LIFE PARAMETERS OF CABBAGE BUTTERFLY ON DIFFERENT CAULIFLOWER GENOTYPES UNDER FIELD CONDITIONS

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خلاصہ

گوبھی کی دس اقسام پر گوبھی کی سنڈی (P.brassica) کی دوران حیات کا تجربہ کیا گیا ہے۔جن میں گوبھی کی اقسام White Corona, Snow mystique, Snow Grece, Local, Clima, 5340, Sydney, Snow Crown, White Megic اور AX-2034 شامل ہیں۔یہ تجربہ ایگلچرل ریسرچ انسیٹیٹوٹ ترناب پشاور میں کیا گیا تھا۔اس تجربہ میں گوبھی کی سنڈی کے انڈے دینے کے بعد ان پودوں کو 2x2 فٹ کے جال میں بند کر دیا گیا تھا۔تجربے کے نتائج ظاہر کرتے ہیں۔کہ گوبھی کی سنڈی کا دور حیات مکمل ہونے کا کم سے کم دورانیہ Clima پر تھا۔جو کہ 35 دن تھا۔جبکہ 80 فی صد لاروہ کی موت AX-2034 پر ریکارڈ کی گئی تھی کویا Pupa))کا وزن سب سے زیادہ 0.45 گرام (Snow mystique) پر جبکہ کم سے کم کویا Pupa)) کا دورانیہ 20.67 دن (White megic) پر ریکارڈ کیا گیا تھا۔سب سے زیادہ کویا Pupa)) کی موت 100 فی صد (White Corona) پر ریکارڈ کی گئی تھی۔تتلی کے پروں کا پھیلاؤ سب سے زیادہ Snow Grece پر ریکارڈ کیا گیا۔جس میں مادہ کے پر کا پھیلاؤ 71.20 ملی لیٹر اور نر میں 66.64 ملی لیٹر تھا۔اس تجربے کے نتائج مستقبل میں گوبھی کی سنڈی کے خلاف مدافعتی جین کو معلوم کرنے میں مددگار ثابت ہونگے۔

Abstract

An experiment on Life parameters of cabbage butterfly *Pieris brassicae* L. on ten cauliflower genotypes i.e, Snow mystique, White magic, Sydney,White corona, Local, Snow grece, Clima, 5340, Snow crown and AX-2034 was conducted at Entomology section ARI Tarnab Peshawar under field condition. *P. brassicae* eggs were marked on cauliflower genotype and caged the whole plant in 2x2 sq feet iron cage. The results from the ten cauliflower genotypes showed that minimum period of larval development was observed on Clima (35 days), maximum larval mortality was (80%) on AX-2034, and weight of pupa was higher (0.45 g) on Snow mystique ,minimum pupal period was recorded on White magic (20.67days), Pupal mortality was (100%) on White corona, 5340 and AX-2034 and Female to male sex ratio was highest of 1:5 on Snow crown and White magic . Wing span of both female and male was highest on Snow grece i.e 71.20 mm and 66.64 mm respectively. These results might provide useful basic information for screening of resistant genotype of cauliflower against *P. brassicae* under field conditions.

Introduction

In Peshawar valley cauliflower crop is mostly attacked by cabbage butterfly (*Pieris brassicae* L.). *P. brassicae* is a destructive insect which is present throughout the year and cause economic losses to cruciferous at different developmental stages of crop, which considerably reduce the yield. A single larva of *P. brassicae* can consume 74–80 cm^2 leaf area. Younas *et al*. (2004). *P. brassicae* can lay 150 to 300 eggs. Eggs are laid in batches on upper and lower side of leaves. It hatches in 4 to 16 days. Young larvae live gregariously and scraping the leaves while the older larvae live individually, gnawing the leaves leaving thick veins only and contaminating the crop with excrement. Larval stage is 13 to 38 days depending upon temperature. Length of 5th instar larvae is 50-60 mm. Its pupae are greenish-yellow with black dots. Its pupal duration is 8 to 15 days. There are 2 to 5 generations per year depending on region. Butterflies need nectar as additional food before start oviposition. Its older larvae are capable of long distance migrations in search food and suitable site for pupation. *P. brassicae* is adversely affected by high temperatures (above 26°C) and with low air humidity (60%). Pest distribution becomes limited in winter when temperatures reached to -20°C and lower. (Ovsyannikova and Grichanov ,2009). Economic damage to caluliflower occurs when the percent destroyed leaf area reach within 13.80- 16.89% in early cauliflower, 7.79-9.63% in late cauliflower, 3.97-10.41% in early cabbage and 10.75-13.76% in the late cabbage (Jogar *et al*., 2005). Hasan and Ansari (2010) reported that *P. brassicae* life parameters are affected by biotic and abiotic factors, e.g. host plant. To get higher yield and and reduce abundant use of insecticides different resistant cultivars are sown. Variety selection and crop management practices are the main factors that contribute to growing profitable cauliflower (Zerkoune, 2000). As *P.*

brassicae has attained important pest status of the *Brassica* family. The aim of our study was to evaluate commercially available cauliflower genotypes for resistance against *P. brassicae*.

Material and Methods

Experiment was conducted on ten commercially available genotypes of cauliflower, i.e. Snow mystique, White magic, Sydney,White corona, Local, Snow grece,Clima, 5340, Snow crown and AX-203 at the Agricultural Research Institute Tarnab, Peshawar to study the biology of *P. brassicae* under field condition. Cauliflowers were transplanted in the last week of September, on ridges in separate plots each measuring 4 m x 2m. Plant to plant and row to row distance was kept at 45 cm and 75cm, respectively. Batches of *P. brassicae* eggs were selected on each genotype and marked and cover 3 plants in each genotype in each replication by iron cage of 2x2 sq feet to study the developmental parameters i.e larval developmental period (days), percent larval mortality, pupal period (days), pupal weight (g), percent pupal mortality, sex ratio and wing span (mm) of adults. Aanalytical scale was used for pupal weight. The genotypes having no natural egg laying are provided batches of eggs for study. The field experiments were laid out in RCBD with three replications.

Results

Following parameters represent in Table 1 of *P. brassicae* were studied under field conditions. While ratio and wing span of ten genotypes of wave given in Table.2.

Larval developmental period (days)

P. brassicae larval developmental period fed on various cauliflower genotypes under field conditions was maximum on Snow crown (48.67 days), Sydney (48.33 days) and AX-2034 (46.33 days) while minimum (35 days) on Clima.

Larval mortality (%)

P. brassicae reared on ten cauliflower genotypes showed significantly different larval mortalities.Mean larval mortality was significantly higher (80%) on AX-2034 while lower (36 %) on Local genotype.

Table.1. Summary of life parameters of ten genotypes of cauliflower

Varieties	Larval development periods (days)	Larval mortality (%)	Pupal weight (g)	Pupal period (days)	Pupal mortality (%)
White Corona	37.33 bc	61 c	0.43 abc	49 a	99 a
Snow Mystique	37.67 bc	37 e	0.45 a	32 c	16 e
Snow Grece	37.00 bc	71 ab	0.44 ab	20.33 f	84 ab
Local	36.33 bc	36 e	0.44 ab	34.33 b	57 cd
Clima	35.00 c	41 de	0.44 ab	28.33 d	60 bc
5340	35.67 bc	37 e	0.44 ab	29.67 d	100 a
Sydney	48.33 a	69 bc	0.42 bc	26 e	57 cd
Snow Crown	48.67 a	72.67 ab	0.41 c	20.33 f	35 de
White Magic	39.00 b	46.67 d	0.42 bc	20.67 f	58 cd
AX-2034	46.33 a	80 a	0.44 ab	25 e	100 a

Means in columns with similar letters are non-significantly different at $\alpha = 0.05$ (LSD test).

Pupal weight (g)

P. brassicae reared on various cauliflower genotypes resulted in significantly different pupal weight (g), where it was significantly higher (0.45 g) on Snow mystique and lower (0.41g) on Snow crown.

Pupal period (days)

P. brassicae pupal period varied among the cauliflower genotypes under field conditions Mean maximum pupal period (49 days) was recorded on White corona, while minimum (20.33 days) on Snow grece, Snow crown (20.33 days) and White magic (20.67days).

Pupal mortality (%)

Pupal mortality of *P. brassicae* reared on different cauliflower genotypes was significantly different. Pupal mortality was significantly higher on White corona, 5340 and AX-2034 (each 100%) on AX-2034 and lower (16%) on Snow mystique genotype.

Sex ratio and wing span

Table 2 revealed that *P. brassicae* female to male sex ratio and wing span of females and males varied significantly on the various cauliflower genotypes. Female to male sex ratio was highest of 1:5 on Snow crown and White magic and lowest of 1:0 on White corona. Wing span of the female was highest of 71.20 mm on Snow grece and lowest of 60.88 mm on Sydney. Wing span on males was highest of 66.64 mm on Snow Grece and lowest of 57.2 mm on Snow mystique.

Table 2. Sex ratio and wing span of *P. brassicae* adults under field conditions

Genotype	Sex ratio (Female: Male)	Mean Wing span(mm)	
		Female	Male
White Corona	1: 0	61.35	no males found
Snow Mystique	1:2	62.56	57.2
Snow Grece	1:1	71.20	66.64
Local	1.25:1	65.30	58.99
Clima	2:1	61.76	56.80
5340	0:0	-----	-----
Sydney	1.5:1	60.88	59.98
Snow Crown	1:5	70.01	64.00
White Magic	1:5	70.07	68.53
AX-2034	0:0	------	-----

Discussion

P. brassicae larval developmental period fed on various cauliflower genotypes under field conditions was maximum on Snow crown (48.67 days) and minimum (35 days) on Clima. *P. brassicae* mean larval mortality was significantly higher (80%) on AX-2034 while lower (36 %) on Local genotype. Oviposition occurred on different dates on different genotypes and no egg laying was observed on Snow crown, AX-2034 and Sydney. The eggs were provided artificially to study the required parameters. The difference in mortality rates might be due to variation in nutritional and phyto-stimulant factors such as carbon and nitrogen as well as defensive metabolites that directly affect larval development (Awmack and Leather, 2002; Syed and Abro, 2003; Hasan and Ansari, 2010). Ahmad *et al*. (2007) reported that the mortality rate of *P. brassicae* was more during early instars which might be due to low availability of nutrient contents and hardness of tissue texture for the neonate larvae. Moreover, the toxins and digestibility reducers produced by host plant effect the physiology of the larvae and reduce its growth and survival (Schoonhoven *et al*., 2005). Insect mortality during early stage causes reduction in adult populations (Hasan and Ansari, 2010). During the later instars, larval mortality on each host plant reduce automatically because the mouth parts (maxillae and mandibles) of larvae are modified which help larva to eat plant leaves more easily. At later stages of development, low mortality of larvae also occur due to the poor nutritional value of host plants (Font *et al*., 2005; Padilla *et al*., 2007; Scalzo *et al*., 2008; Hasan and Ansari, 2010).

P. brassicae pupal period was maximum (49 days) on White corona, while minimum (20.33 days) on Snow grece, Snow crown. Pupal weight was significantly higher (0.45 g) on Snow mystique and lower (0.41g) on Snow crown, while pupal mortality was significantly higher on White corona, 5340 and AX-2034 (each 100%) and lower (16%) on Snow mystique genotype. In current field experiment pupal parasitoid *Pteromalus puparium* caused pupal mortality. In our experiment different genotypes of cauliflower showed different effect on *P. brassicae.* The most unsuitable genotype was AX-2034. It showed highest antibiosis resistance against *P. brassicae* with high larval developmental period and high mortality of immatures. Such extended developmental period of *P. brassicae* could increase the chances of parasitization by its natural enemies (Hasan and Ansari, 2011).

Female to male sex ratio was highest of 1:5 on Snow crown and White magic and lowest of 1:0 on White corona. Wing span of the female was highest of 71.20 mm on Snow grece and lowest of 60.88 mm on Sydney. Wing span on males was highest of 66.64 mm on Snow Grece and lowest of 57.2 mm on Snow mystique. Our results are in agreement with that of Arshad and Rizvi (2007). They had reported that on Cole crops maximum number of adults were recorded in laboratory than the field conditions. It might be due to the presence of natural enemies and abiotic factors under the field conditions.

Varieties	Larval development periods (days)	Larval mortality (%)	Pupal weight (g)	Pupal period (days)	Pupal mortality (%)
White Corona	37.33 bc	61 c	0.43 abc	49 a	99 a
Snow Mystique	37.67 bc	37 e	0.45 a	32 c	16 e

Conclusion

It is concluded that all larger in height genotypes have egg laying of *Pieris brassicae* then short height genotypes. Different genotypes of cauliflower showed different effect on life parameters of *P. brassicae.* The most unsuitable genotype was AX-2034. It showed highest antibiosis resistance against *P. brassicae* with long larval developmental period and high mortality of immature. While Snow mystique prove less resistant genotype by representing short developmental period, less larval pupal mortality and high pupal weight.

Acknowledgement

Higher Education Commission, Islamabad was highly acknowledged to sponsor this part of PhD Dissertation.

Refernces

Ahmad, F., O. Khan, S. Sarwar, A. Hussain and S. Ahmad. 2007. Performance and evaluation of tomato cultivars at high altitude. Sarhad J. Agric. 23(3): 581-585.

Arshad, A. and P.Q. Rizvi. 2007. Developmental response of cabbage butterfly, *Pieris brassicae* L. (Lepidoptera: Pieridae) on different Cole crops under laboratory and field condition. Asian J. Pl. Sci. 6(8):12-41.

Awmack, C.S. and S.R. Leather. 2002. Host plant quality and fecundity in herbivorous insects Ann. Rev. Entomol. 47: 817–844

Font, R., M.D. Rio-Celestino, E. Cartea and A.D. Haro-Bailon. 2005. Quantification of glucosinolates in leaves of leaf rape (*Brassicanapus spp. pabularia*) by near infrared spectroscopy. Phytochem. 75: 175-185.

Hasan, F. and M.S. Ansari. 2010. Effect of different Cole crops on the biological parameters of *Pieris brassicae* (L.) (Lepidoptera: Pieridae) under laboratory conditions. J. Crop Sci. Biotechnol. 13(3): 195-202.

Hasan, F. and M.S. Ansari. 2011. Effects of different brassicaceous host plants on the fitness of *Pieris brassicae* (L.). Elsevier Crop Protec. 30(7): 854-862.

Jogar, K., L. Metspalu, K. Heiisaar, A. Luik, A.J. Martin, M. Mand, R. Jaaniso and A. Kuusik. 2005. Physiology of diapause in pupae of *Pieris brassicae* (L.) (Lepidoptera: Pieridae). Agron. Res. 3(2): 21-37.

Ovsyannikova, E.I. and I.YA. Grichanov. 2009. In: Interactive Agricultural Ecological Atlas of Russia and Neighboring Countries. Economic Plants and their Diseases, Pests and Weeds. http://www.agroatlas.ru

Padilla, G., M.E. Cartea, P. Velasco, A.D. Haro and A. Ordas. 2007. Variation of glucosinolates in vegetable crops of *Brassica rapa*. Phytochem. 68: 536-545.

Scalzo, R.L., A. Genna, F. Branca, M. Chedin and H. Chassaigne. 2008. Anthocyanin composition of cauliflower (*Brassica oleracea* L. var. *botrytis*) and cabbage (*B. oleracea* L. var. *capitata*) and its stability in relation to thermal treatments. J. Food Chem. 107: 136-144.

Schoonhoven, L.M., J.J.A. van Loon and M. Dicke. 2005. Insect Plant Biology, 2nd Ed. Oxford University Press, Oxford, UK.

Syed, T.S. and G.H. Abro. 2003. Effect of brassica vegetable hosts on biology and life table parameters of *Plutella xylostella* under laboratory conditions. Pak. J. Biol. Sci., 22: 1891-1896.

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

Zerkoune, M.A. 2000. Field evaluation of cauliflower varieties grown in southwest low desert soils.The University of Arizona College of Agriculture, Vegetable Report index at http://ag.arizona.edu/pubs/crops/az1177/. Retrieved on September 2, 2011.