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Effect of sowing time on growth, yield and seed quality of chickpea (BARI chhola-6)

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Abstract
A field experiment was conducted at the Agronomy research field of Sher-e-Bangla Agricultural University, Dhaka, during the period from November 2013 to March 2014 to study the effect of sowing time and seed treatment on growth and yield of chickpea. The experiment comprised as one factor: sowing date - 3 times: 1st sowing date: 19th November – S_1, 2nd sowing date: 29th November – S_2 and 3rd sowing date: 9th December – S_3. The experiment was laid out in Randomized Complete Block Design (RCBD) with five replications. The result indicated significant variations in date of emergence, date of first flowering, date of 50% flowering, plant height, number of branches plant^{-1}, total dry matter content, number of pod plant^{-1}, date to pod maturity, pod length, weight of 1000 seed, grain yield, stover yield, biological yield, harvest index, germination percentage and vigor index due to sowing time. Among the treatment on maximum plant height and dry matter content recorded of plant in S_2 irrespective of growing period. This treatment also exhibited maximum number of pods plant^{-1}, longest pod length and maximum number of seed pod^{-1}, where as required minimum duration for pod maturity. The maximum weight of 1000 seed, highest grain yield, harvest index and also found maximum germination percentage and vigour index were found when chickpea was sown on 29th November and ensure the best performance.

Keywords: Chickpea, sowing time, growth, yield and seed quality.

1. Introduction
Chickpea (*Cicer arietinum* L.) is one of the major pulses crop in Bangladesh and it is the third most important food legume grown in the world after beans and peas. It is contributes about 3.87 % of total pulses production in Bangladesh (BBS, 2013). The average yield of chickpea is 1.32 t ha^{-1} but it is very low compared to other countries of the world. Total production of pulse in Bangladesh is 3,35,470 metric tons and total production of chickpea is 12,460 metric ton (BBS, 2013). In Bangladesh, its cultivation is mostly concentrated in the Gangetic Flood Plain of western part of the country. Domestic pulse production satisfies less than half of the other countries demands. The rest, near about 1,40,000 ton, near to import at a cost of about 32.2 million USD per annum. The resulting high prices have led to widespread protein malnutrition especially among vulnerable groups, such as rural children and the aged. Chickpea plays an important role the agro-economy and human healthy of Bangladesh. Bangladesh Agricultural Research Institute (BARI) has developed several high yielding varieties of chickpea- BARI chhola 5, BARI chhola 6, BARI chhola 7 and BARI chhola 8. So, we have a great opportunity to increase the production by using these released varieties of chickpea.

Chickpea contain 20% protein, 4.8% fat, 9.1% crude fibre, 1.37% lysine, 195 - 205 mg/g carotene, 89 - 94 mg/g Ca and 9.2 - 9.4 mg/g Fe. Also, it is an important crop for both human consumption and animal feed due to 17 - 31% protein in seeds and biological activity of its protein ranges between 52 - 78% (Ciftci, 2004; Khan, 1981; Kaul, 1982). It supplies about four times as much protein and eight times as riboflavin and the caloric value of it is equal to rice (Anonymous, 1966). Moreover, it is known as poor man's meat. It is a versatile source of nutrients for man, animal and soil (Miah, 1976). Sufficient amount of vitamin viz. vitamin-A (161 U), thiamine (0.23 mg) and vitamin-C (2.5 mg) are available from a gram of chickpea (Annonymous, 1966) and it forms a balanced diet when supplemented with cereals (Abu-Shakars and Tannous, 1981).

Pulses mainly being the rabi season crop is losing area under cultivation each year for increasing cultivation of wheat, vegetable and high yielding boro rice due to increased irrigation facilities. On the other hand, cultivable land area is decreasing year after year for rapid growth of population. So, we have no scope to increase production of pulses as well as chickpea horizontally in our country. In this situation we have only a way of increasing production vertically by means of using of high yielding varieties, adjustment of planting time and using

improved technologies. A number of agronomic practices have been found to influence the yield of pulse crop (Boztok, 1985). Sowing time had a marked effect on growth and development of crop (Mittel and Srivastava, 1964). Optimum sowing time provides more time for growth and development of plant which is favorable for higher yield whereas both early and late hinder the growth and development with lowest yield potential (Gurung *et al.*, 1996). Early sown crop grows luxuriantly followed by less number of pods and seeds production thus limits yield. Late sowing also resulted in lower yield, the growth is hampered and the seed development period is shorten. Similar findings were pointed out by Yadev *et al*. (1998). In order to reduce yield losses in spring planting, seeds should be sown as early as possible but sowing is usually delayed to escape anthracnose epidemics and unfavorable early planting condition. So, proper sowing time, a non-monetary input can help getting higher yield of chickpea.
Information on the responses of sowing time on growth and yield of chickpea. Considering the present situation, the present research work was carried out with the following objective to select appropriate time of sowing of chickpea.

2. Materials and methods

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 effect of sowing time and seed treatment on growth and yield of chickpea. The location of the site is $23^0 74'$N latitude and $90^0 35'$E longitude with an elevation of 8.2 m from sea level. The soil belongs to "The Modhupur Tract", AEZ – 28 (FAO, 1988). Top soil was silty clay in texture, olive-gray with common fine to medium distinct dark yellowish brown mottles. Soil pH was 5.6 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 and the pre-monsoon period or hot season from March to April and monsoon period from May to October. BARI chhola-6 was collected from Bangladesh Agricultural Research Institute (BARI), Joydevpur, Gazipur. The experiment comprised as one factor of sowing date viz. S_1: 1st sowing date: 19th November, S_2: 2nd sowing date: 29th November, S_3: 3rd sowing date: 9th December. The experiment was laid out in Randomized Complete Block Design (RCBD) with five replications. The size of each unit polt 4.0 × 2.5 m. The spacing between blocks and polts were 1.0 m and 0.5 m. The plot selected for the experiment was opened in the last week of October, 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 50-90-40-10-10@urea, TSP, MP, Gypsum and borax, respectively were applied. The one third amount of urea and entire amount of TSP, MP, Gypsum, Zinc sulphate and borax were applied during the final preparation of land. Rest urea was applied in two equal installments at vegetative and flowering stage (BARI, 2011).
After establishment of seedlings, various intercultural operations were accomplished for better growth and development of the chickpea. The crop was harvested at full maturity on 08 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 chickpea 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 t ha^{-1}.
Data were collected on date of emergence, date of 1st and 50% flowering, plant height (cm), number of branches plant^{-1}, total dry matter, number of pods plant^{-1}, days to pod maturity, pod length plant^{-1}, number of seeds pod^{-1}, weight of 1000 seeds (g), grain yield (Kg ha^{-1}), stover yield (Kg ha^{-1}), biological yield (Kg ha^{-1}), harvest index (%), germination (%) and vigor index. 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 significance of the difference among the treatments means was estimated by the Duncan's Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984).

3. Results and discussion

3.1 Date of emergence

There was no significant variation in time required for days to emergence but numerical minimum duration required. When seeds were sown 19th November whereas maximum duration required in S_1 treatment (Figure 1).

3.2 Days of first flowering

Significant variation was observed for days of first flowering among the sowing time. The maximum days of first flowering (58.86 days) was observed is S_1, which statistically similar result (57.40 days) found S_3, while the minimum (56.40 days) was recorded is S_2. When seeds were sown 19th November whereas minimum duration required in S_1 treatment (Figure 2).

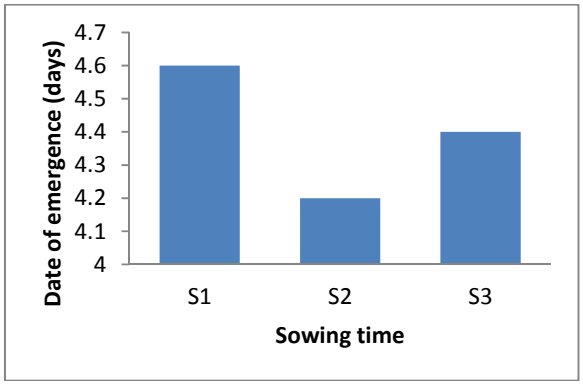

Fig 1. Effect of sowing time on date of emergence of chickpea

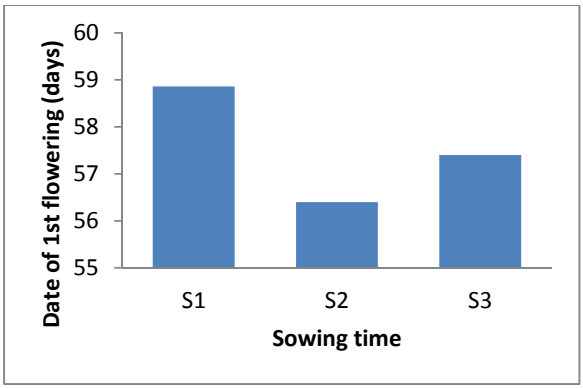

Fig 2. Effect of sowing time on date of 1st flowering of chickpea

3.3 Date of 50% flowering

Significant variation was observed for days of 50% flowering among the sowing time. The maximum days of 50% flowering (78.86 days) was observed S_1, which the minimum

days of 50% flowering (76.40 days) was observed S_2 (Figure 3). The minimum number of days for 50% flowering was observed on 29th November sowing.

3.4 Plant height

Significant variation was recorded for plant height of chickpea due to sowing time at 20, 40, 60 DAS and at harvest. The tallest plants (10.84, 33.49, 41.32 and 39.49 cm) were observed from S_2, while the shortest plants (9.63, 31.53, 39.03 and 37.21 cm) were found in S_1 at same days after sowing (Figure 4). Allam (2002) reported that chickpea sowing 20th November gave taller plants. Hanlan *et al.* (2006) reported 0.3 to 0.4 m plant height for different cultivars of chickpea.

3.5 Number of branches plant^{-1}

Number of branches plant^{-1} of chickpea were significantly influenced by sowing time at 20, 40, 60 DAS and at harvest. The maximum number of branches plants^{-1} (1.42, 8.81, 18.09 and 19.98) were observed from S_2, which was statistically similar (1.40, 8.65, 17.68 and 19.92) to that of S_3 and the minimum number of branches plants^{-1} (1.35, 8.24, 17.30 and 18.16) were found in S_1 at same days after sowing (Figure 5).

3.6 Total dry matter

Significant differences were recorded for dry matter content in plant of chickpea due to different sowing time at 20, 40 and 60 DAS. The maximum total dry matter in chickpea plant (5.46, 7.66 and 11.22 g) was recorded from S_2, which were statistically similar (5.22, 7.75 and 10.86 g) to S_3 at 20, 40 and 60 DAS, while the lowest dry matter content in plant (4.45, 7.23 and 10.19 g) were found in S_1 at same days after sowing (Figure 6).

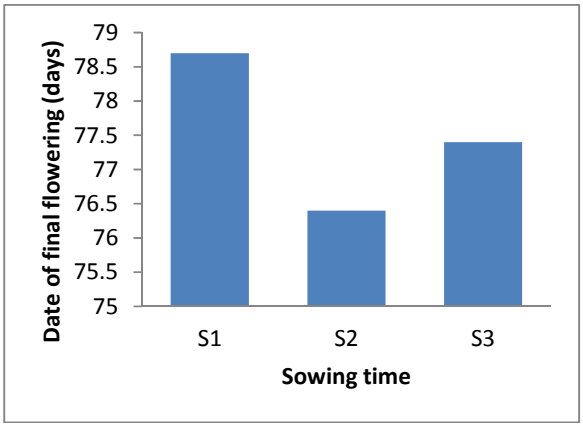

Fig 3. Effect of sowing time on date of final flowering of chickpea

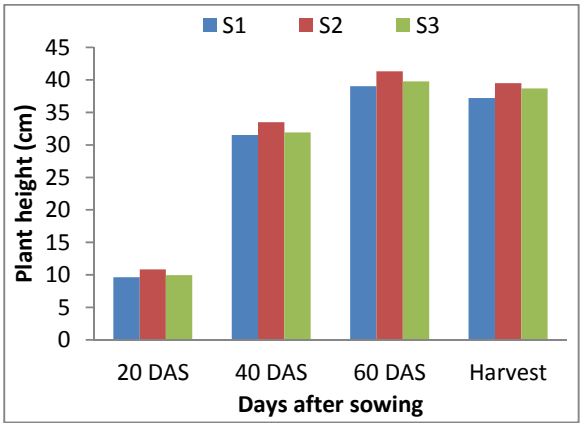

Fig 4. Effect of sowing time on plant height of chickpea

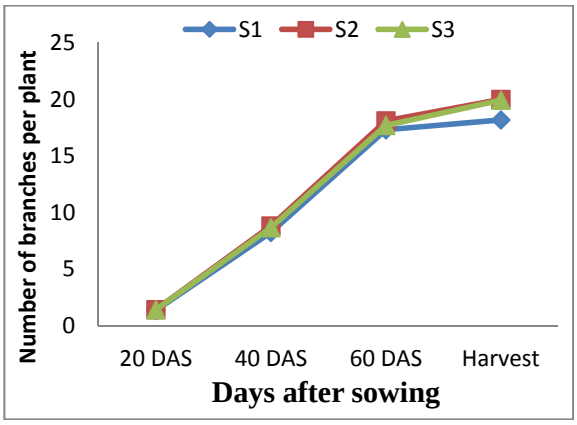

Fig 5. Effect of sowing time on number of branches plant^{-1} of chickpea

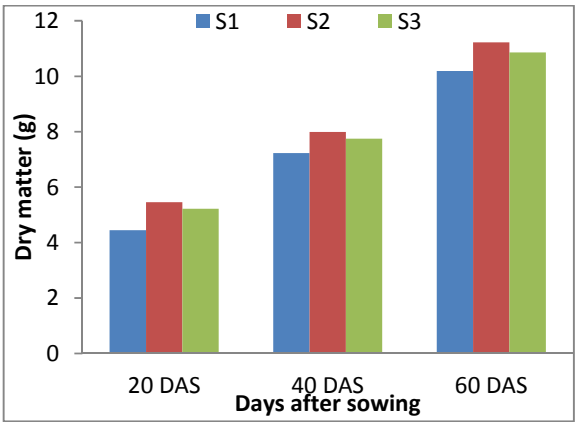

Fig 6. Effect of sowing time on dry matter (%) of chickpea

3.7 Number of pods plant^{-1}

Sowing time exhibited significant differences between them in respect of number of pods plant^{-1}. The maximum number of pods plant^{-1} (45.80) was recorded from S_2, whereas the lowest number of pods plant^{-1} (41.20) were found in S_1, which were statistically similar (43.00) to S_3 (Figure 7).

3.8 Days to pod maturity

Statistically significant differences were found for days to pod maturity of chickpea due to sowing time. The maximum days (113 days) of pod maturity was recorded from S_1, whereas the minimum days of pod maturity (103 days) was observed from S_2 (Figure 8). The lowest days to pod maturity was found 29th November.

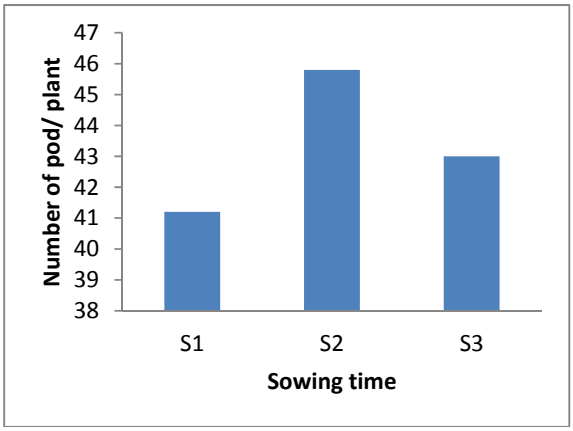

Fig 7. Effect of sowing time on number of pod plant^{-1} of chickpea

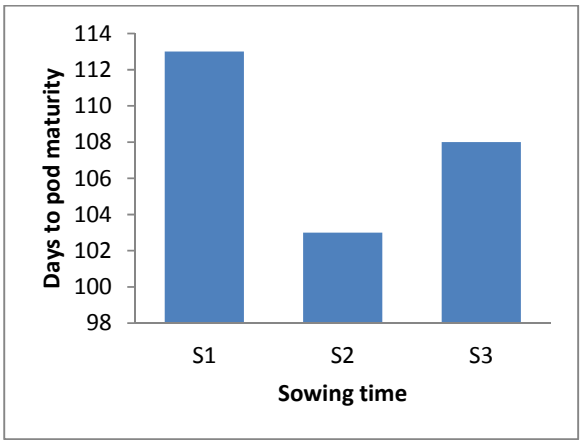

Fig 8. Effect of sowing time on days to pod maturity of chickpea

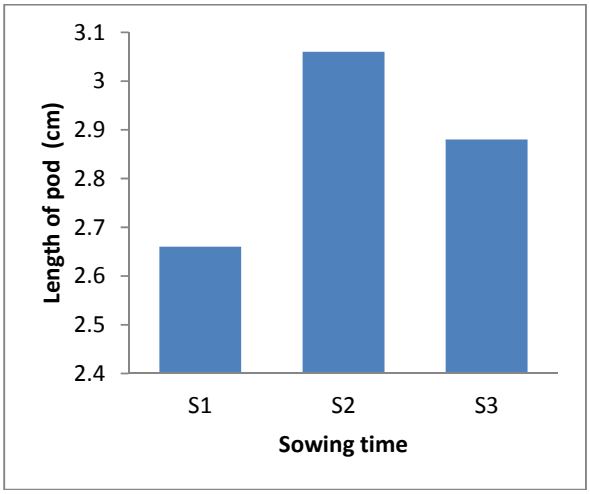

Fig 9. Effect of sowing time on length of pod of chickpea

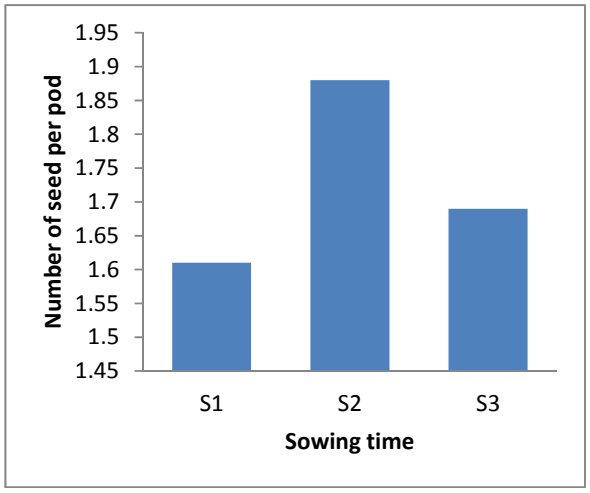

Fig 10. Effect of sowing time on number of seeds pod^{-1} of chickpea

3.9 Pod length plant^{-1}

Statistically significant differences were found for pod length plant^{-1} of chickpea due to sowing time. The maximum pod length plant^{-1} (3.06 cm) was recorded from S_2, which the statistically similar (2.88 cm) to S_3, whereas the minimum pod length plant^{-1} (2.66 cm) was observed from S_1 (Figure 9).

3.10 Number of seeds pod^{-1}

Statistically significant differences were found for number of seeds pod^{-1} of chickpea due to sowing time. The maximum number of seeds pod^{-1} (1.88) was recorded from S_2, whereas the minimum number of seeds pod^{-1} (1.61) was observed from S_1 (Figure 10).

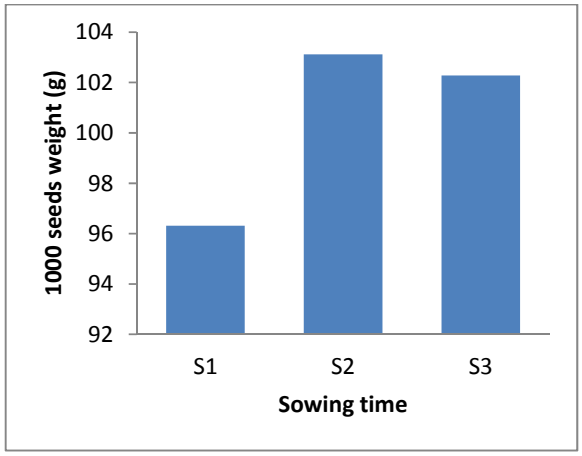

Fig 11. Effect of sowing time on 1000 seeds weight of chickpea

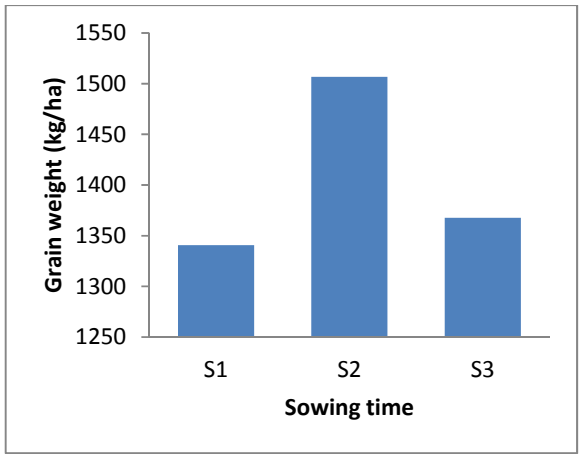

Fig 12. Effect of sowing time on grain weight of chickpea

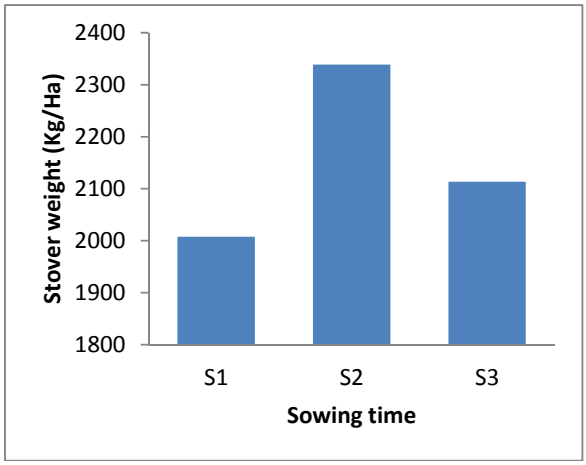

Fig 13. Effect of sowing time on stover weight of chickpea

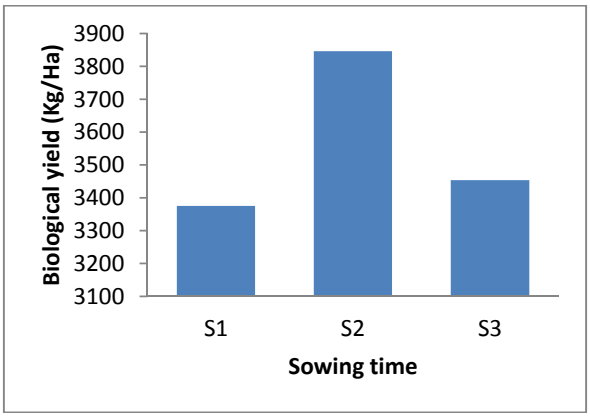

Fig 14. Effect of sowing time on biological yield of chickpea

3.11 Weight of 1000 seeds (g)

Statistically significant differences were found for weight of 1000 seeds of chickpea due to sowing time. The highest weight of 1000 seeds (103.12 g) was recorded from S_2, which statistically similar (102.28 g) to S_3, whereas the lowest weight of 1000 seeds (96.31g) was observed from S_1 (Figure 11)

3.12 Grain yield (Kg ha^{-1})

Grain yield showed exerted significant differences among sowing time. The maximum grain yield (1506.73 Kg ha^{-1}) was observed from S_2, which the minimum grain yield (1340.52 Kg ha^{-1}) was found in S_1, which statistically similar (1367.61 Kg ha^{-1}) to S_3 (Figure 12).

3.13 Straw yield (Kg ha^{-1})

Straw yield of chickpea were significantly influenced by sowing time. The highest straw yield (2339.03 Kg ha^{-1}) was observed from S_2, whereas the lowest straw yield (2007.65 Kg ha^{-1}) was found in S_1 (Figure 13).

3.14 Biological yield (kg ha^{-1})

Sowing time differed a significantly in producing biological yield. The maximum biological yield (3845.76 Kg ha^{-1}) was observed from S_2, whereas the minimum biological yield (3375.26 Kg ha^{-1}) was found in S_1, which statistically similar (3453.98 Kg ha^{-1}) to S_3 (Figure 14).

3.15 Harvest Index (%)

A significant difference was observed for harvest index due to sowing time. The maximum harvest index (40.52%) was observed from S_2, which statistically similar (39.18%) to S_3, the minimum harvest index (38.81%) was found from S_1 (Figure 15).

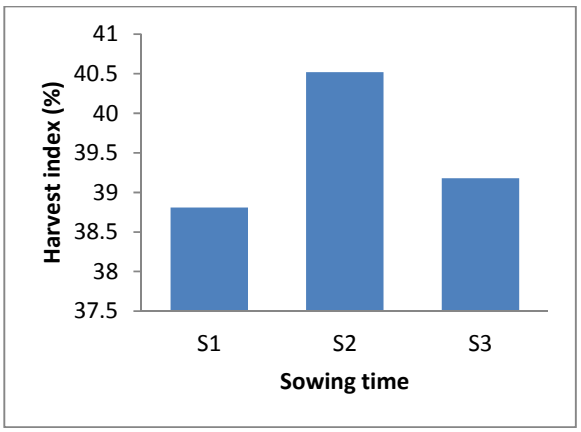

Fig 15. Effect of sowing time on harvest index of chickpea

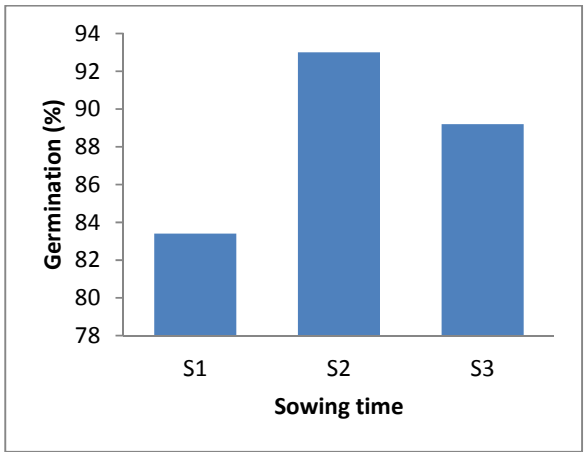

Fig 16. Effect of sowing time on germination (%) of chickpea

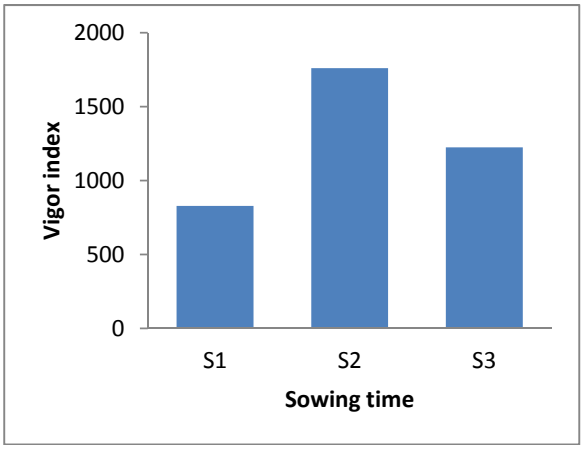

Fig 17. Effect of sowing time on vigor index of chickpea

3.16 Germination (%)

Sowing time differed a significantly in germination percentage. The maximum germination percentage (93.00) were observed from S_2 and the minimum germination percentage (83.40) were found in S_1 (Figure 16).

3.17 Vigor Index

Sowing time differed a significantly in vigor index. The maximum vigor index (1761.00) was observed from S_2 and the minimum (828.20) was found in S_1 (Figure 17).

4. Conclusion

In this experiment, the maximum grain yield, harvest index, germination percentage and vigor index was observed from S_2. So, the chickpea cultivation was suitable on 29th November to "The Modhupur Tract", AEZ – 28.

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