International Journal of Research and Review
www.gkpublication.in E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

Evaluation of Management Practices for Suppressing the Major Insect Pests and Growth and Yield of Soybean

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Received: 01/07/2015 *Revised: 10/07/2015* *Accepted: 17/07/2015*

ABSTRACT

The experiment was conducted at the experimental Field of Sher-e-Bangla Agricultural University, Dhaka during the Kharif season from April, 2012 to August, 2012 to study the evaluation of some management practices for suppressing the insect pests and growth and yield of soybean. The experiment comprised with six different insecticides and one botanicals including untreated control viz. T_1-Neem oil @ 3ml/L water, T_2-Ripcord 10EC @ 2ml/L water, T_3-Aktara 25 WG @ 0.3 mg/L water, T_4-Sumialfa 5EC @ 2ml/L water, T_5-Marshal 20EC@ 2ml/L water, T_6-Control treatment were used as treatments. The experiment was laid out in Randomized Complete Block Design (RCBD) single factor with three replications. The maximum numbers of leaves, number of branch, maximum leaf length, number of flower, minimum number of infected pod, maximum number of healthy pod per plant, were found from the treatment Sumialfa 5EC @ 2ml/L of water. Similar treatment also produced the yield plot^{-1} (3.29 kg) and yield per hectare (3.65 t/ha) of soybean. Those results indicate that the Sumialfa 5EC @ 2ml/L of water showed the best performance on growth and yield among the all applied insecticide in this study.

Key Words: Soybean, insect pest, management practices, growth and yield.

INTRODUCTION

Soybean [Glycine max (L.) Merrill] is a fascinating crop with innumerable possibilities of not only improving agriculture, but also supporting industries. Soybean is a major source of edible oil (20%) and high quality protein (40%). It is a rich source of amino acids, vitamins and minerals. Soybean is a very important recognized oil seed and protein crop in the world. It is a good source of protein, unsaturated fatty acids, minerals like Ca and P including vitamins A, B and D that meet different nutritional needs. [1] The seed contains about 40-45% protein, 18-20% edible oil and 20-26% carbohydrate. [2] The multipurpose use of soybean is gradually increasing day by day in our country.

Soybean is a major oil seed crop of world grown in an area of 91m ha with production of 204 mt and productivity of 2,233 kg/ha. The crop is mainly cultivated in USA, China, Brazil, Argentina and India. India contributes more than 90 per cent of world's acreage. In India it is grown over an area of 8.17 m ha with production of 9.46 mt

and productivity of 1,069 kg per ha. [3] Major soybean growing states in India are Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Uttar Pradesh, Andhra Pradesh and Gujarat. In Karnataka, soybean occupies an area of 1.62 lakh ha with production of 1.53 lakh tonnes and productivity of 950 kg per ha. [3] In Bangladesh, about five thousand hectares of land is under soybean cultivation and annual production is approximately 4 thousand metric tons with an average yield of 1.5-2.3 t/ha. [4]

The low productivity of soybean both at national and state level is attributed to abiotic and biotic stresses like drought, weeds, insect pests and diseases. Among these, insect pests often pose a serious threat to soybean production by increasing cost of cultivation and impairing quality of produce in many ways. The luxuriant crop growth, soft and succulent foliage attracts many insects and provides unlimited source of food, space and shelter. Soybean crop is reported to be attacked by about 350 species of insects in many parts of the world. [5] About 65 insect pests have been reported to attack soybean crop from cotyledon to harvesting stage. [6,7,8,9] Among them some are fatal to this crop and have changed their severity of attack in last few years.

Soybean is very much susceptible to insect attack from seedling to mature stage. All parts of the plant including plant leaves, stems and pods are subjected to attack by different species of insect in Bangladesh. Different species of insects cause serious damage by direct feeding as well as by transmitting various diseases. [10] The frequency and severity of pest damage vary considerably between the growth stages. Thirty nine species of insect pest have been recorded at the different growth stages of soybean in Noakhali region. Of these, eight species were recorded as the major pests and rests were minor importance. The most damaging insects were hairy caterpillar, leaf roller, common cutworm, pod borer, stem flies, bugs and whitefly were found to damage during vegetative, flowering and pod formation stage of the crop. [11] According to Rahman *et al.* [12] thirteen species of insect pest and three species of natural enemies were recorded in the experimental field, soybean semilooper, soybean hairy caterpillar, soybean leaf roller, soybean fly, jassid, soybean pod borer, soybean leaf hopper, stink bug, black leaf beetle, short horned grass hopper, green leaf hopper, brown plant hopper, cut worm and the natural enemies found were lady bird beetle, carabid beetle and spider.

The researchers later recognized the harmful effects of pesticides and tried to bring eco-friendly approaches to reduce pesticide load in environment by using bio-agents and bio-pesticides but these are not easily available and are costly. So it has been difficult for farmers to utilize these tools in pest management. To overcome these problems, plant based substances and indigenous practices offer safe and better alternative methods of pest management. [13] Considering the facts as stated above, the present investigation was under taken with the following objectives to find the infestation of different insect pests at different growth stage of plant and to explore the efficiency of different control options on the reduction of different insect pest infestations on soybean.

MATERIALS AND METHODS

The experiment was conducted at the experimental central Field of Sher-e-Bangla Agricultural University, Dhaka during the Kharif season from April, 2012 to August, 2012 to study on effect of management practices on the incidence and reduction the major insect pests of soybean (*Glycine max* L.). Geographically the experimental field was located at 23^0 77′ latitude and 90^0 33′ E longitudes at an altitude of 9 m above the

mean sea level. The soil belonged to the Agro-ecological Zone - Modhupur Tract (AEZ 28). The land topography was medium high and soil texture was silt clay with pH 8.0. The climate of the locality is subtropical which is characterized by high temperature and heavy rainfall during Kharif season (April-September) and scanty rainfall during Rabi season (October-March) associated with moderately low temperature. The experiment was carried out with soybean variety "Shohag". Seeds of shohag were collected from siddique bazar, Dhaka. There were six treatments under the present study including untreated controland they are follows: T_1-Neem oil @ 3ml/L of water mixed with trix @ 10ml/L of water at 15 days interval, T_2-Ripcord 10EC @ 2ml/L of water at 15 days interval, T_3-Aktara 25 WG @ 0.3 mg/L of water at 15 days interval, T_4-Sumialfa 5EC @ 2ml/L of water at 15 days interval, T_5-Marshal 20EC@ 2ml/L of water at 15 days interval and T_6-Untreated control. The experiment was laid out in a one factors randomized complete block design (RCBD) having three replications. The unit plot size was 9 m^2 (3m ×3m). The blocks and unit plots were separated by 1.0 m and 0.50 m spacing, respectively.

During the study, the mainland was opened with a power tiller on 15th November, 2011. Ploughing and cross ploughing were done with country plough followed by laddering. Land preparation was completed on 28th November, 2011 and was ready for sowing the seeds of soybean. The fertilizers were applied as basal dose at final land preparation where N, K_2O, P_2O_5 Ca and S were applied @ 20.27 kg ha^{-1}, 33 kg ha^{-1}, 48 kg ha^{-1}, 3.3 kg ha^{-1} and 1.8 kg ha^{-1} respectively in all plots. All fertilizers were applied by broadcasting and mixed thoroughly with soil. Intercultural operations such as weed control, thinning, irrigation and drainage was done as needed. Insect and pest control such as Neem oil, Ripcord, Aktara, Sumialfa and Marshal were sprayed in assigned plots with recommended dosages by using Knapsak sprayer.

Data were collected on plant height (cm), number of leaves $plant^{-1}$, length of leaf, number of branches $plant^{-1}$, number of flowers $plant^{-1}$, number of infested pods $plant^{-1}$, number of healthy pods $plant^{-1}$, yield $plot^{-1}$ (g) and yield (t ha^{-1}). All parameter was counted from the 10 selected plant sample and then the average was calculated. For benefit cost analysis, records of the costs incurred for labour, inputs, application of inputs in each treatment and that of control without insecticide were maintained. The result of Benefit-Cost analysis was expressed in terms of Benefit-Cost Ratio (BCR). BCR for each treatment was calculated dividing adjusted net return to total management cost of the respective treatment which may be expressed as:

$$\text{Benefit Cost Ratio} = \frac{\textbf{Adjusted}\ net\ reture}{\textbf{Total}\ management\ \ cost}$$

The collected data were analyzed statistically following the analysis of variance technique and the mean differences were adjudged with Duncan's Multiple Range Test (DMRT) using the statistical computer package program, MSTAT-C. [14]

RESULTS AND DISCUSSION

Plant Height: Plant height was significantly affected by the application of chemicals and botanical used as treatment at harvest level. Among the treatments, the tallest plant (89.67 cm) was observed at chemicals pesticide Sumialfa 5EC @ 2ml/L of water. On the other hand, the shortest plant (72.67) was recorded from control treatment (Figure 1). Sumialfa 5EC @ 2ml/L of water the most effective insecticide for controlling against soybean pests.

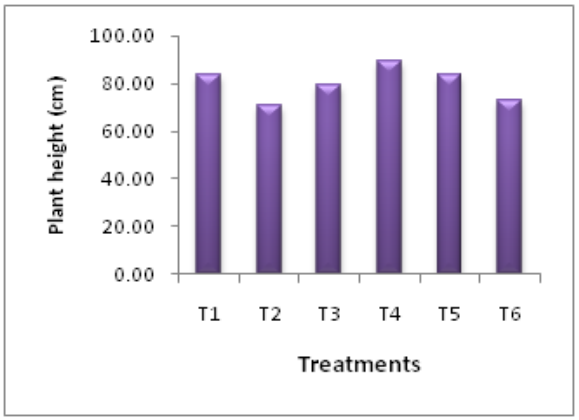

Figure 1. Effect on different management practices on the plant height of soybean

Number of leaves plant^{-1}: Effect of chemicals and botanical (Neem oil) showed significant variation in respect of number of leaves plant^{-1} at harvest. Among the treatments, the maximum number of leaves (17.33) was found from the treatment Sumialfa 5EC @ 2ml/L of water. The lowest results were obtained by control treatment (Figure 2).

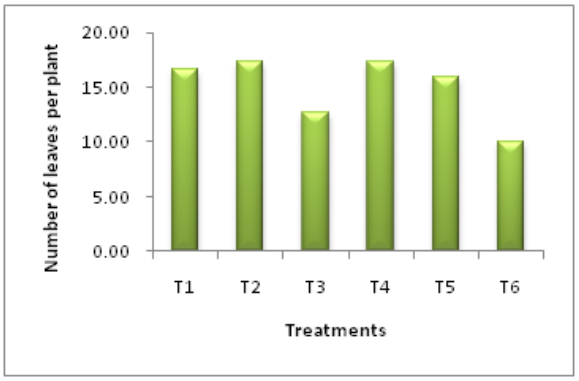

Figure 2. Effect on different management practices on the number of leaves plant^{-1} of soybean

Number of branch plant^{-1}: A significant variation was also observed due to the effect of different chemicals and botanical management of pest on soybean plant in respect of number of branch plant^{-1} at harvest. The maximum number of branches (4.33) was found at Sumialfa 5EC @ 2ml/L of water. On the other hand, the minimum number of branches (1.83) was recorded from control treatment (Figure 3). Sumialfa 5EC @ 2ml/L of water was the most effective insecticide against soybean insect pests.

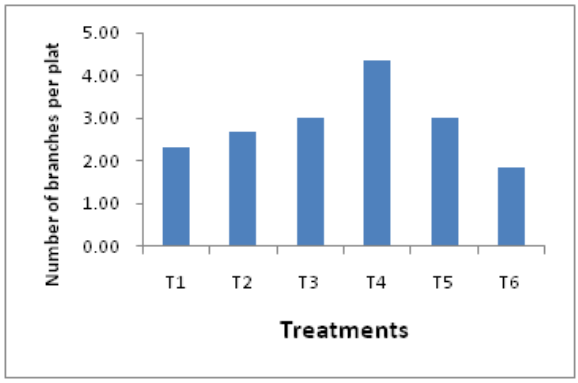

Figure 3. Effect on different management practices on the number of branches plant^{-1} of soybean

Leaf length (cm): A significant variation was also observed due to the effect of different chemicals and botanical management of pest on soybean plant in respect of leaf length. The maximum leaf length (15.27) was found at Sumialfa 5EC @ 2ml/L of water. On the other hand, the minimum leaf length (10.53) was recorded from control treatment (Figure 4). Probably, control measures ensure optimum photosnthesis as well as maximum accumulation of nutrients which ultimately contributed to increase the length of the leaf.

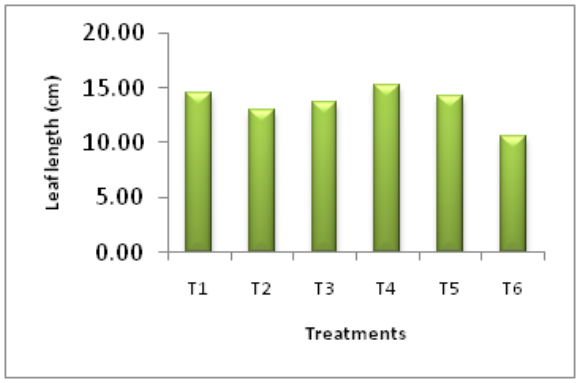

Figure 4. Effect on different management practices on the leaf length of soybean

Number of flowers plant^{-1}: A significant variation was also observed due to the effect of different chemicals and botanical

management of pests on soybean plant in respect of number of flower plant^{-1}. The maximum number of flowers (19.33) was found at Sumialfa 5EC @ 2ml/L of water. On the other hand, the minimum number of flowers (10.00) was recorded from control treatment (Table 1). Probably, control measures ensure optimum photosynthesis as well as maximum accumulation of nutrients which ultimately contributed to increase the number of flower per plant.

Number of infested pod plant^{-1}: The effect of different chemicals and botanical management of insect pests on soybean were significantly influenced due to number of infested pod plant^{-1}. The minimum number of infested pod (5.53) was found at Sumialfa 5EC @ 2ml/L of water. On the other hand, the maximum number of infested pod (11.07) was recorded from control treatment (Table 1). Sumialfa 5EC @ 2ml/L of water the most effective insecticide against soybean pest.

Number of healthy pod plant^{-1}: A significant variation was found due to the effect of different chemicals and botanical control agent against insect pests on soybean in respect of number of healthy pod plant^{-1}. Among the treatment, Sumialfa 5EC @ 2ml/L of water to ensure produced the maximum number of healthy pod per plant (22.60) where as the minimum number of pest was effective on soybean. Similarly, the minimum number of healthy pod per plant (16.07) was recorded from control (Table 1).

Table 1: Effect of chemicals and botanical (neem oil) to manage the pest and its impact on yield characteristics of soybean

Treatments	No. of flowers		No. of infested pods		No. of healthy pods	
T_1	17.67	ab	9.27	b	20.53	ab
T_2	14.67	ab	10.20	ab	21.33	ab
T_3	14.00	ab	5.80	c	19.53	b
T_4	19.33	a	5.53	c	22.60	a
T_5	14.00	ab	5.87	c	20.60	ab
T_6	10.00	b	11.07	a	16.07	c
$LSD_{(0.05)}$	7.08		1.40		2.28	
CV (%)	26.05		9.65		6.23	

In column, the treatments means having similar letter(s) are statistically identical at 5% level of significance.

Yield plot^{-1}(kg): Yield plot^{-1} was significantly affected by the application of different treatments as a control agent of major insect pests of soybean. As a result, Sumialfa 5EC @ 2ml/L (T_4) of water showed the highest yield per plot (3.29 kg). On the other hand, the lowest yield per plot (2.54 kg) was found from the control treatment (T_6) (Table 2). From the above results investigate, it was found that the among all applied different treatments in this study, Sumialfa 5EC @ 2ml/L of water showed the superior performance on control the pests as to ensure the optimum vegetative growth and highest number of flowers and healthy fruits per plot as well as maximum yield per plot.

Yield hectare^{-1}: Yield was significantly affected by the application of different insecticides and botanicals. Different insecticides were used to manage the pest in this study. As a result, Sumialfa 5EC @ 2ml/L of water (T_4) showed the highest yield (3.65 t/ha). On the other hand, the lowest yield (2.82 t/ha) was found control treatment (Table 2). From the above results investigate, it was found that the among all applied insecticide treatments in this study, Sumialfa 5EC @ 2ml/L of water showed the superior performance on control the pest to ensure the optimum vegetative growth and highest number of flowers and healthy fruits per plot as well as maximum yield per hectare.

Table 2: Effect of chemicals and botanical (neem oil) to manage the pest and its impact on yield of soybean

Treatment	Yield (kg/plot)		Yield (t/ha)	
T_1	2.97	b	3.30	b
T_2	2.79	c	3.10	c
T_3	2.94	b	3.27	B
T_4	3.29	a	3.65	A
T_5	3.19	a	3.55	A
T_6	2.54	d	2.82	D
$LSD_{(0.05)}$	0.141		0.15	
CV (%)	5.89		6.78	

In column, the treatments means having similar letter(s) are statistically identical at 5% level of significance.

Benefit Cost Ratio Analysis: The highest benefit cost ratio (6.00) was obtained in T_4 (Sumialfa 5EC @ 2ml/L water) the treated plot. The second highest benefit cost ratio (5.40) was found in T_5 (Marshal 20EC@ 2ml/L water) treated plot. The lowest benefit cost ratio (1.30) found in T_2 (Ripcord 10EC @ 2ml/L of water) treated plot (Table 3).

Table 3. Economic analysis of different management practices for managing soybean pest.

Treatments	Cost of pest management (TK)			Yield (t/ha)	Gross return (Tk.)	Net return (Tk.)	Adjusted return (Tk.)	Benefit cost ratio (BCR)
	Insecticides (Tk.)	Labour	Total					
T_1	9000	2520	11520	3.30	330000	227610	36780	3.2
T_2	9750	2520	12270	3.10	310000	206860	16030	1.3
T_3	9000	2520	11520	3.27	326700	224310	33480	2.9
T_4	9375	2520	11895	3.65	365000	262235	71405	6.0
T_5	8850	2520	11370	3.55	355000	252760	61930	5.4
T_6	---	---	---	2.82	281700	190830		

Price of Soybean seed=TK100.00/kg, Neem oil =TK 600.00/L, T_2: Ripcord 10EC=Tk 1300.00/L, T_3: Aktara 25 WG=TK 800/L, T_4: Sumialfa 5EC =TK. 1250.00/L, T_5: Marshal 20EC=Tk 1180.00/L and Cost of lobour-TK 180.00/ day.

CONCLUSION

All growth and yield character were significantly affected by the application of chemicals and botanical extract uses as treatment. Sumialfa 5EC @ 2ml/L of water showed the highest yield (3.65 t/ha). It is also revealed that (T_4) performed as the best treatment in terms of benefit cost ratio (6.00) followed by T_5 (5.40).

From the above results investigation, it could be concluded that among the all applied insecticidal and botanical treatments in this study, Sumialfa 5EC @ 2ml/L of water showed the growth and yield characteristics. The following recommendation may be suggested for this present study-

1. Further study may be needed to ensuring the growth and yield performance.
2. More chemicals treatments may be needed to include for future study as sole or different combination to make sure the better performance of Sumialfa 5EC @ 2ml/L of water.

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How to cite this article: Akter A, Haque Md. N, Akter Mst. M et. al. Evaluation of management practices for suppressing the major insect pests and growth and yield of soybean. Int J Res Rev. 2015; 2(7):391-397.

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