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Host suitability of cabbage butterfly *Pieris brassicae* L. (Pieridae: Lepidoptera) among different cauliflower Germplasms in Pothwar region

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Abstract
The present study was conducted for the evaluation of different cauliflower cultivars against Cabbage butterfly *Pieris brassicae* L. (Pieridae: Lepidoptera) at Barani Agricultural Training Institute Daghal, Rawalpindi during 2006. The data regarding population dynamics of Cabbage butterfly larvae at 10 weeks interval were recorded. The maximum numbers of larvae with 36.33 per leaf were observed on tropical cultivar. The minimum populations of larvae were recorded on Pioneer (23.33) per leaf. The leaf infestation of Tropical cultivar was maximum with 9.08 percent while the minimum infestation was recorded on Pioneer i.e. 5.83 percent. On the basis of these findings the pioneer cultivar is comparatively resistant among all other cultivars of cauliflower.

Keywords: Cauliflower, cabbage butterfly, population dynamics and infestation level

1. Introduction

Cauliflower belongs to Brassicaceae family also called crucifers and cole crops [1]. In the World, Pakistan is in top ten countries producing the cauliflower vegetable. Production of this crop in 2011 was more than 0.2 million tons/year [2]. Cauliflower is one of the attractive vegetables due to its nutritional importance and is extensively grown in Pothwar region. But there are certain limiting factors for its quantitative and qualitative production. Among these, insect pests cause complete failure of the crop. One of the most destructive insect pest is Cabbage butterfly (*Pieris brassicae*) [3]. Cabbage butterfly is the most notorious pest of cauliflower crop that cause injurious damage to the Crucifer family especially cauliflower. This pest causes severe losses among the cauliflower cultivars at the different developmental stages [4]. This pest is distributed worldwide and is found wherever cruciferous vegetables are grown. The infestation was reported in other countries, the cabbage butterfly consider as a serious pest of cruciferous plants in Pakistan [5]. The caterpillars of butterflies feed on foliage and produce large, irregular holes, while the older ones of *P. rapae* and *M. brassicae* penetrate into the heads of cabbage or cauliflower plants. The stimulant for feeding behaviour in the larvae corresponds closely with the oviposition stimulant for the adult [6]. Embryonic development lasts from 6 to 10 days. First instar larvae live in colonies, narrowly grouped one against the other. After the second moult, they scatter into groups of 4 to 5 individuals. The large caterpillars make more damage to the leaves, often leaving only the large veins [7]. The larvae of this pest are sparsely covered with hairs. During the development, a single larva can consume 70-80 cm^2 leaf area. Leaves, branches, pods and the seeds of the cabbage and cauliflower are eaten by the larvae [8]. In Pakistan, the control of *Pieris brassicae L.* on vegetables is usually carried out with the use of conventional chemical insecticides. The health hazard problems associated with the use of such chemical pesticides on vegetables urged the need to generate opportunities for the development of alternative control tactics of vegetable pests. One of the effective and cheapest techniques to manage insect pest abundance is the use of resistant cultivars against cabbage butterfly. The use of host plant resistance for the insect pest control is environmental friendly practice. It plays important role in integrated pest management program. Keeping in view positive and negative aspects of different control measures, the present study was conducted to evaluate different cauliflower cultivars against cabbage butterfly. It will also help to increase the cauliflower production and facilitate the small farmer community for growing of this important vegetable.

2. Materials and Methods

The experiment was conducted in a Randomized Complete Block Design (RCBD) to screen out the various cultivars of cauliflower with three replications at Barani Agricultural Training Institute Daghal, Rawalpindi during 2006.

2.1 Research Area

There are different climatic conditions persist in Pakistan. Rawalpindi region summer is hot and rainy while winters are too much cold and dry. Its temperature in summer is about 34.2 °C but in winter it about 24.4 °C. The average annually rainfall is almost 1143 mm and humidity is about 55%. The different cauliflower cultivars were collected for the field experiment as well as for the screening of cauliflower cultivars against cabbage butterfly.

2.2 Screening of Cauliflower Cultivars

Sowing of different cauliflower cultivars were done by using the dip method. The land was prepared by ploughing, laddering and was fertilized with the organic manure. The plot size was dimension 3 m × 2 m. The distance from plant to plant and row to row was maintained as 45 cm and 75 cm respectively. Fertilizer, irrigation and all other agronomic practices were carried out in the experimental field as when needed. Observation on population dynamics of insect pests started as soon as their infestations were noticed. Population density was determined on randomly selected plants at weekly interval.

2.3 Larval Population

The number of grubs of *P. brassic*ae L. was recorded on weekly (7± 1 day) interval from the ten different selected plants of each replication. The grubs were counted from randomly selected upper, middle and lower portion of leaf of each selected plant. The average was calculated by using the formula:

$$\text{Average number of grubs per leaf} = \frac{\text{Total no. of grubs counted}}{\text{Total no. of leaves observed}}$$

2.4 Damaged Leaves

The healthy and damaged leaves were counted from ten randomly selected plants at weekly interval from 28th October to 30th December, 2006. The plants were selected randomly and tagged to avoid repetition. Percentage damage of leaves was calculated by the formula:

$$\text{Damaged leaves (\%)} = \frac{\text{Total no of damaged leaves}}{\text{Total no of healthy leaves}} \times 100$$

2.5 Statistical Analysis

The data regarding the population dynamics of cabbage butterfly *Pieris brassicae* L. on different cauliflower cultivars and leaves infestation of various varieties were subjected to statistical analysis and means were compared with Duncan's Multiple Range test at 5% level of probability.

3. Results

3.1 Population dynamics of Cabbage butterfly *(Pieris brassicae* L.) on weekly basis

3.1.1 Larval Population at 1st Week

Data regarding population dynamics of cabbage butterfly in first week (28th October to 4th November) revealed that larval population exposed that Tropical was the susceptible cultivar with 32.66 larvae per leaf and Pioneer was the comparative resistant cultivar with 27 larvae per leaf (Table 1).

3.1.2 Larval Population at 2nd Week

During the second week observation (4th November to 11th November) results showed that the highest number of larvae were recorded on Tropical cultivar with 36.33 larvae per leaf and Pioneer was comparative resistant cultivar against *Pieris brassicae* L. with 23.33 larvae per leaf which were followed by Snowball and Snowdrift with an average of 32.66 and 25 larvae per leaf respectively (Table 1).

3.1.3 Larval Population at 3rd Week

Data regarding larval population depicted that Pioneer was the comparatively resistant and significantly different different from all other cutivars with 21.66 larvae per leaf. The highest larval population was recorded on Tropical which was the most susceptible cultivar with 33.66 larvae per leaf. The larval population was recorded on Snowball and Snowdrift with 29.33 and 22.66 larvae per leaf that were statistically different with each other's (Table 1).

3.1.4 Larval Population at 4th Week

Forth week (18th November to 25th November) revealed that Pioneer cultivar was the comparatively resistant and significantly different from all other cauliflower cultivars with 15.66 larvae per leaf. The results also showed that Tropical variety was the susceptible with 29.33 followed by variety Snowball (23.66) and Snowdrift (18.66) larvae per leaf (Table 1).

3.1.5 Larval Population at 5th Week

Data regarding fifth week (25th November to 2nd December) showed that highest larval population was observed on variety Tropical with 22.66 larvae per leaf and statistically different from all other cultivars. The results also revealed that Pioneer was least with 12.33 larvae per leaf and comparatively resistant against cabbage butterfly (Table 1).

3.1.6 Larval Population at 6th Week

Data regarding sixth week (2nd December to 9th December) revealed that Pioneer variety was comparatively resistant and significantly different from all other cultivars with 9 larvae per leaf. The Tropical cultivar was the susceptible and more larval population was recorded i.e. 19.33 larvae per leaf (Table 1).

3.1.7 Larval Population at 7th Week

During seventh week (9th December to 16th December) showed that Tropical was the susceptible cultivar and highly significantly different from other cultivars with 15.33 larvae per leaf. Pioneer was the comparatively resistant cultivar with 4.66 larvae per leaf. Snowball variety (14) larvae per leaf were statistically different from Snowdrift cultivar with 8 larvae per leaf (Table 1).

3.1.8 Larval Population at 8th Week

Highest insect population during eighth week (16th December to 23th December) was recorded on variety Tropical with 12.66 larvae per leaf and highly significantly different to Pioneer variety that was comparatively resistant with 1.66 larvae per leaf which were followed by Snowball and Snowdrift with an average of 11.33 and 4.66 respectively (Table 1).

3.1.9 Larval Population at 9th Week

During ninth week (23nd December to 30th December) results showed that maximum larval population was recorded on the

variety Tropical and significantly different from other cauliflower cultivars with 10.66 larvae per leaf. Pioneer showed minimum insect population and comparative resistant cultivar with 0.00 larvae per leaf (Table 1).

3.1.10 Larval Population at 10th Week

Data regarding 10th week (30th December revealed that maximum larval population was recorded on Tropical cultivar that was susceptible to cabbage butterfly and significantly different from other varieties with 6.00 larvae per leaf. The results also showed that Pioneer and Snowdrift cultivars were statistically similar to each others with 0.00 and 0.00 larvae per leaf respectively (Table 1).

Table 1: Larval Population of Cabbage butterfly *(Pieris brassicae* L.) on weekly basis

Cultivars	Larval Population 1st Week	Larval Population 2nd Week	Larval Population 3rd Week	Larval Population 4th Week	Larval Population 5th Week	Larval Population 6th Week	Larval Population 7th Week	Larval Population 8th Week	Larval Population 9th Week	Larval Population 10th Week
Snowball	30 ab	32.66 b	29.33 b	23.66 b	20 b	17.33 b	14 b	11.33 b	9 b	3 b
Snowdrift	24 c	25 c	22.66 c	18.66 c	13.66 c	11 c	8 c	4.66 c	2 c	0 c
Tropical	32.66 a	36.33 a	33.66 a	29.33 a	22.66 a	19.33 a	15.33 a	12.66 a	10.66 a	6 a
Pioneer	27 b	23.33 d	21.66 d	15.66 d	12.33 d	9 d	4.66 d	1.66 d	0 d	0 c

Means sharing similar letter (s) are not significantly different by DMR Test at p=0.05

3.2 Percentage damage of cabbage butterfly (*Pieris brassicae* L.) on weekly basis

3.2.1 Leaf Infestation at 1st Week

Data regarding damaged leaves (%) of *P. brassicae* L. during first week 28th October to 4th November indicated that Tropical cultivar was most damaged than others and significantly different from other varieties with 8.16 percent. Pioneer and Snowdrift were statistically similar to each other 6.75 and 6.00 percent respectively (Table 2).

3.2.2 Leaf Infestation at 2nd Week

Data of second week 4th November to 11th November revealed that Pioneer with 5.83 percent was least infested and comparative resistant cultivar against cabbage butterfly. Tropical with 9.08 percent was more infested. Snowball and Snowdrift cultivars were damaged 8.16 and 6.25 percent respectively as shown (Table.2).

3.2.3 Leaf Infestation at 3rd Week

Data relating to percentage damage caused by cabbage butterfly on different varieties of cauliflower 11th November to 18th November revealed that maximum percentage damage was recorded on variety Tropical with 8.41 percent that was moderately susceptible. Pioneer was least infested with 5.41 percent and comparatively resistant cultivar against *Pieris brassice* L**.** (Table 2).

3.2.4 Leaf Infestation at 4th Week

During fourth week 18th November to 25th November results showed that Tropical was most infested and susceptible cultivar to cabbage butterfly with 7.33 percent. Pioneer was least damage (3.91%) and comparatively resistant cultivar followed by Snowball and Snowdrift with 5.91 and 4.66 percent respectively (Table 2).

3.2.5 Leaf Infestation at 5th Week

Data of fifth week 25th November to 2nd December revealed that Pioneer cultivar showed best performance and comparative resistant against cabbage butterfly with 3.08 percent. Tropical was more infested and moderate susceptible with 5.66 percent. Snowdrift was statistically different to Snowball with 3.41 and 5.00 percent respectively (Table 2).

3.2.6 Leaf Infestation at 6th Week

Data regarding sixth week 2nd December to 9th December showed that maximum percentage damage was recorded on Tropical cultivar and significantly different from other cultivars with 4.83 percent. Pioneer was least infested and showed resistant against cabbage butterfly with 2.25 percent (Table 2).

3.2.7 Leaf Infestation at 7th Week

Data relating to seventh week 9th December to 16th December results exposed that Tropical variety was more infested and moderate susceptible to cabbage butterfly with 3.83 percent. Pioneer with 1.16 percent was least damage and comparative resistant cultivar. Snowball was damage with (3.50) percent and variety Snowdrift with (2.00) percent (Table 2).

3.2.8 Leaf Infestation at 8th Week

Highest percentage damage during eighth week 16th December to 23th December was recorded on Tropical that was susceptible and significantly different from other cultivars with 3.16 percent. The results also revealed that Pioneer with 0.41 percent was least infested and resistant against cabbage butterfly. Snowball and Snowdrift were statistically similar with 2.83 and1.16 percent respectively (Table 2).

3.2.9 Leaf Infestation at 9th Week

During ninth week 23nd December to 30th December results exposed that Tropical was more infested that was moderate susceptible cultivar and significantly different from others with 2.66 percent. While the Pioneer with 0.00% was least damage to cabbage butterfly and comparatively resistant cultivar (Table 2).

3.2.10 Leaf Infestation at 10th Week

Data regarding 10th week (30th December) results revealed that Pioneer was least infested to cabbage butterfly and statistically similar to Snowdrift with 0.00 and 0.00 percent. Tropical was more infested and moderately susceptible cultivar with 1.50 (Table 2).

Table 2: Leaf Infestation of Cabbage butterfly *(Pieris brassicae* L.) on weekly basis

Cultivars	Leaf Infestation 1st Week	Leaf Infestation 2nd Week	Leaf Infestation 3rd Week	Leaf Infestation 4th Week	Leaf Infestation 5th Week	Leaf Infestation 6th Week	Leaf Infestation 7th Week	Leaf Infestation 8th Week	Leaf Infestation 9th Week	Leaf Infestation 10th Week
Snowball	7.5 ab	8.16 b	7.33 b	5.91 b	5 a	4.33 a	3.5 a	2.83 a	2.25 a	0.75 ab
Snowdrift	6 c	6.25 c	5.66 c	4.66 c	3.41 b	2.75 b	2 b	1.16 b	0.5 b	0 b
Tropical	8.16 a	9.08 a	8.41 a	7.33 a	5.66 a	4.83 a	3.8 a	3.16 a	2.66 a	1.5 a
Pioneer	6.75 b	5.83 c	5.41 c	3.91 d	3.08 b	2.25 b	1.3 c	0.41 c	0 b	0 b

Means sharing similar letter (s) are not significantly different by DMR Test at p=0.05

4. Discussion

In this study four cultivars of cauliflower cultivars namely Snowball, Snowdrift, Tropical and Pioneer were studied for the population dynamics of cabbage butterfly at weekly interval throughout the season from October to December, 2006. The population density of Cabbage butterfly (*Pieris brassicae* L.) was recorded on the basis of larval population per plant on ten different randomly selected plants. There were significant variations in the population pattern of cabbage butterfly on various cultivars. The results of the present research expose that Pioneer showed comparatively resistance while the Tropical cultivar proved moderately susceptible to the cabbage butterfly. Snowball and Snowdrift cultivars revealed in-between susceptibility. These results are in conformity to [4, 9] who reported that cabbage butterfly (*Pieris brassicae* L.) was observed on cauliflower crop from the month of October and from May to September. Maximum population of (*Pieris brassicae* L.) throughout the season was observed during second week on variety Tropical (36.33) followed by variety Snowball (32.66) and Snowdrift (25), while minimum larval population was observed on variety Pioneer (23.33). It may be due to more favorable temperature for growth and development of the pest [10]. Minimum population was observed during tenth week maximum population of insects was observed on the variety Tropical (6.00) followed by variety Snowball (3.00). Pioneer (0.00) and Snowdrift (0.00) showed minimum population. It may be due to egg laying response of cabbage butterfly (*Pieris brassicae* L.) as suggested [11].who reported that butterflies lay more eggs on young plants than old ones of the same size. Maximum percentage damage throughout the season was observed during second week on Tropical (9.08) which was highest. Pioneer (5.83) got minimum damage during this week followed by Snowdrift (6.25) and Snowball (8.16). Results are in similarity with [12] who observed maximum percentage damage during October. They reported that leaf damage by (*Pieris brassicae* L.) in varieties snowball and snowdrift was highly significant. The results are also comparable with the findings of previous worker of [13]. The present result of insect pest infestation level is somewhat similar to [13] recorded that cauliflower germplasms i.e. Snowball and Snowdrift were more leaf infested caused by cabbage butterfly.

5. Conclusion

According to the present study results. Pioneer is comparatively resistant cultivar as it has the lowest insect pest abundance throughout the crop season as well as minimum leaf infestation against cabbage butterfly *Pieris brassicae* L. and consider as the least susceptible cultivar among cauliflower germplasms. On the basis of this research Pioneer has been recommended for the cultivation in Pothwar region.

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