Int.J.Curr.Microbiol.App.Sci **(2018) Special Issue-6: 2339-2346**

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7692 **Special Issue-6 pp. 2339-2346**
Journal homepage: http://www.ijcmas.com

Original Research Article

Evaluation of Crop-Crop Diversity Pattern for Incidence of Pod Borer Complex in Pigeonpea

M. M. Deshmukh*, B. B. Bhosle and B. V. Bhede

Department of Agricultural Entomology, Vasantarao Naik Marathwada Krishi Vidyapeeth, Parbhani – 431402, Maharashtra, India
**Corresponding author*

Keywords

Pigeonpea, intercopping system, *H. armigera*, *M. obtusa*, *E. atomosa*

A B S T R A C T

The field experiment was carried out during kharif 2011-12 and 2012-13 at Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani to understand the influence of cropping system on incidence of pod borer complex. The pooled results indicated that all the intercropping system reduced the incidence *H. armigera*, *M. obtusa* and *E. atomosa* population. With regard to pod damage at green pod stage pooled results showed that pigeonpea + sorghum intercropping recorded minimum green pod damage (11.53 and 16.82 per cent) by *H. armigera* and *M. obtusa*, respectively. Maximum green pod damage (15.95 and 23.03 per cent) by *H. armigera* and *M. obtusa* respectively was recordedin pigeonpea + soybean treatment. There were no significant differences in green pod damage by *E. atomosa*. With regard to grain damage by H. armigera and M. obtusa, pigeonpea + sorghum treatment proved best recorded 6.53 and 14.81 per cent grain damage respectively and pigeonpea + soybean recorded maximum grain damage (8.98 and 20.7 per cent) by *H. armigera* and *M. obtusa*, respectively. All intercropping system were superior than sole pigeonpea.

Introduction

Pigeonpea *Cajanus cajan* (L.) Millp. is an important pulse crop after gram, which is widely cultivated throughout India. It is also known by names like arhar, red gram or tur, grown in *Kharif* season of tropics and sub-tropics. Dominant producers of this crop are the countries in the India subcontinent, Africa and Central America.

In the tropics, intercropping is an important component of small farm agriculture, the reason for evolution of these cropping systems may be the lower incidence of insect pest and yield of two crops. The lower incidence of pest might be due to the factors like increased parasitoid and predator population, availability of alternative prey, decreased colonization and reproduction in pest, chemical repellency making feeding inhibition by odor from non-host plant, prevention of emigration in pests and optimum synchrony. These factors were likely to be important in pest regulation in intercropping system (Bhatnagar and Davies, 1976). Hence the present investigations were carried out to understand the effect of intercropping on incidence of pod borer complex (*Helicoverpa armigera*, *Melanagromyza obtusa* and *Exelastis* atomosa) and their damages in pigeonpea.

Materials and Methods

The field experiment was carried out during *Kharif* season of 2011 and 2012, at the experimental farm of the Department of Agril. Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). To understand the influence intercropping system on incidence of pod borer complex (*H. armigera*, *M. obtusa* and *E. atomosa*) in pigeonpea. The investigation was laid out in randomized block design in four replications with variety BDN-711. All the recommended cultural and agronomical practices were followed homogeneously in all the treatments to raise the good crop. The pigeonpea variety BDN-711 sown in first week of July on plots measuring 6.3m X 5.4m. Following five intercropping system were evaluated for incidence of pod borer complex as well as pod damage in pigeonpea. The details of experiment given below.

The field observations on larval population of *H. armigera, M. obtusa* and *E. atomosa* as well as population of natural enemies were recorded. The observations on green pod damage were recorded by collecting fifty pods randomly at weekly interval and brought to the laboratory in polythene bags. The numbers of healthy and damaged pods were recorded by dissecting individual pods and per cent green pod damage was calculated for individual pod borer complex. Dry pod and grain damage by individual pod borer complex was recorded after harvest of pigeonpea crop.

At harvest five plants were randomly selected from each plot and observed for the individual pod borer damage. The per cent pod damage was calculated by counting the total number of healthy pods and infested pods. Hundred randomly selected pods at harvest were observed for the number of seed damage by the borer and pod fly. Finally per cent grain damage was calculated by using formula

$$\% \text{ infestation of grain} = \frac{\text{Weight of infested grain}}{\text{Weight of total grains}} \times 100$$

From the above observations, the best intercropping system was recommended in order to evolve most effective preventive measures for the effective management of pod borer complex in pigeonpea. Finally the data was analyzed statistically.

Results and Discussion

The effectiveness of various intercropping system against pod borer complex presented in the form of per cent pod damage at green pod stage and harvest stage and grain yield and the larval count of pod borer complex. The results of experimentation revealed that during *kharif* 2011-12. The lowest population of *H. armigera* (1.80 /plant) was recorded in pigeonpea + sorghum treatment followed by pigeonpea + black gram 1.90/plant and pigeonpea + green gram treatment (2.20/plant). These treatments are at par with each other. The highest population of *H. armigera* was recorded in pigeonpea + soyabean treatment (2.65 /plant) and at par with sole pigeonpea (2.60/plant). During *kharif* 2012-13 and pooled results indicated similar trend, lowest popuation was recorded in pigeonpea + sorghum treatment (1.75 and 1.77/plant) respectively. While pigeonpea + soybean recorded 2.62 and 2.63/plant respectively (Table 1). Regarding the incidence of *M. obtusa* pigeonpea + sorghum combination proved better recored 2.03, 2.10 and 2.06/pod during 2011-12, 2012-13 and pooled results. While highest population (2.72, 2.78 and 2.75/pod) was recorded in pigeonpea + soybean treatment respectively.

During 2011-12 there were no significant differences in population of *E. atomosa* in different cropping system. Similar results were obtained during *kharif* 2012-13. However, pooled results also indicated no significant differences in *E. atomosa* population in various cropping system which may be due to negligible population of *E. atomosa* (Tale 1). These results are in conformity with those of Deokar *et al.*, (1983) also reported that pigeonpea intercropped with pearl millet in 2:1 row proportion recorded higher incidence of *H. armigera* in intercropping than in pure crop of pigeonpea. The experiment conducted on research farm of CRIDA on eight intercrops with pigeonpea as the base crop during rainy season of 2003, 2004 and 2005 revealed that the density of *H. armigera* population differed significantly across intercropping systems. Sole crop had higher infestation and intercropping with sorghum and castor reduced the infestation.

With regard to pod damage at green pod stage during *kharif* 2011-12, minimum green pod damage by *H. armigera* (11.02 per cent) was noticed pigeonpea + sorghum treatment followed by pigeonpea + black gram (13.02/per cent) and 13.80 per cent pod damage was noticed in pigeonpea + green gram treatment. These are on par with each other. Maximum pod damage was recorded in pigeonpea + soybean treatment (15.90 per cent) which was on par with sole pigeonpea (15.30 per cent). While, during 2012-12, maximum green pod damage by *H. armigera* was recorded in sole pigeonpea (16.40 per cent) and minimum pod damage was noticed in pigeonpea + sorghum treatment (12.05 per cent). Pooled results indicated similar trend, maximum pod damage was recorded in pigeonpea + soybean treatment (15.95 per cent) and minimum pod damage (11.53 per cent) in pigeonpea + sorghum treatment (Table 2).

Green pod damage by *M. obtusa* was minimum (16.60, 17.05 and 16.82 per cent) in pigeonpea + sorghum tretment during 2011-12, 2012-13 and in pooled results, respectively. During 2011-12, maximum green pod damage by *M. obtuse* (23.05 per cent) was noticed in pigeonpea + soybean treatment and during 2012-13, it was maximum (23.12 per cent) in sole pigeonpea. Pooled results showed maximum green pod damage (23.03 per cent) by *M. obtusa* in pigeonpea + soybean treatment. There were no significant differences in green pod damage by *E. atomosa* in different cropping system in both seasons as well as in pooled data (Table 2).

During *kharif* 2011-12, minimum dry pod damage by *H. armigera* (12.60 per cent) was noticed in pigeonpea + black gram treatment. This was on par with pigeonpea + green gram and pigeonpea + sorghum treatments which recorded 13.05 and 13.10 per cent pod damage, respectively. Pigeonpea + soybean treatment recorded maximum (14.04 per cent) pod damage which was on par with sole pigeonpea (13.78 per cent). During *kharif* 2012-13, maximum dry pod damage by *H. armigera* was observed in pigeonpea + soybean treatment (14.07 per cent) followed by sole pigeonpea (13.40 per cent). Minimum dry pod damage (12.05 per cent) was noticed in pigeonpea + black gram treatment. This was on par with pigeonpea + sorghum and pigeonpea + green gram treatments which recorded 12.50 and 13.02 per cent pod damage, respectively. Similar trends of dry pod damage were noticed in pooled data (Table 19). Pigeonpea + black gram treatment recorded minimum (12.32 per cent) dry pod damage. This was on par with pigeonpea + sorghum and pigeonpea + green gram treatments which recorded 12.81 and 13.03 per cent pod damage, respectively.

Table.1 Average population of pod borer complexin different cropping system in pigeonpea

Treatments	Population of *H. armigera* (larve/plant)			Population of *M. obtusa* (maggots and pupae/pod)			Population of *E. atomosa* (larve/plant)		
	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
Pigeonpea + Sorghum	1.80* (1.52)	1.75 (1.50)	1.77 (1.50)	2.03* (1.59)	2.10 (1.61)	2.06 (1.60)	1.70* (1.48)	1.70 (1.48)	1.70 (1.48)
Pigeonpea + Soybean	2.65 (1.77)	2.62 (1.77)	2.63 (1.77)	2.72 (1.80)	2.78 (1.81)	2.75 (1.80)	1.80 (1.52)	1.78 (1.51)	1.79 (1.51)
Pigeonpea + Green gram	2.20 (1.64)	2.30 (1.67)	2.25 (1.65)	2.45 (1.72)	2.40 (1.71)	2.42 (1.71)	1.60 (1.45)	1.60 (1.44)	1.60 (1.44)
Pigeonpea + Black gram	1.90 (1.54)	2.05 (1.60)	1.97 (1.56)	2.12 (1.62)	2.20 (1.64)	2.16 (1.63)	1.70 (1.48)	1.60 (1.45)	1.65 (1.46)
Sole pigeonpea	2.60 (1.76)	2.50 (1.73)	2.55 (1.74)	2.67 (1.78)	2.72 (1.80)	2.69 (1.78)	1.70 (1.48)	1.68 (1.48)	1.69 (1.48)
SE ±	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.02	0.02
CD at 5%	0.10	0.11	0.10	0.10	0.09	0.09	NS	NS	NS

Figures in parentheses are $\sqrt{X + 0.5}$ transformed values.
*Average of 15 MW observations

Table.2 Damage in green pods bypod borer complexin different cropping system in pigeonpea

Treatments	Damage in green pods by *H. armigera*(%)			Damage in green pods by *M. obtusa* (%)			Damage in green pods by *E. atomosa*(%)		
	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
Pigeonpea + Sorghum	11.02* (19.39)	12.05 (20.31)	11.53 (19.84)	16.60* (24.04)	17.05 (24.38)	16.82 (24.21)	8.00* (16.43)	8.40 (16.84)	8.20 (16.63)
Pigeonpea + Soybean	15.90 (23.49)	16.02 (23.56)	15.95 (23.52)	23.05 (28.69)	23.00 (28.74)	23.03 (28.71)	8.88 (17.33)	9.18 (17.63)	9.03 (17.47)
Pigeonpea + Green gram	13.80 (21.78)	15.20 (22.96)	14.50 (22.37)	20.25 (26.74)	21.15 (27.38)	20.70 (27.05)	8.02 (16.45)	8.42 (16.87)	8.22 (16.66)
Pigeonpea + Black gram	13.02 (21.15)	14.07 (22.03)	13.54 (21.59)	18.40 (25.38)	19.16 (25.95)	18.78 (25.66)	8.20 (16.63)	9.00 (17.45)	8.60 (17.04)
Sole pigeonpea	15.30 (23.04)	16.40 (23.86)	15.85 (23.45)	22.25 (28.14)	23.12 (28.62)	22.62 (28.38)	8.48 (16.92)	9.00 (17.45)	8.74 (17.18)
SE ±	0.13	0.15	0.14	0.11	0.06	0.09	0.15	0.16	0.16
CD at 5%	0.41	0.48	0.43	0.34	0.19	0.26	NS	NS	NS

Figures in parentheses are Angular transformed values.
*Average of 15 MW observations

Table.3 Damage in dry pods bypod borer complexin different cropping system in pigeonpea

Treatments	Damage in dry pods by *H. armigera*(%)			Damage in dry pods by *M. obtusa* (%)			Damage in dry pods by *E. atomosa*(%)		
	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
Pigeonpea + Sorghum	13.10	12.55	12.81	14.20	15.05	14.62	6.45	6.50	6.47
	(21.13)	(20.69)	(20.92)	(22.13)	(22.82)	(22.47)	(14.71)	(14.77)	(14.73)
Pigeonpea + Soybean	14.04	14.07	14.06	20.80	21.05	20.92	7.00	7.00	7.00
	(21.95)	(22.03)	(21.98)	(27.11)	(27.31)	(27.20)	(15.34)	(15.34)	(15.33)
Pigeonpea + Green gram	13.05	13.02	13.03	19.07	20.00	19.53	6.80	7.07	6.93
	(21.17)	(21.15)	(21.16)	(25.89)	(26.54)	(26.21)	(15.11)	(15.42)	(15.26)
Pigeonpea + Black gram	12.60	12.05	12.32	17.02	17.48	17.25	6.40	6.50	6.45
	(20.79)	(20.31)	(20.54)	(24.37)	(24.71)	(24.53)	(14.65)	(14.77)	(14.70)
Sole pigeonpea	13.78	13.40	13.59	20.00	20.70	20.35	7.02	7.65	7.33
	(21.78)	(21.45)	(21.61)	(26.56)	(27.06)	(26.80)	(15.37)	(16.05)	(15.71)
SE ±	0.09	0.10	0.09	0.14	0.06	0.11	0.12	0.12	0.12
CD at 5%	0.30	0.31	0.29	0.45	0.21	0.33	NS	NS	NS

Figures in parentheses are Angular transformed values.

*Average of 15 MW observations

Table.4 Grain damage bypod borer complexin different cropping system in pigeonpea

Treatments	Grain damage by *H. armigera*(%)			Grain damage by *M. obtusa* (%)			Grain damage by *E. atomosa*(%)		
	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
Pigeonpea + Sorghum	7.05	6.02	6.53	14.32	15.30	14.81	4.00	4.20	4.10
	(15.37)	(14.21)	(14.78)	(22.24)	(23.02)	(22.62)	(11.54)	(11.82)	(11.67)
Pigeonpea + Soybean	9.12	8.85	8.98	20.20	21.20	20.7	5.40	5.40	5.40
	(17.58)	(17.30)	(17.44)	(26.70)	(27.41)	(27.05)	(13.43)	(13.43)	(13.43)
Pigeonpea + Green gram	8.15	7.40	7.77	18.60	19.52	19.06	4.82	4.70	4.76
	(16.59)	(15.78)	(16.18)	(25.55)	(26.22)	(25.88)	(12.68)	(12.52)	(12.60)
Pigeonpea + Black gram	7.60	7.02	7.31	16.65	17.42	17.03	4.20	4.15	4.17
	(16.00)	(15.37)	(15.68)	(24.08)	(24.67)	(24.37)	(11.82)	(11.75)	(11.78)
Sole pigeonpea	8.70	8.00	8.35	19.50	20.30	19.90	5.00	5.02	5.01
	(17.15)	(15.43)	(16.78)	(26.18)	(26.78)	(26.47)	(12.92)	(12.95)	(12.93)
SE ±	0.11	0.13	0.12	0.11	0.12	0.11	0.15	0.13	0.41
CD at 5%	0.36	0.42	0.37	0.34	0.37	0.34	NS	NS	NS

Figures in parentheses are Angular transformed values.

Crop	**Variety**
Pigeonpea	BDN-711
Sorghum	PVK-801
Soybean	MAUS-71
Green gram	BM-4
Black gram	BDU-1

Treatment details	**Ratio**	**Spacing**
T-1 Pigeonpea + Sorghum	2:4	45cm x 15cm
T-2 Pigeonpea + Soybean	2:4	45cm x 7.5cm
T-3 Pigeonpea + Green gram	2:4	45cm x 7.5cm
T-4 Pigeonpea + Black gram	2:4	45 cm x 7.5cm
T-5 Sole pigeonpea		90cm x 15cm

Maximum pod damage (14.07 per cent) was recorded in pigeonpea + soybean treatment followed by 13.59 per cent pod damage in sole pigeonpea. During *kharif* 2011-12, dry pod damage by *M. obtusa*was maximum (20.80 per cent) in pigeonpea + soybean treatment. While it was minimum in pigeonpea + sorghum treatment (14.20 per cent). Similar trends was noticed during 2012-13 and in pooled data indicated minimum dry pod damage (15.05 and 14.62 per cent) in pigeonpea + sorghum treatment respectively. pigeonpea + soybean treatment recorded maximum dry pod damage by *M. obtuse* (21.05 and 20.92 per cent) respectively during 2012-13 and in pooled data. There were no significant differences in dry pod damage by *E. atomosa* in different cropping system in both seasons as well as in pooled data (Table 3). The present findings are in consonance with the findings of earlier workers. Yadav *et al.,* (1992) also reported that incidence of *M. obtusa* on pods was significantly less (9.4 per cent) when intercropped with green gram in comparison with sole crop in which incidence was maximum (10.7 per cent) during the year 1984. During the year 1985, the incidence on pods by *M. obtusa* was significantly less (7.8 per cent) in pigeonpea + green gram intercropping than sole crop (8.3 per cent). Ameta and Bhardwaj (1995) also reported that the per cent pod damage to the pods by all five species of pod borers in blackgram + pigeonpea intercrop was 24.96 and 26.11 per cent which was 43.98 and 49.23 per cent lower than the per cent damage to pods in sole pigeonpea crop during 1990 and 1991, respectively. Yelshetty *et al.,* (2009) also found the similar results and reported that, pigeonpea + sorghum at the ratio 1:2 proved better by recording lowest pod damage of 28.56 and 34.97 per cent during 2000 and 2001, respectively over sesame (71.46 and 68.16 per cent). Pattar *et al.,* (2012) studied the effect of intercropping on gram pod borer in chickpea and noticed that significantly lower pod damage was recorded in chickpea + sunflower intercropping system (19.50 per cent) compared to sole chickpea recorded pod damage to an extent of 24.28 per cent. Overall per cent dry pod damage was minimum in intercropping than in sole pigeonpea. Overlapping of pod formation and flowering of pigeonpea with ear-head formation of sorghum might have reduced the feeding damage to main crop pigeonpea by the pest. These findings agree with those of Amoako Atta *et al.,* (1983) and Duffield and Reddy, (1977).

With regard to grain damage by *H. armigera* during *kharif* 2011-12, it is observed that minimum grain damage (7.05 per cent) was recorded in pigeonpea + sorghum treatment and maximum grain damage (9.12 per cent) was observed in pigeonpea + soybean treatment similarly during *kharif* 2012-13 and in pooled data minimum grain damage (6.02 and 6.53 per cent) recorded in pigeonpea + sorghum treatment, respectively. Similar trend was noticed in grain damage by *M. obtusa* during *kharif* 2011-12, 2012-13 and in pooled data, indicated 14.32, 15.30 and 14.81 per cent grain damage in pigeonpea + sorghum treatment, respectively. There were no significant differences in grain damage by *E. atomosa* in different cropping system in both seasons as well as in pooled data (Table 4).The present results are discussed in the light of findings of previous workers as Yadav *et al.,* (1992) studied the effect of crop management practices on the incidence of *M. obtusa* in 1984 and 1985 and found that grain damage was 3.8 per cent in sole crop and 3.3 per cent in pigeonpea + green gram intercropping. Ameta and Bhardwaj (1995) also observed that the incidealence of pod borer complex was found to be less in intercropping system than in sole pigeonpea crop. The experiment conducted on research farm of CRIDA also revealed the similar results, pigeonpea + sorghum registered lowest level of grain damage (15.15 per cent) and the intercrop groundnut and blackgram also reduced the grain damage (Srinivasa Rao *et al.,* 2006). Overall per cent grain damage was less in intercropping system as compared to sole pigeonpea. This is may be due to overlapping of pod formation and flowering of pigeonpea with ear-head formation of sorghum which might have reduced the feeding damage to main crop pigeonpea by the pests.

Acknowledgments

The authors are thankful to the Department of Science and Technology (DST), New Delhi for providing financial assistance through the release of INSPIRE fellowship is gratefully acknowledged.

References

Ameta, O.P. and Bhardwaj, S.C. 1995. Influence of intercropping vis-à-vis insecticides on the major insects pests of pigeonpea *Cajanus cajan* L. Millsp. *Indian J. Appl. Ent.,* 9: 49-57.

Amoaka-Atta, B. Omolo, E. O. and Kidega, E. K. 1983. Influence of maize, cowpea and sorghum intercropping systems on stem pod borer infestations. *Insect Science and its Application,* 4: 47-57.

Bhatnagar, V.S. and Davies, J.C. 1976. Intercropping studies, cropping system Entomology, *ICRISAT Annual Report*, pp: 17-25.

Deokar, A.B., Barud, R.W. and Umarani, N. K. 1983. Incidence of pod borer on pigeonpea cultivars under intrcropping. *International Pigeonpea Newsletter,* 2-61-62.

Duffield, S. J. and Reddy, Y. V. R. 1997. Distribution and increment of predators of *Helicoverpa armigera* in intercropped sorghum and short duration pigeonpea. *Crop Research,* 14: 315-355.

Pattar, P.S., Mansur, C.P., Alagundagi, S.C. and Karbantanal, S.S. 2012. Effect of intercropping systems on gram pod borer *Helicoverpa armigera* Hubner and its natural enemies in chickpea. *Indian J. Ento.*, 74 (2): 136-141.

Srinivasa Rao, M., Rama Rao, C. A., Ramkrishana, Y. S., Srinivas, K., Sreevani, G. and Vittal K. P. R. 2006. Crop-crop diversity as a key component of IPM in pigeonpea. *Research Bulletin*, CRIDA, Hyderabad, India.

Yadav, L.S., Choudhary, J.P. and Yadav, P. R. 1992. Effect of crop management practices on the incidence of *M. obtusa* Malloch in pigeonpea *Indian J. Ento.*, 52 (2): 109-114.

Yelshetty, S., Gopali, J. B., Tegelli, R. and Narayana, D. 2009. Validation of integrated pest management modules for the management of pod borer, *Helicoverpa armigera* (Hubner) and Fusarium wilt in pigeonpea based intercropping system. *Karnataka J. Agric. Sci.*, 22 (3-spl. Issue): 529-531.