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EVALUATION OF PHOTO-INSENSITIVE COUNTRY BEAN GENOTYPES UNDER VARIED SUPPORT SYSTEMS

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Abstract

An experiment was conducted at the experimental field of the Horticulture Department, Sylhet Agricultural University, during the summer season on 15 May 2017 to evaluate three photo-insensitive (summer) country bean genotypes viz., Sikribi sheem-1, Sikribi sheem-2, and SB003 under two different support systems viz, trellis and staking. This experiment was conducted in two factors randomized complete block design (RCBD) with three replications. In the case of Sikribi sheem-2, minimum days (47.50) were required for the first flowering, followed by Sikribi sheem-1(49.66) and SB003 (50.00). All the genotypes required around 80 days to first green pod harvest. Sikribi sheem-1 produced the maximum number of pods plant-1 (211.5) followed by SB003 (187.0), while it was the lowest for Sikribi sheem-2 (168.0). The green pod yield of Sikribi sheem-1 (1.19 kg plant-1) and SB003 (1.05 kg plant-1) was significantly higher than that of Sikribi sheem-2 (0.69 kg plant-1). Considering support system, a higher number of pods plant-1 (194.55) was harvested from the plant grown under the staking system than the trellis system (183.11). In the case of an interaction effect, the highest number of pods plant-1 was recorded from the genotype Sikribi sheem-1 when grown under a staking support system (220.0), and the corresponding gross margin was 2424 taka/decimal while it was the lowest for Sikribi sheem-2 when grown in trellis support system (155.66) and the corresponding gross margin was 984 taka/decimal. So growers can ensure more profit (more than 2000 taka per decimal) by cultivating Sikribi sheem-1 during the summer season in the Sylhet region, followed by SB003.

Keywords: Photo-insensitive, trellis, staking system, pod yield per plant, genotypes.

Introduction

Country bean (*Lablab purpureus* L. Sweet), belongs to the family Fabaceae (formerly Leguminosae), is one of the most important and nutritious vegetables as well as pulse in Bangladesh, and is grown extensively all over the country (Biswas et al., 2021; Rashid, 1999; Philip, 1982). It is reported to be originated in India (Sibiko et al. 2013; Chowdhury et al.1989) and then spread to many tropical and subtropical countries worldwide. Country been is popularly known as the "poor man's meat" due to its low fetching price and being a good source of proteins (Mortuza & Tzen, 2009). Generally, it contains 20-30% protein on a dry seed, nearly three times more than in most cereals (Mia, 1989). Besides, it contains vitamin A, vitamin C, riboflavin, and minerals like magnesium, calcium, phosphorus, potassium, iron, sulphur, and sodium (Jukanti et al, 2012, Deka and Sarkar, 1990). It also provides significant nutritional and health benefits and reduces several non-communicable diseases, such as colon cancer and cardiovascular diseases (Yude et al, 1993; Jukanti et al, 2012). The foliage of the crop can be used as silage and green manure (Preetham, et al., 2020). It occupied a unique position as a vegetable among the legume crops due to producing 144050 metric tons from 51578 acres of the land area during 2018-2019 (BBS, 2019). This crop is well adapted to the temperature around 18-30 0C. Under 32/27°C day/night temperature, the considerable reduction in pod set was due to enhanced abscission of flower buds, flowers, and young pods (Konsens et al., 1991). Being a short-day plant, the critical day length for those winter varieties is 12-13 hours. Rainfall ranging from 700-900 mm per annum is considered adequate (Ismunadji and Arsyad, 1990). : The availability of lablab beans is restricted in winter months due to its photosensitive behaviour and favorable conditions for pod production. Though its demand remains equally high around the year, during summer, production of this crop is quite difficult due to adverse climatic conditions in Bangladesh, especially in Sylhet region. High rainfall, longer duration rainfall, high humidity, disease infestation due to high humidity, high temperature (both day and night), and soil acidity are major constraints for lower production of been in Sylhet during summer (Anonymous, 2012). To mitigate this problem Horticulture Research Center (HRC) of Bangladesh Agricultural Research Institute (BARI) and

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Sylhet Agricultural University (SAU) have developed some photo-insensitive country bean varieties. Though an assessment of the morphological variability of these varieties was performed by Akter et al. (2017) during the summer season in the Sylhet region, there is no evidence about the yield attributes of these photo-insensitive (summer) country been in different support systems, especially during the summer season in Sylhet. Yield performance largely depends on several factors, such as fertilizer management, irrigation, spacing, planting time, different support systems etc. Genotypic responses on yield may be affected due to different support systems, viz. trellises or stakes. Considering the facts, the present study was undertaken to evaluate varieties at various support systems during the summer season in the Sylhet region.

Materials and Methods

The study was conducted at the experimental field of the Horticulture Department, Sylhet Agricultural University, Sylhet, during the summer season on 15 May, 2017. Three photo-insensitive (summer) country bean genotypes viz., Sikribi sheem-1, Sikribi sheem-2 and SB003 were evaluated under two different support systems viz, trellis and staking. The experiment was conducted in a randomized complete block design (RCBD) with three replications in which planting geometry was maintained at 2.0 m X 1.0 m between row-to-row and plant to plant distance, respectively. For planting three seeds of each genotype were sown in polybags containing well-prepared soil mixture on 15 May 2017. Then after complete germination, around 10-day-old seedlings were transplanted in the pit, and two weeks after transplanting, out of three seedlings, two were thinned out, allowing one seeding to grow in the pit. A single bamboo stake in each pit supported the young growing plant. Plants were supported by two ways, viz. 1. Trellis (made with the help of bamboo and nylon rope) and 2. Staking (which was given with a branched bamboo head). The crop was fertilized with cow dung, urea, TSP, and MP at the rate of 10 tons, 50 kg, 150 kg, and 150 kg per hectare, respectively (Rashid, 1999). Full doses of well-decomposed cow dung and half of TSP were applied to the plots and incorporated into the soil during land preparation. The rest of TSP and the entire amount of MP were applied in pits seven days before seed sowing. Urea was applied in two installments at 20 and 40 days after seed sowing. Irrigation, drainage weeding etc. were done as and when necessary. Fencing was made around the experimental plots to avoid damage from the pest. The pods were also protected from aphids, jute hairy caterpillars, and pod borer attacks by applying Maladan @ 2 ml L-1 of water. Data on different parameters were collected for pod yield and yield attributes from both the supporting system. Collected data were analyzed using MSTAT software for the interpretation of the results. To show economic importance of the genotypes, Benefit Cost Ratio (BCR) was calculated. Some pictorial views of the photo-insensitive country bean genotypes growing at two different support systems were shown in Plate 1.

Plate 1. Some pictorial views of photo-insensitive (summer) country bean genotypes at different support systems.

Results & Discussion

Effect of genotype

The effect of genotype on pod yield and yield attributes of summer country bean is presented in table 1. Significant variations were observed among the genotypes on pod yield and yield attributes. Minimum days (47.50) were required for first flowering in the case of Sikribi sheem-2 followed by Sikribi sheem-1(49.66) and SB003 (50.00). All the genotypes required around 80 days to first green pod harvest. Moniruzzaman et al. (2010) observed that the time required for first harvesting ranged from 62-134 days after planting. Among the genotypes, Sikribi sheem-1 produced the maximum number of pods per plant (211.5) followed by SB003 (187.0), while it was the lowest for Sikribi sheem-2

(168.0). Individual pod weight of Sikribi sheem-1 (5.62 g) and SB003 (5.59 g) was significantly higher than that of Sikribi sheem -2 (4.09 g). Maximum pod length was identified in the case of Sikribi sheem-1(8.43 cm) and SB003 (8.5 cm). On the other hand, maximum pod breadth was found in Sikribi sheem-1(2.30 cm) and Sikribi sheem-2(2.01 cm). Green pod yield of Sikribi sheem-1 (1.19 kg plant-1) and SB003 (1.05 kg plant-1) was significantly higher than that of Sikribi sheem-2 (0.69 kg plant-1) due to having the maximum number of pod plant-1 and maximum pod weight. A similar result was in harmony with some previous studies of Pengelly and Maass (2001) and Sultana (2001). Among these three genotypes, minimum borer infestation was found in Sikribi sheem-1(2.8%).

Table 1. Effect of genotype on pod yield and yield attributes of summer country bean.

Genotypes	Days to flower	Days to harvest	No of pods plant^{-1}	Individu al pod wt. (g)	Pod yield plant^{-1} (kg)	Pod length (cm)	Pod breadth (cm)	% borer infestation
Sikribi sheem-1	49.66a	79.5	211.5a	5.62a	1.19a	8.43a	2.30a	2.8
Sikribi sheem-2	47.50b	77.66	168.0c	4.09b	0.69b	7.16b	2.01a	3.7
SB003	50.00a	79.66	187.0b	5.59a	1.05a	8.5a	1.73b	3.4
F-test	*	ns	**	**	**	**	**	na
CV (%)	3.11	2.51	5.06	12.5	13.33	7.3	8.4	-

ns indicates not-significant, * indicates significant at 5% and ** indicates significant at 1% level of probability. Values of a column having the same letter do not differ significantly.

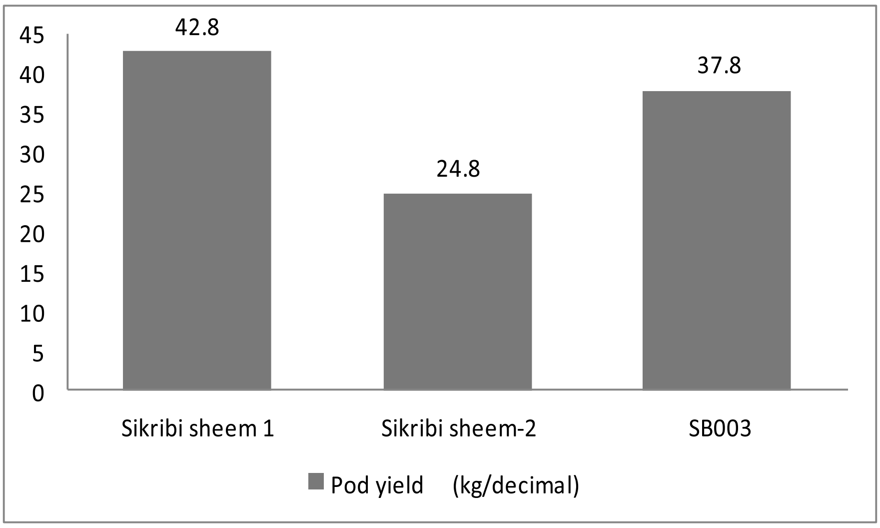

Figure 1. Pod yield (kg decimal^{-1}) of country bean genotypes.

Corresponding pod yield per decimal was also indicated that (Fig. 1) Sikribi sheem-1, Sikribi sheem- 2, and SB003 produced 42.8 kg, 24.8 kg, and 37.8 kg of the green pod, respectively, during summer. Among these genotypes, Sikribi sheem-1 showed better performance. A similar variation of pod yield during the summer season was also reported by Akter (2015) when grown at different sowing dates during the summer season.

Effect of support system

No significant variations were found for pod yield and yield attributes of summer country beans grown under two different support systems (Table 2). However, higher number of pods per plant (194.55) was harvested from the plant grown under the staking system than the trellis system (183.11). Similar result was also reported by Khan (2003), in which the number of pods per cluster, number of pods per plant, and pod yield per plant were slightly higher in staking support than in the trellis support system.

Table 2. Effect of support system on pod yield and yield attributes on summer country bean production.

Genotypes	Days to flower	Days to harvest	No of pods plant^{-1}	Individual pod wt. (g)	Pod yield plant^{-1} (kg)	Pod length (cm)	Pod breadth (cm)	% borer infestation
Trellis	49.00	78.33	183.11	5.15	0.95	7.95	2.04	2.9
Staking	49.11	79.55	194.55	5.06	1.01	8.11	1.98	3.7
F-test	ns	ns	*	ns	ns	ns	ns	na
CV (%)	3.11	2.51	5.06	12.5	13.33	7.3	8.4	-

ns indicates non-significant and * indicates significant at 5% level of probability.

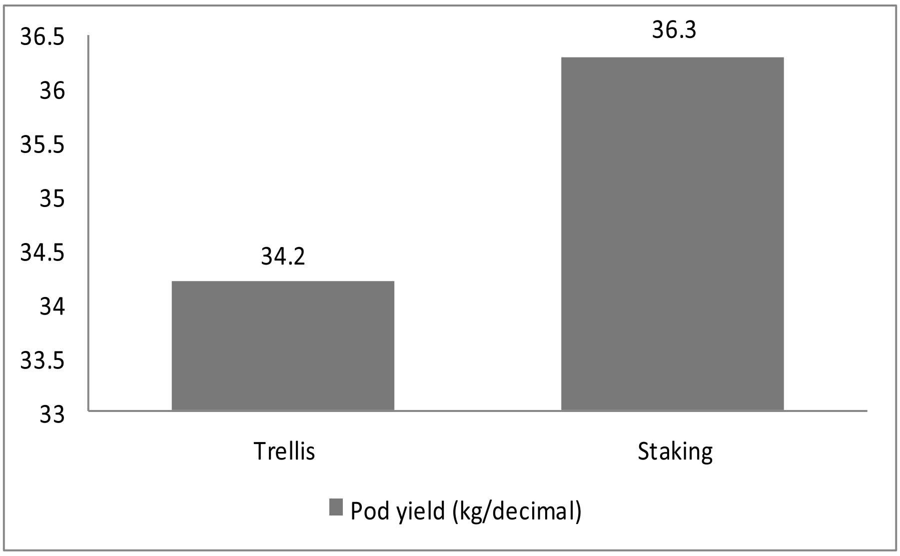

Figure 2. Pod yield (kg decimal-1) of summer country bean under different support systems.

Plants grown under the staking support system (36.3 kg pods per decimal) provided higher pod yield than trellis system (34.2 kg per decimal) (Fig. 2). This might be due to the plants in trellis support were not able to utilize the vertical space properly. On the contrary, the plant in the staking system could occupy more space with less shading and more radiation interception by the well-distributed leaves (Khan, 2003).

Interaction effect

The interaction effect between genotypes and support systems is presented in Table 3. Most parameters were not significantly affected due to interaction between genotypes and support system except the number of pods plant-1 and pod yield plant-1. The highest number of pods per plant was recorded from the genotype Sikribi sheem-1 when grown under the staking support system (220.0), while it was the lowest for Sikribi sheem-2 when grown in the trellis support system (155.66). A similar trend was also recorded for pod yield per plant. The genotype Sikribi sheem-1 produced the maximum pod yield per plant at the staking support system (1.25 kg), which was identical to that of SB003 grown under the staking support system (1.15 kg plant-1). The lowest pod yield per plant (0.61 kg) was achieved from Sikribi sheem-2 grown under the staking support system. In the case of individual pod weight, pod length, and pod breadth, genotype Sikribi sheem-1 showed better performance when grown in the staking support system. This might occur due to more space, the light and a favorable microclimate in the staking system. Borer infestation was almost similar for all these genotypes in both support systems. The effect of staking on yield and quality of Phaseolus vulgaris cvs was studied by Edje and Mughogho (1978), in which vertical staking showed a better performance.

Table 3. Interaction effect between support system and genotype on growth and yield of summer country bean.

Genotypes	Days to flower	Days to harvest	No of pods plant^{-1}	Individual pod wt. (g)	Pod yield plant^{-1} (kg)	Pod length (cm)	Pod breadth (cm)	% borer infestation
S1V1	49.33	79.33	203.00ab	5.54	1.12ab	8.3	2.30	4.5
S1V2	47.33	77.00	180.33bc	4.26	0.78cd	7.16	2.13	6.0
S1V3	50.33	78.66	166.00c	5.64	0.95bc	8.40	1.70	7.0
S2V1	50.00	79.66	220.00a	5.69	1.25a	8.56	2.30	7.5
S2V2	47.66	78.33	155.66c	3.93	0.61d	7.16	1.90	8.0
S2V3	49.66	80.66	208.00a	5.55	1.15a	8.6	1.76	6.5
F-test	ns	ns	**	ns	***	ns	ns	na
CV (%)	3.11	3.92	5.06	12.5	13.33	7.3	8.4	-

S1= Trellis, S2= Staking, V1=Sikribi sheem-1, V2= Sikribi sheem-2, V3= SB003. NS indicates non-significant, * indicates significance at 5% , ** indicates significance at 1% , and *** indicates significance at 0.1% level of probability. Values of a column having the same letter did not differ significantly.

Per decimal green pod yield at different treatment combinations are given in Figure 3. The maximum green pods were harvested from the plants of Sikribi sheem-1 (45.0 kg) followed by SB003 (41.4 kg) grown under a staking support system. While it was only 22.0 kg decimal-1 for Sikribi sheem-2 when grown under the staking support system.

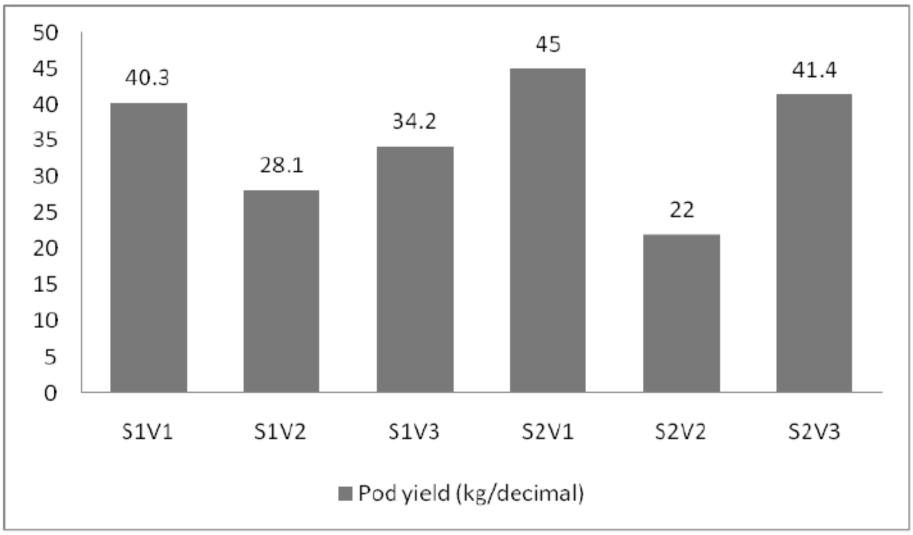

Figure 3. Pod yield (kg decimal-1) of country bean genotypes under different planting systems.

A remarkable incidence of disease and insect was found in the country bean during summer season (Table 4.). Aphid, pod borer, and cercospora leaf spot infestation was noticed more or less in all the genotypes during the summer season due to having the congenial environmental condition for the pathogen. However, bean common mosaic virus infestation was found only in the genotype SB003 at 55 days after sowing, indicating that this genotype was more susceptible to the virus. Appropriate control measure was proven effective against these pests and diseases. These findings provided evidence that summer cultivation of the country bean might be possible with proper management of pests, diseases, and microclimate around the plant.

Table 4. Incidence of disease and insects in summer country bean genotypes.

Insects/Diseases	Description
1. Aphid	All the genotypes were infested at 40 days after sowing. Hand destruction and application of insecticide twice (admire @ 0.5 ml per litre of water) were found effective.
2. Pod borer	Pod infestation was found at the later harvesting stage. Percent infestation was found to be very negligible (4.0-8.0%)
3. Bean common mosaic virus	Growing twigs of two plants of SB003 infected with virus at 55 day after sowing. Infected twigs were immediately pruned off and destroyed. No further infection was found in the field.
4. Cercospora leaf spot	Lower leaves of all genotypes were infected by the cercospora leaf spot 80 days after sowing. Application of Bavistin (fungicide 2%) was found effective in reducing the incidence.

Economic analysis of summer country bean production is presented in Table 5. It was found that only bamboo is required for the construction of the support system. This study found that Sikribi sheem-1 produced maximum pod yield, and the corresponding gross margin was 2424 taka decimal-1. Hence, growers can ensure more profit (more than 2000 taka per decimal) by cultivating Sikribi shemm-1 during summer season in the Sylhet region followed by SB003. The highest Benefit Cost Ratio (BCR) was found in Sikribi sheem-1(3.40) followed by SB003 (3.02) and Sikribi sheem-2 (1.98).

Table 5. Yield and yield attributes of country bean genotypes during summer

Genotype	Pod yield (kg decimal^{-1})	Cost (Tk decimal^{-1})	Return decimal^{-1} (@ 80 Tk kg^{-1})	Gross margin	BCR
Sikribi sheem-1	42.8	1000/ (only bamboo sticks and rope are required)	3424	2424	3.40
Sikribi sheem-2	24.8		1984	984	1.98
SB003	37.8		3024	1624	3.02
Average	35.13		2810.6	1677.3	2.81
Range	24.8-42.8		1984-3424	984-2424	1.98-3.4

From the discussion, it may be concluded that the country bean production during summer using Sikribi sheem-1, Sikribi sheem-2 and SB003 might be more beneficial for nutritional aspects, ensuring food security, year-round availability, and economic profitability. Though all these three genotypes performed well, Sikribi sheem-1 and SB003 might be strongly recommended for the Sylhet region during the summer. Again, more or less similar yield and yield attributes were found from both support systems viz. trellis and staking. Nevertheless, staking might be recommended for summer country bean cultivation in case of commercial purposes.

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