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Oviposition and larval survival of diamondback moth (*Plutella xylostella*) on Indian mustard under protected field conditions

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Abstract

Incidence of Indian mustard var. Pusa Bold and Pusa Jaikisan on the oviposition of *Plutella xylostella* (Order Lepidoptera: Family, Plutellidae) has significantly (P<0.05) preferred to oviposit on cauliflower (control) as compared to Indian mustard in both choice and no-choice tests. In the choice test, females preferred to lay more eggs on Pusa Bold than on Pusa Jaikisan. In the experiment conducted in the month of October (2017-18), female oviposits significantly (P<0.05) highest number of eggs laid by *P. xylostella* was recorded in the month of October and the smallest in January 2017-18, and 2018-19 where 72.05 eggs/female on cauliflower. Fecundity of *P. xylostella* was found significantly (P<0.05) highest on cauliflower as compared to Indian mustard. Cauliflower received a maximum number of eggs (225.72) during the experiment in the month of October but fecundity tends to decrease from November to January. Pusa Bold is significantly (P<0.05) more preferred by female *P. xylostella* to lay eggs than that of Pusa Jaikisan. The Pusa Jaikisan may be more effective for integrated pest management of brassica crops.

Key words: Cauliflower, Indian mustard, *P. xylostella*, Pusa Bold, Pusa Jaikisan, oviposition

Introduction

India is the largest producer of vegetables in the world after China with an annual production of 101.43 million tonnes from 6.76 million ha of land (Rai and Pandey 2007). Cauliflower is most preferred winter vegetables and their total share in country's vegetable production is 6.1 and 4.4 percent, respectively (Anonymous 2005). The important insect pests associated with cauliflower are Diamondback moth (DBM), *Plutella xylostella* (Linn.) (Lepidoptera: Yponomeutidae) is a major and destructive insect pest of *Brassicaceous* crops worldwide (Sarfaraz *et al.,* 2005). Krishnakumar *et al.,* (1984) have estimated a 52 percent loss in marketable cabbage due to DBM attack while Srinivasan (1984) reported 90-92 percent loss could occur if cauliflower is left unprotected and also vary from 30-100 percent (Lingappa *et al.,* 2000). Whereas it

causes an annual loss of US $ 16 million (Mohan and Gujar, 2003) and outbreaks of DBM in South East Asia sometimes have caused more than 90 percent losses (Talekar and Shelton 1993). Although diamondback moth outbreaks are sporadic, it is always present during the growing season, 1997 and 1998, Shanghai, China in 1992 and 1994 where losses were estimated to be 99 percent and 80 percent respectively (Zhao *et al.,* 1996), Kenya in 1995 (Kibata 1996), Western Australia in 2001 and New South Wales in 2002 (Endersby *et al.,* 2003). Use of intercropping provides an excellent opportunity as an ecological approach in pest management. According Aung *et al.,* (2020) The Intercropping is one of the cultural control methods. It involves the cultivation of two or more crops simultaneously in the same field and intercropping can reduce pest population because of the diversity of crops grown. Intercropping affects the pest by microclimate through changes in crop canopies (Bach and Tabashnik, 1990, and Wu *et al.,* 1999). For some crop insect's situation in cropping has reduced pest population because the plants act as a physical barrier to the movement of pest insect. Natural enemies are more abundant and or the chemical or visual communication between pest insect and their host plant is disrupted (Risch 1981). The present study effect of Indian mustard on the oviposition and larval survival of diamondback moth were carried out to find a most suitable variety of brassica crops that can be used as potential management of *P. xylostella* under different condition.

Materials and methods

The experiment was conducted at the field Department of Plant Protection, Faculty of Agricultural sciences, A.M.U. Aligarh for two Rabi seasons: 2017 and 2018. Oviposition and larval survival of *P. xylostella* was studied on cauliflower and Indian mustard var. Pusa Bold and Pusa Jaikisan under protected field condition (no-choice test) for two consecutive years from 10th September of 2017-18 and 2018-19. Soil with farm yard manure (FYM) in a ratio of 3:1 and then they were kept under protected condition to avoid insect infestation. Thinning was done 30 days after sowing where only one plant is left in a single earthen pot and plants (40 days after sowing) were exposed to adults. Five potted host plants were kept under the nylon cage (1x1x1m) and five pairs of newly emerged adults obtained from the stock culture were released in the cage. Sugar solution soaked in cotton was kept inside the cage for feeding the adults. The host plants were removed from the cage after 24 hr and the experiment was replicated 10 times. The plants were then kept in cages covered with fine nylon netting under field condition so that parasites and predators may be avoided. 100 eggs were selected on the plants of known age for construction of stage specific life table. Hatched and unhatched eggs were counted. The same method was adopted for other host plants. Stage specific, fertility table and life indices were calculated as described earlier. Finally, the data was analyzed statistically by application of correlation, and ANOVA and further subjected to test of significance. Daily maximum and minimum temperatures were also recorded for two years with reference method of Wilson and Barnett (1983).

Results and discussion

Oviposition (Choice test): Pots containing plant of Pusa Bold, Pusa Jaikisan and a cauliflower were kept in a nylon cage measuring 1x1x1x mt and 5 pairs of adults of *P. xylostella* were released inside the cage and sugar solution socked in cotton also kept in the nylon cage. The potted plants were removed after 2 days of exposure and fresh pots containing above mentioned plants were

introduced in cage and it was carried out till the death of adult respectively (Table 1) Eggs were counted on each plant and then calculated the average number of eggs/females. The experiment was replicated three times. The plants containing eggs were kept under protected condition for further observation. Ahmad *et al*., 2008 reported female diamondback moth laid 200 eggs on *Brassica juncea* in field condition while as 140-175 egg in laboratory condition

Oviposition (No-Choice test): Pots containing plant of Pusa Bold, Pusa Jaikisan and cauliflower were exposed individually for no-choice test. A single plant was kept under a nylon cage measuring 1x1x1mt and then one pair of adults was released into the cage for two days along with sugar solution soaked in cotton as a food source for adult. The potted plant was removed from the cage and replaced by another potted plant for another two days and the same was repeated till the death of adults. Eggs were counted on the plant and these potted plants were kept under protected condition for further observation. Five replicates were made for each host plant i.e., Pusa Bold and Pusa Jaikisan and a parallel control for cauliflower was also run for each replicate.

Table 1: Effect of Indian mustard on the oviposition of *P. xylostella* under protected field condition

Host Cropping season 2017-18	Choice test		No-Choice test	
	Total no. of eggs / 5 females	Average no. of eggs / female	Total no. of eggs / 5 females	Average no. of eggs / female
Pusa Bold	185.76±2.92^{b}	37.15±1.18^{b}	624.82±2.34^{b}	124.96±1.76^{b}
Pusa Jaikisan	152.48±1.20^{a}	30.49±1.17^{a}	585.55±2.91^{a}	117.11±1.18^{a}
Cauliflower	685.24±2.93^{c}	137.04±2.32^{c}	1128.64±7.52^{c}	225.72±2.32^{c}
LSD *P*=0.05	3.03	0.98	6.57	1.75
Pusa Bold	168.24±1.75^{b}	33.64±1.17^{b}	528.22±1.74^{b}	105.64±1.75^{b}
Pusa Jaikisan	136.12±1.74^{a}	27.24±1.21^{a}	454.54±1.75^{a}	90.90±1.18^{a}
Cauliflower	504.68±1.76^{c}	100.93±2.93^{c}	1016.46±3.49^{c}	203.29±1.75^{c}
LSD *P*=0.05	1.87	0.71	5.94	1.25
Pusa Bold	134.42±1.74^{b}	26.88±1.20^{b}	448.32±1.74^{b}	89.66±1.75^{b}
Pusa Jaikisan	105.94±1.72^{a}	21.18±1.17^{a}	365.85±1.18^{a}	73.17±1.74^{a}
Cauliflower	415.56±1.74^{c}	83.11±2.92^{c}	813.92±4.65^{c}	162.78±1.17^{c}
LSD *P*=0.05	1.73	0.63	5.53	1.19
Pusa Bold	114.88±1.74^{b}	22.97±1.19^{b}	412.96±1.17^{b}	82.59±1.18^{b}
Pusa Jaikisan	85.54±1.75^{a}	17.11±1.17^{a}	285.38±1.74^{a}	57.07±1.18^{a}
Cauliflower	360.26±3.49^{c}	72.05±2.33^{c}	675.66±2.34^{c}	135.13±2.32^{c}
LSD *P*=0.05	1.67	0.57	4.18	1.08

Values not followed by same letter are significantly different (P=0.05) by DMRT

Analyzed result (Table 2) showed that female *P. xylostella* has significantly (*P*<0.05) preferred to oviposit on cauliflower (control) as compared to Indian mustard in both choice and no-choice tests. In choice test, females preferred to lay more eggs on Pusa Bold than to on Pusa Jaikisan. The experiment conducted in the month of October; female oviposits significantly (*P*<0.05) more eggs on Pusa Bold than Pusa Jaikisan but highest number of eggs deposited by female *P. xylostella* on cauliflower. Almost similar results

obtained in the month of November, December and January. Fecundity of *P. xylostella* is considerably decreased from November to January. It is also found that highest of number of eggs laid by *P. xylostella* was recorded in the month of October, 2008 and smallest in January, 2009 where 76.52 eggs/female on cauliflower.

No-Choice test

Fecundity of *P. xylostella* was found significantly (P<0.05) highest on cauliflower as compared to Indian mustard. Cauliflower received maximum number of eggs (228.94) during the experiment in the month of October but fecundity tends to decrease from November to January. Pusa Bold is significantly (P<0.05) more preferred by female *P. xylostella* to lay eggs than that of Pusa Jaikisan. In the month of October, 125.75 eggs were laid by a female on Pusa Bold while, 118.47 eggs on Pusa Jaikisan. According some investigation that the effect of intercropping to reduce infestation of diamondback moth on cabbage. (Karavina *et al*., 2014). They found that onion, tomato, garlic and chilli (pepper) can be used as intercrops to reduce DBM infestation on cabbage because of their repellent ability. Furthermore, mustard, Chinese cabbage and collard can also be used as trap crop (Singhamuni and Hemachandra 2013).

Table 2: Effect of Indian mustard on the oviposition of *P. xylostella* under protected field condition

Host Cropping season 2017-18	Choice test		No-Choice test	
	Total no. of eggs / 5 females	Average no. of eggs / female	Total no. of eggs / 5 females	Average no. of eggs / female
Pusa Bold	188.92±2.64^{b}	37.78±1.15^{b}	628.78±2.38^{b}	125.75±1.74^{b}
Pusa Jaikisan	156.84±2.12^{a}	31.36±1.18^{a}	5.92.38±2.82^{a}	118.47±1.62^{a}
Cauliflower	694.68±3.25^{c}	138.93±2.34^{c}	1144.68±6.82^{c}	228.94±2.34^{c}
LSD P=0.05	2.98	0.92	6.62	1.72
Pusa Bold	174.28±1.82^{b}	34.85±1.18^{b}	535.26±1.78^{b}	107.05±1.73^{b}
Pusa Jaikisan	142.18±1.78^{a}	28.43±1.24^{a}	462.46±1.64^{a}	92.49±1.16^{a}
Cauliflower	517.52±1.84^{c}	103.50±2.88^{c}	1034.62±3.62^{c}	206.92±1.74^{c}
LSD P=0.05	1.82	0.73	5.88	1.34
Pusa Bold	138.24±1.54^{b}	27.64±1.21^{b}	435.23±1.38^{b}	87.04±1.74^{b}
Pusa Jaikisan	112.88±1.48^{a}	22.57±1.18^{a}	372.92±1.52^{a}	74.58±1.73^{a}
Cauliflower	428.65±1.72^{c}	85.73±2.92^{c}	862.78±3.84^{c}	172.56±1.18^{c}
LSD P=0.05	1.76	0.65	5.46	1.22
Pusa Bold	119.64±1.65^{b}	23.92±1.18^{b}	418.62±1.24^{b}	83.72±1.18^{b}
Pusa Jaikisan	88.72±1.72^{a}	17.75±1.16^{a}	292.82±1.68^{a}	58.56±1.17^{a}
Cauliflower	382.62±3.38^{c}	76.52±2.34^{c}	686.74±2.45^{c}	137.34±2.34^{c}
LSD P=0.05	1.63	0.54	4.06	1.14

Values not followed by same letter are significantly different (P=0.05) by DMRT

Conclusion

Effect of Indian mustard var. Pusa Bold and Pusa Jaikisan on the oviposition of *P. xylostella* were concluded that preference of female diamondback moth for egg laying on cauliflower (control) as compared to Indian mustard in two different type tests choice and no-choice tests. In choice test, female lay more eggs on Pusa Bold than to on Pusa Jaikisan. Fecundity of *P. xylostella* was found highest on

cauliflower as compared to Indian mustard. Cauliflower received maximum number of eggs during the experiment in the month of October but fecundity tends to decrease from November to January. The Indian mustard of different variety can be used trap crop in between cabbage and cauliflower production for management of diamondback moth. For advancement of rural areas and promote the use of Integrated pest management to avoid uses of chemical is necessary that farmers should be trained for intercropping of mustard crop for management of diamondback moth.

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