The Bioscan 11(4): 2205-2208, 2016
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

EVALUATION OF DIFFERENT CROPS OF CAULIFLOWER IN RELATION TO INCIDENCE OF CABBAGE BUTTERFLY, *PIERIS BRASSICAE* (LINNAEUS) IN THE PLAINS OF PUNJAB

RANVIR SINGH* AND INDERPAL SINGH SANDHU
Department of Entomology,
Punjab Agricultural University, Ludhiana, Punjab - 141 004, INDIA
e-mail: ranvirverma11@gmail.com

KEYWORDS
Cauliflower
Cabbage butterfly
Pieris brassicae
Cotesia glomerata
Seasonal abundance

Received on :
14.07.2016

Accepted on :
13.11.2016

***Corresponding author**

ABSTRACT
The experiment was attempted during 2014-15 to evaluate the different crops of cauliflower in relation to incidence of cabbage butterfly, *Pieris brassicae* (Linnaeus). Early crop (transplanted on July 28, 2014) was free from *P. brassicae* infestation. On mid-crop (transplanted on September 9, 2014), the larvae were first recorded (1.88 / plant) during 11th week after transplanting (WAT) (November, 23), with peak larval population (1.88 / plant) in the same week. On the late crop (transplanted on November 11, 2014), the larvae were first recorded (2.08 / plant) during 14th WAT (February, 15) and the peak larval population (8.65 / plant) was recorded during 17th WAT (March, 8). On super late crop (transplanted on January 5, 2015), the peak larval population (9.50 / plant) was recorded during 13th WAT (April, 5). The average maximum larval population was recorded on late crop (5.03 / plant) which clearly revealed that late crop was more prone to *P. brassicae* infestation. A parasitoid, *Cotesia glomerata* (L.) was recorded on the larvae of *P. brassicae*. The larval parasitization ranged from 10.42 to 43.75 per cent on different crops.

INTRODUCTION

Cauliflower (*Brassica oleracea var. botrytis*) is one of the most popular winter vegetables grown in India. With the development of tropical types in addition to the temperate ones, it has now become possible to grow this vegetable almost throughout the year. Cauliflower is known to be infested by several insect pests *viz.*, diamond back moth, *Plutella xylostella* (Linnaeus), the head borer, *Hellula undalis* (Fabricius), the tobacco caterpillar, *Spodoptera littoralis* (Boisdouv), the cabbage semilooper, *Thysanoplusia orichalcea* (Fabricius) and cabbage butterfly, *Pieris brassicae* (Linnaeus) (Atwal and Dhaliwal, 2008). Among these *P. brassicae* is emerging as an important pest (Sachan and Gangwar, 1990). *P. brassicae* is primarily a pest in hilly region. Extreme winter in hills led to the migration of the pest to plains (Fletcher, 1925). A single larva can consume about 74 to 80 cm^2 leaf area (Younas *et al.,* 2004). In cruciferous vegetables, this pest alone causes 40 per cent yield loss annually in India (Hasan and Ansari, 2010). The severity of the incidence of insect pests is greatly influenced by the prevailing climatic conditions (Meena *et al.*, 2013). Kumar *et al.* (2007) reported that the *P. brassicae* appeared only on the late crop *i.e.,* last week of January to last week of March. Sood (2007) also reported the significant difference between the effects of different transplanting dates on the incidence of *P. brassicae*. It is learnt from the works of the past researchers that the dates of transplanting have a great effect on the incidence of the insect pest which may be due to the difference in weather conditions. Though the agro-climatic condition of Punjab is highly favourable for the successful cultivation of cauliflower, little work has been carried out and the information available at present is of little relevance. Hence, the present experiment was conducted to evaluate the different crops of the cauliflower in relation to the incidence of *P. brassicae* and the effect of weather parameters on the incidence of *P. brassicae* with the objective of arriving at the crucial conclusion on the most suitable cropping season so to decrease pest infestation for higher yield and productivity with least damage to the environment. Also, attempt was made to find out most important natural enemies of *P. brassicae* in cauliflower agro-ecosystem.

MATERIALS AND METHODS

The experiment was conducted at Entomological Research Farm, Punjab Agricultural University and Ludhiana during 2014-15. Four successive crops of cauliflower were raised for recording the incidence on different crops. The early crop was transplanted on 28th July, the mid-crop on 9th September, the late on 11th November 2014 and the super late on 5th January 2015. The plot size was 5m x 5m each with four replications and the experiment was laid out in Randomized Block Design. The crop was kept unsprayed throughout the season. The number of larvae was counted from 10 randomly selected cauliflower plants from each plot at weekly interval from the time of planting to harvest as suggested by Sood

(2007). The experimental data were subjected to statistical analysis for interpretation. Least Significant Differences (LSD) at 5 per cent level of significance were computed based on ANOVA following Randomized Block Design (RBD), after needful transformation of data. Data on weather parameters were obtained from the meteorological laboratory of the School of Climate Change and Agricultural Meteorology, Punjab Agricultural University, Ludhiana. The relationship of weather parameters with seasonal incidence was worked out through correlation analysis. For the recording of abundance of natural enemies, egg masses, 3rd to 5th instar larvae and pupae of *P. brassicae* were collected from experimental field as well as from vegetables growing areas and reared in laboratory. Observation was recorded for the emergence of any parasitoid from these field collected stages. Per cent parasitization was worked out from these field collected stages of *P. brassicae,* following the methodology of Kumar (2012).

RESULTS AND DISCUSSION

Different crops of cauliflower were evaluated in relation to incidence of *P. brassicae* larvae. Weekly data based on larval counts revealed that early crop was free from insect infestation (Table 1 & 2). The average temperature and relative humidity during this season ranged from 17.5 to 31.4ºC and 61 to 85 %, respectively.

On the mid-crop, the larvae were first recorded during 11th week after transplanting (WAT) (November, 23) and remained active up to 12th WAT (November, 30). After this, larvae were not reported till harvesting. The peak larval population (1.88 / plant) was recorded at 11th WAT (November, 23) (Table 1 & 2). The average temperature and relative humidity during this season ranged from 9.3 to 29.5ºC and 61 to 89 %, respectively. Whereas, the average temperature and relative humidity during the period of pest occurrence ranged from 16.8 to 18.9ºC

Table 1: Weekly incidence of *Pieris brassicae* on different crops of cauliflower during different months - 2014-15

Month	Date of observation	*Mean larval population per plant			
		Early crop	Mid-crop	Late crop	Super late crop
August	03.08	0.00	-	-	-
	10.08	0.00	-	-	-
	17.08	0.00	-	-	-
	24.08	0.00	-	-	-
	31.08	0.00	-	-	-
September	07.09	0.00	-	-	-
	14.09	0.00	0.00	-	-
	21.09	0.00	0.00	-	-
	28.09	0.00	0.00	-	-
October	05.10	0.00	0.00	-	-
	12.10	0.00	0.00	-	-
	19.10	0.00	0.00	-	-
	26.10	0.00	0.00	-	-
November	02.11	0.00	0.00	-	-
	09.11	0.00	0.00	-	-
	16.11	0.00	0.00	0.00	-
	23.11	Harvesting	1.88	0.00	-
	30.11	-	1.83	0.00	-
December	07.12	-	0.00	0.00	-
	14.12	-	0.00	0.00	-
	21.12	-	0.00	0.00	-
	28.12	-	0.00	0.00	-
January	04.01	-	Harvesting	0.00	-
	11.01	-	-	0.00	0.00
	18.01	-	-	0.00	0.00
	25.01	-	-	0.00	0.00
February	01.02	-	-	0.00	0.00
	08.02	-	-	0.00	0.00
	15.02	-	-	2.08	0.00
	22.02	-	-	3.75	0.00
March	01.03	-	-	5.63	2.13
	08.03	-	-	8.65	3.73
	15.03	-	-	Harvesting	4.53
	22.03	-	-	-	4.63
	29.03	-	-	-	6.88
April	05.04	-	-	-	9.50
	12.04	-	-	-	4.60
	19.04	-	-	-	1.08
	26.04	-	-	-	0.00
May	03.05	-	-	-	Harvesting

*Mean of four replications

Table 2: Weekly incidence of *Pieris brassicae* on different crops of cauliflower

Crops	*Mean larval population per plant (weeks after transplanting)											Mean larval population per plant
	7	8	9	10	11	12	13	14	15	16	17	
Early	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (1.00)**
Mid	0.00	0.00	0.00	0.00	1.88	1.83	0.00	0.00	0.00	0.00	0.00	1.86 (1.68)
Late	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.08	3.75	5.63	8.65	5.03 (2.44)
Super late	0.00	2.13	3.73	4.53	4.63	6.88	9.50	4.60	1.08	0.00	0.00	4.64 (2.38)
LSD (p = 0.05)												(0.25)

*Mean of four replications; **Figures in parentheses are the means of $\sqrt{n+1}$ transformed values

Table 3: Correlation coefficient between the *P. brassicae* (larval stage) with the agro-meteorological parameters during different crops of cauliflower

crops	Air temperature (°C)			Relative humidity (%)			Rainfall (mm)	Sunshine(hrs)
	Max	Min	Average	Morning	Evening	Average		
early	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
mid	-0.04^{NS}	-0.27^{NS}	-0.17^{NS}	0.21^{NS}	-0.40^{NS}	-0.36^{NS}	-0.14^{NS}	0.20^{NS}
late	0.23^{NS}	0.51^{S}	0.35^{NS}	-0.10^{NS}	0.12^{NS}	0.08^{NS}	0.29^{NS}	0.36^{NS}
super late	0.39^{NS}	0.44^{NS}	0.42^{NS}	-0.07^{NS}	-0.20^{NS}	-0.16^{NS}	0.14^{NS}	0.32^{NS}

NS – non significant; S - significant

and 63 % respectively. The *P. brassicae* population showed a non-significant negative correlation with maximum, minimum and average temperature, evening and average relative humidity and rainfall whereas, it showed non-significant positive correlation with morning relative humidity and sunshine hours (Table 3). The present findings are more or less in accordance with the report of Younas (2004) who reported highest average population (86.67 / plant) in the first week of November and lowest average population (0.67 / plant) in the first week of December on the cauliflower, transplanted in October. Sachan and Gangwar (1990) concluded that from November and mid-February, the incidence was of minor nature, because extreme cold during the later period was detrimental for multiplication of the insect.

On the late crop of cauliflower, the larvae were first recorded during 14th WAT (February, 15) and reported up to harvesting (March, 8) of crop. The peak larval population (8.65 / plant) was recorded at 17th WAT (March, 8) (Table 1 & 2). The average temperature and relative humidity during this season ranged from 9.3 to 19 ^{0}C and 61 to 89 %, respectively. Whereas, the average temperature and relative humidity during the period of pest activity ranged from 15.5 to 19 ^{0}C and 77 to 86 % respectively. The *P. brassicae* population showed a non-significant negative correlation with morning relative humidity whereas, non-significant positive correlation with maximum and average temperature, evening and average relative humidity, rainfall and sunshine hours but, significant positive correlation with minimum temperature (Table 1). The present findings are more or less in accordance with the report of Bhati *et al*. (2015), who reported that the pest was active during February to March. Venkateswarlu *et al*. (2011) reported that the *P. brassicae* first appeared during 2nd week of January and the peak larval population (27.7 / plant) was recorded during 2nd week of March. Kumar *et al*. (2007) also recorded it from January to the last week of March.

On the super late crop, the larvae were first recorded during 8th WAT (March, 1), with peak larval population (9.50 / plant) during 13th WAT (April, 5). The incidence was recorded up to 15th WAT (April, 19) on the super late crop, thereafter, the larval population declined (Table 1 & 2). The average temperature and relative humidity during this season ranged from 10.3 to 29.1 ^{0}C and 41 to 87 %, respectively. Whereas the average temperature and relative humidity during the period of pest activity ranged from 15.5 to 27.5 ^{0}C and 63 to 80 % respectively. The *P. brassicae* population showed non-significant negative correlation with morning, evening and average relative humidity where as non-significant positive correlation with maximum, minimum and average temperature, rainfall and sunshine hours (Table 3). In support of the present findings, Shaik and Prasad (2004) reported that the *P. brassicae* first appeared during 1st week of March and reached its peak (12 / plant) in the 3rd week of March and thereafter the population declined, but the pest remained in the field till first week of April. Palande *et al*. (2004) also reported that the pest was active during February to April and later on, the pest population declined.

The data presented in Table 2 indicate that all the crops of cauliflower supported statistically significantly different larval population however, in late crop and super late crop; population remained at par with each other. The early crop was free from insect infestation. The mean of total observations showed that minimum larval population per plant was associated with mid-crop (1.86 / plant) followed by super late crop (4.64 / plant) and late crop (5.03 / plant). Based on this information preventive measures can be taken to manage *P. brassicae* infestation. Sood (2007) reported that the incidence of *P. brassicae* was higher in cabbage crop transplanted during last week of April and second fortnight of May and it was very low in cabbage transplanted after mid-June. Vanlaldiki *et al*. (2013) reported significant variation of *Plutella xylostella* incidence on cabbage transplanted on different dates. However, the present findings could not be compared with these earlier reports as the weather conditions and agronomic practices are completely different in this region.

Abundance of Natural Enemies of *P. Brassicae* on Different Crops

During the experimental period, egg and pupal parasitoids were not recorded. A larval parasitoid, *Cotesia glomerata* (L.) (Hymenoptera: Braconidae) was recorded from the parasitized larvae. Larval parasitization ranged from 10.42 to 28.57 % with a mean of 16.58 $\pm$ 3.03 % on late crop of cauliflower, while on super late crop it ranged from 7.14 to 43.75 % with a mean of 21.19 $\pm$ 4.21 %. *Cotesia glomerata* (L.) is already reported as a major parasitoid of *P. brassicae* in the field. Kumar (2012) recorded larval parasitization of this pest as high as 86 per cent in *Brassica* agro-ecosystem. It is a gregarious endoparasitoid that lays its eggs inside the body of the first / second instar of *P. brassicae* and the parasitoid larvae emerge from the host body through its fifth instar (Laing and Levin, 1982), the host larvae die up-to 3 days later but do not feed in the parasitized periods (Feltwell, 1985).

REFERENCES

Atwal, A. S. and Dhaliwal, G. S. 2008. Agricultural Pests of South Asia and their Management. *Kalyani Publishers,* Ludhiana. pp. 20-21.

Bhati, R, Sharma, R. C. and Singh, R. 2015. Studies on occurrence of insect- pests of different *Brassica* species. *Int. J. Curr. Sci.* **14:** 125-132.

Feltwell, J. 1985. Large white butterfly: The Biology, Biochemistry and Physiology of *P. brassicae* L. *W. Junk Publishers*, The Hague, Boston, London. p. 535.

Fletcher, T. B. 1925. Migration as a factor in pest outbreak. *Bull. Ent. Res.* **16:** 177-181.

Hasan, F. and Ansari, M. S. 2010. Effect of different cole crops on the biological parameters of *Pieris brassicae* (L.) (Lepidoptera: Pieridae) under laboratory conditions. *J. Crop Sci. Biotech.* **13**: 195-202.

Kumar, P., Prasad, C. S. and Tiwari G. N. 2007. Population intensity of insect pests of cabbage in relation to weather parameter. *Ann. Plant Prot. Sci.* **51(1):** 235-281.

Kumar, S. 2012. *Cotesia glomerata* (Hymenoptera: Braconidae): A potential biocontrol agent for large white butterfly, *Pieris brassicae* (Lepidoptera: Pieridae). *J. Ent.* **9**: 171-177.

Laing, J. E. and Lewin, D. B. 1982. A review of the biology and bibliography of *Apanteles glomeratus* (Hymenoptera: Braconidae). *Biocontr. News Inform.* **3:** 7-23.

Meena, R. S., Ameta, O. P and Meena, B. L. 2013. Population dynamics of sucking pests and their correlation with weather parameter in chili, *Capsicum annum* L. crop. *The Bioscan* **8(1):** 177-180.

Palande, P. R, Pokharkar, D. S. and Nalawade, P. S. 2004. Seasonal incidence of cabbage pests in relation to weather. *Pest Manag. Hort. Ecosyst.* **10(2):** 151-156.

Sachan, J. N. and Gangwar, S. K. 1990. Seasonal incidence of insect pests of cabbage, cauliflower and knol-khol. *Indian J. Ent.* **52**: 111-124.

Shaik, J. and Prasad, S. K. 2004. Severe infestation of cabbage butterfly, *P. brassicae* (L.) on six species of *Brassica* and effects of abiotic factors on its population dynamics. *J. Ent. Res.* **28(3):** 193-197.

Sood, P. 2007. Effect of transplanting dates on the incidence of *Pieris brassicae* L. and extent of losses in cabbage under dry temperate condition of Himachal Pradesh. *Legume Res.* **30(4):** 297-300.

Vanlaldiki, H., Singh, M. P. and Lalrinsanga, R. 2013. Effect of staggared planting on the seasonal abundance of diamondback moth (*Plutella xylostella* Linn.) on cabbage under North Eastern hill zone, Imphal. *The Bioscan.* **8(4):** 1211-1215.

Venkateswarlu, V., Sharma, R. K., Chander, S. and Singh, S. D. 2011. Population dynamics of major insect pests and their natural enemies in cabbage. *Ann. Pl. Protec. Sci.* **19(2):** 272-277.

Younas, M., Naeem, M., Raqib, A. and Masud, S. 2004. Population dynamics of cabbage butterfly (*Pieris brassicae*) and cabbage aphids (*Brevicoryne brassicae*) on five cultivars of cauliflower at Peshawar. *Asian J. Pl. Sci.* **3:** 391-393.