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Effect of Border Crops on the Incidence of Insect Pests in Chickpea

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Abstract

The primary objective of this study is to measure the effect of border crops on the incidence of insect pests and predators in chickpea (*Cicer arietinum* L.), commonly known as gram. The present study was conducted in the experimental field of Sher-e-Bangla Agricultural University farm, Sher-e-Bangla Nagar, Dhaka 1207, Bangladesh during the period from December, 2011 to April, 2012. The experiment was laid out in Randomized Complete Block Design (RCBD) using eight treatments with three replications. The treatments were T_1: Gram sole (control), T_2: Gram + Onion (*Allium cepa*), T_3: Gram + Garlic (*Allium sativum* L.), T_4: Gram + Coriander (*Coriandrum sativum* L.), T_5: Gram + Radhuni (*Coriandrum* spp.), T_6: Gram + Mustard (*Brassica* spp.), T_7: Gram + Methi (*Trigonella foenumgraecum*) and T_8: Gram + Wheat (*Triticum aestivum*). Aphid, whitefly, butterfly, grasshopper, cutworm were found as the insect pests and lady bird beetle, ant, spider, syrphid fly, rove beetle were found as predators in gram agroecosystem. The lowest population of aphid (4.28/plant), butterfly (1.00/plot), grasshopper (1.33/plant), whitefly (2.00/plant), cutworm (0.00/plot) was found in T_3 (Gram border cropping with garlic) at vegetative stage. At reproductive stage, similar trend of insect pests' incidence was found in T_3 treatment. Garlic was found to be more effective as border crop for the management of insect pests of gram.

Keywords: *Chickpea (BARI Chola 2), Insect pest and Border crops.*

1. Introduction

Pulse crops are those plants belonging to the legume family with papilionaceous flowers and pods containing seeds. About a dozen pulse crops are grown in the winter and summer seasons in Bangladesh. Among these, grass pea, lentil, chickpea, black gram, mung bean, field pea, cowpea, and fava bean are grown during the winter season (November– March). Black gram and mung bean can also be grown in late winter (June–March) in southern region of Bangladesh such as the Bhola, Barisal, and Chittagong districts. Pulses occupy about 4 percent of the total cropped area and contribute about 2 percent to the total grain production of Bangladesh. In 2010, the total pulse production was recorded 218000 metric ton ("BBS, 2011"). The area and production of pulse production as decreased continuously for the past 10 years. The average annual yield of the different pulses ranges from 700 to 800 kg per hectare ("BBS, 2010").

Chickpea (gram) is one of the important pulse crops in Bangladesh as well as in the world. It is an important grain legume in Asia, Africa and America ("FAO, 2006"). The crop is locally known as chola, boot or botjam in different parts of Bangladesh. In Bangladesh, about 85% of the gram is grown in greater districts of Faridpur, Jessore, Kustia, Rajshahi and Pabna. It is generally grown under rain-fed or residual soil moisture conditions in rabi season. Among the major pulses grown in Bangladesh, gram ranked the fifth in area and production but second in consumption priority. It covers an area of 16,446 ha producing 12,315 tons of yields with national average of 761 kg ha^{-1} ("BBS, 2008").

Gram plays a vital role in human and animal nutrition having 20.8% protein ("Gowda and Kaul, 1982"). It is a major source of dietary protein to the large vegetarian population of South Asian countries. Its dry stems and husks serve as good source of animal feeds (Kay, I979). According to the "FAO (2006)" yield of gram in Bangladesh is miserably low (761 kg ha^{-1}) as compared to that of other countries like India (833 kg ha^{-1}), Myanmar (1106 kg ha^{-1}), Mexico (1600 kg ha^{-1}), Israel (1813 kg ha^{-1}), Russian Federation (2400 kg ha^{-1}), Kazakjhastan (3000 kg ha^{-1}) and China (6000 kg ha^{-1}). There are many factors responsible for low yield of gram of which insect pests appear to be the most vital factor. In Bangladesh, gram is attacked by eleven species of insect pests. Among these pests the pod borer, *Helicoverpa armigera* (Hubner) is one of the most serious pests of gram in Bangladesh ("Begum *et al.*, 1992").

In a countrywide survey, an average of 30 to 40% pod damage due to chickpea/gram pod borer was reported in Bangladesh ("Sachan and Katti, 1994"). The young larvae of this pest feed on the foliage for some time and later bore into the pod. In favourable condition, the pod damage goes up to 90-95% ("Shongal and Ujagir, 1990"). Farmers are being reluctant to cultivate gram due to its susceptibility to pod borer. The young larva skeletonizes the leaves, while grown up larva bores the pods and feeds on the seeds, thereby rendering them unfit for human consumption. On the other hand, other insects like aphids (*Aphis craccivora* Koch.) and whitefly (*Bemesia tabaci* G.) attack in vegetative stage and cause a considerable damage of the crop.

At present, effective control techniques other than insecticide application against the pest are not available. But continuous use

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of insecticides leads to the hazardous effect on the pollinator's, natural enemies' like's predators, parasitoids and also causes the environmental pollution ("Nugrar and More, 1998"). Under these circumstances, it becomes necessary to find out some eco-friendly alternative methods for pest management of gram. Among the various alternatives, the exploitation of host plant resistance is perhaps the most effective, convenient, economical and environmentally acceptable method of insect control ("Dhaliwal and Dilawary, 1993"). Now-a-days, effective control techniques other than insecticide application against insect and pest of agricultural crops are highly demanding. Considering the above aspects, management of insect pests in gram through agronomic manipulation may be considered as one of the possible alternative options. An agronomic practice like border cropping of crops of diver's growth habits may be found as a very useful technique in controlling a large number of crop pests. Border cropping is the cultivation of two crops on the same field. It is situated in the border of the main crops. Border cropping reduces the insect pest's population because of the diversity of the crops grown. When other crops are present in the field, the insect pests are confused and they need more time in hot solution pressure. Under the above perspective, border cropping has been thought to be an environment friendly option for the management of insect pests in gram. However, very little attention has been given in this area in Bangladesh. Considering the above facts, the study finds out the effect of border crops on incidence of insect pests in gram.

2. Materials and Methods

The experiment was conducted in the field of Sher-e-Bangla Agricultural University farm, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from December, 2010 to April, 2011. Seeds of gram variety BARI chola 2 were used as a test crop for the study and the seeds of this variety were collected from Bangladesh Agricultural Research Institute (BARI), Gazipur. BARI chola 2 is a spreading type plant and can be easily grown in minimum or shading light. In this experiment onion (*Allium cepa*), garlic (*Allium sativum*), coriander (*Coriandrum sativum*), radhuni (*Coriandrum* spp.), mustard (*Brassica campestris*), Methi (*Trigonella foenumgraecum*) and wheat (*Triticum aestivum*) were sown as border crop with gram. The land was prepared with the help of a power tiller and prepared by three successive ploughing and cross-ploughing. Each ploughing was followed by laddering to have a desirable fine tilth. The visible larger clods were hammered to break into small pieces. All kinds of weeds and residues of previous crop were removed from the field. Individual plots (size, no, distance between plot etc.) were cleaned and finally leveled with the help of wooden plank. Standard doses of fertilizers urea 1kg, triple super phosphate 2.0kg, Muriate of Potash (MP), 1.0 kg, Gypsum 1.0 kg and cowdung 100.0 kg were applied as basal dose at the time of sowing seeds. The seeds of main and border crop were sown in rows with spacing of 30 cm × 30 cm for all border crops but in sole crops it was sown at a spacing of 40 cm × 30 cm. There were 8 treatments among them 01 was used as sole crop and others with border crop. The details of the treatments are presented below: T_1: Gram sole (control), T_2: Gram + Onion, T_3: Gram + Garlic, T_4: Gram + Coriander, T_5: Gram + Radhuni, T_6: Gram + Mustard, T_7: Gram + Methi and T_8: Gram + Wheat. The experiment was laid out in RCBD with three replications. The treatments were randomly allotted in each block. The unit plot size was 3.0m × 3.0m with a distance of 1.0 m between the plots and 1.0 m between the replications. The data were collected from each plot at weekly interval commencing from germination to harvest. Five plants were selected randomly from each plot and insect pests infested plant by aphid (plate4), whitefly, butterfly, grasshopper (plate7) and cutworm (plate5) were observed regularly and recorded. After last observation, the population of aphid, whitefly and grasshopper was converted number per plant and that was butterfly and cutworms were converted per plot. The data obtained for different characters were statistically analyzed to find out the significant difference among the treatments. The mean values of all the characters were evaluated and analysis of variance was done by the 'F' (variance ratio) test. The mean differences were evaluated by Duncan's Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984).

3. Results and Dicussion

Incidence of insects on gram agro ecosystem was recorded under different treatments for the entire cropping season; Aphid, butterfly, grasshopper, whitefly and cutworm were observed. The data for the incidence of insects per plot are vegetative stage and reproductive stages are presented in different Table 1 to table 5. The data on incidence insect pest's viz., aphid, whitefly, butterfly, grasshopper and cutworm show significant variation under different treatments vegetative stage and reproductive stages of gram.

Aphid is one of the most important sucking insect of field crops. The number of aphid/plant of gram was significantly affected by pod infestation due to application of various treatments. The lowest number of aphid (4.28/plant) was recorded from treatment T_3 (gram + garlic) and T_5 (Gram + Radhuni) and T_8 (Gram + Wheat) gave the highest number of aphid (8.00/plant) at vegetative stage. At the reproductive stage the lowest number of aphid (0.00/plant) were also recorded from treatment T_3 (gram + garlic) and the highest number of aphid (4.00/plant) were obtained from treatment T_1 (Gram sole), T_6 (Gram + Mustard) and T_8 (Gram + Wheat) respectively. This result indicates that border cropping of gram with other crops has significant effect on incidence of aphid. However the best effect was found in case of border cropping with garlic. This effect might be the repellent effect of garlic on aphid. The similar result was observed by "Kirtkar and Basu (1975)" who reported that garlic and coriander had strong repellent action against aphid and reduced their population in crop field.

Table 1. Mean population of aphid under different treatments at vegetative and reproductive stages

Treatments	Number of aphid plant^{-1}	
	Vegetative stage	Reproductive stage
T_1	4.33 c	4.00 b

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T_2	5.00 bc	3.00 bc
T_3	4.28 c	0.00 d
T_4	4.33 c	3.00 bc
T_5	8.00 a	1.00 d
T_6	5.00 bc	4.00 b
T_7	7.00 ab	2.00 cd
T_8	8.00 a	4.00 b
$LSD_{(0.05)}$	2.320	1.486
CV(%)	14.77	7.75

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) which significant at 5% level.

Whiteflies are the most important sucking insects of gram which suck the cell sap from leaf, young shoot, inflorescence etc. Similar to aphid/plant, the number of whiteflies/plant respondent significantly to pod infestation applied from different treatments. The number of whiteflies/plant due to different treatments varied from 2.00/plant to 7.00/plant at vegetative stage and 2.00/plant to 6.00/plant at reproductive stage. At vegetative stage the treatment T_3 (Gram + Garlic) containing the number of whiteflies/plant 2.00 the lowest result and the treatment T_5 (Gram + Radhuni) showed the highest number of whiteflies/plant 7.00. At the reproductive stage the treatment T_3 (Gram + Garlic) containing the number of whiteflies/plant 2.00, the lowest result and the treatment T_6 (Gram + Mustard) showed the highest number of whiteflies/plant 6.00/plant. This result indicates that border cropping of gram with other crops has significant effect on the incidence of whitefly. However, the best effect was found in case of border cropping with garlic. The similar result was observed by "Kirtkar and Basu (1975)" who reported that garlic and coriander had strong repellent action against sucking insects and reduced their population in crop field.

Table 2. Mean population of whitefly recorded at vegetative and reproductive stages in different treatments with border crops

Treatments	Number of aphid plant^{-1}	
	Vegetative stage	Reproductive stage
T_1	4.00 cd	3.00 bc
T_2	5.00 bc	3.00 bc
T_3	2.00 e	2.00 c
T_4	5.00 bc	4.00 abc
T_5	7.00 a	3.00 bc
T_6	6.00 ab	6.00 a
T_7	4.00 cd	5.00 ab
T_8	3.00d e	4.00 abc
$LSD_{(0.05)}$	1.451	2.145
CV(%)	5.39	9.78

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) which significant at 5% level.

Butterflies are adult Lepidopteron insects and visit crop field for laying eggs or feeding nectar. The number of butterflies/plant respondent significantly to pod infestation applied from various treatments. The lowest number (1.00/plant) of butterfly was observed in T_3 (Gram + Garlic) was recorded at vegetative stage and the highest number (4.00/plot) was found in T_1 (Gram sole). Similarly, the lowest number (1.00/plant) of butterfly was found in T_3 (Gram + Garlic) at reproductive stage on the other hand, the highest number (4.00/plant) was found in T_8 (Gram + Wheat). These results indicate that border cropping of gram with other crops repels the butterfly away from the field. Although garlic showed the best performance. This effect might be repellent action of the border crop. These results agree with the findings of several researchers ("Devendra and Binay 2002, Hosain *et al*. 1998").

Table 3. Mean population of butterfly under different treatments at vegetative and reproductive stages

Treatments	Number of aphid plant^{-1}	
	Vegetative stage	Reproductive stage
T_1	4.00 a	2.00 b
T_2	2.00 b	2.00 b
T_3	1.00 a	1.00 a
T_4	2.00 ab	2.00 b
T_5	2.00 ab	3.00 ab
T_6	2.00 ab	2.00 b
T_7	2.00 ab	2.00 b
T_8	2.00 ab	4.00 a
$LSD_{(0.05)}$	1.857	1.767
CV(%)	6.06	5.84

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) which significant at 5% level.

Grasshoppers are chewing insects and their nymph and adults feed on leaves of field crops. The number of grasshoppers/plant respondent significantly to pod infestation applied from different treatments. The data reveal that the lowest numbers (1.33/plant) of grasshopper were recorded from T_3 (gram + garlic) and the highest numbers (3.00/plant) were recorded from T_8 (Gram + Wheat) at vegetative stage. Similarly, the T_3 (gram + garlic) had the lowest number of grasshopper (1.33/plant) was observed from T_8 (gram + Wheat) at reproductive stage. Another treatments (2.00/plant) there is no significant difference between, T_1 (gram sole), T_2 (gram + Onion), T_4 (gram + Coriander), T_5 (gram + Radhuni), T_6 (gram + Mustard) , T_7 (gram + Methi) and T_8 (gram + Wheat) respectively. This result indicates that border cropping of gram with other crops has significant effect on incidence of grasshopper. Grasshopper population was increased in case of T_8 (border cropping with wheat). However the best effect was found garlic in case of effect of border crops on grasshopper. The similar result was observed by "Halepyatic et al. (1987)" who reported that garlic, mustard, methi and coriander had reduced the population of grasshopper.

Table 4. Mean population of grasshopper under different treatments at vegetative and reproductive stages

Treatments	Number of aphid plant^{-1}	
	Vegetative stage	Reproductive stage
T_1	2.00 ab	2.00 a
T_2	2.00 ab	2.00 a
T_3	1.33 b	1.33 a

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T_4	2.00 ab	2.00 a
T_5	2.00 ab	2.00 a
T_6	2.00 ab	2.00 a
T_7	2.00 ab	2.00 a
T_8	3.00 a	2.00 a
$LSD_{(0.05)}$	1.442	1.109
CV(%)	6.12	7.84

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) which significant at 5% level.

The cutworm larva/plant respondent significantly to pod infestation applied from different treatments. The number of cutworm larva/plant due to different treatments varied from 0.00/plant to 5.00/plant at vegetative stage and 0.67/plant to 2.00/plant at reproductive stage. At vegetative stage the treatment T_3 (Gram + Garlic) containing the number of cutworm larva/plant 0.00 the lowest result and the treatment T_6 (Gram + Mustard) showed the highest number of cutworm larva/plant 5.00. Similarly, the lowest number (0.67/plant) was recorded from T_3 (Gram + Garlic) in reproductive stage while the highest number (2.00/plant) was found from T_1 (Gram sole), T_4 (Gram + Coriander), T_6 (Gram + Mustard), T_7 (Gram+ Methi), T_8 (Gram + Wheat) respectively. This result indicates that border cropping of gram with other crops has significant effect on incidence of cutworm. However the best effect was found in case of border cropping with garlic. This effect might be the repellent effect of border crops on cutworm. The similar result was observed by "Manisegaran et al. (2001)" who reported that garlic and gram sole had strong repellent action against cutworm.

Table 5. Mean population of cutworm under different treatments at vegetative and reproductive stages

Treatments	Number of aphid plant^{-1}	
	Vegetative stage	Reproductive stage
T_1	1.00 c	2.00 a
T_2	1.00 c	1.00 a
T_3	0.00 d	0.67 a
T_4	1.00 c	2.00 a
T_5	2.00 bc	1.00 a
T_6	5.00 a	2.00 a
T_7	2.00 bc	2.00 a
T_8	3.00 b	2.00 a
$LSD_{(0.05)}$	1.671	1.627
CV(%)	6.50	7.30

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) which significant at 5% level.

Conclusion

Significant variation of insect population was observed on gram under different border crop treatments at vegetative and reproductive stage. Aphid, whitefly, butterfly, grasshopper and cutworm were found as the insect pests attacking on gram. The population abundance of aphid (4.28/plant), butterfly (1.00/plant), grasshopper (1.33/plant), whitefly (2.00/plant) and cutworm (0.00/plot) was found lowest in T_3 (Gram border cropping with garlic) at vegetative stage. Similar trend of population abundance of different insect pests was also observed during reproductive stage of the gram. However, aphid population was found highest in T_8 (Gram border cropping with mustard) at both stage of gram and the whitefly population was observed maximum in T_6 (Gram border cropping with wheat). The population incidence of all the insect pests was higher in sole crops (Gram) at vegetative and reproductive stages of the crops. Based on the result of the study it may conclude that garlic is the best border crop against pest population of gram.

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