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EFFECT OF DIFFERENT WEEDING REGIMES ON GROWTH, NODULATION, AND YIELD PERFORMANCE OF SOYBEAN CV. BARISOYBEAN-6

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A B S T R A C T

The experiment was conducted at Agricultural field laboratory in Noakhali Science and Technology University during the period from mid-January 2019 to 1st week of May 2019, to find out the growth, nodulation, and yield performance of soybean cv. BARI soybean 6 under different weeding regimes. The experiment consists of four treatments viz. T_0 (No weeding), T_1 (Weed free), T_2 (Two hand weeding at 15 DAS and 30 DAS) and T_3 (Three hand weeding at 15 DAS, 30 DAS and 45 DAS). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Characters like plant height, number of pod plant^{-1}, number of effective pod plant^{-1}, number of non-effective pod plant^{-1}, number of seed pod^{-1} and yield varied significantly among the different weeding regimes. The highest seed yield (1.275-ton ha^{-1}) was recorded at T_1 (weed free) and the lowest seed yield (0.903-ton ha^{-1}) was observed at T_0 (No weeding) condition. The economic analysis of the treatments showed that farmers will be better off by adopting two weeding regimes and weeding at 15 DAS and 30 DAS is therefore recommended for high income.

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INTRODUCTION

Soybean is an important source of food, protein, and oil, and hence more research is essential to increase its yield under different conditions, including stress. Soybean oil finds a variety of uses for domestic and industrial purposes besides its use in several food preparations and animal feed (Aditya Pratap *et al*., 2011). It can play a vital role in balancing the protein deficiency of our diet (Mondal and Wahhab, 2001). Soybean is a profitable oil edit and establishes a vital part of smallholder trimming frameworks, with significant potential for upgrading family unit sustenance and nourishment security in Sub-Saharan Africa (Mohamedkheir et al., 2018). The capacity of vegetables to utilize air nitrogen fixed by advantageous rhizobial microbes, offers the potential for enhancing yield without nitrogen manure. In soybean, nitrogen fixation can just happen within the sight of perfect bacterial strains, commonly of the sort Bradyrhizobium (Joost van et al., 2018). Evaluation of soybean production, worldwide, can improve our understanding relative to the effects of different factors affecting the growth and yield of soybean globally (Pagano, M. C. 2016). Soybean is the most important oil crops in Bangladesh. Out of the total cropped areas of 14.418 million ha, oil crops occupy about 0.366 million ha and the total production of the country stands at 0.786 million tonnes. Out of total oil copped area, Soybean occupies 0.041 million ha and production of soybean is 0.064 million tonnes (BBS, 2013). The world average yield of soybean is about 3-ton ha^{-1} while that in Bangladesh 1.2-ton ha^{-1} is only (Woodruff, 1998) compared to other soybean producing countries. This is mainly due to use of low yield potential varieties and poor agronomic management practices. Among the agronomic practice use of high yielding variety as well as the weeding regimes have remarkable influence on soybean yield. The yield is largely affected by yield contributing characters which are influenced by environment during the growth and development of the crop.

Development, improvement, and yield of soybeans rely upon the hereditary capability of a cultivar and its collaboration with nature. In a field circumstance, nature gives the real segment of the ecological impact on soybean advancement and yield, be that as it may, soybean makers can control this condition with demonstrated administrative practices (Fatima et al., 2017). Weed control is largely based on herbicide application; however, chemical herbicides are often toxic and cause environmental problems. Use of aggressive cultivars can be effective cultural practice for weed growth suppression. According to Bussan *et al*. (1997), the competitive ability of crop can be expressed in two ways. First is the ability of the crop to compete to weeds, reducing weed seed and biomass production. The second possibility is having crop tolerate competition from weeds, while maintaining high yields (Rezvani *et al.*, 2012). But the effects of different weeding regimes on the soybean yield are noticeable. Weed infestation can cause a huge yield loss in soybean. Inadequate weed control is one of the main factors related to decrease in soybean production. Weeds compete with crops by resources (water, light, and nutrients). This competition is important mainly in the initial stages of crop development, due to possible losses in production that can be up to 80% or even, in extreme cases, hinders harvest operations. Weeds have traits which confer them great aggressiveness even in adverse environments. High number of seeds, seed dormancy, discontinuous germination, effective dispersal mechanisms and population heterogeneity, are very important for weed establishment during crop development. During this phase, weeds may rapidly capture resources and occupy space; this is often linked to their competitive ability, because rapid growth requires the prompt and efficient conversion of resources into biomass. Thus, the yield is reduced, and production costs increase, resulting in a decrease in farmer's income. Besides reducing crop yield, weeds can cause other problems, like reduce grain quality, cause loss and difficulty during harvesting and serve as hosts of pests and diseases. The role of weeds as alternate hosts for soybean crop pests and diseases and their interference with cultivation operations resulting into higher costs of production must not be overlooked. Weeds can also release toxins highly harmful to crop development (Alexandre *et al.*, 2013). Considering the above facts present study was undertaken to find out the effect of different weeding regimes on growth, nodulation, and yield of soybean.

MATERIALS AND METHODS

Location

The experiment was carried out at the field of Agriculture in Noakhali Science and Technology University, Noakhali, during the period from Mid-January 2019 to 1st week of May 2019 to evaluate the growth, nodulation and, yield performance of BARI soybean-6 under different weeding regimes. The area lies between 10 m above sea level and latitude 22.79^0 and the area was characterized by sub-tropical climate. The average temperature and rainfall were 27.5^{0}C and 33.125 mm respectively during the experimental time (WMN 2019).

Soil

The experiment field was almost loamy soil, medium high land and moderately alkaline with pH value 7.5 and the soils become saline in dry season. Generally, fertility is medium but low in organic matter. The water holding capacity of the soil is much less. (Source: Soil Resource Development Institute, Noakhali).

Experimental Treatments and design

The experiment consists of four treatments viz. T_0 (No weeding), T_1 (Weed free), T_2 (Two hand weeding at 15 DAS and 30 DAS) and T_3 (Three hand weeding at 15 DAS, 30 DAS and 45 DAS). The study was laid out in a Randomized Complete Block Design (RCBD) with four treatments replicated thrice. The size of each plot was 4 m × 2.5 m. The replication was separated from one another by 1 m spacing. The spacing between the individual plots was 0.5 m.

Seed Collection

Seeds of BARI soybean6 were collected from the Bangladesh Agriculture Research Institute (BARI), Gazipur, Bangladesh.

Field preparations and fertilizations

The experimental land was first opened with a power tiller. Later, the land was prepared by ploughing and cross-ploughing and subsequently leveled by laddering. Thereafter, the land was ploughed, and deep ploughing was obtained good tilth, which was necessary to get better yield. Laddering was done to break the soil clods into small pieces followed by ploughing. The fertilizers applied in the soil during final land preparation were urea, TSP, MoP, Gypsum and Boric acid @ 55, 150, 100, 80 and 10 kg ha^{-1}.

Seed sowing

The seeds of soybean were planted in the line sowing method maintained 3-4 cm depth on mid- January using 30 cm × 5cm spacing. Two irrigations were applied in the experimental field. First irrigation was done at 20 DAS and second irrigation was provided at 55 DAS.

Economic analysis

Economic analysis was carried out using the prevailing market prices for inputs at planting and for outputs at the time the crop was harvested. All costs and benefits were calculated on hectare basis in BDT. The following concepts used in the partial budget analysis are defined as mean grain yield is the average yield (t/ha) of each treatment. The average yield was adjusted downwards by 5%. The adjusted yields represent the potential yield from the farmer's field using the same treatments. The gross field benefit was calculated by multiplying the field price by the adjusted yield. The net benefits were calculated by subtracting the total costs that vary from the gross field benefits for each treatment.

Data collection and statistical analysis

For data collection, five hills were selected at random from each plot and tagged for measuring plant height and five hills were selected for counting the number of nodules plant^{-1} at 45, 60 and 75 DAS. To determine dry weight the sample plants were first air dried for 5-6 hours. Then the samples were packed in labeled brown paper bags and dried in the oven for 24 hours until constant weight was reached. After oven drying, the samples were weighed by using electric balance. Data were collected from randomly selected five hills prior to harvest on yield contributing characters of BARI soybean 6. In each plot central 1m×1m area was harvested to record the yields of grain. The harvested crop of each plot was separately bundled, properly tagged and then brought to the threshing floor. The harvested crops were threshed by hand sticks and the fresh weight of grain yield was recorded plot wise. Data recorded for growth and yield parameter were compiled and tabulated in proper form for statistical analysis. Analysis of variance was done with the help of MSTAT-C computer package programme, developed by Russel (1986). The mean differences among the treatments were adjudged by DMRT test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSIONS

Effect of different weeding regimes on growth parameters of soybean

Plant height was statistically significant at 45 DAS and 60 DAS but at 75 DAS the plant height was found statistically non-significant (Table-1). Number of nodules plant^{-1} was statistically significant at 45 DAS, 60 DAS and 75 DAS (Table-1). The highest number of nodule plant^{-1}(23.00) was observed at 75 DAS with T_1 treatment (weed free condition) and lowest number of nodule plant^{-1}(7.467) was recorded at 45 DAS with control (T_0) treatment (Table-1). On the other hand, the dry weight of plant was not statistically significant at 45 DAS and 60 DAS but statistically significant at 75 DAS (Table-1). The maximum dry weight (15.07) was found with T_1treatment (weed free condition) and minimum dry weight (4.87) was recorded with control treatment (Table-1)

Effect of different weeding regimes on yield and yield contributing characters of soybean cv. BARI soybean 6

Plant height (cm)

Plant height was significantly influenced by weeding regimes (Table-2). The highest plant height (64.27 cm) was observed at T_1 (Weed free) treatment compared with other treatment and the lowest plant height (53.8 cm) was observed at T_0 (No weeding) condition (Table-2).

Number of pods plant^{-1}

Weeding regimes had significant effect on number of pods plant^{-1} (Table-2). The highest number pods plant^{-1} (56.20) was recorded in T_1 (Weed free) treatment, and the lowest number pods plant^{-1} (45.67) was found in T_0 (No weeding) treatment (Table-2).

Number of effective pods plant^{-1}

The effect of weeding regimes on the number effective pods plant^{-1} was statistically significant at 1% level of probability (Table-2). The highest number of effective pods plant^{-1} (53.67) was recorded at T_1 (Weed free) treatment, and the lowest number of effective pods plant^{-1} (43.34) was found at T_0 (No weeding) treatment (Table-2).

Number of non-effective pods plant^{-1}

The effect of weeding regimes on the number non-effective pods plant^{-1} was statistically significant at 1% level of probability (Table-2). The highest number of non-effective pods plant^{-1} (2.77) was recorded at T_2 treatment (Two hand weeding at 15 DAS and 30 DAS) and the lowest number of non-effective pods plant^{-1} (2.33) was found at T_0 (No weeding) treatment (Table-2).

Pod length (cm)

Weeding regimes had no significant influence on pod length (Table-2). The highest pod length (3.99 cm) was recorded at T_1 (Weed free) treatment, and the lowest pod length (3.70 cm) was observed at T_0 (No weeding) control condition (Table-2).

Number of seeds pod^{-1}

The effect of weeding regimes on the number of seeds pod^{-1} was statistically non-significant (Table-2). The highest number of seeds pod^{-1} (2.93) was recorded at T_1 (Weed free) treatment, and the lowest number of seeds pod^{-1} (2.56) was observed at T_0 (No weeding) treatment (Table-2).

Weight of thousand seeds (gm)

Different weeding regimes had no significant effect on weight of thousand seeds (Table-2). The highest thousand seeds weight (104.23 gm) was obtained at T_1 (Weed free) condition, and the lowest thousand seed weight (90.39 gm) was recorded at T_0 (No weeding) treatment (Table-2).

Yield (ton ha^{-1})

Seed yield (ton ha^{-1}) was significantly influenced by the weeding regimes at 1 % level of probability (Table-2). The result showed that highest seed yield (1.275-ton ha^{-1}) was obtained at T_1 (Weed free) treatment and the lowest yield (0.903-ton ha^{-1}) was found at T_0 (No weeding) treatment (Table-2).

Table 1. Effect of different weeding regimes on growth performance of soybean cv. BARI soybean 6

Treatment	Plant height (cm)			No. of nodules plant^{-1}			Dry wt. (gm plant^{-1})		
	45DAS	60DAS	75DAS	45DAS	60DAS	75DAS	45DAS	60DAS	75DAS
T_0	35.67 c	43.53 abc	39.59	7.467 d	8.343 c	14.89c	4.87	5.19	9.917 bc
T_1	37.22 a	47.33 a	55.55	12.30 a	16.00 a	23.00 a	6.77	7.04	15.07 a
T_2	36.33 ab	42.43 c	47.23	11.49 b	14.00 abc	16.59 bc	7.30	8.58	13.73 ab
T_3	34.22 abc	46.56 ab	53.69	8.253 cd	15.25ab	17.39 b	6.88	7.44	12.98 abc
Level of Significance	**	**	NS	**	**	**	NS	NS	**
CV (%)	3.03	4.23	12.75	20.24	22.37	16.18	14.45	17.27	14.43

In a column figure with same letter do not differ significantly. NS = non-Significant, ** = Indicate significant at 1% level of probability.
T_0 = No weeding; T_1 = Weed free; T_2 = Two hand weeding at 15 DAS and 30 DAS; T_3 = Three hand weeding at 15 DAS, 30 DAS and 45 DAS.

Table 2. Effect of different weeding regimes on the yield and yield contributing characters of soybean cv. BARI soybean 6

Treatments	Plant height (cm)	No. of pod plant^{-1}	No. of effective pod plant^{-1}	No. of non-effective pod plant^{-1}	Pod length (cm)	No. seed pod^{-1}	Weight of 1000 seeds (gm)	Yield (ton ha^{-1})
T_0	53.8c	45.67d	43.34d	2.33b	3.70	2.56c	90.39	0.903d
T_1	64.27a	56.20a	53.67a	2.53c	3.99	2.93a	104.23	1.275a
T_2	59.2b	52.10b	49.33b	2.77a	3.86	2.80b	100.30	1.192b
T_3	60.1b	49.15c	46.48c	2.67b	3.75	2.60c	91.70	1.067c
Level of significance	**	**	**	**	NS	**	NS	**
CV (%)	7.25	8.67	9.15	7.85	3.36	6.37	6.92	14.59

In a column figure with same letter do not differ significantly, NS = non-Significant, ** = Indicate significant at 1% level of probability.
T_0 = No weeding; T_1 = Weed free; T_2 = Two hand weeding at 15 DAS and 30 DAS; T_3 = Three hand weeding at 15 DAS, 30 DAS and 45 DAS.

Economic analysis

The results in this study indicated that the total grain yield (discounted at 5%) ranged from 857.85 kg/ha in the no weed plot to 1211.25 kg/ha (Table 3). The yield value in (BDT) ranged from BDT 51471 (USD 643.39) in the no weeding plot to BDT 61944 (USD 774.3) in the two weeding regimes. The cost that varies ranged from BDT 0 (USD 0) in the no weeding plot to BDT 6000 (USD 75) in the two weeding regimes. The net profit value ranged from BDT 51471 (USD 643.39) in the no weed plot to BDT 61944 (USD 774.3) in the two weeding regimes. Generally, all the treatments had higher benefit over no weed control. The low net benefit recorded in the control may be due to low yield because of high weed competition leading to depletion of nutrients for the crop growth and development (Nathanael et al., 2013).

Table 3. Partial budget for four different weeding regimes of soybean seeds

Item	Treatment			
	Weeding regimes			
	T_0	T_1	T_2	T_3
Average yield (Kg/ha)	903	1275	1192	1067
Adjusted yield (Kg/ha)	857.85	1211.25	1132.4	1013.65
Gross field benefit (BDT/ha)	51471	72675	67944	60819
Cost of weeding (BDT/ha)	0	15000	6000	9000
Cost of seeds (BDT/ha)	0	0	0	0
Total cost that varies (BDT/ha)	0	15000	6000	9000
Net benefit (BDT/ha)	51471	57675	61944	51819

Average yield adjusted 5% downwards; Farm gate price of soybean as at May 2019= BDT 60 per kg; Price of weeding 1 hectare as 2019= BDT3000.

CONCLUSION

Different weeding regimes had a great impact on the nodulation and seed yield of soybean. The economic assessment of the treatments showed that application of two weeding regimes was more profitable than all the other treatments. Based on the findings of this experiment, it is recommended that two weeding regimes could maximize farm income.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this paper.

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