maximum temperature ranged from 5.9 °C to 22.8 °C, relative humidity ranged from 71.2 to 81.8 percent and rainfall of 10.8 to 12.2mm, respectively (Table 1).

Table 1: Seasonal Incidence of peach leaf curl aphid, *B. helichrysi* on peach

Months**	SMW*	2013					2014					2015					Monthly average No of aphids/10 leaves
		No of aphids/10 leaves	Max temp (°C)	Min temp (°C)	RH (%)	Rainfall (mm)	No of aphids/10 leaves	Max temp (°C)	Min temp (°C)	RH (%)	Rainfall (mm)	No of aphids/10 leaves	Max temp (°C)	Min temp (°C)	RH (%)	Rainfall (mm)	
Jan-Feb I	5	50.1	22.8	7.9	74.6	10.8	82.4	19.6	8.2	81.8	0.0	72.3	21.6	5.9	71.5	12.2	90.75
Feb II	6	74.2	21.6	7.2	74.8	4.0	70.8	18.6	7.8	83.0	10.6	104.1	23.9	6.4	73.6	0.0	
Feb III	7	88.4	26.6	8.5	77.7	12.6	60.1	19.4	6.6	79.2	15.2	154.2	25.7	10.0	75.2	4.2	
Feb IV	8	56.2	22.5	9.8	81.6	35.0	158	22.7	8.6	77.1	2.8	118.2	26.9	12.9	75.3	43.5	
Feb- March I	9	102.4	25.3	9.4	70.8	10.8	115.2	22.2	9.5	74.2	40.2	90.3	22.6	9.8	79.2	80.2	195.62
March II	10	264.2	29.5	13.0	66.6	0.0	296.8	25.1	10.0	61.7	9.6	299.2	25.5	8.4	72.0	4.6	
March III	11	288.6	27.4	11.6	64.4	7.2	284.4	28.1	12.2	71.3	9.0	197.0	25.6	11.5	69.6	52.0	
March IV	12	142.2	29.4	13.6	65.0	32.3	218.3	26.8	13.8	65.8	10.2	217.2	30.7	15.1	68.0	0.0	
March V	13	132.5	28.2	14.2	66.1	1.0	130.3	28.5	14.3	60.5	3.8	155.7	31.5	16.3	62.7	8.0	
April I	14	118	32.3	14.6	51.5	0.0	119.2	30.4	14.5	61.4	1.8	128.1	29.0	16.5	68.1	10.4	64.37
April II	15	77.2	34.4	17.3	49.3	0.0	95.1	33.1	12.5	44.7	1.2	90.4	33.0	16.9	58.8	21.4	
April III	16	36.7	35.8	17.3	48.7	0.0	42.4	31.3	15.5	57.3	30.8	80.0	35.2	18.6	58.2	2.5	
April IV	17	30.9	34.6	17.8	51.9	2.1	28.9	37.2	18.3	48.0	0.0	49.2	37.0	19.8	48.2	0.0	
April V	18	22.4	38.5	19.5	37.3	0.0	24.8	38.1	21.0	51.1	0.0	22.2	38.1	18.5	43.9	4.2	
Annual Mean aphid population/10 leaves		106					123.3					127					

SMW*=Standard meteorological weeks

Jan-January, Feb-February

The highest population (288.6 aphids/10 leaves) was recorded in 11th standard meteorological week (SMW) when the minimum and maximum temperature was 11.6 °C and 27.4

°C with relative humidity ranged 64.4 percent and rainfall of 7.2mm, respectively in year 2013. The highest mean population 296.8 aphids/10 leaves and 299.2 aphids/10 leaves

was recorded during 10th SMW during the year 2014 and 2015 respectively. However, lowest mean population of 22.4, 24.8 and 22.2 aphids/10 plants was recorded during 18th SMW in 2013, 2014 and 2015, respectively when the minimum and maximum temperature ranged from 18.5 °C to 38.5 °C, average relative humidity ranged from 37.3 to 51.1 percent and rainfall recorded 4.2 mm. The infestation of peach by this aphid has been reported by several authors [4, 14-18]. Our studies

are in line with Purti *et al.* (2017) [19] who reported highest population of coriander aphids in the 1st week of March. During these three population aphid gradually increased from its initial population from the 5th standard week attaining a peak population in 10th and 11th standard week and then there was a sudden decrease of aphid population upto 18th standard week. There was significant reduction in fruit yield (by 32%) due to aphid incidence when compared with sprayed orchards (Table 2)

Table 2: Comparison of yield in aphid infected and sprayed orchard

Treatment	Fruit No	Fruit Weight (g)	Fruit Yield (Kg/tree)
Unsprayed	571.33	55.3	32.67
Sprayed	801.40	60.00	48.08
CD at 5%	9.31	1.2	3.4

Influence of weather parameters on the incidence of peach leaf curl aphid, *B. helichrysi* on peach

The correlation studies of mean aphid population with mean of different weather parameters (average of three years for each month) revealed that a significant positive relation of aphid population was recorded with the RH. There was positive but significant correlation was observed with T_{max} (r=0.941* and r=0.968*) in the month of February and March respectively (Table III) which depicts that with increase in maximum temperature there was increase in aphid population. However, in the month of April significant but negative

correlation was observed with T_{max} (r=-0.962) resulting in decrease in aphid population with increase in maximum temperature. Similarly minimum temperature showed positive but non significant (r=0.860 and r=0.520) correlation with aphid population during the month of February and March, respectively (Table 3) while negative and significant relation (r=-0.950*) was depicted during the month of April resulting in decrease in aphid population. Rainfall exhibited insignificant negative (r=-0.782, r=-0.504 and r=-0.295) impact on the pest multiplication for these months (Table 3).

Table 3: Relationship of mean incidence of *B. helichrysi* on peach with weather parameters during spring season from 2013-15

Weather Parameters	February	March	April
	No of aphids/10 leaves	No of aphids/10 leaves	No of aphids/10 leaves
T _{max} (°C)	-0.941*	0.968*	-0.962*
T _{min} (°C)	-0.860	0.520	-0.950*
Relative humidity (%)	0.965*	0.319	0.843
Rainfall (mm)	-0.782	-0.504	-0.295

*Significant at 5%

Relative humidity was the other most important factor closely related to the activity of the pest. The correlation coefficient of mean relative humidity was positive and significant (r=0.965*) in the month of February while during March and April it was positive and non significant (r=0.319 and r=0.843) so at lower RH there was decrease in aphid population. The relative humidity recorded during the February and March may be optimal for the aphid development and in this period the higher incidence of aphid was observed. The correlation coefficient studies indicated that temperature and RH plays important role in the build up of aphid population during different months. As pest population decreases with increase in temperature, similarly with decrease in the relative humidity the pest population tends to decrease. So pest population causes more damage under warm humid condition. These observations suggest that among abiotic factors particularly temperature and relative humidity play predominant role in determining the population of aphids.

These findings fall in line with those Tobias and Olson (2006) [20] who reported that environmental conditions especially high temperature had adverse effects on the population of *M. persicae*. Similarly Ghosh (2017) [21] reported significant negative influence of aphid (*Aphis gossypii*) incidence with total rainfall. These results are in line with Yadav *et al.* (2018) [22] who reported significant negative correlation between infestation of aphid with maximum temperature whereas relative humidity showed positive significant correlation.

Further he present finding are in conformity with Kumar and Paul (2017) [23] who found a significant negative correlation between incidence of aphid and maximum temperature and while significant positive correlation with relative humidity. High humidity and cloudy weather is known to fasten the population of this aphid [24]. The aphid population was negatively correlated with temperature sensing by Chaudhari *et al.* (2001) [25]. It is concluded from the present investigation that the seasonal incidence of population build up of peach leaf curl aphid on peach significantly influenced with the change in the temperature. As in the temperature ranges from 18.6-26.6 °C the aphid population on the peach orchard was significantly increased while in range from 26.6-38.1 °C there was significant decreased in the aphid population build up. Relative humidity from 80-65% was favourable for population build up while further decrease in RH 65-35 % was not conducive for the incidence of the pest. The correlation studies further revealed that temperature had a significant effect on population build up. The rainfall had negative influence on the population build up. Farmers must be advised to take appropriate plant protection measure to minimize the damage when this favourable temperature conditions are prevailing.

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