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Effect of Sowing Date on Yield and Seed Quality of Soybean

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Authors' contributions

This work was carried out in collaboration between all authors. Author PKK wrote the protocol and worked in the field. Author TSR designed the study. Author MSHK managed the literature searches and author KP helped in data collection. Author HEMKM helped in statistical analysis, writing the paper and corresponding with the editor of the journal. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted at the research field of Sher-e-Bangla Agricultural University, Dhaka, in the Robi season during the period from November 2013 to March 2014 to study the effect of sowing date on yield and seed quality of soybean. The aim of the study was to find out the appropriate sowing time of soybean. The experiment consists of four different sowing date *viz.,*18th November, 25th November, 2nd December and 9th December. The experiment was laid out in Randomized Complete Block Design (RCBD) factorial with five replications. The result indicated significant variations in number of pods plant^{-1}, pods length, number of seeds pod^{-1}, 1000-seed weight, seed yield, stover yield, biological yield, harvest index, germination percentage, vigor index, protein content and oil content due to different sowing dates. The results revealed that, the maximum number of pods plant^{-1} (27.11), pods length (3.48 cm), number of seeds pod^{-1} (1.91),

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weight of 1000-seeds (86 g), seed yield (2243 kg ha^{-1}), harvest index (61.55%) and also maximum germination percentage (94.42%), vigor index (2103), protein content (39.37%) and oil content (25.94%) were found when soybean was sown on 2nd December that given the maximum yield and good quality soybean seed.

Keywords: Soybean; sowing time; yield; seed quality; protein content; oil content.

1. INTRODUCTION

Soybean (*Glycine max* L.) belongs to the family Fabaceae sub family Faboideae. It is one of the major oil seed crops of the world. Among the legume crops soybean contains the highest amount of protein (40%) and oil (20%) and a good amount of other nutrients like calcium, phosphorus, iron and vitamins with about 40% proteins. The oil content of soybean is about 20% while all other pulse contains about 1-2% oil [1]. Generally human consumes protein from plant and animals source. The common people of Bangladesh cannot afford for animal protein like egg, milk, meat and fish in their daily diet because of their high cost [2]. Therefore, soybean can play a vital role to supplement protein our food to the common people of Bangladesh.

Bangladesh has made significant improvement in agriculture sector but the chronic food deficiency has persisted unabated for many years. The growth of population in our country is much faster than agricultural production. In Bangladesh, soybean is not popularly used as a food nor it consumed as a grain legume (pulse), rather it is mostly used as poultry and fish feed. However, for its increasing local demand a huge amount of soybean is imported every year. In the traditional soybean producing countries, like China and Japan, it is consumed as varieties of food products such as soy milk, soy sauce, curd and high protein biscuit, bread etc. According to FAO [3] recommendation, a minimum intake of pulse by a human should be 80 g/day, where as it is 7.92 g in Bangladesh [4]. It holds the 3th in protein content and 4th in both acreage and production in Bangladesh [5].

The expansion of soybean has been limited due to lack of supply of quality seed, this is because soybean seed often losses its viability in storage and thus the seed cannot be stored from one rabi season to the next [6]. The loss of seed viability may be related to the production environment during the ripening stage and method of harvesting and threshing. Reports available in that soybean seed could not be stored from one rabi season to the next whereas Rahman and Miah [7] was able to keep soybean seed with high germination and vigor by festering in containers at 50-60% RH. This seed quality decline was probably related to the unfavourable environment during ripening and harvesting of the crop. Tang [8] reported that sowing date is an important factor regulating soybean seed quality. Mechanical damage at harvesting might have created the deed quality problems [9]. The present study was therefore, undertaken with the following objective to identify the suitable date of sowing from studied soybean cultivars to get maximum yield.

2. MATERIALS AND METHODS

2.1 Climate and Soil

The experiment was conducted at the Agronomy experimental field of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from November 2013 to March 2014 to study the influence of sowing date on yield and seed quality of soybean. The soil belongs to "The Modhupur Tract", AEZ – 28. Top soil was silty clay in texture, olive-gray with common fine to medium distinct dark yellowish brown mottles. Soil pH was 6.1 and has organic carbon 0.45%. The geographical location of the experimental site was under the subtropical climate, characterized by 3 distinct seasons, winter season from November to February (maximum 26℃ and minimum 11℃ temperature and average rainfall 17 mm) and the pre-monsoon period or hot season from March to April (maximum 36℃ and minimum 19℃ temperature and average rainfall 99 mm) and monsoon period from May to October (maximum 34℃ and minimum 24℃ temperature and average rainfall 255 mm). The experiment consists of four different sowing date *viz.,*18th November, 25th November, 2nd December, 9th December.

2.2 Experimental Design

The experiment was laid out in Randomized Complete Block Design (RCBD) factorial with five

replications. The size of each unit plot was 5.0 × 3.0 m. The spacing between blocks and plots were 1.0 m and 0.5 m respectively. The seeds of the test crop i.e., BARI Soybean-5were collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur.

2.3 Intercultural Operation

The plot selected for the experiment was opened in the first week of November, 2013 with a power tiller, and was exposed to the sun for a week, after which the land was harrowed, ploughed and cross-ploughed several times followed by laddering to obtain a good tilth. The fertilizers N, P, K, S and B in the form of urea, TSP, MP, Gypsum and boron, respectively were applied. Entire amounts of urea, TSP, MP, Gypsum and boron were applied during the final land preparation. First gap filling was done for all of the plots at 12 days after sowing (DAS) by planting same aged and same sources seedlings. The plots were infested by caterpillar which was successfully controlled by applying Basudin 10 G at the rate of 16.8 kg ha^{-1}. There was no disease infestation on the crop.

2.4 Data Collection

The crop was harvested at full maturity on 8th March, 2014 and harvesting was done manually from each plot. The harvested crop of each plot was bundled separately, properly tagged and brought to threshing floor. Enough care was taken for harvesting, threshing and also cleaning of soybean seed. Fresh weight of grain and stover were recorded plot wise. The grains were cleaned and finally the weight was adjusted to a moisture content of 12%. The stover was sun dried and the yields of grain and stover $plot^{-1}$ were recorded and converted to kg ha^{-1}. The following data were collected during the experimentation: pod length (cm), number of pods $plant^{-1}$ (no.), number of seeds pod^{-1} (no.), 1000-seed weight (g), seed yield (kg ha^{-1}), stover yield (kg ha^{-1}), biological yield (t ha^{-1}), harvest index (%), seed grading (by weight), germination (%), vigor index (%), protein content (%) and oil content (%).

2.5 Data Analysis

The data obtained for different characters were statistically analyzed to observe the significant difference among the treatment by using the MSTAT-C computer package program. The mean values of all the characters were calculated and analysis of variance was performed. The significance of the difference among the treatments means was estimated by the LSD at 5% level of probability.

3. RESULTS AND DISCUSSION

3.1 Length of Pods (cm)

There is no statistically significant differences were found for pods length of soybean due to sowing time (Table 1). The numerically, longest pod (3.48 cm) was recorded from 2nd December whereas, the shortest (3.34 cm) was observed from 18th November. This might be due to decrease vegetative growth and increased reproductive growth, which favoured the pod length [10].

3.2 Number of Pods $Plant^{-1}$

Statistically significant differences were found for number of pods $plant^{-1}$ of soybean due to sowing date (Table 1). The maximum number of pods $plant^{-1}$ (27.11) was recorded from 2nd December whereas, the minimum (19.59) was observed from 18th November. Egli and Bruening [11] showed the similar trends of result. Wafaa [12]

Table 1. Effect of sowing date on yield components of soybean

Sowing date	Length of pods (cm)	Pods $plant^{-1}$ (no.)	Seeds pod^{-1} (no.)	1000-seeds weight (g)
18th November	3.34	19.59 d	1.71	60.35 d
25th November	3.39	21.78 c	1.86	75.90 c
2nd December	3.48	27.11 a	1.91	86.00 a
9nd December	3.43	25.64 b	1.85	85.20 b
$LSD_{(0.05)}$	NS	0.7240	NS	3.7231
CV (%)	4.41	12.64	8.47	9.81

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability. NS=Non-significant

observed that number of pods plant^{-1} was significantly affected by sowing date. Early planting date of traits like pods in the main stem, number of pods sub bough^{-1} and number of pods plant^{-1} had the highest amount than the late planting date [13-15].

3.3 Number of Seeds Pod^{-1}

Statistically non significant results were found for number of seeds pod^{-1} of soybean due to sowing time (Table 1). The numerically, highest number of seeds pod^{-1} (1.91) was recorded from 2nd December and the lowest (1.71) was observed from 18th November. Number of seeds pod^{-1} depends on genotype and it is independence of environmental factors and just special environmental stress in period of establishment of seed effect on it. Scientist have reported that the similar results [14,16].

3.4 1000-seed Weight (g)

Statistically significant differences were found for 1000-seed weight of soybean due to sowing date (Table 1). The maximum 1000-seed weight (86 g) was recorded from 2nd December. The minimum 1000-seed weight (60.35 g) was found in 18th November. This might be due to the short vegetative growth period and long reproductive and grain filling period that significantly raised the 1000-seed weight. These results are similar with Pedersen and Lauer [15], in case of soybean, who stated that average seed weight from early sowing was higher than that from late sowing. Early planted varieties got more time and growth period to accumulate more photo-assimilates [14,17].

3.5 Seed Yield (kg ha^{-1})

Seed yield showed exerted significant differences among sowing date (Fig. 1). The maximum seed yield (2243 kg ha^{-1}) was observed from the 2nd December (S_3) treatment and the minimum seed yield (1083 kg ha^{-1}) was found in 18th November (S_1) treatment. Late planting due to the loss of suitable time for the growth, the plant was not achieved its potential ability because light interception and crop simulates partitioning were severely affected and consequently lead to yield decline. In case of early planting then plant get more time for plant growth and development, so seed yield increased was rational [18,19].

3.6 Stover Yield (kg ha^{-1})

Stover yield of soybean were significantly influenced by sowing date (Table 2). The maximum stover yield (2517 kg ha^{-1}) was observed from the 18th November whereas, the minimum (1401 kg ha^{-1}) was found in the 2nd December. It might be the results of higher plant height, number of plant m^{-2}, pod plant^{-1}, and higher dry matter accumulation plant^{-1}, which resulted evidently due to the profuse branching. Norwal and Malik [20] revealed the same results.

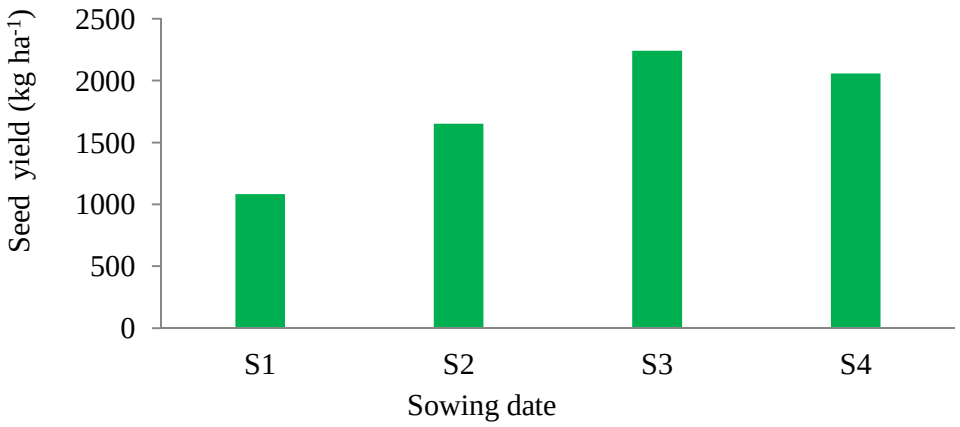

Fig. 1. Effect of sowing date on seed yield of soybean (Kg ha^{-1})
S_1 –18th November, S_2 –25th November, S_3 –2nd December and S_4 –9th December
($LSD_{0.05}$ = 205.106)

3.7 Biological Yield (t ha^{-1})

Sowing date significantly varied for producing biological yield (Table 2). The highest biological yield (3995 kg ha^{-1}) was observed from 25th November and the lowest (3600 kg ha^{-1}) was found in 18th November. It was shown that the late planting date, biological yield decreased because the flowers appear in late and produced terminal buds leaves new growth and the plant stops the reproductive growth. Scientist reported that a reduction in biological yield due to delayed planting [21]. Similar results were recorded with the late planting by scientist [18,19] in their experiments.

3.8 Harvest Index (%)

A significant difference was observed from harvest index due to sowing date (Table 2). The highest harvest index (61.55%) was observed from 2nd December. The lowest harvest index (30.04%) was found from 18th November. Heydari and Khajepour [22] revealed that harvest index is affected by planting date. Early planting date results in higher harvest index [15,23] which was contradictory with the present findings; but Turk [24] reported that harvest index was not affected by planting date which agrees with this experiment.

3.9 Grading of Seed (% by weight)

There was significant variation in grading of seed in small, medium and large (Fig. 2). 18th November (S_1) produced the maximum percentage (24.68) of small seed which was statistically similar with S_2 (24.39%), whereas, the minimum (23.61%) was produced by 9th December (S_4) treatment. In case of medium seed, 2nd December (S_3) produced the maximum number of seed (33.35%) which was statistically similar with S_1 (33.28%) whereas, the minimum (32.47%) was produced by 9th December (S_4). In case of large seed, the maximum grade of seed weight (42.86%) was produced by 9th December (S_4) which was statistically similar (42.73%) by 2nd December (S_3) whereas, the minimum (42.04%) was produced by 18th November (S_1) treatment.

3.10 Germination (%)

Sowing date differed a significantly in germination percentage of soybean (Fig. 3). The maximum germination (94.42%) was observed from 2nd December (S_3) treatment and the minimum (87.50%) were found in 18th November (S_1) treatment.

3.11 Vigor Index (%)

Sowing date differed significantly in vigor index of soybean (Fig. 4). The highest vigor index (21.03%) was observed from S_3 treatment which was statistically similar to S_4 (20.88%) treatment. The lowest vigor index (10.09%) was found in S_1 treatment.

3.12 Protein Content (%)

Protein content in seed showed significant differences among sowing date (Fig. 5). The maximum protein content in seed (39.37%) was observed from the 2nd December (S_3) treatment which was statistically similar with 18th December (38.03 %) whereas, the minimum (32.87%) was found in 18th November (S_1) treatment.

3.13 Oil Content (%)

Oil content of soybean seed was significantly influenced by sowing date (Fig. 5). The highest oil content (25.94%) was observed from the S_3 treatment and the lowest (18.12%) was found in the S_1 treatment.

Table 2. Effect of sowing date on stover yield, biological yield and harvest index of soybean

Sowing date	Stover yield (Kg ha^{-1})	Biological yield (Kg ha^{-1})	Harvest index (%)
18th November	2517.00 a	3600.00 d	30.04 d
25th November	2342.00 b	3995.00 a	41.38 c
2nd December	1401.00 d	3644.00 c	61.55 a
9nd December	1874.00 c	3930.00 b	52.32 b
$LSD_{(0.05)}$	194.998	35.09	8.998
CV (%)	10.12	17.37	12.16

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

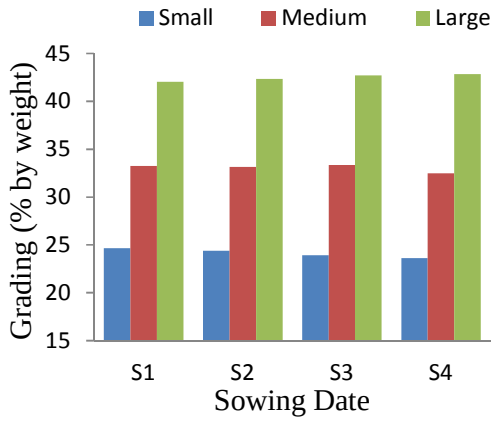

Fig. 2. Effect of sowing date on seed grading (% by weight) ($LSD_{0.05}$=0.05, 0.02 and 0.04 for small, medium and large, respectively)

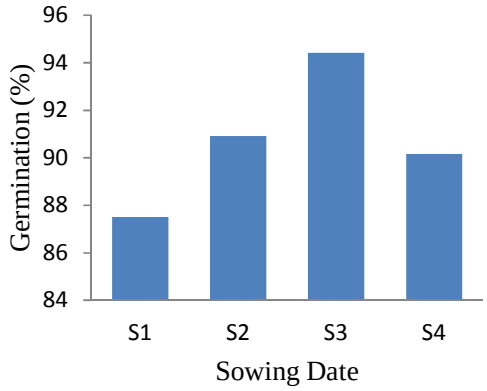

Fig. 3. Effect of sowing dates on germination (%) of soybean ($LSD_{0.05}$= 1.594)

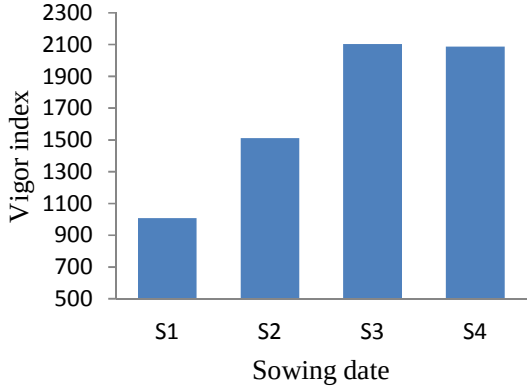

Fig. 4. Effect of sowing date on vigor index of soybean ($LSD_{0.05}$= 1.594)

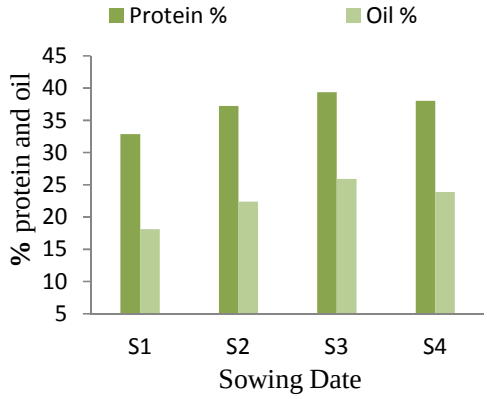

Fig. 5. Effect of sowing date on protein and oil content (%) of soybean ($LSD_{0.05}$= 1.72 and 1.23 for protein and oil, respectively)

4. CONCLUSION

The effect of sowing time had positive effect on yield and yield attributes and good quality soybean seed. The maximum seed yield 2243 kg ha^{-1}, the highest harvesting index (61.55%), the maximum germination percentage (94.42%), protein content (39.37%) and oil content (25.94%) were obtained from S_3 treatment. So it can be said that sowing on 2nd December is the more suitable time for getting maximum yield and good quality soybean seed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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