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Impact of Intercrops on Insect Pests of Blackgram, *Vigna mungo* L.

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ABSTRACT

The effect of intercrops viz., ground nut, sorghum and pearl millet with blackgram on different insect pests was studied in Tamil Nadu, India under irrigated conditions. Blackgram+intercrops were raised in different ratios at 3:1, 4:1 and 5:1. The incidence of insect pests, whitefly *Bemisia tabaci*, leaf hopper *Empoasca kerri*, defoliator *Madurasia obscurella*, pod borers *Maruca vitrata, Lampides boeticus, Helicoverpa armigera* were assessed on blackgram. The predatory coccinellid population was also recorded in different intercropping situations. The results revealed that the sucking pests *B. tabaci* and *E. kerri* population was low in the intercropped blackgram when compared to sole crop. The legume pod borer and other pod borer damage were low in the sorghum intercropped blackgram. The non-leguminous cereals intercropped blackgram plants had low pest incidence as well as higher coccinellid population.

Key words: Intercrops, blackgram, *B. tabaci, E. kerri*, pod borers, coccinellids

INTRODUCTION

Pulses are important dietary component in South Asia and growing legume pulses enriches soil health due to the root nodule fixing atmospheric nitrogen in soil. Pulses in India have long been considered as the poor man's only source of protein. India accounts for 33% of the world area and 22% of the world production of pulses. However, the potential yield is very low and insect pests are major constraint in pulse production. More than 250 insect pests are reported to affect pulses in India. Among the pests affecting pulse crops, nearly twelve insect species causes considerable yield loss in blackgram. Due to decline in productivity, the net availability of pulses has come down from 60 g/day/person in 1951 to 31 g/day/person in 2008. Annually about 2.0 to 2.4 million tonnes of pulses with approximate monetary value of Rs.6000 crores are lost due to the damage caused by insect pest (Reddy, 2009). Important insect pests attacking pulses during vegetative stage are whitefly, leafhopper, thrips, black aphid, bihar hairy caterpillar, stemfly (Singh and Kumar, 2003). *Maruca vitrata* (Geyer) is an important internal pod borer causing serious damage to tropical grain legumes apart from *Helicoverpa armigera*, *H. legume* pod borer, *M. testulalis* Geyer and African boll worm *H. armigera* are important pests of grain legumes viz., common bean, lablab, chickpea, lima bean and greengram causing pod as well as seed damage (Muthomi *et al.*, 2008). Conventional methods of pulse improvement through development of insect pest resistant varieties have not succeeded because of unavailability of suitable donors for crossing programme and efficient screening technique besides, chemical insecticides causes environmental problems and leads to the development of insecticide resistance (Sharma *et al.*, 2002). Use of insecticides in the short duration crops leads to health hazards and possibility of insecticides resistant development. Chemical insecticides cause ecological imbalance and also accumulate residues in the produces (Pappas *et al.*, 2011). Use of botanicals and aqueous extracts of tropical plants considerably reduces major pests particularly legume pod borer and pod bugs in cowpea (Mbonu, 2006) and mixture soap, water and kerosene with naphthalene were also found effective in reducing the sucking pests and pod borers in cowpea (Oparaeke *et al.*, 2006). Utilizing the natural agro diversity and altering the microclimate is one of the cultural method and novel approach. Properly planned cropping systems involving crop rotation or intercropping of non-host crops are cost effective components of IPM. A study on impact of different intercrops along with blackgram was tested against insect pest incidence in blackgram.

MATERIALS AND METHODS

Field experiments were conducted during kharif (June-Sep) season of 2009 and 2010 at National Pulses Research Centre, Tamil Nadu Agricultural University, Vamban, (Latitude 11° 30' N; Longitude 79° 26' E Tamil Nadu, India with 10 different treatments and replicated four times. Three intercrops viz., groundnut *Arachis hypogaea* (var. Co 3), sorghum *Sorghum bicolor* (Var. Co S 28) and pearl millet *Pennisetum thypoides* (local cultivar) at 3 different ratios viz., 1:3, 1:4, 1:5 with blackgram var. VBN -3. Each treatment was raised in a plot size of 8×6 m in a randomized block design with a spacing of 30×10 cm. The treatments are T_1-Blackgram+Ground nut (3:1), T_2-Blackgram+Ground nut (4:1), T_3-Blackgram+Ground nut (5:1), T_4-Blackgram+Sorghum (3:1), T_5-Blackgram+Sorghum (4:1), T_6-Blackgram+Sorghum (5:1), T_7-Blackgram+Pearl millet (3:1), T_8-Blackgram+Pearl millet (4:1), T_9-Blackgram+Pearl millet (5:1), T_{10}-Blackgram pure crop.

The incidence of insect pests viz., flea beetle *M. obscurella*, whitefly *B. tabaci*, leaf hopper *E. kerri* and coccinellid predators were recorded during vegetative stage of the crops. The flea beetle incidence was recorded at 15 Days After Sowing (DAS), while whitefly and leafhopper incidence was recorded at weekly intervals from 15 DAS to 35 days upto 50% flowering. The coccinellid predator species observed during the period were *Cheilomenes sexmaculatus* and *Coccinella transversalis*. The flea beetle incidence was recorded based on damage in the young leaves. Observations were taken randomly on 5 plants in each replication on 15 DAS and number of leaves damaged by *M. obscurella* was expressed in percentage. The sucking pest *B. tabaci* and *E. kerri* population were recorded on five plants in random, 3 leaves per plant and at weekly intervals the observations were recorded. The coccinellid predators were recorded as number of coccinellid adults per plant.

During flowering and reproductive stage of the crop, the incidence of legume pod borer, *M. vitrata* was observed based on the number of web larva per plant at 40 DAS. The damage on the pods by different pod borers was recorded in the harvested pods. The pod borers like *H. armigera*, *L. boeticus* and *M. vitrata* were recorded based on the damage hole on the pods. The damage hole of *H. armigera* is bigger in size and irregular in shape whereas, *L. boeticus* larval damage in smaller in size. In case of *Maruca* the pods are with silken tunnel and two or three pods attached with each other and hole is small in size (Soundararajan and Chitra, 2011). The pod borer complex in the harvested pods were recorded in about 500 pods collected in each replication and sorted out based on the damage hole by different borers. The data were expressed in perecent and cumulative damage was worked out.

Statistical analysis: The data collected were transformed into angular or square-root values as per the standard requisites (Gomez and Gomez, 1984). The experiments were subjected to statistical scrutiny following the method of Panse and Sukhatme (1989) and the means were compared with Least Significant Difference (LSD).

RESULTS AND DISCUSSION

Significant difference was observed in the sucking pests (df = 9,39, F = 20.89, p = 0.05), leaf beetle (df = 9,39, F = 2.75, p = 0.05), predator (df = 9.39, F = 16.82, p = 0.05) and pod borer complex (df = 9.39, F = 12.14, p = 0.05) among different intercropping systems statistically (p = 0.05%) during the two year field experiments (Table 1). In 2009 trials, the early season pest *M. obscurrella* incidence was high in the pure crop with the leaf damage of 72.85%. Though all intercropped blackgram plants showed less damage than pure crop, sorghum intercropped with blackgram plants at 1:3 ratio had least damage of 44.50% whereas, 1:4 ratio had 49.30% and 1:5 ratio recorded 47.50% damage. The overall mean of different ratio of sorghum intercropped blackgram plants recorded the damage of 47.10% and in case of ground nut intercrop system it was 55.55% damage by the leaf beetles. Among the groundnut intercropped system 1:5 ratio intercropped plots had low damage of 50.70% by the beetles. In pearl millet intercropped system the damage by flea beetle was 61.10, 54.60 and 55.70% in 1:3, 1:4 and 1:5 ratio, respectively. In 2010 experimental trials also less damage (41.45%) by *M. obscurrella* was observed in sorghum intercrop at 1:5 ratio with blackgram plants. The mean of three ratios of sorghum intercropped system was recorded low as 44.51% damage followed by groundnut intercrop (49.03%). In a study carried out on groundnut intercropped with cowpea, sesamum, greengram, castor and redgram at early stage of the crop (upto 3 weeks) all redgram reduces pest population compared to that of in groundnut (Ganiger *et al*., 2009). In the present study the defoliator *M. obscurella* incidence was observed upto 70% in early stage of the crop in sole blackgram. However, the damage was less in sorghum intercropped blackgram indicates the role of non-leguminous crops on the incidence of the flea beetle (Fig. 1). During the two year experiments, the intercropped blackgram plants had less damage by the flea beetle. Though all intercropped blackgram plants showed less damage than pure crop, sorghum intercropped with blackgram plants at 1:3 ratio had least damage (44.50%). When pearl millet intercropped with blackgram the damage was 54.60-61.1%.

Table 1: Influence of intercrops on sucking pests and coccinellids in blackgram

Treatments	Leaf damage by *M. obscurella* (%)		*B. tabaci* population (No./leaf)		*E. kerri* population (No./leaf)		Predator coccinellid (No./plant)	
	2009	2010	2009	2010	2009	2010	2009	2010
T_1	56.90	42.41	0.95	2.35	1.25	2.05	1.20	1.20
T_2	59.05	49.48	1.50	2.05	1.40	2.30	1.85	1.70
T_3	50.70	55.20	0.65	2.70	0.65	2.70	2.70	0.95
T_4	44.50	43.48	0.85	1.55	0.25	1.15	4.30	3.90
T_5	49.30	48.60	0.351	1.70	0.30	1.05	5.10	4.15
T_6	47.50	41.45	1.50	1.90	0.35	0.85	4.75	4.05
T_7	61.10	49.20	1.20	1.85	0.35	2.20	4.30	3.90
T_8	54.60	48.85	1.65	2.20	0.50	1.80	4.10	3.55
T_9	55.70	51.40	1.60	2.00	0.30	1.85	3.75	3.90
T_{10}	72.85	66.30	1.95	3.65	1.50	2.50	1.50	1.05
SED	4.11	2.84	0.09	0.11	0.11	0.17	0.18	0.16
CD (0.05)	8.43	5.83	0.18	0.22	0.23	0.34	0.38	0.30

In a column means followed by the same letters are not significantly different at p = 0.05

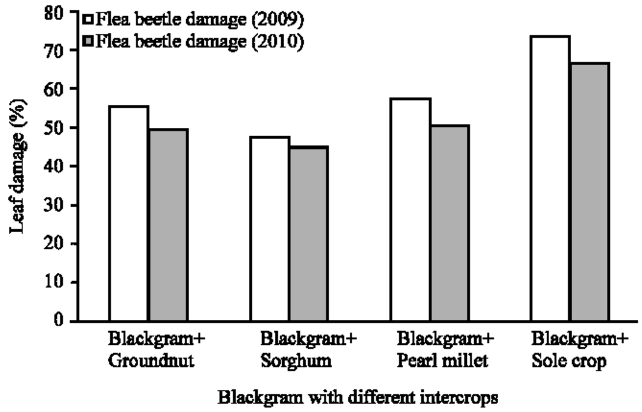

Fig. 1: Mean flea beetle on blackgram during 2009 and 2010

The incidence of sucking pests *B. tabaci* (1.95 and 3.65/leaf) and *E. kerri* (1.50 and 2.50/leaf) was high in pure crop. *B. tabaci* population was low (0.35/plant) in sorghum intercropped blackgram plants at 1:4 ratio during 2009. Population of whitefly in other sorghum intercropped plots was 0.85/leaf and 1.50/leaf in 1:3and 1:5 ratio, respectively. The average whitefly population in the sorghum based intercropping system was 0.90/plants, whereas in pearl millet system the population was 1.48/plants which was higher than ground nut based systems (1.03/plant). In pearl millet intercropped blackgram *B. tabaci* population was 1.20, 1.65, 1.60/plant in 1:3, 1:4, 1:5 ratio, respectively. In the pure crop whitefly population was recorded maximum of 1.95/plant during the period. The overall whitefly incidence was more during 2010 compared to previous year experiment. In the pure blackgram plots the whitefly population was 3.65/leaf during 2010. Sorghum intercropped blackgram plants at 1:3 ratio had the lowest whitefly population (1.55/plant). The incidence of *B. tabaci* was less than 2/plant in blackgram plants at three different ratios of sorghum (1.55, 1.70, 1.90/plant) intercrop. The overall mean whitefly population was 1.72/plant in sorghum intercropping systems followed by pearl millet intercropping systems (2.02/plant). In the ground nut intercropped plots the blackgram plants had the population of 2.35, 2.05 and 2.70/plant in 1:3, 1:4, 1:5 ratio, respectively. The leaf hopper population was low in the sorghum intercropped blackgram plants. During 2009, the leaf hopper incidence was low (0.25/plant) in 1:3 ratio whereas, in 2010, 1:5 ratio sorghum:blackgram plots had low population (0.85/plant). In ground nut intercropped plots the population of *E. kerri* was high in 1:3 and 1:4 ratios (1.25 and 1.40/plant). In the pure crop the leaf hopper population was 1.50/plant. In general, the leaf hopper incidence was also high during 2010 trials compared to 2009. In 2010 trials, the incidence was maximum in pure blackgram plants (2.50/plant). The mean leaf hopper population in different intercropping system showed sorghum with blackgram had low leafhopper incidence of 0.85/plant in 1:5 ratio during the period. In a study on greengram intercropped with pearl millet the pulse crop recorded minimum thrips incidence followed by greengram-sorghum and greengram-maize combination with statistically parity (Sreekant *et al.*, 2004). In the present study though thrips incidence was not noticed during the periods of the study, the other sucking pests *B. tabaci* and *E. kerri* population was low in the sorghum and pearl millet intercropped with blackgram compared to sole blackgram crop. The sucking pests *B. tabaci* and *E. kerri* was high in sole blackgram crop than intercropped plots. *B. tabaci* population was 1.55/plant in sorghum intercropped blackgram plants at 1:3 ratio during 2010. In pure crop the population was 3.65/plant. Leaf hopper population was

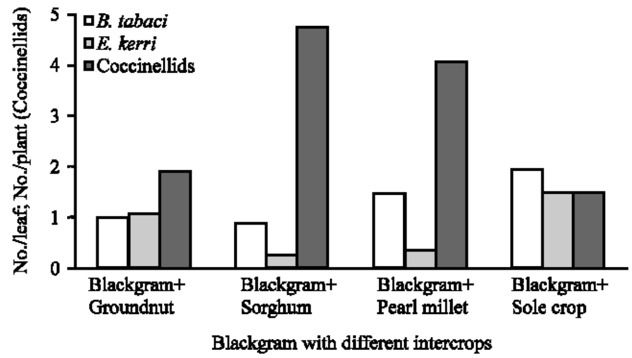

Fig. 2: Mean population of sucking pests and coccinellids on blackgram (2009)

low (0.85/plant) in sorghum intercropped at 1:5 ratio whereas, in pure crop it was 2.50/plant. In pearl millet intercropped plots also the whitefly population was low (1.85, 2.20, 2.00/plant) compared to the pure crop and it clearly indicates the role of the graminaceous tall intercrops on hindering the *B. tabaci* and *E. kerri* activity.

Sorghum as intercrop reduced leafhopper infestation in pigeonpea (Sekhar *et al.*, 1997) and in groundnut (Nath and Singh, 1998). The leafhopper infestation was reduced by the presence of various intercrops like cluster bean, greengram, blackgram in cotton (Balasubramanian *et al.*, 1998). In pigeonpea- sorghum intercrop system, rapid growth of sorghum resulting in shading and suppression of growth and vigour of pigeonpea plants. Plants suppressed in this way become less attractive to a pest and provide less suitable food source. Gold *et al.* (1990) found that the suppressed plants were less effective interceptors of the weekly flying insects like leafhoppers and whiteflies.

The predatory coccinellid population was more in all the intercropped systems than the pure blackgram. The highest coccinellid population was observed in 1:4 sorghum intercropped blackgram plants during the two year experiments (5.10 and 4.15/plant, respectively for 2009 and 2010). Pearl millet intercropped blackgram had the coccinellid population of 4.3, 4.10 and 3.75/plant, respectively for three different ratios in 2009. The overall coccinellid population was more than 4.00/plant in sorghum and pearl millet intercropped blackgram plants in 2009. Similar trend was observed in 2010 also however, the population was less compared to previous year. In sorghum intercropped blackgram plants the population was 4.03/plants whereas, in pearl millet system it was 3.78/plant. In groundnut intercropped system the population was 1.92 and 1.28/plant, respectively in 2009 and 2010. Earlier studies on predators in pigeonpea intercropping system revealed that predator coccinellids and spiders showed a clear preference for sorghum as intercrop where number peaked during flowering stage of pigeonpea (Rao *et al.*, 2003a). The short duration pigeonpea intercropped with sorghum and also castor recorded higher population of predators followed by medium duration pigeonpea with sorghum and castor. In another study leaf hopper *E. kerri* infestation level was assessed in the same ecosystems. Sorghum and castor as intercrop reduced the leafhopper infestation significantly than the sole pigeonpea crop (Rao *et al.*, 2003b). In the present experiment with pulse ecosystem demonstrated a similar results that sorghum intercropped blackgram plants had less leaf hopper *E. kerri* and more coccinellid population (Fig. 2). More coccinellid beetles were recorded in sorghum intercropped blackgram plants as 5.10 and 4.15/plant, respectively during 2009 and 2010 field experiments. There was common practice in part of semi-

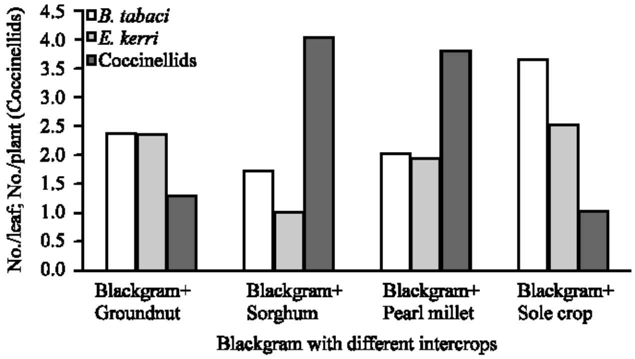

Fig. 3: Mean population of sucking pests and coccinellids on blackgram (2010)

arid tropics that intercropping groundnut with pearl millet and maize and this practice could reduce plant mortality due to bud necrosis disease by about 10% (Wightman and Amin, 1988) which was possible only by inhibiting the activity of the vector. The dominant predators *Coccinella* sp. and *Menochilus sexmaculatus* and the dominant parasitoids *Chelonus* sp. were found controlling sucking pests like thrips significantly (Kennedy *et al.*, 1990). Sorghum as intercrop was found to significantly increase the natural enemies viz., *Laius malleifer*, *C. septempunctata*, *Orius* sp. and *Cheilemenes sexmaculata* which effectively controlled thrips infesting groundnut (Singh *et al.*, 1991). In the present study also the intercrops sorghum and pearl millet had more predatory coccinellid population which might be the reason for the lower sucking pests incidence (Fig. 3). Several other studies recorded reduced disease incidence when other crops were intercropped with pearl millet (Sharma and Varma, 1975; Wightman and Amin, 1988; Ganapathy and Narayanasamy, 1991) and sorghum (Ganapathy and Narayanasamy, 1991). Intercropping bulb onion with vegetables carrot, spider plant and French bean were found in reducing the foliar diseases such as downy mildew and purple blotch (Narla *et al.*, 2011). Even growing trees with annual crops like rice, Jhau-rice intercrop system reduces four major diseases such as bacterial leaf blight, sheath blight and brown spot in rice (Monjur Alam *et al.*, 2002).

There was significant difference in the pod borer complex in different intercropped systems of blackgram. Among different intercrops, sorghum intercropped system had the low *M. vitrata* larval population (3.18/plant) whereas, the pure crop had maximum larval population (9.50/plant) during 2009. Among the different ratio 1:4 sorghum: blackgram had lowest larval population (2.55/plant). At 1:3 and 1:5 ratios the web larva population was 3.55 and 3.45/plant, respectively. In ground nut intercrop system the mean larval population of three ratios was 4.25/plant and in pearl millet system it was 4.90/plant. In pure crop, the blackgram plants had maximum larval population of 9.50/plant. In 2010 also sorghum intercrop system had low larval population (2.75/plant) in the 1:3 ratio plots. On average sorghum based intercropped blackgram had the larval population of 3.08/plants followed by pearl millet based (5.67/plant) and groundnut based (7.45/plant) system. In the pure crop the larval population was high compared to all other treatment plots (9.70/plant). Nwilene *et al.* (2011) reported that intercropping maize and cassava with NERICA rice varieties reduces the stem borer damage in rice and concluded that maize act as a trap crop and cassava as refuge for generalist predators against stem borers. When cotton and okra raised as mixed crop highest boll worm *Earias* spp. infestation recorded on okra mono crop (Abro *et al.*, 2004).

Table 2: Influence of intercrops on pod borers in blackgram

			Damage in harvested pods (%)							
	M. vitrata larva/plant		*M. vitrata*		*L. boeticus*		*H. armigera*		Cumulative pod borer damage	
Treatments	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
T_1	4.86	7.14	11.40	12.15	4.00	3.10	2.60	1.50	18.00	16.75
T_2	5.23	8.80	10.30	12.30	4.00	3.05	1.30	0.95	15.60	16.30
T_3	2.65	6.40	9.50	11.80	5.15	3.10	0.65	0.75	15.30	15.65
T_4	3.55	2.75	8.20	8.90	5.30	2.35	1.35	1.90	14.85	12.40
T_5	2.55	3.10	8.70	9.05	4.15	2.10	1.90	0.95	14.75	11.95
T_6	3.45	3.40	9.30	8.15	4.80	2.85	1.85	1.20	15.95	13.10
T_7	5.50	4.75	11.30	13.20	4.10	3.05	0.95	0.90	16.35	17.15
T_8	4.35	6.15	11.85	14.10	4.70	3.10	0.50	1.15	17.05	18.35
T_9	4.85	6.10	14.10	13.80	5.35	3.00	0.70	0.75	20.15	17.55
T_{10}	9.50	9.70	16.50	20.40	6.15	5.80	2.20	2.95	24.85	29.15
SED	0.11	0.14	0.19	0.06	0.18	0.19	0.18	0.15	0.18	0.06
CD (0.05)	0.22	0.29	0.39	0.13	0.37	0.38	0.37	0.31	0.36	0.12

In a column means followed by the same letters are not significantly different at p = 0.05

In the harvested pods the damage by legume pod borer *M. vitrata* is higher than the other pod borers (Table 2). In 2009, maximum pod damage was recorded in pure crop of blackgram (16.50%) and minimum damage in sorghum intercropped plants (8.73%) followed by ground nut intercropped blackgram plants (10.40%). Among sorghum based intercrop system, 1:3 ratio had the lowest pod damage (8.20%) compared to other two ratios (8.70 and 9.30%). In ground nut intercropped blackgram the damage by *M. vitrata* was 11.40, 10.30 and 9.50%, respectively. In pearl millet intercropped blackgram plants the damage was 11.30, 11.85 and 14.10, respectively. The pod damage by *M. vitrata* is higher in 2010 trials and the damage was 20.40% in the pure crop. Sorghum intercropped at 1:3 ratio had the lowest damage (8.15%) and overall mean damage in three sorghum based ratios was 8.70%. Blue butterfly *L. boeticus* damage was low in the groundnut intercropped blackgram plants (4.38%) in 2009. The maximum damage was recorded in pure crop (6.15%). In sorghum intercropped plants the damage was 5.30, 4.15 and 4.80% in 1:3, 1:4 and 1:5 ratio, respectively. During 2010 field experiment the damage by blue butterfly was least in sorghum intercropped at 1:4 ratio blackgram plants 2.10% followed by 1:3 (2.35%) and 1:5 (2.85%). In ground nut intercropped plots the damage in three different ratios was 3.10, 3.05 and 3.10%, respectively. Highest damage was observed in the pure crop (5.80%). The gram pod borer, *H. armigera* damage was low in pearl millet based cropping system as the damage recorded 0.95, 0.50 and 0.70%, respectively for 1:3, 1:4 and 1:5 ratios during 2009 field experiments. Highest damage was observed in pure cropped blackgram plants (2.20%). In sorghum intercropped plots the damage ranged between 1.35 and 1.90%. In 2010, the damage was less (0.75%) in groundnut intercropped at 1:5 ratio and pearl millet intercropped at 1:5 ratio. However, the cumulative pod borer damage was less in sorghum based blackgram intercropping system as the mean of three ratios was 15.18% during 2009 trials. The cumulative damage in three ratios of sorghum intercropped blackgram plants were 14.85, 14.75 and 15.95%, respectively. In blackgram pure crop the cumulative damage was 24.85%. Cumulative damage during 2010 experiments also recorded low in sorghum intercropped blackgram plants as the damage in three different ratio crops were 12.40, 11.95 and 13.10%, respectively. The mean of three ratios sorghum intercropped blackgram

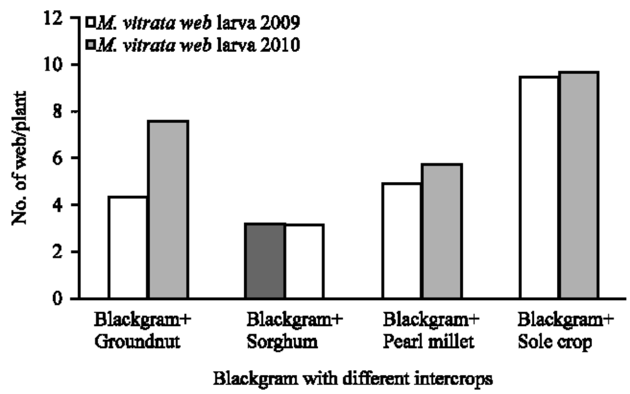

Fig. 4: Mean *M. vitrata* web larval population on blackgram during 2009 and 2010

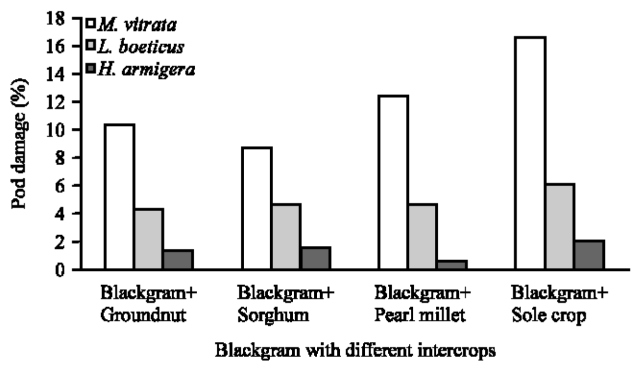

Fig. 5: Mean pod damage by pod borers in blackgram (2009)

plants was 12.48% damage and highest in the pure crop (29.15%). In groundnut intercropped plots the cumulative damage was 16.75, 16.30 and 15.65%, respectively for three ratios. In case of cotton strip intercropped with sorghum, redgram, *Crotalaria orchroleuca* population of *H. armigera* and other phytophagous insect was lower in the strip intercropped than in pure cotton crop and the total number of natural enemies was more abundant in the cotton strip intercropping (Chamuene *et al.*, 2007). Though *H. armigera* is not a major problem in blackgram the incidence was recorded up to 2.65 and 2.90% damage on harvested pods in the present study. The major pod borer in blackgram is legume pod borer *M. vitrata* which causes damage in flowering stage as the larva web the flowers together, feed inside and also damage the pods. The larval population was low in the sorghum intercropped blackgram plants (Fig. 4) showed that the intercropping has significant influence on the insect rather larval feeding or oviposition by the adult insects. The damage in harvested pods also low in the sorghum intercropped blackgram followed next by pearl millet with blackgram (Fig. 5, 6). One well known reason was that all non-host cereals were good physical barriers (Ganapathy and Narayanasamy, 1991). In addition, results elsewhere revealed that intercropping with pearl millet significantly increased the natural enemies like coccinellid members. Lowest larval density of *Chilo partellus* (Swinh.) was recorded in sorghum-cowpea intercrop and highest density in sorghum-maize. The predators play a significant role and that intercropping sorghum with cowpea or maize does not interfere with their activity (Oloo and Ogeda, 1990). Use of trap crops, neem and *Trichogramma chilonis* (Ishii) as push-pull strategy in cotton increased the activity of

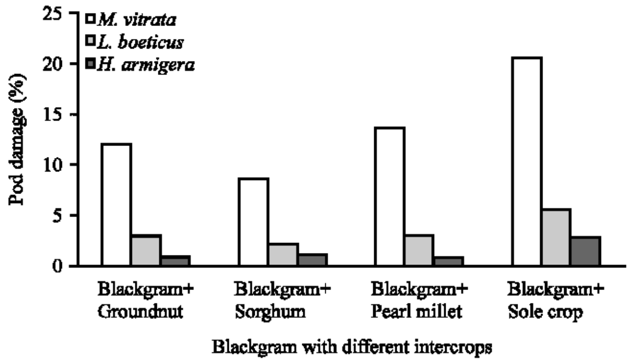

Fig. 6: Mean pod damage by pod borers on blackgram (2010)

parasitoids and reduce *H. armigera* incidence. Neem seed kernel extract applied on cotton crop leaving trap crop okra and pigeonpea 46 DAS found more parasitism in cotton (Duraimurugan and Regupathy, 2005). Evaluation of border cropping system in okra with maize, sorghum, pigeonpea and pearl millet revealed that maize border plots recorded highest number of parasitoids on aphids of okra. Some border crops have potential use in aphid management in okra crop and can be used in combination with border spraying in an integrated pest management strategy (Nderitu *et al.*, 2008).

In sesame, larval population of short borer *Antigastra catalunalis* was significantly reduced in intercropped plots compared to sesame sole crop. Intercropped grain yield was maximum in sesame with blackgram followed by cluster bean and greengram (Ahirwar *et al.*, 2009). Growing of non leguminous crops increased the yield of pulses in many cases and improve biological efficiency. When maize was intercropped with greengram as intercrop the yield has been increased by 4% (Akhtar *et al.*, 2000). Mudita *et al.* (2008) revealed that biological point of view greater efficiency would be achieved by adopting strip intercropping arrangement of 5 maize: 2 soybean rows as a cropping pattern. Association of different crops can minimize weed population also. When egusi-melon raised in association with maize and cowpea the weed population was suppressed (Emuh, 2007).

Components of intercrops are often less damaged by pest and disease organisms than when grown as sole crops but the effectiveness of this escape from attack often varies and unpredictable. The presence of associated plants in the intercrop can lead to attack escape in three ways, all involving lower population growth rate of the attacking organism. In one, the associates cause plants of the attacked component to be less good hosts; in the second, they interfere directly with activities of the attacker; and the third, they change the environment in the intercrop so that natural enemies of the attacker are favoured (Trenbath, 1993). Intercropping or trap cropping has been suggested as an important agronomic practice to reduce pest infestation levels on the main crops (Domagola *et al.*, 1992; Giraldo, 1993).

CONCLUSION

The present study concluded that intercropping sorghum a non-leguminous crop with blackgram had significant impact on the insect pests in blackgram. After large scale demonstrations the component can be well fit into integrated pest management systems in pulse ecosystem as environmentally safe and cost effective strategy in small farmers' holdings.

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