



Short Communication

Host Plant Resistance and Population Dynamics on Different Genotypes of Cabbage against Diamondback Moth, *Plutella xylostella* in Faisalabad, Pakistan

YASMIN AKHTAR¹, MUHAMMAD ASHFAQ, ANJUM SUHAIL AND RASHID AHMAD KHAN[†]

Department of Agricultural Entomology, University of Agriculture, Faisalabad, Pakistan

[†]Department of Forestry, Range and Watershed Management, University of Agriculture, Faisalabad, Pakistan

¹Corresponding author's e-mail: akhtaryasmeen94@yahoo.com

ABSTRACT

The studies on the host plant resistance of different genotypes of cabbage against Diamondback Moth (DBM), *Plutella xylostella* (L.), were carried out for two consecutive years, viz., 2007 and 2008 at a farmer's field in Faisalabad (Chak No. 204), Pakistan. Fifteen genotypes of cabbage viz. Green Challenger, Summer Green, Green Globe, Asha, Takila, BC-305, Zennith, Pruktor, Domon, HTC-9089-08, SSP-2200, KS-Cross, CB-60, Clandia F1,H, Broccoli and Adavanta were tested for their relative resistance/susceptibility as a preliminary study during 2007 and then categorizing them resistant, intermediate and susceptible in final screening trial during 2008. All the cultivars of cabbage during 2007 as well as during 2008 showed significant difference among themselves at $P \leq 0.01$. Green Challenger, Summer Green and Green Globe were susceptible during 2007, while Adavanta, Clandia F1, H, Broccoli and CB-60 appeared as resistant with pest's population ranging from 6.17 to 6.25 and 1.27 to 1.46 larvae per 20 leaves, respectively. Domon, Pruktor, Zennith appeared as intermediate with larval population range of 2.67 to 2.73 per 20 leaves. Similar trend was also observed during 2008 i.e., Green Globe, Green Challenger and Summer Green showed susceptible response with larval population range of 7.19 to 7.50 per 20 leaves. CB-60, Clandia F1, H, Broccoli and Adavanta 1402 appeared as resistant with larval population range of 1.85 to 2.21 per 20 leaves. The month of November was peak infestation time in both years on all genotypes. The results are discussed in relation to earlier documented incidence of DBM on cabbage. © 2012 Friends Science Publishers

Key Words: Resistance; Diamondback moth; Larval population; Cabbage genotypes; Punjab; Pakistan

INTRODUCTION

The cabbage crop during its growth period is attacked by a large number of insect pests every year including whitefly (*Bemisia tabaci*), armyworm (*Spodoptera* sp.), cabbage looper (*Trichoplusia binotalis*) and cabbage butterfly (*Pieris brassicae*) (Shuaib *et al.*, 2007). Amongst them diamond back moth (DBM) (*Plutella xylostella* L.) is the most serious pest of cabbage. It is a very destructive pest in southern Sind (Hydrabad & Karachi regions) of Pakistan where cruciferous vegetables are grown throughout the year and due to its severe infestations, growers are sometimes compelled to plough down their standing crops in spite of multiple insecticide applications (Abro *et al.*, 1994). In recent years, DMB has become most destructive pest insect of cruciferous plants throughout the World and annual cost of managing the pest has been increasing since early nineties (Talekar & Shelton, 1993). Due to popularizing of cabbage for daily vegetable as fresh or cooked and expansion of its production in tunnel in Punjab, (Pakistan), diamond back moth (DBM) has been reported to cause serious damage to this crop in certain years (Syed, 2003).

Though substantive work on the biology and ecology of DBM is scanty in Pakistan, yet a few significant publications have indicated the work on potential of insecticide resistance in DBM against recently introduced insecticides for vegetable production (Mushtaque *et al.*, 1986; Irshad & Mohyuddin, 1990; Khaliq *et al.*, 2007). One of the ways of managing/preventing insecticide resistance, host plant preference has been accepted as rational approach (Dhaliwal & Dilawari, 1993; Saeed *et al.*, 2010). Host plant resistance in cabbage/cauliflower/crucifers has not been treated meticulously in case of cabbage in Pakistan. Eigenbrode and Pillai (1998) have reported leaf surface wax as component of resistance towards DBM. The number of cabbage germplasms is enormous and is being imported. The imported seed materials of any crop need careful examination of their behavior towards insects. Infestation of the DBM larvae is criterion to the surveillance of resistance to crucifers and mostly used in experiments as an important component of integrated pest management (Bhatti *et al.*, 1976). The response of varieties towards DBM has been reported elsewhere (Jankowska, 2005). The peak infestation of DBM on crucifer was found to be in the beginning of

August during 1997. The highest infestation of diamond back moth was observed in mid July.

The present studies, therefore, were planned to screen the available genotypes of cabbage for resistance / susceptibility based on larval population against DBM.

MATERIALS AND METHODS

The studies were conducted in two consecutive growing seasons, i.e., 2007 and 2008; the experiments were and laid out in Randomized Complete Block Design (RCBD) with four replications per cultivar and plot size for each replicate was maintained as 5 × 5 m. Row to row expanse was 75 cm, while plant to plant distance as 30 cm.. Observations were recorded from 20 leaves of uniform size of randomly selected from 20 plants per replicate. Observations were started one week after the transplanting of seedlings into the field at weekly intervals and continued till harvest of the crop.

Preliminary screening trial: Fifteen cultivars of cabbage, viz., Green Challenger, Summer Green, Green Globe, Asha, Takila, BC-305, Zennith, Pruktor, Domon, HTC-9089-08, SSP-2200, KS-Cross, CB-60, Clandia F1,H, Broccoli and Adavantawere were sown in Faisalabad (Chak 204) during 2007 crop season. Approximately 3-4 leaf stage seedlings were transplanted in the field. The plant protection measure in the form of chemical was not applied. Based on larval population of *Plutella xylostella* (L.) per 20 leaves, nine cultivars, (three showing resistant, three susceptible & three intermediate responses), were selected for final screening experiments. Mean number of DBM was calculated from observations from 20 plants.

Final screening trial: Nine cultivars of cabbage {three showing resistance (Adavanta, Clandia F1, H, Broccoli & CB-60) three intermediate (Domon, Pruktor & Zennith) and three susceptible (Green Challenger, Summer Green & Green Globe)} were selected from preliminary screening trial were sown in the same experimental area during 2008-2009. The larval population in two years on different varieties were compared by ANOVA and means were separated by DMR test ($P = 0.05$).

RESULTS AND DISCUSSION

Preliminary screening (Year 2007): The larval populations in the years 2007 and 2008 is represented as number of larvae of DBM from 20 leaves. The results (Table I) revealed that Green Challenger, Summer Green and Green Globe were found to be susceptible showing maximum population of *P. xylostella* i.e., 6.25, 6.25 and 6.17, respectively and did not show significant difference with each other. The minimum population of *P. xylostella* was recorded to be 1.27 larvae per 20 leaves on Adavanta and it had non-significant difference with Clandia F1-H, Broccoli, CB-50 and KS-Cross having 1.38, 1.46 and 1.69 larvae, respectively. The cultivars, Asha, Takila, BC-305, Zennith, Pruktor, Domon

Table I: Comparison of larval population of DBM per 20 leaves on different genotypes cultivars of cabbage during years 2007 and 2008

Cabbage genotypes	Mean larval population per 20 leaves	
	2007	2008
Green Challenger	6.25 a	7.27 a
Summer Green	6.25 a	7.19 a
Green Globe	6.17 a	7.50 a
Asha	2.83 b	Not included in this year
Takila	2.83 b	
BC-305	2.81 b	
Zennith	2.73 b	4.67 b
Pruktor	2.71 b	4.75 b
Domon	2.67 b	4.98 a
HTCV-9089-08	2.60 b	Not included in this year
SSP-2200	1.79 c	
KS-Cross	1.69 cd	
CB-60	1.46 cd	1.85 d
Clandia F1,H, Broccoli	1.38 cd	1.98 d
Adavanta	1.27 d	2.21 cd
LSD Value at $P = 0.05$	0.38	0.31
F-value	157.15**	467.09
CV%	31.92	15.67

Means sharing similar letters are not significantly different by DMR Test

and HTC-9089-08 possessed 2.83, 2.83, 2.81, 2.73, 2.71, 2.67 and 2.60 larvae, respectively, showing intermediate response and had non-significant difference among them. The cultivar SSP-2200 with 1.79 larvae showed non-significant difference with those of recorded on KS-Cross, BC-60 and Clandia F1, H, Broccoli. Fluctuation of larval populations on different genotypes is shown in Fig. 1. A Significant peak population of larvae was seen in first and second week of November; however, there was only one peak i.e., November 08, during the season 2007.

Final screening (Year 2008): The results (Table I) revealed that maximum larval population of *P. xylostella* was recorded (7.50) in cultivar Green Globe, which had non significant difference with Green Challenger and Summer Green having 7.27 and 7.19 larvae, respectively. The minimum larval population of the pest (1.85) was recorded in cultivar CB-60-F1, H and it showed non-significant difference with Clandia F1, H, Broccoli (1.98 larvae) and Adavanta 1402 (2.21 larvae). The cultivar Domon and Pruktor with 4.98 and 4.75 larvae did not show significant difference between each other and were ranked as intermediate. The Pruktor showed non significant difference with Zennith (4.67 larvae). From these results Green Globe with maximum larvae population of the pest proved to be the most susceptible, whereas, CB-60-F1, H was resistant with minimum larval population of *P. xylostella*. The trend of seasonal and peak infestation in the year 2008, as well, was same as witnessed in previous year.

Based on the results obtained during years 2007 and 2008 Green Challenger, Summer Green and Green Globe were categorized as susceptible, Adavanta, Clandia F1, H, Broccoli as resistant and Domon, Pruktor, Zennith as intermediate accounting larval populations in these years. The present findings cannot be compared with those of Abro and Wright (1989), Syed and Abro (2003), Sharma et

Fig. 1: Comparison of larval population of DBM per 20 leaves at various dates of observation on cabbage during 2007

LSD value at P 0.05 =0.356, F. value = 212.36; CV = 31.92%. Means sharing similar letters are not significantly different by DMR Test

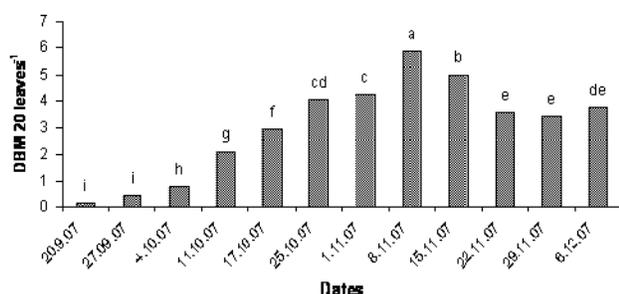
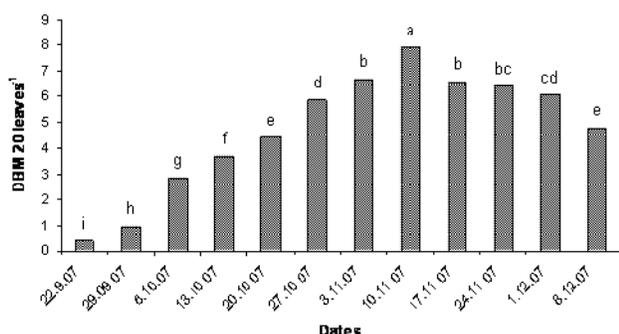


Fig. 2: Comparison of larval population of DBM per 20 leaves at various dates of observation on cabbage during 2008

LSD value at P0.05 =0.34; F value = 366.58; CV = 15.67%. Means sharing similar letters are not significantly different by DMR Test.



al. (2004), Rafiq (2005), Jankowska (2005) and Sarfraz *et al.* (2007) as they studied different cultivars of cauliflower for their resistance/susceptibility against *P. xylostella*, however, these studies enabled to classify cultivars on the basis of larval population alone. The leaf/fruit damage was not considered as an important indicator for this classification, thus in a way the methodology adopted in the present studies are in line with previous work.

The present findings are not in conformity with those of above and many other studies in which pest infestation time has been reported different; this variation is not due to cultivars but to the geographical locations. It is generally accepted that *P. xylostella* infestation in Pakistan generally commences by late July and extends until April (Attique *et al.*, 2006). The months of October and November are important as peak infestation time period for DBM under Faisalabad conditions. Further studies are required to find out mechanism of resistance in resistant genotypes in relation to variation in climatic and geographical feature and effect of these on crop phenology.

REFERENCES

- Abro, G.H. and D.J. Wright, 1989. Host plant preference and the influence of different cabbage cultivars on the toxicity of abamectin and cypermethrin against *Plutella xylostella* Lepidoptera: Plutellidae. *Ann. Appl. Biol.*, 115: 481–487
- Abro, G.H., A.L. Jayo and T.S. Syed, 1994. Ecology of diamondback moth, *Plutella xylostella* (L.) in Pakistan 1. Host plant preference. *Pakistan J. Zool.*, 26: 35–38
- Attique, M.N.R., A. Khaliq and A.H. Sayyed, 2006. Could resistance to insecticides in *Plutella xylostella* (Lep., Plutellidae) be overcome by insecticide mixtures? *J. Appl. Entomol.*, 130: 122–127
- Bhatti, M.A., M. Saeed, N. Chatta and S. Iqbal, 1976. Host Plant resistance and importance to insect population suppression in cotton crop. *Proc. Cott. Prod. Seminar*, pp: 132–142. ESSO, Pakistan Fertilizer Co., Ltd Dhaliwal, G.S. and V.K. Dilawari, 1993. *Advances in Host Resistance to Insect*. Kalyani Publishers, New Delhi, India
- Eigenbrode, S.D. and S.K. Pillai, 1998. Neonate *Plutella xylostella* responses to surface wax components of a resistant cabbage (*Brassica oleracea*). *J. Chem. Ecol.*, 24: 1611–1627
- Irshad, M. and A.I. Mohyuddin, 1990. Efficacy of microbial pesticides [bactospeine] against *Plutella xylostella* (L.) (Plutellidae: Lepidoptera) in Pakistan. In: Ahmad, M. (ed.), *Proceedings of Eight Pakistan Congress of Zoology*, pp: 257–261. Lahore, Pakistan
- Jankowska, B., 2005. A comparison of the occurrence of diamond back moth, *Plutella xylostella* L. (Lepidoptera, Plutellidae) on different cabbage vegetables. *Vegetable Crops Res. Bull.*, 62: 153–163
- Khaliq, A., M.N.R. Attique and A.H. Sayyed, 2007. Evidence for resistance to pyrethroids and organophosphates in *Plutella xylostella* (Lepidoptera: Plutellidae) from Pakistan. *Bull. Entomol. Res.*, 97: 191–200
- Mushtaque, M., S.A. Hasan and A.I. Mohyuddin, 1986. *Plutella xylostella* (L.) (Plutellidae: Lepidoptera), a pest of crucifers in Pakistan. *Proceed. 5th Pakistan Congr. Zool.*, pp: 191–197. University of Karachi, Karachi, Jan. 8-11
- Rafiq, M.N., 2005. Insecticide resistance in diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae) and strategies of its management. *Ph.D. Thesis*, p: 125. University Arid Agriculture, Rawalpindi, Pakistan
- Saeed, R., A.H. Sayyed, S.A. Shad and S.M. Zaka, 2010. Effect of different host plants on the fitness of diamond-back moth, *Plutella xylostella* (Lepidoptera: Plutellidae). *Crop Protect.*, 29: 178–182
- Sarfraz, M., L.M. Dossall and B.A. Keddie, 2007. Resistance of some cultivated Brassicaceae to Infestations by *Plutella xylostella* (Lepidoptera: Plutellidae). *J. Econ. Entomol.*, 100: 215–224
- Sharma, A., H.S. Kanwar, U.K. Kohli and A.K. Verma, 2004. Response of cauliflower genotypes for resistance to the diamondback moth, *Plutella xylostella* (L.) and cabbage white butterfly, *Pieris brassicae* (L.). *Pest Manage. Econ. Zool.*, 12: 7–15
- Shuaib, M., S.H. Khan and S.M.R. Kazmi, 2007. Effect of different a biotic factors on population dynamic of insect pests on cabbage crop (*Brassica oleracea* L.) in Dera Ghazi Khan District, Punjab, Pakistan. *8th Afr. Crop Sci. Soci. Conf.*, pp: 943–946. El-Minia, Egypt, Oct. 27-31
- 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. *Pakistan J. Biol. Sci.*, 6: 1891–1896
- Syed, T.S., 2003. Management of *Plutella Xylostella* (L.) on cruciferous vegetable crops. *Ph.D. Thesis*, Sindh Agriculture University, Tando Jam, Pakistan
- Talekar, N.S. and A.M. Shelton, 1993. Biology, Ecology and Management of the diamondback moth. *Annu. Rev. Entomol.*, 38: 275–301

(Received 21 March 2012; Accepted 05 April 2012)