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Influence of Different Methods of Sowing and Phosphorus Levels on Yield and Economics of Late Sown Wheat (*Triticum aestivum* L.)

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ABSTRACT: Planting method plays an important role in the placement of seed at proper depth, which ultimately affects crop growth. The selection of suitable planting method for wheat is dependent upon the time of planting, availability of soil water at planting time, amount of residue in the field. A field experiment was executed during *Rabi* season of 2020-21 at Crop Research Farm of SHUATS, Prayagraj to study about the influence of different methods of sowing and phosphorus levels on growth and yield of wheat. The experiment was laid out in Randomized Block Design (RBD), comprising two factors and 9 treatments, each replicated thrice. In view of this experiment three methods of sowing, *i.e.* M_1 Broadcasting, M_2-Line sowing, M_3-System of Wheat Intensification as well as and three Phosphorus levels P_1- 40 kg/ha, P_2-60 kg/ha and P_3-80 kg/ha. Maximum values were recorded higher in the application of (T_9) SWI+ Phosphorous 80 kg/ha in effective tillers (9.50) and dry weight (17.46 gm). Maximum values were recorded higher in the application of (T_8) Line sowing + 80 kg/ha P in plant height (79.89 cm) grain yield (3.37 t/ha) and straw yield (4.56 t/ha). Maximum harvest index (44.65%) was recorded in the application of (T_5) Line sowing + 60 kg/ha P. However, B:C ratio (2.71) was obtained with application of (T_8) Line sowing + Phosphorous 80 kg/ha. Therefore, concluded that the (T_8) Line sowing + 80 kg/ha P can produce more grains and will be economically effective.

Keywords: Sowing methods, Phosphorus, Yield and Economics.

INTRODUCTION

Wheat (*Triticum aestivum* L.) a member of Poaceae family and a cereal of which is a worldwide staple food. The most widely grown is common wheat (*Triticum aestivum* L.). It is one of the entire world's greatest crops that excels all other cereals both in area and production, called as "king of cereals". Wheat is second most important staple crop after rice in country, which contributes nearly one third of the total food grain production. It is consumed mostly in the form of bread as "chapati". Wheat is grown all over India from the sea level up to an elevation of 3500 m in the Himalaya. The common bread wheat occupies more than 90% of the total wheat area and along with 10% area under (*Triticum durum*). Its cultivation is common under rainfed condition only, on account of higher susceptibility to rusts. In India wheat crop is cultivated in *Rabi* season. It is normally sown during November and harvested between March and April. The cultivated area under wheat at national level has shown increasing trend, from 29.04 million hectares to 30.54 million hectares with a magnitude of 1.5-million-hectare (5%) net gain in terms of area. Uttar Pradesh has largest share in area with 9.75 (32%), followed by Madhya Pradesh (18.75%), Punjab (11.48%), Rajasthan (13%). The production of wheat has also showed an increasing trend, from 87.39 to 94.57 million tonnes from 2012-2013 to 2017-2018 with a magnitude of 7.18 million tonnes (8.22%). The national productivity trend for wheat showed a marginal improvement, which has increased from 3009 kg/ha to 3100 kg/ha from 2012-2013 to 2017-2018. The rise in productivity is due to adoption of high-yielding varieties coupled with other inputs (Ramadas *et al.*, 2019).

The Broadcasting method produced the foremost effective spacing. While different methods of sowing methods are adopted by farmers for wheat cultivation. Line sowing is being practiced with proper row spacing and is an advisable sowing method because of its uniform plant population per unit area. As seeds are planted at a fair depth and covered with soil, high germination and uniform stands are expected.

SWI is that the modified agronomic practices such end in lower seed rate, seed treatment, sowing of seeds at proper spacing, control of water in the crop field, weeding or hoeing inputs which result in a higher ratio of tillers, to mother seedlings, increased number of the effective per hill, enhance panicle length and bolder grains and eventually enhanced of wheat. This technology has high potentiality to supply high yield per drop of water and per kg of agricultural inputs (Bhargava *et al.*, 2016).

Phosphorus plays a very important function in plant physiology. It strengthens the straw and increases flower formation and fruit production (Anon., 1998). Application of fertilizer in dryland improve yield and increases soil water usage (Li *et al.*, 2001). It increases

wheat yield with the increasing rate of phosphorus. The application of phosphorus to wheat crops significantly increased the number of tillers per plant, grain and straw yield. Moreover, the improved growth of wheat depends on the source of phosphorus in soil and the rate of application. Furthermore, side banding of phosphorus fertilizer rates is equally efficient grain yield increases (Noonari *et al.,* 2016).

MATERIAL AND METHODS

An experiment was conducted during the *Rabi* season of 2020-21, at Crop Research Farm of Department of Agronomy at Sam Higginbottom University of Agriculture (SHAUTS), Technology and Sciences, Prayagraj which is located at 25° 24′42″N latitude, 81° 50′56″ E longitude and 98 m altitude above the mean sea level (MSL). To assess the evaluation of varied Methods of sowing and Phosphorus levels on wheat (*Triticum aestivum* L.). The experiment was laid out in Randomized Block Design with Nine treatments which were replicated thrice. The treatment combination has two factors. The primary comprises of three methods of sowing i.e., Broadcasting, Line sowing (20 × 10), System of Wheat Intensification (SWI) (22.5 × 22.5) while the second factor has three Phosphorus levels P_1 – 40 kg/ha, P_2- 60 kg/ha, P_3- 80 kg/ha. The treatment combination are as follow (T_1) Broadcasting + Phosphorus 40kg/ha, (T_2) Line sowing + Phosphorous 40kg/ha, (T_3) SWI + Phosphorous 40kg/ha, (T_4) Broadcasting + Phosphorous 60 kg/ha, (T_5) Line sowing + Phosphorous 60kg/ha, (T_6) SWI + Phosphorous 60 kg/ha, (T_7) Broadcasting + Phosphorous 80 kg/ha, (T_8) Line sowing + Phosphorus 80 kg/ha, (T_9) SWI + Phosphorus 80 kg/ha. As fertilizers are applied as basal dose to fulfill the N and another nutrient requirement at early growth stages and rest half dose of N requirement is fulfilled through urea as top dressing at 30 DAS. The recommended dose of fertilizer is 120-60-40 kg/ha.

Chemical analysis: Composite soil samples are collected before the layout of the experiment to work out the initial soil properties. The soil samples are collected from 0-15 cm depth and were dried under shade, powdered with wooden pestle and mortar, more matured 2 mm sieve and were analyzed for organic carbon by quickly titration method by Nelson and Sommers (1975). The type of soil in the experiment field is sandy clay with a pH of 7.3, EC of 0.47 dSm^{-1}, organic carbon was 0.46%. The Nitrogen status of the experiment field was (278 kg/ha), available Phosphorus (19.3 kg/ha) while the available potassium status was in the higher range (238.3 kg/ha). Yield attributing characters *viz*., grain yield, straw yield and harvest index were recorded manually on five randomized selected representative plants from each plot of each replication separately as likewise as economics. Soil texture by Bouyoucos Hydrometer Method (Gee and Baudev, 1986). Available nitrogen was estimated by alkaline permanganate method by Subbiah and Asija (1956), available phosphorous, and available potash was decided by Flame photometric method (Jackson, 1973).

Statistical analysis: The data recorded were different characteristics were subjected to statically analysis by adopting Fishers the method of analysis of variance (ANOVA) as described by Gomez and Gomez (2010). Critical Difference (CD) values were calculated the 'F' test was found significantly at 5% level.

RESULTS AND DISCUSSION

Response on Plant height (cm): Observations regarding the plant height (cm) of wheat are given in Table 1 and there was an increased with crop growth duration. At harvest, maximum plant height was recorded with application of (T_8) Line sowing + Phosphorus 80 kg/ha (79.89 cm) which was significantly superior over all the treatments and T_9) SWI + Phosphorus 80 kg/ha (78.14 cm) was found statistically at par to (T_8). The broadcasting method resulted in shortest plant compared to those recorded in SWI and line sowing treatments. Sowing with proper plant density facilitates for sufficient aeration, moisture, sunlight and nutrient availability, resulting in proper root system development from the first stage of crop growth (Abraham *et al*., 2014) which enhanced the plant height.

Response on number of tillers per plant of wheat: The obtained results in response to the tillers per hill were depicted in Table 1 and there were tillers progressively increased with the advancement of the crop during the crop growth period. At harvest, maximum number of tillers per plant was recorded with application of (T_9) SWI + Phosphorous 80 kg/ha (9.50) which was significantly superior over all the treatments and (T_6) SWI + Phosphorous 60 kg/ha (9.40) and (T_3) SWI + Phosphorous 40 kg/ha (9.13) was found statistically at par to (T_9). Number of tillers was influenced significantly by different spacings and planting method. SWI technique decreases the competition between the plants for light, water, space and nutrient hence there is increase number of tillers. There is increase in number of tillers in wheat crop due to influence of different fertilizer combinations **(**Singh *et al*., 2015). At later stages of growth, the number of tillers may need increased due to enhanced cell expansion and various metabolic processes within the presence of abundant supply of nutrients (Laghari *et al*., 2010).

Response on Dry weight (g/plant): Recorded observations relative to the dry weight were given in Table 1 and there was dry weight had given consecutively increased performance from 20 DAS to till harvest. At harvest, maximum dry weight was recorded with application of (T_9) SWI + Phosphorous 80 kg/ha (17.46 gm) which was significantly superior over all the treatments and (T_6) SWI + Phosphorous 60 kg/ha (17.19) and (T_3) SWI + Phosphorous 40 kg/ha (16.90) was found statistically at par to (T_9).The explanation for rapid increase of dry weight at crop harvest of ripening stage was possibly due to emergence of number of new tillers per plant and more fertile spike per plant (Alam, 2013).

Table 1: Influence on growth attributes of wheat by different methods of sowing and phosphorus levels.

	Growth attributes		
Treatments	**Plant height (cm)**	**Number of Tillers/plant**	**Dry weight (gm)**
T_1- Broadcasting + Phosphorus 40 kg/ha	70.77	4.93	13.66
T_2 - Line sowing + phosphorus 40 kg/ha	75.74	6.40	15.01
T_3 - SWI + Phosphorus 40 kg/ha	74.77	9.13	16.90
T_4 - Broadcasting + Phosphorus 60 kg/ha	72.14	5.13	13.99
T_5 - Line sowing + Phosphorus 60 kg/ha	76.46	6.63	15.36
T_6 - SWI + Phosphorus 60 kg/ha	75.76	9.40	17.19
T_7 - Broadcasting + Phosphorus 80 kg/ha	73.49	4.90	14.31
T_8 - Line sowing + Phosphorus 80 kg/ha	79.89	7.20	15.53
T_9 - SWI + Phosphorus 80 kg/ha	78.14	9.50	17.46
SEm(±)	0.62	0.19	0.28
CD (p=0.05)	1.84	0.59	0.84

Yield: Data related to grain and straw yield were evaluated and tabulated in Table 2. Maximum grain yield (3.37 t/ha) and straw yield (4.56 t/ha) was influenced significantly with application of treatment (T_8) Line sowing + Phosphorous 80 kg/ha which superior over all the treatments and (T_9) SWI + Phosphorous 80 kg/ha in both parameters grain yield (3.28 t/ha) and straw yield (4.29 t/ha) was found statistically at par to (T_8). Similar findings were also reported in the higher yield may be due to fact that the positive impact of availability of individual plant nutrients and humic substance from balanced supplement of NPK through inorganic fertilizers might have induced cell division, expansion of cell wall, meristematic activity, photosynthetic efficiency and regulation of water intake into the cell, resulting in the enhancement of yield parameters (Singh *et al*., 2008). Maximum harvest index found with treatment (T_5) Line sowing + Phosphorous 60 kg/ha (44.65 %) which was significantly superior over all the treatments and (T_9) SWI + Phosphorous 80 kg/ha (42.91 %) and (T_8) Line sowing + Phosphorous 80 kg/ha (42.49 %) was found statistically at par to (T_5).

Table 2: Influence of different methods of sowing and phosphorus levels on Yield.

Treatments	**Yield**		
	Grain yield (t/ha)	**Stover yield (t/ha)**	**Harvest index (%)**
T_1- Broadcasting + Phosphorus 40 kg/ha	1.88	3.14	37.70
T_2- Line sowing + Phosphorus 40 kg/ha	3.00	4.10	42.24
T_3- SWI + Phosphorus 40 kg/ha	2.63	3.46	41.57
T_4- Broadcasting + Phosphorus 60 kg/ha	2.17	3.42	38.83
T_5- Line sowing + Phosphorus 60 kg/ha	3.13	3.91	44.65
T_6- SWI + Phosphorus 60 kg/ha	2.47	3.51	41.30
T_7- Broadcasting + Phosphorus 80 kg/ha	2.27	3.52	39.19
T_8- Line sowing + Phosphorus 80 kg/ha	3.37	4.56	42.49
T_9- SWI + Phosphorus 80 kg/ha	3.28	4.29	42.91
SEm(±)	0.03	0.13	0.7
CD (p=0.05)	0.10	0.40	2.2

Table 3: Influence of different methods of sowing and phosphorus levels on Economics.

	Treatments	**Cost of cultivation (INR/ha)**	**Gross returns (INR/ha)**	**Net returns (INR/ha)**	**B:C Ratio**
T_1	Broadcasting + Phosphorus 40 kg/ha	29,460.00	56,400.00	26,940.00	0.91
T_2	Line sowing + phosphorus 40 kg/ha	27,885.00	90,000.00	62,115.00	2.22
T_3	SWI + Phosphorus 40 kg/ha	27,360.00	78,900.00	51,540.00	1.88
T_4	Broadcasting + Phosphorus 60 kg/ha	30,335.00	65,100.00	34,765.00	1.14
T_5	Line sowing + Phosphorus 60 kg/ha	28,760.00	93,900.00	65,140.00	2.26
T_6	SWI + Phosphorus 60 kg/ha	28,235.00	74,100.00	45,865.00	1.62
T_7	Broadcasting + Phosphorus 80 kg/ha	31,210.00	68,100.00	36,890.00	1.18
T_8	Line sowing + Phosphorus 80 kg/ha	29,635.00	1,10,100.00	80,465.00	2.71
T_9	SWI + Phosphorus 80 kg/ha	29,110.00	98,400.00	69,290.00	2.38

Economics: It is revelated from the data presented in Table 3. The cost of cultivation of wheat crop recorded numerically higher (₹ 31,210/ha) value for the treatment of application of (T_8) Line sowing + Phosphorous 80 kg/ha (42.49 %) Broadcasting + Phosphorous 80 kg/ha and numerically minimum cost of cultivation was recorded with application of SWI + Phosphorous 40 kg/ha (₹ 27,360/ha). Numerically higher Gross return (₹ 1,10,100/ha), Net returns (₹ 80,465/ha) and B:C ratio (2.71) were obtained with application of (T_8) Line sowing + Phosphorous 80 kg/ha among all the treatments.

CONCLUSION

On the basis of one season experimentation maximum Grain yield (3.37 t/ha), Net returns (₹ 80,465/ha) and B:C ratio (2.71) was obtained with application of (T_8) Line sowing + Phosphorous 80 kg/ha which was significantly superior over all the treatments.

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Conflict of Interest. None.

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