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Effect of Sowing Depth on the Yield of Spring Wheat

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Abstract: The experiment was conducted to study the effect of sowing depth on the yield of spring wheat. The experiment consisted of two factors i.e. three sowing depth viz. 2 cm, 4 cm, 8 cm and two modern wheat varieties viz. Bijoy and Prodip. A randomized complete block design was adopted with three replications. Results indicated that the effect of sowing depth was significant on almost all the parameters except spike length. Sowing on 4 cm depth gave the highest grain yield (3.88 t ha^{-1}) followed by 2 cm (3.75 t ha^{-1}) and 8 cm sowing depth (3.62 t ha^{-1}). Significant variation was found due to different varieties in respect of all the parameters studied. Bijoy produced the highest grain yield (3.92 t ha^{-1}) and the lowest one was produced by Prodip (3.57 t ha^{-1}). Bijoy produced the highest grain yield (4.06 t ha^{-1}) when sown on 4 cm depth.

Key Words: Sowing depth, Wheat. Variety, Yield

Introduction

Agriculture has the dominant economic activity in Bangladesh and regarded as the lifeline of the Bangladesh economy. Agriculture is the single largest producing sector of the economy since it comprises about 18.6% of the countries GDP and employes around 45% of the total labour force (AB, 2010). Although rice and jute are the primary crops incase a plurality of Bangladeshis earn their living from agriculture, wheat is assuming greater importance and better performance (AB, 2011-12).

It is one of the most important cereal crops in the world which cultivated in the tropical, sub tropical and temperate region. It ranks first in respect of production and consumers. In Bangladesh, wheat is one of the most important food grain crop. It has become established as the second major cereal crop of this country, the second staple food crop next to rice having an annual production of 9.58 lakh tones and total area of 4.39 lakh hectares (AIS, 2010). It is one of the cheapest source of carbohydrates and its grain is superior to that of rice in nutritional quality and contains approximately protein 12%, fat 1.72% carbohydrate 69.60%, mineral 27.2% and much amount of gluten (BARI, 2008).

In comparison to rice, wheat output in 1999 was 1.90 million metric tons. Population pressure continues to place a severe burden on productive capacity, creating a food deficit and also unemployment problems, specially of wheat has more potential and play an important role in enhancing food security, in foreign assistance and it commercial imports fill the gap (AB, 2011-12). Though wheat is an important cereal crop in Bangladesh, its average yield is very low compared to other wheat growing countries of the world. In Bangladesh among total food grain production in the 2010-11 was 34.5 mmt. in which the contribute of wheat was 0.97 mmt respectively (BFSR, 2011) and in 2011-12 production of wheat 2.780 mt ha^{-1} (BBS, 2011-12).

The yield of wheat in the farmer field is much lower than that in the research farm (Anonymous, 1990). The yield and quality of wheat grain is know to be influenced by several factors such as variety, sowing time, sowing depth, seed rate, water and nutrient management, harvesting time and other agronomic practices.Variety has also played or important role in producing better yield components and yield and seed quality of wheat. Varietal differences shows among the varieties due to genetic makeup, input requirement, growth process and prevailing environment during growing season.

The seedling emergence, crop stand, establishment, yield attribute and quality of wheat seeds is, therefore, greatly contribute on the sowing depth. The accurate depth of sowing depends on the climate and soil of the location as well as the variety used. Considering the above information the present investigation was undertaken to study the effect of sowing depth on the yield of spring wheat.

Materials and Methods

The present research work was carried out at the Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of

Rajshahi during the period from November, 2011 to April, 2012 to study the effect of sowing depth on the yield of spring wheat. The experiment consisted of two factors i.e. sowing depth viz. 2 cm, 4 cm, 8 cm and wheat varieties viz. Bijoy and Prodip. A randomized complete block design was adopted with three replications. The size of the each unit plot was 3m × 4m. The experimental field was fertilized with urea, TSP, MoP and gypsum at the rate of 220,180, 50, 120 kg ha^{-1}. One third of urea and all other fertilizer were applied during the final land preparation. The second one third urea applied at 21 days after sowing and last one third at second irrigation. All the applied fertilizers were thoroughly mixed to the soil. Wheat seeds were sown on 2 cm, 4cm and 8 cm depth on 29 November, 2011 at the rate of 120 kg ha^{-1} with 25 cm apart rows opened by specially made in iron hand tine. Two weeding at 21 and 52 days after sowing were done before fertilizer application to control weeds in the experimental field. Thinning was done followed by first weeding for maintaining 5 cm apart from plant to plant. Two irrigations were applied. First irrigation was applied at 21 days after sowing and second irrigation at 53 days after sowing followed by weeding. Data on yield and yield contributing characters were recorded. The data were compiled and tabulated for statistical analysis. The data were analyzed statistically and the mean differences among the treatments were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984) with the help of MSTATC software.

Results and Discussion

Plant height

Plant height responded significantly due to sowing depth. The tallest plant (93.75 cm) was found in the 4 cm sowing depth and the shortest one (91.24 cm) in 8 cm sowing depth. Significant variation was observed in respect of plant height due to different varieties. Bijoy had the tallest (93.86 cm) plant where as the shortest one (90.72 cm) was produced by Prodip (Table 1). It was found that plant height was significantly influenced by the interaction of sowing depth and variety. The highest plant height (95.11 cm) was obtained from the treatment combination of 4 cm sowing depth and Bijoy variety and the lowest one (88.86 cm) was obtained from 8 cm sowing depth with Prodip variety (Table 2).

Effective tillers $plant^{-1}$

Sowing depth and variety exerted a significant influence on the production of effective tillers $plant^{-1}$. The highest number of effective tillers $plant^{-1}$ (4.09) was obtained from 4 cm sowing depth and the lowest one (3.90) was obtained from 8 cm sowing depth. The maximum number of effective tillers $plant^{-1}$ (4.12) was produced by Bijoy and the minimum one (3.87) was produced by Prodip (Table 2). Varietal differences regarding the production of effective tillers $plant^{-1}$ may be due to their genetic makeup as well as environmental factors (Table 1). The interaction effect between sowing depth and variety on the number of effective tillers $plant^{-1}$ was not statistically significant. The maximum number of effective tillers $plant^{-1}$ (4.21) was recorded from the treatment combination of 4 cm sowing depth and Bijoy variety and the lowest number of effective tillers $plant^{-1}$ (3.77) was recorded in the treatment combination of 8 cm sowing depth and Prodip variety (Table 2).

Spike length

Spike length did not show significant variation due to different sowing depth. The longest spike (11.14 cm) was obtained from 4 cm sowing depth and the shortest one (10.93 cm) was found at 8 cm sowing depth. Variety had significant effect on spike length. The highest spike length (11.26 cm) was recorded from Bijoy variety. The lowest spike length (10.86 cm) was given by Prodip variety (Table 1). Significant effect was not observed in respect of spike length due to the interaction of sowing depth and variety. The highest length of spike (11.33 cm) was noted from 4 cm sowing depth with Bijoy variety and the lowest one (10.71 cm) from 8 cm sowing depth with Prodip variety (Table 2).

Spikelets $spike^{-1}$

The number of spikelets $spike^{-1}$ was differed significantly among different sowing depth. The highest number of spikelets $spike^{-1}$ (14.15) was obtained from 4 cm sowing depth and the lowest number (12.87) was obtained from 8 cm sowing depth. Number of spikelets $spike^{-1}$ was significantly influenced due to different varieties. The highest number of spikelets $spike^{-1}$ (14.16) was produced by Bijoy variety and the lowest number of spikelets $spike^{-1}$ (12.95) was produced by Prodip variety (Table 1).The number of spikelets $spike^{-1}$ was not significantly influenced by the interaction of sowing depth and variety. The highest number of spikelets $spike^{-1}$ (14.93) was found in 4 cm sowing depth in Bijoy variety and the lowest one (12.60) was recorded due to interaction of 8 cm sowing depth with Prodip variety (Table 2).

Fertile spikelets $spike^{-1}$

The number of fertile spikelets spike^{-1} was significantly influenced by sowing depth. The highest number of fertile spikelets spike^{-1} (11.62) was obtained from 4 cm sowing depth where as the lowest number of fertile spikelets spike^{-1} (10.58) was recorded from 8 cm sowing depth which was statistically identical at 2 cm sowing depth. There was significant variation among varieties in terms of fertile spikelets spike^{-1}. The highest number of fertile spikelets spike^{-1} (11.72) was produced by Bijoy variety and the lowest number of fertile spikelets spike^{-1} (10.44) was produced by Prodip variety (Table 1).The number of fertile spikelets spike^{-1} was significantly influenced by the interaction of sowing depth and variety. The highest number of fertile spikelets spike^{-1} (12.43) was observed at 4 cm sowing depth coupled with Bijoy variety and the lowest number of fertile spikelets spike^{-1} (10.03) was noticed at 8 cm sowing depth coupled with Prodip variety (Table 2).

Grains spike^{-1}

Sowing depth had significant effect on the number of grains spike^{-1}. Table 1 represented that the maximum number of grains spike^{-1} (40.70) was obtained from 4 cm sowing depth and the minimum one (39.42) was observed at 8 cm sowing depth. The number of grains spike^{-1} was affected significantly by the variety. The highest number of grains spike^{-1} (40.87) was produced by Bijoy variety and lowest one (39.23) was produced by Prodip variety (Table 1). The number of grains spike^{-1} was not significant due to interaction of sowing depth and variety. It was evident that the highest number of grains spike^{-1} (41.58) was recorded from 4 cm sowing depth with Bijoy variety and the lowest number of grains spike^{-1} (38.44) was recorded from interaction effect of 8 cm sowing depth with Prodip variety (Table 2).

1000-grain weight

1000-grain weight was significant with different sowing depths. The highest 1000-grain weight (51.18 g) was resulted from 4 cm sowing depth and it was lowest (49.10 g) when sowing was done in 8 cm depth. Variety had significant effect on 1000-grain weight of wheat. The highest weight of 1000-grain was (51.41 g) in Bijoy variety and the lowest one (48.77 g) in Prodip variety (Table 1).The interaction due to sowing depth and variety affected significantly the weight of 1000-grain. The highest weight of 1000-grain (52.69 g) was observed in the treatment combination of 4 cm sowing depth and Bijoy variety. The lowest weight of 1000-grain (47.86 g) was recorded in the combination of 8 cm sowing depth and Prodip variety (Table 2).

Grain yield

Different sowing depth have significant effect on the grain yield of wheat. The highest grain yield (3.88 t ha^{-1}) was obtained from 4 cm sowing depth followed by 2 and 8 cm sowing depth which was 3.75 t ha^{-1} and 3.62 t ha^{-1} respectively. Increasing the sowing depth more than 4 cm resulting reduces the spikes m^{-2} significantly. This was mainly due to the less number of emergence percent which ultimately caused the less number of plants m^{-2}. The emergence percent was highest in 2 cm sowing depth but total number of spikes was less than that of 4 cm. The number of spikes m^{-2} was less than the number of total tillers m^{-2} indicating many tillers initiated at vegetative stage tailed to produce more number of spikes m^{-2}. Significantly higher number of grains spike^{-1} was recorded from 8 cm depth. Generally deeper the sowing depth greater was the seed size. This was rather expected because lesser number of seedlings emerged from deeper sown seeds and sparsely populated plants had better growth Significantly highest grain yield was obtained with 4 cm sowing depth and the lowest from 8 cm sowing depth and they were significantly different. The results compare favorably with the findings of Al-Amin *et al*. (1994) who observed that sowing deeper than 4 cm greatly reduced grain yield. Grain yield was influenced significantly by different varieties. The highest grain yield (3.92 t ha^{-1}) was produced by Bijoy variety and the lowest one (3.57 t ha^{-1}) was given by Prodip variety (Table 1).There was no significant effect in respect of grain yield due to the interaction of sowing depth and variety. The maximum grain yield (4.06 t ha^{-1}) was observed in Bijoy at 4 cm sowing depth and the minimum one (3.45 t ha^{-1}) was observed in Prodip when it was sown at 8 cm sowing depth (Table 2).

Straw yield

Straw yield of wheat was also significantly influenced by different depth of sowing .The maximum straw yield (4.50 t ha^{-1}) was observed at 4 cm sowing depth and lowest one (4.25 t ha^{-1}) at 8 cm sowing depth. Straw yield was affected significantly due to variety. The maximum straw yield (4.57 t ha^{-1}) was obtained from Bijoy where as the lowest one (4.17 t ha^{-1}) was obtained from Prodip. This is due to the genetic makeup and varietal differences among the varieties (Table 1).Significant effect was not observed in respect of straw yield of wheat due to interaction of sowing depth and variety. The highest straw yield (4.70 t ha^{-1}) was obtained from 4 cm sowing depth coupled with Bijoy variety and the lowest one (4.05 t ha^{-1}) was obtained from 8 cm sowing depth coupled with Prodip variety (Table 2).

Table 1. Effect of sowing depth on the yield components and yield of wheat

Sowing depth	Plant height (cm)	Effective tillers plant^{-1} (no.)	Spike length (cm)	Spikelets spike^{-1} (no.)	Fertile spikelets spike^{-1} (no.)	Grains spike^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
S_1	91.89b	3.99b	11.09	13.68ab	11.05b	40.02b	49.99b	3.75a	4.35b
S_2	93.75a	4.09a	11.14	14.15a	11.62a	40.70a	51.18a	3.88a	4.50a
S_3	91.24b	3.90c	10.93	12.87b	10.58c	39.42c	49.10c	3.62b	4.25b
LS	0.01	0.01	NS	0.05	0.01	0.01	0.01	0.01	0.01
SE	0.2684	0.0020	-	0.1913	0.0092	0.1334	0.0408	0.5284	0.0129
Variety									
V_1	90.72b	3.87b	10.86b	12.95b	10.44b	39.23b	48.77b	3.57b	4.17b
V_2	93.86a	4.12a	11.26a	14.16a	11.72a	40.87a	51.41a	3.92a	4.57a
LS	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
SE	0.2598	0.0105	0.0611	0.2178	0.0435	0.1616	0.0957	0.0149	0.0149

In a column figures having similar letters (S) or without letters (s) do not differ significantly as per DMRT

Table 2. Interaction effect of sowing depth and variety on the yield components and yield of wheat

Sowing depth × Variety	Plant height (cm)	Effective tillers plant^{-1} (no.)	Spike length (cm)	Spikelets spike^{-1} (no.)	Fertile spikelets spike^{-1} (no.)	Grains spike^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
S_1V_1	90.92cd	3.86	10.90	12.96	10.49e	39.41	48.78e	3.58	4.16
S_1V_2	92.86bc	4.13	11.29	14.40	11.62b	40.63	51.21b	3.92	4.54
S_2V_1	92.38bc	3.97	10.96	13.30	10.81d	39.43	49.67d	3.69	4.31
S_2V_2	95.11a	4.21	11.33	14.93	12.43a	41.58	52.69a	4.06	4.70
S_3V_1	88.86d	3.77	10.71	12.60	10.03f	38.44	47.86f	3.45	4.05
S_3V_2	93.62ab	4.03	11.16	13.15	11.13c	40.40	50.33c	3.79	4.45
LS	0.05	NS	NS	NS	0.01	NS	0.01	NS	NS
SE	0.3374	-	-	-	0.0548	-	0.0329	-	-

In a column figures having similar letters (S) or without letters (s) do not differ significantly as per DMRT

S_1 = 2 cm sowing depth S_2 = 4 cm sowing depth S_3 = 8 cm sowing depth V_1 = Prodip V_2 = Bijoy
NS = Non-significant LS = Level of significance SE = Standard error

Conclusion

It may be concluded that the highest grain yield of wheat could be achieved from the variety Bijoy at 4 cm sowing depth.

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