

Effect of insect infestation on the growth and yield of soybean plants grown under three different tree species

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Abstract: Insect pests and their effects on the growth and yield of soybean grown in association with Albida (*Acacia albida*), Jhau (*Casuarina equisetifolia*), Akashmoni (*Acacia auriculiformis*) and in the open field condition were investigated during January to May 2008 in the field laboratory of Agroforestry Department, Bangladesh Agricultural University, Mymensingh. Ten different insect species were detected in the soybean field under the above mentioned tree species of which two were natural enemies i. e. insect predator. Highest insect population was recorded under Albida trees (315) followed by Akashmoni (216), open field (197) and Jhau (193), respectively. Severe infestation was recorded in the vegetative stage followed by pod maturation, flowering, pod initiation and pod filling stages, respectively. Highest yield of soybean was found under Jhau tree (1.84 t ha⁻¹) which was statistically similar with the open field (1.74 t ha⁻¹) and under Akashmoni trees (1.70 t ha⁻¹). Lowest yield was found under Albida trees (1.29 t ha⁻¹). Compared with recommended soybean yield, 35%, 15%, 13% and 8% yield were reduced under Albida tree, Akashmoni tree, open field condition and Jhau tree, respectively.

Key words: Insect pest, Soybean, Agroforestry, *Acacia albida*, *Casuarina equisetifolia*, *Acacia auriculiformis*,

Introduction

Multipurpose trees (MPTs) are the essential components of all agroforestry production system. MPTs supplies diversified products such as food, fodder, fuel-wood, timber, conserve soil fertility, and improve farm viability and sustainability in the long-term. Akashmoni (*Acacia auriculiformis*), Jhau (*Casuarina equisetifolia*) and Albida (*Acacia albida*) are three important MPTs suitable for agroforestry production systems.

Soybean (*Glycine max*) is the most important leguminous grain crop used as understorey crops in agroforestry production systems. It contains higher amount of oil and protein than any other legume crops. As a good source of protein, unsaturated fatty acid, minerals like Ca and P including vitamin A, B, C and D, soybean can meet up different nutritional needs (Rahman, 1982). In Bangladesh soybean can be cultivated throughout the year (Haque, 1976) as monocrops or intercrops.

Numerous kinds of insects occur in soybeans field. Some are beneficial or harmless, but some can cause damage by reducing yield and even total crop failure if can't be managed properly. Soybean is very much susceptible to insect attack from seedling to mature stage. Scanty information is available about the insects associated with multipurpose trees and shrubs that are gaining economic importance as components of agroforestry systems. Many factors govern insect pest intensity in agroforestry and each factor may have a different effect on pests at different times under different situation such as, vegetation diversity, host range of pest, biological control potential, microclimate, exotic plants and pests, domestication of plants, tree-crop competition for nutrition and management practices. Now, it is necessary to determine the insect pest's severity of soybean under

different tree species. Therefore, this study investigates the insect pest prevalence, severity of infestation and effects of infestation on the yield performance of soybean in association with different MPTs.

Materials and Methods

The study was conducted in the Agroforestry experimental field of Bangladesh Agricultural University (BAU), Mymensingh during January to May, 2008. Soybean variety G-2 (Bangladesh soybean-4) was grown in association with three MPTs. Three multipurpose trees (MPTs) were Albida (*Acacia albida*), Akashmoni (*Acacia auriculiformis*) and Jhau (*Casuarina equisetifolia*). Insect infestation and yield performance of soybean was observed under these three MPTs and these were the treatments of this study. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 4 replications. The treatments were randomly distributed within the block separately for each species. Treatments were as: T₁- insect infestation and yield performance of soybean in the open field-control; T₂- insect infestation and yield performance of soybean under Albida; T₃- insect infestation and yield performance of soybean under Jhau and T₄- insect infestation and yield performance of soybean under Akashmoni. Except insect control, all necessary intercultural operations were done when required. The common insect pests of soybean from the different treatments were sampled at different growth stage of soybean. Sampling stages were vegetative, flowering, pod initiation, pod filling and pod maturation. Sampled insects were identified and confirmed with the help of reference book. Infested leaves of soybean plants were counted only in the vegetative stage. Infested leaf counting was started from 30 days after sowing (DAS), every four days

interval infested leaves was counted and continued upto 54 DAS (i. e., 30, 34, 38, 42, 46, 50 and 54 DAS). Plant height (cm) was measured only just before the harvesting by meter scale. Number of pods per plants was counted after the pod maturation. Yield of soybean as grain were determined for each individual plots (4 m x 2.5 m i. e., 10 m²) and then converted to t ha⁻¹. The collected data were analyzed statistically using a computer based package programme MSTAT-C and Duncan's Multiple Range Test (DMRT) was used to separate the means (Russell, 1986).

Results and Discussion

Insect species in soybean field

A total of ten (10) species of insect pests viz. cutworm (*Agrotis ipsilon*), Soybean semi looper (*Pseudoplusia includens*), Soybean hairy caterpillar (*Spilaractia obliqua*), Soybean leaf roller (*Omiodes indicata*), Brown plant hopper (*Nilaparvata lugens*), Sting bug (*Nezara viridula*), Black leaf beetle (*Cerotoma trifurcata*), and soybean pod borer (*Maruca testulalis*) were identified (Table 1). Among ten insects species two viz. lady bird beetle and spider were natural enemies. Natural enemies serve as insects controlling agents because they are insect predator.

Table.1. Insect pests recorded in the soybean field

Common name	Scientific name	Family	Order
A. Insect pest			
Soybean semi looper	<i>Pseudoplusia includens</i>	Noctuidae	Lepidoptera
Soybean hairy caterpillar	<i>Spilaractia obliqua</i>	Arctiidae	Lepidoptera
Soybean leaf roller	<i>Omiodes indicata</i>	Pyralidae	Lepidoptera
Brown plant hopper	<i>Nilaparvata lugens</i>	Cicadellidae	Homoptera
Soybean pod borer	<i>Maruca testulalis</i>	Pyralidae	Lepidoptera
Stink bug	<i>Nezara viridula</i>	Pentatomidae	Hemiptera
Black leaf beetle	<i>Cerotoma trifurcata</i>	Chrysomelidae	Coleoptera
Cutworm	<i>Agrotis ipsilon</i>	Noctuidae	Lepidoptera
B. Natural enemies			
Lady bird beetle	<i>Hippodamia convergens</i>	Coccinellidae	Coleoptera
Spider	<i>Siler sp., Oxyopes sp.</i>	Lycosidae	Aranae

Insect pests in different treatments at different growth stages of soybean

Total 921 insects population were identified among the all treatments of which highest (315) number of insects recoded under Albida tree followed by Akashmoni (216), open field (197) and Jhau (193), respectively (Fig. 1). Highest number of insects population were recorded in the vegetative stage followed by Pod maturation, Pod initiation, flowering and Pod filling stages, respectively (Fig. 2). Both Vegetative and Pod maturation stages number of insects increases as the order of Jhau < Open field < Akashmoni < Albida and other stages no. of insects were almost similar in all treatments (Fig. 1). These results indicate that most of the insects infestation occurred in the vegetation stage then gradually decrease upto pod filling stage and again slowly increase in the pod maturation stage. Shepard *et al.* (1999) also found highest number of insect population in the vegetation stage of soybean. Among the all treatments highest no. of insects were observed under the Albida tree and lowest under akashmoni which were almost similar with Jhau and Open field condition (Fig. 1). Probable reasons for highest insects population under the Albida tree may be Albida is the host of identified insects and lowest insect population under Akashmoni and Jhau may be

due to both of species act as the biological insect controlling agent (by birds).

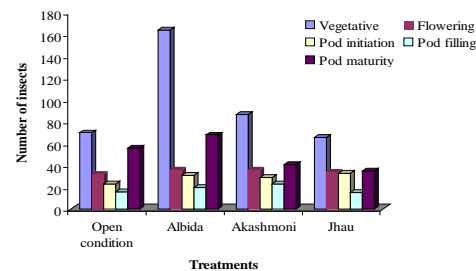


Fig.1. Number of insect pests on soybean under different treatments

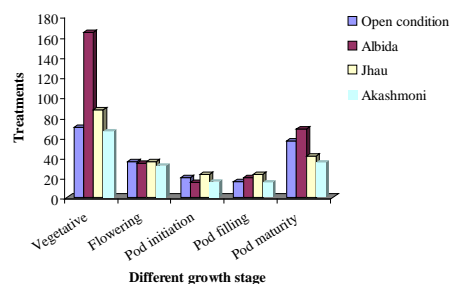


Fig.2. Number of insect pests in the different growth stages of soybean under different treatments

Infested leaves at vegetative stage of soybean in different treatments

More than half of the insects were observed in the vegetative of the soybean and infestation in the vegetative stage of soybean is more important than other stages. Due to above reasons leaves infested by different insects were recorded only in the vegetative of soybean under Albida, Akashmoni, Jhau and open field condition. Significantly highest number of infested soybean leaves per plant (2.63) was recorded under Albida trees upto 46 days after sowing (DAS)

and number of infested leaves per plant under Akashmoni (2.22), Jhau (2.19) and in open field condition (2.15) were statistically similar (Table 2). Highest number of insect per plant also observed under Albida tree and in other three treatments number of insect per plant was almost similar. So, it is clear number of infested leaves is directly correlated to number of insects. After 46 DAS due to cutworm infestation this relationship was not exactly true.

Table 2. Infested leaves at vegetative stage of soybean in different treatments

Treatment	Infested leaves plant ⁻¹ (No.)						
	30 DAS	34 DAS	38 DAS	42 DAS	46 DAS	50 DAS	54 DAS
T ₁	1.50 c	1.91 b	1.92c	2.09c	2.15b	1.70c	1.63b
T ₂	2.04a	2.32a	2.47a	2.57a	2.63a	2.07a	1.98a
T ₃	1.45c	1.94b	2.01bc	2.05c	2.19b	1.77bc	1.85a
T ₄	1.78b	1.89b	2.15b	2.24b	2.22b	2.01ab	1.90a
Level of Significance	**	**	**	**	*	**	NS
CV%	9.27	6.29	4.21	2.76	7.76	5.96	7.34

In a column, figure having similar letter (s) or without letters do not differ significantly where as figures bearing the dissimilar letter (s) differ significantly as per DMRT.

* and ** significant at 5% and 1% level of probability

T₁- insect infestation and yield performance of soybean in the open field-control; T₂- insect infestation and yield performance of soybean under Albida; T₃- insect infestation and yield performance of soybean under Jhau; T₄- insect infestation and yield performance of soybean under Akashmoni

Plant height and number of pods/plant in the insect infested soybean plants in different treatments

Plant height was observed in the insects infested soybean field grown in association with Albida, Akashmoni, Jhau trees and also open field condition (Table 3). Highest average plant height (52.2cm) was recorded under Akashmoni tree which was statistically similar with plant height under Jhau tree (51.5 cm) and open field condition (49.7cm) and lowest plant height observed under Albida tree (43.9 cm) (Table 3).

Plant height observed lowest under Albida tree may be due to maximum insect infestation and gradually increased as in open field > under Jhau tree > under Akashmoni tree may be due to shade influence. According to Hillman (1994) reduced light encouraged higher apical dominance resulting taller plants under shade condition. Like plant height, average number of pods per plant also lowest under Albida tree (47.0). Highest number of pods per plant was found in open field condition (52.95) and statistically similar number of pods per plant was observed under Jhau (50.85) and Akashmoni (48.92) tree (Table 3). Number of pods per plant lowest under Albida tree may be also due to maximum insect infestation.

Table 3 Plant height and number of pods/plant in the insect infested soybean plants in different treatments

Treatments	Av. plant height (cm)	No. of pods per plant
Open field	49.7a	52.95a
Under Albida tree	43.9b	47.00c
Under Jhau tree	51.5a	50.55b
Under Akashmoni tree	52.2a	48.92b
Level of significance	**	*
CV%	4.89	3.90

In a column, figure having similar letter (s) or without letters do not differ significantly where as figures bearing the dissimilar letter (s) differ significantly as per DMRT.

* and ** significantly at 5% and 1% level of probability, respectively.

Effect of insect infestation on soybean yield

Significant effect of insect infestation was observed in the yield of soybean in association with Albida, Akashmoni, Jhau trees and also in open field condition (Table 4). Highest yield was found under Jhau tree (1.84 t ha⁻¹) which was statistically similar with yield in the open field (1.74 t ha⁻¹) and under Akasmoni trees (1.70 t ha⁻¹). Lowest yield found under Albida trees (1.29 t ha⁻¹, Table 5). Compared with recommended soybean yield (BARI, 2005), 35%, 15%, 13% and 8% yield reduced under Albida tree, Akashmoni tree, open field condition and Jhau tree, respectively. Melo and Silveira (1998) found 25% yield reduction in common beans by bean pod

Table 4. Effect of insects infestation on yield of soybean in association with Albida, Akashmoni, Jhau trees and open field

Treatments	Yield (t ha ⁻¹)	Recommended yield (t ha ⁻¹)
Open field	1.74a	1.6 – 2.25 (BARI, 2005)
Under Albida tree	1.29b	
Under Jhau tree	1.84a	
Under Akashmoni tree	1.70a	
Level of significance	**	
CV%	5.26	

In a column, figure having similar letter (s) or without letters do not differ significantly where as figures bearing the dissimilar letter (s) differ significantly as per DMRT.

** significantly at 1% level of probability

borer. Yield under Albida tree was lowest may be due to the maximum infestation of insects and also it may be the host of some insects. Comparatively highest yields was under Jhau tree, probable reasons may be Jhau tree keeps many birds and serves as biological insect controlling agents.

Finally it may be concluded that ‘Albida and soybean’ based agroforestry production system is susceptible to insect infestation; whereas ‘Jahu and soybean’ and ‘Akashmoni and soybean’ based agroforestry production system are relative by resistant to insect infestation.

References

- Bangladesh Agriculture Research Institute (2005) Sowing methods and plant population on the yield of Bangladesh Soybean-4, Joydebpur, Gazipur-1701, Bangladesh.
- Haque, M.Z.1976. Soybean cultivation in Bangladesh; Crop management and improvement. Paper presented at the first National Workshop on Oil seed and Pulses, 11-13 Oct, 1976, Dhaka.
- Hillman, J. K. 1994, Apical dominance. In : Wilking, M. B.(ed) Advanced Plant Physiology, Pilman, London, pp. 127-148.
- Melo, M. and Silveira, E. P. (1998). Pod borer of *Etiella zinckenella* (Treit). (Lepidoptera; Pyralidae) damage to common bean. *Anais da Sociedade Entomologica do Brasil*. 27 (3): 477-479.
- Rahman, L. 1982. Cultivar of soybean and its use. City press, Dhaka. P. 5-7
- Russell, D. F. 1986. MSTAT-C Package Program. Crop and Soil Science Department, Michigan State University, USA.
- Shepard, B. M., Carner, G. R., Barron, A. T., Ooi, P. A. C. and Van den Berg, H. 1999. Insect pest and their natural enemies associated with vegetable and soybean in South East Asia. Quality Printing Company, Orangeburg, S. C. 29116-1106. USA.