DOI: 10.2478/cerce-2019-0019 **Original Article**
Available online: www.uaiasi.ro/CERCET_AGROMOLD/
Print ISSN 0379-5837; Electronic ISSN 2067-1865

Cercetări Agronomice în Moldova
Vol. LII , No. 2 (178) / 2019: 186-196

ECO-FRIENDLY MANAGEMENT OF FLOWER THRIPS AND POD BORERS OF MUNGBEAN THROUGH SESAME INTERCROPPING

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Received: Apr. 01, 2019. Revised: July 13, 2019. Accepted: July 30, 2019. Published online: Oct. 18, 2019

ABSTRACT. Effectiveness of sesame intercropping in mungbean for the management of flower thrips and pod borer of mungbean was studied at Pulses Research Centre, Ishurdi, Pabna, Bangladesh, during two consecutive season of kharif-I 2017 and 2018. Sesame intercropping in mungbean reduced flower thrips infestation and pod borer infestation significantly in both the years. Among the intercropped treatments, mungbean: sesame at 2:2 row ratio arrangements was found the best intercropping arrangements in reducing flower thrips and pod borer infestation. Sesame intercropping showed statistically similar performance in reducing pod borer infestation, as like as insecticide spraying (Imitaf 20 SL @ 0.5 ml/l). Mungbean equivalent yield varied depending on the prevailing weather condition of the cropping season and market prices of both mungbean and sesame, but the total production was always higher in intercropped treatments than sole cropping of mungbean. Hence, sesame intercropping in mungbean might be eco-friendly management approach against flower thrips and pod borers of mungbean providing higher production and benefit.

Keywords: thrips infestation; borer infestation; row ratio arrangement; insecticide spraying.

INTRODUCTION

Mungbean (*Vigna radiata* L.) is one of the important pulse crops in Bangladesh. Due to availability of short duration varieties, farmers are becoming more interested in cultivating this valuable crop after harvesting rabi crops in kharif-I season. However, insect pests usually cause significant loss of this crop yield. More than 12 species of insect pests were found to infest mungbean in Bangladesh (Rahman *et al*., 2000). Among them, flower thrips and pod borers are the most important. Flower thrips (*viz. Megalurothrips distalis*

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Karny, *Megalurothrips usitatus* Bagnall and *Caliothrips indicus* Bagnall) are associated mostly with the damage of tender buds and flowers of mungbean. Severe infestation of thrips resulted flower shedding causing significant yield loss (Chhabra and Kooner, 1985; Lal, 1985). Pod borer is another insect pest causing significant yield reduction. The pod borer (*Maruca vitrata*) damages flowers, flower buds and developing or mature pods (Poehlman, 1991).

In Bangladesh, pod borers (*viz. Maruca vitrata*, *Helicoverpa armigera* Hubner and *Euchrysops* sp.) often cause serious problem resulting severe loss of the crop (Bakr, 1998). Farmers usually do not take any measure to control the insect pests due to its low profit margin. However, recent development of high yielding and short duration varieties and increased market value of mungbean, farmers become interested on the cultivation of mungbean following pest management measures. At present, insecticidal management is only method to control the insect pests, due to its easy availability. Because insecticides are costly, poor farmers of Bangladesh cannot always afford to use of insecticides. Moreover, use of insecticide is not environment friendly.

Hence, there is a need to develop eco-friendly alternate method to manage the pests. Agronomic practices, like intercropping, have been found very useful in managing the insect pests of many other crops.

Sesame (*Sesamum indicum* L.) is the second most important oilseed crop whose climatic requirement is similar to those of mungbean. It can be suitably fitted as intercrop in mungbean, that may reduce thrips and pod borer population by building up a cross barrier against the insect movement, physically interfere with the pest ability to find a host, emit chemicals and change in microclimate through change in crop canopy, that adversely affect the host. Therefore, the present study has been taken to determine the effect of sesame intercropping in suppressing flower thrips and pod borers damage in mungbean.

MATERIAL AND METHODS

The experiment was conducted at Pulses Research Center, Ishurdi, Pabna, Bangladesh, during two consecutive seasons of kharif-I 2017 and 2018. There were four different row ratio arrangements of sesame intercrops with sole mungbean and sole mungbean with insecticide spraying, considered as six treatments, *viz.* T_1 = Sole mungbean, T_2 = Mungbean : sesame (2 : 1 row ratio), T_3= Mungbean : sesame (2 : 2 row ratio), T_4 = Mungbean : sesame (3 :1 row ratio), T_5 = Mungbean : sesame (3 :2 row ratio), T_6 = Sole mungbean with spraying Imitaf 20 SL @ 0.5 ml/l

The experiment was laid out in randomized complete block design with three replications. To make sesame intercropping more profitable with efficient use of land, the plot size and row to row distance of intercropped treatments were assigned in convenient way, as the unit plot size was 4.8 m × 4 m with a distance

of 1 m between the plots and 1.5 m between the replications. The seeds of BARI Mung-6 and BARI Til-4 were sown on March 29 in rows with the spacing of 30 cm in each plot in both the years. The unit plot contains 16 rows × 4 m.

The plant populations of mungbean and sesame were maintained constant by keeping plant to plant distance 7 cm and 5 cm, respectively. Urea, triple super phosphate, muriate of potash and boric acid were applied in both sole and intercropped plots @ 40-90-40-7.5 kg/ha during final land preparation. Post sowing flood irrigation was done to provide sufficient soil moisture for seed germination to get optimum plant population in all the treatments. Insecticidal spray treatment, imidacloprid (Imitaf 20 SL @ 0.5 ml/l) was sprayed three times, first at 100% flowering (33 DAS), second at 100% podding (40 DAS) and third at seed developing stage (47 DAS) of the crop.

The population data for thrips in flowers were collected twice- one day after both first and second spraying. Thrips population was assessed from 20 opened flowers, which were randomly collected from two rows of each side of the sole mungbean plot, avoiding border and central rows. In case of sesame intercropped plots, thrips population data were collected from middle rows of the plots in between the sesame intercrops. The collected flowers were immediately opened on the white paper board and counted the adult and immature thrips present in the flowers.

At the maturity, pods of 10 randomly selected plants from the middle rows of each plot were collected and examined. The bored (infested) and the total numbers of pods were counted and the per cent pod infestation was calculated.

The pods of central four rows of each plot comprising 4.8 m^2 (1.2 × 4 m) area were harvested in incase of sole crop. In intercropped treatments, whole plot was harvested. The pods of both mungbean and sesame were then threshed; grains were cleaned and sun dried. The grains obtained from each plot were converted into kg/ha. The mungbean equivalent yield was computed by converting the yield of sesame in the the yield of mungbean on the basis of prevailing market prices of the commodity using following formula:

$$\text{Mungbean equivalent yield (in case of sesame)} = \frac{Yi \times Pi}{Pc}$$

where, Yi = Yield of sesame, Pi = Price of sesame and Pc = Price of mungbean.

The gross return and benefit cost ratio (BCR) was calculated on the basis of prevailing market prices of mungbean, sesame and cost of cultivation etc. The benefit cost ratio (BCR) was calculated as follows:

$$BCR = \frac{\text{Gross income}}{\text{Cost of cultivatio n}}$$

The experimental data were analyzed by Genstat software. The per cent infestation data were transformed by square root for statistical analysis. Mean comparisons for treatment parameters were compared using Duncan's Multiple Range Test at 5% level of significance.

RESULTS AND DISCUSSION

Effect of sesame intercropping and insecticide spraying on flower thrips infestation and thrips population in mungbean

Intercropping sesame in mungbean and insecticide spraying showed significant effect on flower

infestation and thrips population in mungbean flowers (*Table 1*).

During kharif-I 2017, significantly the lowest percentage of flower infestation (25.00%) was observed in mungbean sprayed with insecticide (Imitaf 20 SL), followed by mungbean intercropped with sesame at 2:2 row ratio. The highest percentage of flower infestation (61.83%) was observed in sole cropping of mungbean, which was higher, but statistically at par with mungbean intercropped with sesame at 2:1, 3:1 and 3:2 row ratio treatments.

In kharif-I 2018, the lowest percentage of flower infestation (63.33%) by thrips was observed in sole mungbean sprayed with insecticide (Imitaf 20 SL), which was statistically similar to all the intercropped treatments. The highest percentage of flower infestation (93.33%) was observed in sole mungbean. Among all the intercropped treatments, mungbean intercropped with sesame at 2:2 row ratios received significantly the lowest percentage of thrips infested flower.

The population of flower thrips also varied depending on sesame intercropping at different row ratio arrangements and insecticide spraying. During kharif-I 2017, the lowest number of thrips (6.00/ 20 open flowers) was observed in mungbean sprayed with insecticide (Imitaf 20 SL). The second lowest thrips population (13.50/ 20 open flowers) was observed in mungbean intercropped with sesame at 2:2 row ratio treatment, which was statistically identical to other intercropped treatments. Significantly the highest thrips population (26.67/ 20 open flowers) was found in sole cropping of mungbean.

Again, in kharif-I 2018, the lowest flower thrips population (31.00/ 20 open flowers) was also observed in mungbean sprayed with insecticide (Imitaf 20 SL), which was statistically identical to all the sesame intercropped treatments. Among the sesame intercropped treatments, the lowest number of thrips (36.33/ 20 open flower) was found in mungbean intercropped with sesame at 2:2 row ratio arrangements. Significantly the highest thrips population (64.33/ 20 open flowers) was found in sole cropping of mungbean. So, it revealed that intercropping sesame in mungbean reduced flower infestation and thrips population in the flowers (*Table 1*).

Hence, in both the years, it is observed that both flower infestation and thrips population were significantly lower in sesame intercropped plots than that of sole cropping of mungbean. It is likely that because of higher canopy, the sesame plant in intercropped plots builds up a cross-barrier against the thrips movement. Again, chemicals emitted from sesame plants might repel the flower thrips in mungbean. Manjunath *et al.* (2001) showed the similar effect of tomato, garlic and coriander intercropping in reducing thrips infestation in chilli. Shivaprasad *et al.* (2010) cited that garlic in two rows

alternated with every row of chilli helps to obtain good quality fruit yield of chilli through reducing leaf curl by reducing the population of thrips and mites. Parella and Lewis (1997) reported that mixed cropping habitat is likely to encourage thrips predators reduced thrips infestation. These natural enemies could have played a role in reducing the thrips population (Silveira *et al*., 2004). Afifi and Haydar (1990) reported that intercropping of onion and garlic with tomato found to decrease the level of thrips incidence by 79 to 85 percent. Other intercropping systems, which have significantly reduced thrips population and plant infestation include leek with clover (den Belder *et al.,* 2000), leek with carrot and clover with French bean (Kucharczyk and Legutowska, 2002).

Table 1 - Effect of sesame intercropping and insecticide spraying on flower thrips infestation and thrips population in mungbean at Pulses Research Center, Ishurdi, Pabna, Bangladesh, during kharif-I 2017 and 2018

Treatments	Flower infestation by thrips, %		Mean no. of thrips / 20 open flowers	
	2017	2018	2017	2018
Sole mungbean	61.83 a	93.33 a	26.67 a	64.33 a
Mungbean : sesame (2 : 1 row ratio)	59.17 a	83.33 ab	20.33 ab	45.67 b
Mungbean : sesame (2 : 2 row ratio)	40.00 b	75.00 ab	13.50 b	36.33 b
Mungbean : sesame (3 :1 row ratio)	55.83 a	81.67 ab	19.50 ab	44.00 b
Mungbean : sesame (3 :2 row ratio)	54.17 a	76.67 ab	18.33 b	40.67 b
Sole mungbean with spraying Imitaf 20 SL @ 0.5 ml/l	25.00 c	63.33 b	6.00 c	31.00 b

Note: In a column, treatment means having the same letter(s) are not significantly different by DMRT at 5% level.

Effect of sesame intercropping and insecticide spraying on pod borer infestation in mungbean

Sesame intercropping and insecticide (Imitaf 20 SL @ 0.5 ml/l) spraying showed very significant effect on pod borer infestation in mungbean. Intercropping and insecticide spraying reduced pod borer infestation significantly (*Table 2*). During kharif-I 2017, the lowest pod borer infestation (7.00%) was observed in mungbean intercropped with sesame at 2:2 row ratios, which was statistically identical to all intercropped treatments and the insecticide (Imitaf 20 SL) spraying. The highest pod borer infestation (12.83%) was observed in sole cropping of mungbean (*Table 2*).

In kharif-I 2018, the lowest pod borer infestation (8.42%) was observed in sole mungbean sprayed with insecticide, which was statistically identical to mungbean intercropped with sesame at 2:2 row

ratios, followed by other sesame intercropped treatments. The highest pod borer infestation (16.22%) was observed in sole mungbean (*Table 2*).

Again, per cent pod infestation reduction by sesame intercropping and insecticide spraying during kharif-I 2017 it ranged from 28.53 to 45.44% (*Table 2*). The highest percentage of pod borer infestation reduction (45.44%) was observed in mungbean intercropped with sesame at 2:2 row ratios. Sesame intercropping reduced 31.18 to 45.44% pod borer infestation in mungbean. Mungbean intercropped with sesame at 2:2, 3:2, 3:1 and 2:1 row ratios reduced 45.44%, 38.97%, 37.65 and 31.18%% pod borer infestation, respectively. The lowest percentage of pod infestation reduction (28.53%) was observed in sole mungbean spraying with insecticide (*Table 2*).

In kharif-I 2018, per cent pod infestation reduction in mungbean by sesame intercropping and insecticide spraying ranged from 29.16 to 48.08% (*Table 2*).

The highest percentage of pod borer infestation reduction (48.08%) was observed in sole mungbean sprayed with insecticide (Imitaf 20 SL). Sesame intercropping treatments reduced 29.16 to 43.03% pod borer infestation. Mungbean intercropped with sesame at 2:1, 3:1, 3:2 and 2:2 row ratios arrangements reduced 29.16%, 31.26%, 34.65% and 43.03%% pod borer infestation, respectively. The lowest percentage of pod infestation reduction (29.16%) was observed in mungbean intercropped with sesame at 2:1 row ratio arrangements (*Table 2*).

So, it is seen that sesame intercropping in mungbean provided equally the best performance in suppression of pod borer infestation, as like as insecticide spraying (Imitaf 20 SL). The sesame plant is erect and taller than mungbean. It is likely that because of higher canopy, the sesame plant in mungbean builds up a cross barrier against the pod borer moth flying over mungbean plants and also its aromatic odour might repel away the female moths from laying eggs in mungbean, which reduced pod borer population in sesame intercropped treatments and accordingly influenced lower pod borer infestation in intercropped treatments than that of sole cropping of mungbean.

Literatures revealed that intercrops exhibited significantly positive effect on the reduction of pod borer infestation in different crops. Hossain *et. al.* (2001) showed a similar effect of coriander, linseed and safflower intercropping in reducing the level of pod borer infestation in chickpea.

These findings are also confirmed by the findings of Hossain (2003) and Hossain *et. al.* (2007), who also found the similar effect of pod borer damage reduction in chickpea when intercropped with coriander, linseed, mustard, wheat and safflower.

Table 2 - Effect of sesame intercropping and insecticide spraying on pod borer infestation in mungbean at Pulses Research Centre, Ishurdi, Pabna, Bangladesh, during kharif-I 2017 and 2018

Treatments	Pod infestation by pod borer (%)		Pod infestation reduction by sesame intercropping and insecticide spraying (%)	
	2017	2018	2017	2018
Sole mungbean	12.83 a (3.59) *	16.22 a (4.03) *	-	-
Mungbean : sesame (2 : 1 row ratio)	8.83 b (2.96)	11.49 ab (3.39)	31.18	29.16
Mungbean : sesame (2 : 2 row ratio)	7.00 b (2.64)	9.24 b (3.04)	45.44	43.03
Mungbean : sesame (3 :1 row ratio)	8.00 b (2.82)	11.15 ab (3.34)	37.65	31.26
Mungbean : sesame (3 :2 row ratio)	7.83 b (2.79)	10.60 ab (3.26)	38.97	34.65
Sole mungbean with spraying Imitaf 20 SL @ 0.5 ml/l	9.17 b (3.03)	8.42 b (2.91)	28.53	48.08

Note: In a column, treatment means having the same letter(s) are not significantly different by DMRT at 5% level. Values in the parentheses are the square root transformed mean values.

Effect of sesame intercropping and insecticide spraying on yield of mungbean

Yield varied significantly depending on mungbean and sesame intercropping row ratio arrangements and also with the level of flower thrips and pod borer infestation (*Table 3*). During kharif-I 2017, significantly, the highest mungbean equivalent yield (1692 kg/ha) was obtained from the sole mungbean spraying with insecticide, followed by sole mungbean without spraying. The lowest mungbean equivalent yield (1171 kg/ha) was recorded from mungbean intercropped with sesame at 2:2 row ratios, which was statistically similar to rest other intercropping treatments except 3:2 row ratio arrangements (*Table 3*). So, it is seen that mungbean equivalent was lower in intercropped plots than that of sole cropping although the total production of intercropped plots were higher. The kharif-I 2017 cropping season received moderate rainfall (*Fig. 1*), which provided the optimum growth of mungbean with higher pod setting. In addition, due to higher market price of mungbean than that of sesame, the mungbean equivalent yield was higher.

In kharif-I 2018, significantly, the highest mungbean equivalent yield (2121 kg/ha) was obtained from mungbean intercropped with sesame at 2:2 row ratio arrangement, followed by 3:2 row ratios. The lowest mungbean yield (932 kg/ha) was recorded from sole mungbean, which was at par with sole mungbean sprayed with insecticide (*Table 3*). So, it is seen that total production and

accordingly mungbean equivalent was higher in sesame intercropped plots than that of sole cropping of mungbean. The kharif-I 2018 cropping season was rainfall enriched (*Fig. 1*). This might be due to frequent rainfall in this cropping season, the mungbean plants are thin and flexible, gets excessive vegetative growth with less pod setting and accordingly provided the poor yield. Again, in this year, due to higher market price of sesame than that of mungbean provided the higher mungbean equivalent yield in sesame intercropped treatments than sole cropping of mungbean.

So, the mungbean equivalent yield was reverse in this year than that of the previous year.

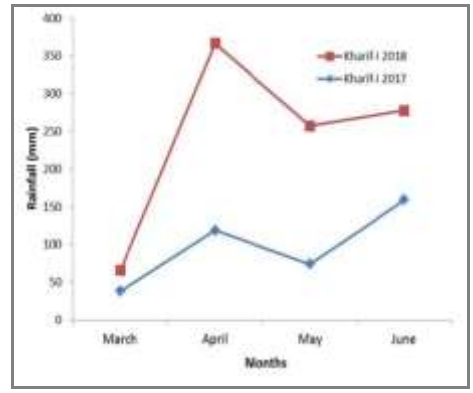

Figure 1 - Monthly average rainfall (mm) during crop seasons, kharif-I 2017 & 2018

Table 3 - Effect of sesame intercropping and insecticide spraying on yield of mungbean at Pulses Research Centre, Ishurdi, Pabna, Bangladesh, during kharif-I 2017 & 2018

Treatments	Yield (kg/ha)				Total production (kg/ha)		Mungbean equivalent yield (kg/ha)	
	Sole crop (mungbean)		Intercrop (sesame)					
	2017	2018	2017	2018	2017	2018	2017	2018
Sole mungbean	1450	932	-	-	1450	932	1450 b	932 e
Mungbean : sesame (2 : 1 row ratio)	929	997	602	559	1531	1556	1230 cd	1648 c
Mungbean : sesame (2 : 2 row ratio)	792	1047	757	921	1549	1968	1171 d	2121 a
Mungbean : sesame (3 :1 row ratio)	978	861	459	471	1437	1332	1208 cd	1410 d
Mungbean : sesame (3 :2 row ratio)	933	885	720	870	1653	1755	1294 c	1870 b
Sole mungbean with spraying Imitaf 20 SL @ 0.5 ml/l	1692	981	-	-	1692	981	1692 a	981 e

Note: In a column, treatment means having the same letter(s) are not significantly different by DMRT at 5% level.

Return and benefit cost ratio (BCR)

Return and benefit cost ratio are presented in *Table 4*.

In kharif-I 2017, the highest gross return (118440 Tk/ha) (84.49 Tk = 1 U.S. Dollar) and accordingly benefit (BCR 2.16) come from sole mungbean spraying with insecticide (Imitaf 20 SL), followed by sole mungbean without spraying. Among the intercropped treatments, the highest gross return (41248 Tk/ha) and benefit (BCR 1.84) was calculated from mungbean inter-cropped with sesame at 3:2 row ratios, which was more or less similar to other intercropped treatments.

During kharif-I 2018, the highest gross return (101808 Tk/ha) and accordingly benefit (BCR 2.07) come from mungbean intercropped with sesame at 2:2 row ratio arrangements, followed 3:2, 2:1 and 3:1 row ratios. Intercrooping sesame in mungbean showed its profitability in different row ratio arrangements.

Among the intercropped treatments, sesame intercropping in mungbean at 2:2 row ratios found the most profitable arrangements. Sole cropping of mungbean was not profitable in the rainfall enriched cropping season.

Table 4 - Cost and return analysis of sesame intercropping and insecticide spraying on mungbean at Pulse Research Center, Ishurdi, Pabna, Bangladesh, during kharif-I 2017 & 2018

Treatments	Mungbean equivalent yield (kg/ha)		Gross return (Tk/ha)		Total variable cost (Tk/ha)		Gross margin (Tk/ha)		Benefit cost ratio (BCR)	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Sole mungbean	1450	932	101500	44736	50950	50950	50500	-6214	1.99	0.88
Mungbean : sesame (2 : 1 row ratio)	1230	1648	86100	79104	49563	49563	36537	29541	1.74	1.60
Mungbean : sesame (2 : 2 row ratio)	1171	2121	81970	101808	49100	49100	32870	52708	1.67	2.07
Mungbean : sesame (3 : 1 row ratio)	1208	1410	84560	67680	50025	50025	34535	17655	1.69	1.35
Mungbean : sesame (3 : 2 row ratio)	1294	1870	90580	89760	49332	49332	41248	40428	1.84	1.82
Sole mungbean with spraying Imitaf 20 SL @ 0.5 ml/l	1692	981	118440	47088	54925		63515	-7837	2.16	0.86

During kharif-I 2017 for calculating return and benefit the following market prices were used: Mungbean = Tk. 70/kg, Sesame = Tk. 35/kg, Imidacloprid (Imitaf 20 SL) = Tk. 2100/litre. Labour wage = Tk. 400/day/labourer (8 hrs day). During kharif-I 2018 for calculating return and benefit the following market prices were used: Mungbean = Tk. 48/kg, Sesame = Tk. 55/kg, Imidacloprid (Imitaf 20 SL) = Tk. 2100/litre. Labour wage = Tk. 400/day/ labourer (8 hrs day).

CONCLUSION

The findings from both the years study it is observed that intercropping sesame in mungbean reduced mungbean flower thrips and pod borer infestation significantly. Sesame intercropping in mungbean physically and chemically interfere both flower thrips and pod borers to infest mungbean. Grain yield and mungbean equivalent yield may vary due to prevailing weather condition and market prices of both mungbean and sesame. Irrespective of yield, these results revealed that sesame intercropping in mungbean suppressed flower thrips and pod borer infestation significantly. Hence, intercropping in mungbean might be eco-friendly management approach against flower thrips and pod borers of mungbean providing higher production and benefit.

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