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Population dynamics of red pumpkin beetle on cucumber in mid-hill Himalayas

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Abstract

The population dynamics of *Aulacophora foveicollis* Lucas in relation to abiotic factors was studied on cucumber (*Cucumis sativus*), *var*. 'Khira-90' during 2009 and 2010. Incidence of red pumpkin beetle in field indicated that its initial activity and peak period varied with the locations and prevailing weather conditions. At Palampur, the insect was found active from second fortnight of April with three peaks during 2nd and 4th weeks of May and 3rd week of July, 2009 whereas, one major peak during 2nd week of May was recorded in 2010. At farmer's field, Bara (Hamirpur) the insect first appearance was noticed during first fortnight of March and reached to its peak during 3rd and 2nd weeks of April, 2009 and 2010, respectively. The highest plant infestation (100 %) was observed when the crop was at its early growing stage. The correlation studies revealed that average minimum temperature showed significant negative correlation at farmer's field whereas other weather parameters had no significant effect on the beetle population at Palampur as well as Bara.

Key words: Red pumpkin beetle, *Aulacophora foveicollis,* cucumber, population dynamics

Introduction

Cucurbits constitute the largest group of summer vegetables grown all over the world. Cucumber is a popular crop of the Cucurbitaceae family grown in low and mid-hills of Himachal Pradesh, Jammu & Kashmir and also in plains of India. Cucurbits are reported to be infested by a number of insect pests from the germination upto harvesting stage (Gupta, 2004) where red pumpkin beetle is of serious concern. This beetle, *Aulacophora foveicollis* (Lucas), is a widely distributed polyphagous pest on cucurbit crops in India (Butani and Jotwani, 1984). The same beetle has also been reported from Greece, South Europe, Algeria, Cyprus, Aden, Iraq, Sri Lanka, Nepal, and Burma (Mann and Sohi, 1983) and is considered as one of the serious pest particularly at seedling stage hindering the commercial cultivation of the cucurbits. Among cucurbits, cucumber is the most preferred one by this pest while bitter gourd and sponge gourd are also equally important (Khan and Hajela, 1987; Mehta and Sandhu, 1989). The beetles initiate feeding just after the germination and retard the growth of the seedlings due to severe foliar damage. Both the grubs and adults of this beetle cause damage where the grubs that live underground are destructive to the roots of the crop. The grubs enter into the roots, underground stem and also sometimes the fruits touching the ground. The adult beetles are mainly responsible for damaging the plant parts above the ground resulting in complete defoliation thus sometimes the entire field requires resowing. The beetle resumes its activity in March and remains in the field till October. The peak period of activity is from April to June and the population starts declining from September onwards (Shinde and Purohit 1978; Butani and Jotwani, 1984). The understanding of population fluctuation in the field in relation to weather factors would provide an idea about the peak period of pest activity and it would help in developing an appropriate strategy for the management. However, detailed ecological study of *A. foveicollis* and its control has not been undertaken so far in Himachal Pradesh. Therefore, the present investigation was carried out to study its population density on cucumber in relation to abiotic factors at two different locations *viz.*, Palampur and Bara (Hamirpur) of Himachal Pradesh.

Materials and methods

Studies on the population build up of *A. foveicollis* on cucumber was carried out at Entomological Experimental Farm, CSKHPAU, Palampur situated at an altitude of 1290 meter above mean sea level between 32°6' North Latitude and 76°3' East Longitude and at a farmer's field, Bara (Hamirpur) situated at 585 meter above mean sea level between 31°35' North Latitude and 76°16' East Longitude during crop growing seasons of 2009 and 2010. Cucumber variety "Khira 90" was grown at both the locations. No plant protection measures were taken up in the field. The observations were recorded on the number of beetles per plant at seven days interval on thirty randomly selected plants after appearance of the pest at both the locations. The per cent plant infestation was also recorded on thirty randomly selected plants. These observations were utilized to work out the infestation index using the formula suggested by Bhalla and Verma (1991). Relationship of population counts of the red pumpkin beetle at weekly interval with abiotic factors *viz.*, minimum temperature, maximum temperature, mean relative humidity, rainfall and sunshine hours was also worked out.

Results

The data presented in Table 1 revealed that *A. foveicollis* appeared first during 4th week (17 SW) of April, 2009 with a mean initial population of 0.60 beetles per plant at Palampur. Thereafter, the pest showed a gradual increasing trend and reached its peak (2.33 beetles/plant) during the 4th week (21 SW) of May. However, highest plant infestation (100 %) was observed from 4th week of

April to last week of May when the crop was at early growing stage. The population declined subsequently to 0.20 beetles per plant during 3rd and 4th weeks (24 and 25 SW) of June with 10.00 and 6.66 % plant infestation, respectively and then abruptly increased to its highest peak of 2.46 beetles with 53.33 % plant infestation during 3rd week (28 SW) of July. During the entire crop growing period, three population peaks were recorded, the 1st and 2nd in the 2nd and 4th weeks (19 and 21 SW) of May and the 3rd one in the 3rd week (28 SW) of July, 2009.

During 2010 crop period also, the pest was noticed in 4th week (16 SW) of April with mean initial population of 0.86 beetles per plant (Table 1). The population increased to 2.20 beetles per plant during 2nd week (19 SW) of May and showed decreasing trend afterwards, where 0.33 beetles per plant with 10.00 % plant infestation was recorded during the 4th week of (25 SW) of June. The population however again showed an increasing trend from 1st week (26 SW) of July and reached to 1.13 beetles per plant with 23.33 % plant infestation during 3rd week (28 SW) of July, 2010. During the cropping season the plant infestation varied from 10.00 to 100 per cent. The highest plant infestation of 100 % was recorded from 4th week (16 SW) of April to 2nd week (19 SW) of May, when the crop was at early growing stage. The analysis of the data revealed that four population peaks occurred during the entire cropping season, the 1st during the 4th week (16 SW) of April, the 2nd and 3rd in the 1st and 2nd weeks (18 and 19 SW) of May, respectively and 4th peak during 3rd week (28 SW) of July, 2010.

At Bara (Hamirpur), the incidence of *A. foveicollis* during 2009 was first observed in the beginning of 3rd week (11 SW) of March, when 0.73 beetles per plant was recorded (Table 2). The population escalated and reached to its peak of 2.73 beetles per plant during 3rd week (16 SW) of April. Thereafter, a steady decline in the population was observed and it reached to zero by the 3rd week (24 SW) of June with the lowest plant infestation of 6.66 per cent. The plant infestation varied between 6.66 and 100.00 during the cropping season. The highest plant infestation of 100.00 per cent was observed when the crop was at early growing stage from 3rd (11 SW) of March to 3rd week (16 SW) of April. The three major population peaks were recorded, the 1st during 2nd week (12 SW) of March and another two during 2nd and 3rd weeks (15 and 16 SW) of April, respectively.

During 2010, the initial incidence of pest was noticed in 2nd week (11 SW) of March with a mean population of 0.46 beetles per plant, which remained steady up to 1st week (14 SW) of April when 1.93 beetles per plant was recorded (Table 2). Thereafter, the population showed declining trend and reached to its minimum of 0.40 beetles per plant during the last week (21 SW) of May. However, the population increased abruptly and reached to 1.26 beetles per plant during 1st week (23 SW) of June, but showed decreasing trend again by the end of crop season when 0.47 beetles per plant was recorded during 3rd week (25 SW) of the month. Three population peaks were recorded during the cropping season, the 1st and 2nd in the 1st and 2nd weeks (14 and 15 SW) of April, respectively when the crop was at early growing stage and the 3rd peak in the 1st week (23 SW) of June, when crop

Table 1. Population builds up of *A. foveicollis* on cucumber at Palampur during 2009 and 2010 (based on 30 observations)

Sampling date		Standard week		Number of beetles/plant		Plant infestation (%)		Infestation index	
2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
April-29	April 23	17	16	0.60	0.86	100.00	100.00	0.2041	0.2695
May-6	30	18	17	1.80	1.60	100.00	100.00	0.4472	0.4150
13	May-7	19	18	2.26	1.80	100.00	100.00	0.5132	0.4472
20	14	20	19	1.73	2.20	100.00	100.00	0.4361	0.5051
27	21	21	20	2.33	0.66	100.00	66.66	0.5224	0.1584
June-6	28	22	21	0.73	0.93	83.33	70.00	0.2041	0.2175
13	June-4	23	22	0.93	0.33	66.66	16.66	0.2095	0.0212
20	11	24	23	0.20	0.73	10.00	36.66	0.0086	0.1038
27	18	25	24	0.20	0.53	6.66	20.00	0.0043	0.0414
July-4	25	26	25	0.80	0.33	20.00	10.00	0.0644	0.0128
11	July-2	27	26	1.00	1.00	20.00	23.33	0.0792	0.0899
18	9	28	27	2.46	1.00	53.33	20.00	0.3636	0.0791
25	16	29	28	1.93	1.13	46.66	23.33	0.2788	0.1003

Table 2. Population builds up of *A. foveicollis* on cucumber at Bara (Hamirpur) during 2009 and 2010 (based on 30 observations)

Sampling date		Standard week		Number of beetles/plant		Plant infestation (%)		Infestation index	
2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
March-16	March-14	11	11	0.73	0.46	100.00	100.00	0.2380	0.1643
23	21	12	12	2.00	0.93	100.00	100.00	0.4771	0.2855
30	28	13	13	1.66	1.20	100.00	100.00	0.4248	0.3424
April-6	April-4	14	14	1.80	1.93	100.00	100.00	0.4471	0.4668
13	11	15	15	2.53	1.66	100.00	100.00	0.5477	0.4248
20	18	16	16	2.73	0.60	100.00	73.33	0.5717	0.1583
27	25	17	17	0.80	0.93	90.00	70.00	0.2355	0.2174
May-4	May-2	18	18	0.53	1.00	56.00	66.66	0.1139	0.2227
11	9	19	19	0.20	0.53	13.33	46.66	0.0128	0.0969
18	16	20	20	0.33	0.46	16.66	33.33	0.0211	0.0606
25	23	21	21	0.33	0.40	20.00	23.33	0.0253	0.0413
June-1	30	22	22	0.26	0.46	10.00	20.00	0.0086	0.0374
8	June-6	23	23	0.40	1.26	13.33	30.00	0.0211	0.1367
15	13	24	24	0.00	0.86	6.66	20.00	0.0000	0.0681
22	20	25	25	0.33	0.47	10.00	16.66	0.0128	0.0293

Table 3. Correlation co-efficient and regression equation between weathers factors and population build up of *A. foveicollis* (pooled data)

Meteorological parameters	Palampur		Bara (Hamirpur)	
	Correlation co-efficient (r)	Regression equation	Correlation co-efficient (r)	Regression equation
Maximum temperature (°C)	-0.292	Y=- 0.088X + 3.85	-0.348	Y=- 0.073X + 3.42
Minimum temperature (°C)	-0.092	Y=- 0.035X + 1.84	-0.461*	Y=- 0.075X + 2.36
Mean RH (%)	+0.204	Y= 0.008X + 0.75	+0.041	Y= 0.003X + 0.74
Rainfall (mm)	+0.235	Y= 0.003X + 1.05	+0.093	Y= 0.001X + 0.91
Sunshine hours per day	-0.301	Y=- 0.087X + 1.80	-0.072	Y=- 0.019X + 1.07

*Significant at 5% level of significance

was at last growing stage. The per cent plant infestation varied from 16.66 to 100.00 per cent. The highest plant infestation of 100.00 per cent was recorded from 2nd week (11 SW) of March to 2nd week (15 SW) of April, 2010. The highest infestation index coincided with the peak population and corresponding highest per cent plant infestation at both the locations *viz.*, Palampur and Bara during both the study years (Table 1&2).

The correlation co-efficient (r) computed between number of beetles per plant and abiotic factors showed varied results at two locations (Table 3). At Palampur, a non-significant negative correlation was observed with maximum, minimum temperatures and sunshine hours (r = -0.292, -0.092 and -0.301, respectively) and non-significant positive correlation with mean relative humidity (r = +0.204) and rainfall (+0.235). The weekly beetle population per plant at Bara (Hamirpur) also exhibited non-significant negative correlation with maximum temperature (r = -0.348) and sunshine hours (r = -0.072), but showed significant negative correlation with minimum temperature (r = -0.461) and non-significant positive correlation with mean relative humidity and rainfall (r = +0.041 and +0.093, respectively).

Discussion

The present investigation revealed that the beetle resumed its activity in the last week (17 SW) of April during 2009 and 2010 at Palampur and in the beginning of 3rd and by the end of 2nd (11 SW) weeks of March at Bara (Hamirpur) during both years. The beetle was found active throughout the crop season having fluctuating trend. As in the early crop stage, the mean beetle population was high than that of late growing stage. The period of commencement of adult activity is reported to fluctuate depending on the prevailing environmental conditions and availability of suitable hosts. The present findings are in conformity with Pareek and Kavadia (1986) who reported that beetle generally appear first in the middle of March. However, Rajak (2000) observed that the overwintering beetles become active during February while Roy and Pande (1991) reported that the pest remained active throughout the year due to favorable conditions and with in year difference could be due to fluctuating climatic conditions and also cropping period.

Three major peaks were observed at Palampur during both the years, two peaks during 2nd and 4th (19 and 21 SW) weeks of May and the 3rd one in the 3rd (28 SW) week of July, 2009 and in 2010, first during last (17 SW) week of April, 2nd and 3rd during 1st and 2nd (18 and 19 SW) weeks of May over the cropping season. These findings are in agreement of Pareek and Kavadia (1986) as they recorded two peaks in April-May. At Bara (Hamirpur) locality three major peaks were found, the 1st during 2nd fortnight of March, 2nd and 3rd peaks during 2nd and 3rd (15 and 16 SW) weeks of April. The present results are in support to Shinde and Purohit (1978) who recorded highest number of beetles in April. However, in this investigation, the population was found to decline with the gradual increased temperature and showed increasing trend with the rainfall. These observations are in close conformity with Sinha and Krishna (1969) and Al Ali *et al.* (1982) findings who reported that adult beetles were unable to survive at temperature beyond 35.2 °C.

It is interesting to note that the overall influence of weather factors had no significant effect on beetle population at both the locations except minimum temperature which showed negative significant effect at Bara (Hamirpur). Johri and Johri (2003) also found non-significant impact of temperature, humidity and rainfall on plant infestation but observed peak activity of beetle population at maximum rainfall. Rajak (2000) reported a non-significant relationship between beetle population and relative humidity and a significant correlation with temperature.

The study revealed that 100% plant infestation occured when the crop was at its early growing stage. The correlation studies revealed that average minimum temperature show significant negative correlation with population build up whereas other weather parameters had no significant effect on the beetle population.

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