RESEARCH ARTICLE

SEASONAL INCIDENCE OF MAJOR INSECT PESTS OF POTATO CROP IN WESTERN U.P

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Abstract: An experiment was carried out under field conditions at the H.R.C of SardarVallabhbhai Patel University of Agriculture and technology, Meerut to study the seasonal incidence of major insect pests of potato crop during 2016-17 and 2017-18.The incidence of aphid, leafhopper and whitefly was recorded during 4th week of January (3rd meteorological standard week), the peak activity of aphid (13.89 aphid/5 plants), whitefly (15.67 whitefly/5 plants) was observed during last week of November (47th meteorological standard week) and the peak activity of leafhopper was observed during first week of December (49th meteorological standard week), respectively. The aphid population showed a significant negative correlation with maximum temperature (T_{max}) r= -0.567, p<0.05, minimum temperature (T_{min}) r= -0.648, p<0.01 and with mean temperature (T_{mean}) r= -0.452, p<0.05. The whitefly population showed a signification positive correlation with maximum temperature (T_{max}) r= 0.654, p<0.01 and mean temperature (T_{mean}) r= 0.678, p<0.01 and minimum temperature (T_{min}) r= 0.569, p<0.01. Whereas a significantly negative correlation was observed with evening relative humidity (RH_{even} r= 0.656, p<0.01 and mean relative humidity (RH_{mean}) r= 0.686, p<0.01. The leafhopper showed a significant negative correlation with minimum temperature (r= 0.583, p<0.05) and evening relative humidity (r= 0.485, p<0.05).

Keywords: Seasonal incidence, Aphid, Leafhopper, Whitefly

INTRODUCTION

Potato, *Solanum tuberosum* L. is one of the most productive and widely grown food crops in the world. It is grown on around 18.3 million hectares with a production of 295 million tonnes. In India area under potato 2.14 mha, production 43.77 million tonnes and productivity 22.09 tonnes/ha. Potato contributes about 2.48 per cent of the total agricultural output from only 1.07 per cent of the total cropped area (MoA&FW, GOI New Delhi 2017). There are various production constraints among which insect pests are the most important. Which includes, aphids (*Myzus persicae* Sulzer), thrips (*Thrips palmi* Karny), leafhopper (*Amrasca biguttula* Ishida), whitefly (*Bemisia tabaci* Genn.) and soil insects like cutworm (*Agrotis spp.)* have significant influence on potato yield (Bhatnagar, 2007; Deen, M. B. and Fayaz, A. A., 2018). Information on seasonal incidence of insect pests on potato can help to take up effective management strategies in time to bring down the population to insect pests using effective control measures. In view of this the present study on population dynamic of insect pests on potato were undertaken.

MATERIALS AND METHODS

The present investigation was carried out under field conditions at the H.R.C of SardarVallabhbhai Patel University of Agriculture and Technology, Meerut-250110 (U.P.) India. Incidence of major insect pests of potato was recorded at weekly intervals from untreated plot. The observations on incidence of whitefly, aphids and leafhopper nymphs on potato plants were recorded at weekly interval from 5 randomly selected potato plants from 3 leaves of upper, middle and lower canopy of the plant throughout the crop season and data obtained on the number of insects/ 5 plant. The daily metrological data pertaining to temperature, rainfall during experimental period was obtained. Relation between per cent infestation and metrological variables were worked out using simple correlation analysis. Simple correlation regression coefficient was done using following formula.

$$r = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{N}}{\sqrt{\left(\sum X^2 - \frac{(\sum X)^2}{N}\right)\left(\sum Y^2 - \frac{(\sum Y)^2}{N}\right)}}$$

r = Correlation coefficient between X & Y
X = Nymph/larvae
Y = Meteorological parameters
N = Number of observations

RESULTS AND DISCUSSION

Seasonal incidence of Aphid population of *Myzus persicae* during *rabi*, 2016-17 and 2017-18.

The present investigation ((Table 1) the population of aphids was observed on potato crop in the range of 2.67 to 13.89 aphid per/5 plants from mid November (46th meteorological standard week) during 2016-17. The first peak was observed during mid December

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(50th meteorological standard week) with highest population (12.53 aphid per/5 plants), whereas second and highest peak of aphid population (13.89 aphid per/5 plants) was recorded during last week of January (3rd meteorological standard week) during 2016-17. Similarly, during 2017-18 aphid incidence started from last week of November (47th meteorological standard week). The first peak was observed during mid December (50th meteorological standard week) with highest population (12.40 aphid per/5 plants). Although, second and highest peak of aphid population (11.33 aphid per/5 plants) was recorded during third week of January (3rd meteorological standard week). Interestingly, during 2016-17 the population of aphid showed a significant negative correlation with maximum temperature (T_{max}) r= -0.567, p<0.05 and with mean temperature (T_{mean}) r= 0.452, p<0.05. Whereas, during 2017-18 the aphid population showed a significantly negative correlation with maximum temperature (T_{max}) r = -0.562, p<0.05, minimum temperature ($T_{min.}$) r = -0.648, p<0.01 and mean temperature (T_{mean}) r = -0.669, p<0.01. The present findings corroborates to those of Sain *et al.* (2017) who reported the population of aphid appeared in first week of November (44th standard week) in western part of Uttar Pradesh. Similarly, the present findings are also in agreement with those of Shrivastava *et al.* (1971), Pandey *et al.* (2007), Sarkar *et al.* (2008) and Shukla (2014) they reported peak activity of aphid during second fort night of January. Similarly, Panday *et al.* (2014) the peak activity of aphid population during third week of January in Pantnagar region (India). The present findings corroborates to those of Pandey *et al.* (2007), Pandey *et al.* (2008), Panday *et al. (*2014) and Shukla (2014) they reported the aphid population was significantly negatively correlated with temperature. Panday *et al. (*2014) also reported non significant positive correlation with relative humidity and rainfall. The present findings also corroborates to those of Bijjur and Verma (1986), Chaudhuri (2001) and Bana *et al.* (2012) who reported aphid population was negatively correlated with maximum temperature.

Seasonal incidence of Whitefly population of *Bemisia tabaci* during *rabi* ,2016 and 2017.

Interestingly, first incidence of whitefly was recorded in second week of November (45th meteorological standard week) and ranged from 1.33 to15.67 whitefly/5 plants during 2016-17. The highest peak of whitefly incidence (15.67 whitefly/5 plants) was observed in last week of November (47th meteorological standard week), after a highest peak during last week of November than whitefly population started to decline subsequently. Similarly, during 2017-18 incidence of whitefly was also started in first week of November (45th meteorological standard week). The first peak was observed during first week December (48th meteorological standard week) with highest population (13.00 whitefly/5 plants) and Second peak of whitefly population (11.33whitefly/5 plants) was recorded during first week of December (49th meteorological standard week). During 2016-17 the population of whitefly population showed a significant positive correlation with maximum temperature (T_{max}) r= 0.654, p<0.01 and mean temperature (T_{mean}) r= 0.678, p<0.01 and minimum temperature ($T_{min.}$) r= 0.569, p<0.05. Similarly, during 2017-18 the whitefly population showed a significantly negative correlation evening relative humidity (RH_{even}) r=-0.656, p<0.01 and mean relative humidity (RH_{mean}) r=-0.686, p<0.01. The present findings corroborates to those of Paul and Konar (2005) who reported that whitefly first appeared on the crop during first week of December with peak in last week of December. Mathur *et al.* (2012) reported peak activity of whitefly during January second week. Similarly, Rashid *et al.* (2013) and Pandey *et al.* (2014) also recorded peak activity during third week of December. Interestingly, these findings also corroborates to those of Nag (2016) who recorded two peaks of whitefly during third week of December and January. The present findings corroborates to those of Pandey *et al.* (2008), Pandey *et al.* (2014) and Kumar and Gupta (2016) who reported a significant negative correlation between *B. tabaci* population and relative humidity and a significant positive correlation between maximum and minimum temperature. Similarly, Anand (2015) showed a negative correlation for minimum temperature and positive correlation with maximum temperature and rainfall.

Seasonal incidence of Leafhopper population of *Empoasca fabae* during *rabi,*2016 and 2017.

The incidence of leafhopper was first noticed on crop in third week of November (46th meteorological standard week) during 2016-17 and leafhopper population ranged between 2.33 to 9.13 leafhopper/5 plants. Two peaks of leafhopper population were recorded, first peak was observed during last week of November (48th meteorological standard week) with highest population (9.13 leafhopper/5 plants) and second peak of leafhopper population (8.33 leafhopper/5 plants) was recorded during last week of January (4th meteorological standard week). Similarly, the incidence of leafhopper during 2017-18 was commenced during last week of November (47th meteorological standard week) and leafhopper population ranged between 3.21 to 10.6 leafhopper/5 plants. Similarly, two peaks of leafhopper population were also recorded during 2017-18, the first peak was observed during first week of December (49th meteorological standard week) with highest population (10.6 leafhopper/5 plants) and second peak of leafhopper population (6.89 leafhopper/5 plants) was recorded during week of Decembre (50th meteorological standard week). Interestingly, leafhopper population showed a non-significant negative correlation with maximum temperature and

a non-significant positive correlation with minimum temperature, mean temperature, morning relative humidity, evening relative humidity, relative humidity and rainfall was recorded during 2016-17. Whereas, during 2017-18, leafhopper population showed a significant negative correlation with minimum temperature (r=- 0.583, p<0.05) and morning relative humidity (r=- 0.485, p<0.05). These findings corroborate to those of Mathur *et al*. (2012) and Nag (2016) recorded maximum density of leafhopper during December last week and during the third week of January, respectively. The findings of present study corroborates to those of Mahmood *et al.* (2002) who reported that incidence of leafhopper, *A. biguttula biguttula* showed positive and significant correlation with maximum and minimum temperatures. Similarly, Muthu kumar and Kalyana sundaram (2003) also observed negative correlation between temperature and leafhoppers population. The findings of present study revealed that, weather parameters contribute very less to leafhopper population fluctuations.

Table 1. Seasonal incidence and correlation of aphid (*Myzus persicae)* population during crop growth period (2016-17)

S. No.	S.W.	Date	Aphid/5 Plats	Meteorological parameters						
				Temperature (^{0}C)			Relative Humidity (%)			Rain fall (mm)
				Max.	Min.	Mean	Mor.	Even.	Mean	
1.	45	**Nov, 7-13**	0	28.66	9.99	19.32	92.50	50.13	71.31	0.00
2.	46	**Nov, 14-20**	2.67	28.56	10.66	19.61	96.54	45.44	70.99	0.00
3.	47	**Nov, 21-27**	5.89	27.69	10.30	18.99	94.66	55.40	75.03	0.00
4.	48	**Nov, 28-Dec, 4**	8.53	27.43	10.21	18.82	94.74	47.34	71.04	0.00
5.	49	**Dec, 5-11**	9.67	23.21	8.90	16.06	95.91	65.93	80.92	0.00
6.	50	**Dec, 12-18**	12.53	23.14	9.36	16.25	96.03	59.89	77.96	0.00
7.	51	**Dec, 19-25**	11.89	23.90	5.64	14.77	96.00	44.53	70.26	0.00
8.	52	**Dec, 26-Jan, 1**	8.93	22.36	7.93	15.14	95.71	65.09	80.40	0.00
9.	1	**Jan, 2-8**	8.53	22.2	8.3	15.27	95.8	61.8	78.81	29.3
10	2	**Jan, 9-15**	5.21	18.5	4.3	11.41	96.9	52.2	74.53	0.0
11.	3	**Jan, 16-22**	13.89	20.1	6.7	13.41	93.9	61.7	77.79	0.0
12.	4	**Jan, 23-29**	10.53	21.8	10.7	16.25	97.7	63.7	80.66	35.7
13.	5	**29 Jan – 04 Feb**	8.53	22.0	8.7	15.34	97.5	64.0	80.78	0.0
14.	6	**Feb, 05 –11**	7.67	22.0	9.3	15.64	97.3	61.0	79.14	1.3
Correlation (r)				**-0.567**	**-0.284**	**0.452**	**-0.501**	**0.239**	**0.438**	**0.161**

Table 2. Seasonal incidence and correlation of aphid (*Myzus persicae)* population during crop growth period (2017-18)

S. No.	S.W.	Date	Aphid/5 plants	Meteorological parameters						
				Temperature (^{0}C)			Relative Humidity (%)			Rain fall (mm
				Max.	Min.	Mean	Mor.	Even.	Mean	
1.	**45**	**Nov, 7-13**	0	26.0	10.7	18.4	96.8	69.0	82.9	0.0

2.	**46**	**Nov, 14-20**	0	27.7	13.1	20.4	94.8	52.7	73.8	0.0
3.	**47**	**Nov, 21-27**	4.21	25.1	6.7	15.9	95.0	28.1	61.5	0.0
4.	**48**	**Nov, 28-Dec, 4**	8.59	24.9	6.1	15.5	95.7	28.4	62.1	0.0
5.	**49**	**Dec, 5-11**	10.4	24.3	7.9	16.1	87.7	28.6	58.2	0.0
6.	**50**	**Dec, 12-18**	12.4	20.0	8.4	14.2	90.9	52.1	71.5	10.0
7.	**51**	**Dec, 19-25**	11.33	23.3	7.9	15.6	96.3	38.1	67.2	0.0
8.	**52**	**Dec, 26-Jan, 1**	8.53	23.0	6.4	14.7	94.3	41.9	68.1	0.0
9.	**1**	**Jan, 2-8**	8.21	15.4	5.9	10.6	91.9	68.7	80.3	0.0
10	**2**	**Jan, 9-15**	8.33	21.9	6.4	14.1	96.0	35.9	65.9	0.0
11.	**3**	**Jan, 16-22**	9.67	23.6	6.9	15.2	91.7	40.4	66.1	0.0
12.	**4**	**Jan, 23-29**	9	19.7	6.6	13.1	94.3	55.3	74.8	0.0
13.	**5**	**29 Jan – 04 Feb**	7.07	24.7	7.8	16.2	94.4	32.9	63.6	0.0
14.	**6**	**Feb, 05 –11**	6.73	23.9	6.6	15.2	90.6	26.6	58.6	0.0
	Correlation (r)			**-0.562**	**-0.648**	**-0.669**	**0.137**	**-0.296**	**-0.562**	**0.380**

Table-3. Seasonal incidence and correlation of whitefly (*Bemisia tabaci)* population during crop growth period (2016-17)

S. No.	**S.W.**	**Date**	**Whitefly/5 plants**	**Meteorological parameters**						
				Temperature (^{0}C)			**Relative Humidity (%)**			**Rain fall (mm)**
				Max.	**Min.**	**Mean**	**Mor.**	**Even.**	**mean**	
1.	**45**	**Nov, 7-13**	3.6	28.66	9.99	19.32	92.50	50.13	71.31	0.00
2.	**46**	**Nov, 14-20**	10.2	28.56	10.66	19.61	96.54	45.44	70.99	0.00
3.	**47**	**Nov, 21-27**	15.67	27.69	10.30	18.99	94.66	55.40	75.03	0.00
4.	**48**	**Nov, 28-Dec, 4**	7.67	27.43	10.21	18.82	94.74	47.34	71.04	0.00
5.	**49**	**Dec, 5-11**	7.33	23.21	8.90	16.06	95.91	65.93	80.92	0.00
6.	**50**	**Dec, 12-18**	4.98	23.14	9.36	16.25	96.03	59.89	77.96	0.00
7.	**51**	**Dec, 19-25**	3.6	23.90	5.64	14.77	96.00	44.53	70.26	0.00
8.	**52**	**Dec, 26-Jan, 1**	2.66	22.36	7.93	15.14	95.71	65.09	80.40	0.00
9.	**1**	**Jan, 2-8**	2.33	22.2	8.3	15.27	95.8	61.8	78.81	29.3
10	**2**	**Jan, 9-15**	1.33	18.5	4.3	11.41	96.9	52.2	74.53	0.0
11.	**3**	**Jan, 16-22**	1.33	20.1	6.7	13.41	93.9	61.7	77.79	0.0
12.	**4**	**Jan, 23-29**	2.66	21.8	10.7	16.25	97.7	63.7	80.66	35.7

13.	**5**	**29 Jan – 04 Feb**	3.67	22.0	8.7	15.34	97.5	64.0	80.78	0.0
14.	**6**	**Feb, 05 – 11**	8.4	22.0	9.3	15.64	97.3	61.0	79.14	1.3
	Correlation (r)			**0.654**	**0.569**	**0.678**	**-0.064**	**-0.242**	**-0.238**	**-0.294**

Table 4. Seasonal incidence of whitefly(*Bemisia tabaci)* population during crop growth period (2017-18)

S. No.	**S.W.**	**Date**	**Whitefly/ 5 plants**	**Meteorological parameters**						
				Temperature (^{0}C)			**Relative Humidity (%)**			**Rain fall (mm)**
				Max.	**Min.**	**Mean**	**Mor.**	**Even.**	**Mean**	
1.	**45**	**Nov, 7-13**	0.87	26.0	10.7	18.4	96.8	69.0	82.9	0.0
2.	**46**	**Nov, 14-20**	1.67	27.7	13.1	20.4	94.8	52.7	73.8	0.0
3.	**47**	**Nov, 21-27**	10	25.1	6.7	15.9	95.0	28.1	61.55	0.0
4.	**48**	**Nov, 28-Dec, 4**	13	24.9	6.1	15.5	95.7	28.4	62.1	0.0
5.	**49**	**Dec, 5-11**	11.33	24.3	7.9	16.1	87.7	28.6	58.2	0.0
6.	**50**	**Dec, 12-18**	6.4	20.0	8.4	14.2	90.9	52.1	71.5	10.0
7.	**51**	**Dec, 19-25**	5.33	23.3	7.9	15.6	96.3	38.1	67.2	0.0
8.	**52**	**Dec, 26-Jan, 1**	5.2	23.0	6.4	14.7	94.3	41.9	68.1	0.0
9.	**1**	**Jan, 2-8**	2.2	15.4	5.9	10.6	91.9	68.7	80.3	0.0
10	**2**	**Jan, 9-15**	3	21.9	6.4	14.1	96.0	35.9	65.9	0.0
11.	**3**	**Jan, 16-22**	3.46	23.6	6.9	15.2	91.7	40.4	66.1	0.0
12.	**4**	**Jan, 23-29**	3.53	19.7	6.6	13.1	94.3	55.3	74.8	0.0
13.	**5**	**29 Jan – 04 Feb**	4.13	24.7	7.8	16.2	94.4	32.9	63.6	0.0
14.	**6**	**Feb, 05 –11**	4.07	23.9	6.6	15.2	90.6	26.6	58.6	0.0
Correlation (r)				**0.177**	**-0.353**	**-0.036**	**-0.432**	**-0.656**	**-0.686**	**0.086**

Table 5. Seasonal incidence and correlation of leafhopper (*Empoasca fabae*) during crop growth period (2016-17)

S.W.	**Date**	**Leafhopper/5 plants**	**Meteorological parameters**						
			Temperature (^{0}C)			**Relative Humidity (%)**			**Rain fall (mm**
			Max.	**Min.**	**Mean**	**Mor.**	**Even.**	**mean**	
45	**Nov, 7-13**	0	28.66	9.99	19.32	92.50	50.13	71.31	0.00
46	**Nov, 14-20**	3.13	28.56	10.66	19.61	96.54	45.44	70.99	0.00
47	**Nov, 21-27**	5.27	27.69	10.30	18.99	94.66	55.40	75.03	0.00
48	**Nov, 28-Dec, 4**	9.13	27.43	10.21	18.82	94.74	47.34	71.04	0.00

49	**Dec, 5-11**	5.4	23.21	8.90	16.06	95.91	65.93	80.92	0.00
50	**Dec, 12-18**	4.73	23.14	9.36	16.25	96.03	59.89	77.96	0.00
51	**Dec, 19-25**	4.33	23.90	5.64	14.77	96.00	44.53	70.26	0.00
52	**Dec, 26-Jan, 1**	4.13	22.36	7.93	15.14	95.71	65.09	80.40	0.00
1	**Jan, 2-8**	3.67	22.2	8.3	15.27	95.8	61.8	78.81	29.3
2	**Jan, 9-15**	2.33	18.5	4.3	11.41	96.9	52.2	74.53	0.0
3	**Jan, 16-22**	5.67	20.1	6.7	13.41	93.9	61.7	77.79	0.0
4	**Jan, 23-29**	8.33	21.8	10.7	16.25	97.7	63.7	80.66	35.7
5	**29 Jan – 04 Feb**	7.67	22.0	8.7	15.34	97.5	64.0	80.78	0.0
6	**Feb, 05 –11**	5.4	22.0	9.3	15.64	97.3	61.0	79.14	1.3
Correlation (r)			**-0.149**	**0.283**	**0.016**	**0.389**	**0.301**	**0.350**	**0.228**

Table 6. Seasonal incidence and correlation of leafhopper (*Empoasca fabae*) during crop growth period (2017-18)

S.W.	**Date**	**Leafhopper/5 plants**	**Meteorological parameters**						
			Temperature (^{0}C)			**Relative Humidity (%)**			**Rain fall (mm)**
			Max.	**Min.**	**Mean**	**Mor.**	**Even.**	**Mean**	
45	**Nov, 7-13**	0	26.0	10.7	18.4	96.8	69.0	82.9	0.0
46	**Nov, 14-20**	0	27.7	13.1	20.4	94.8	52.7	73.8	0.0
47	**Nov, 21-27**	3.93	25.1	6.7	15.9	95.0	28.1	61.55	0.0
48	**Nov, 28-Dec, 4**	8	24.9	6.1	15.5	95.7	28.4	62.1	0.0
49	**Dec, 5-11**	10.6	24.3	7.9	16.1	87.7	28.6	58.2	0.0
50	**Dec, 12-18**	6.89	20.0	8.4	14.2	90.9	52.1	71.5	10.0
51	**Dec, 19-25**	4.56	23.3	7.9	15.6	96.3	38.1	67.2	0.0
52	**Dec, 26-Jan, 1**	6.53	23.0	6.4	14.7	94.3	41.9	68.1	0.0
1	**Jan, 2-8**	5.23	15.4	5.9	10.6	91.9	68.7	80.3	0.0
2	**Jan, 9-15**	3.21	21.9	6.4	14.1	96.0	35.9	65.9	0.0
3	**Jan, 16-22**	4.6	23.6	6.9	15.2	91.7	40.4	66.1	0.0
4	**Jan, 23-29**	4.6	19.7	6.6	13.1	94.3	55.3	74.8	0.0
5	**29 Jan – 04 Feb**	5.27	24.7	7.8	16.2	94.4	32.9	63.6	0.0
6	**Feb, 05 –11**	4.93	23.9	6.6	15.2	90.6	26.6	58.6	0.0
Correlation (r)			**-0.286**	**-0.583**	**-0.453**	**-0.067**	**-0.485**	**-0.286**	**0.207**

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