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# Influence of different methods of sowing and phosphorus levels on growth and yield of wheat (*Triticum aestivum* L.)

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**Abstract**
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 encountered 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. Results were revealed that maximum number of tillers/plant (9.5), dry weight (17.46 g/plant), effective tillers/plant (9.33), length of spike (11.46 cm), no. of grains/spike(56), test weight (36.99 gm) were found to be significantly higher with application of treatment ($T_9$) SWI + 80 kg/ha P as compared to the other treatments. 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. 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 and yield

## 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.).

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It is one of the foremost important cereal crops in the world ranking first both in area and production of the grain crops, and the second-largest producer of the world after china. It is often grown from water level to 5000 m altitude and in areas where rainfall ranges between 300-1130mm. wheat contributes more towards the public distribution system and is the backbone of the country's food security, (Prasad and Gupta. 2012) [14]. In India during 2013-14 area under wheat cultivation was 31.19 million hectares, production 95.91 million tones and yield 3075 kg/ha, now comes in condition with MP area was 5.79 million hectares, which was 18.57% of the total area of India, production was 13.93 million tonnes, the yield was 2405 kg per hectare and this contributed 14.52% of the total yield of India (Bhargava *et al.*, 2016) [5].

The broadcasting method produced the foremost effective spatial arrangements. However, there is no consistent relationship between any of the spatial arrangements and yield performance (Abbas *et al.*, 2009) [1]. It's particular use in establishing dense plant spacing, as for canopy crops and lawns. Compared to traditional drill planting, broadcast seedling would require 10-20% more seed. It's simple, faster and easier than traditional row sowing.

Line sowing is being practised with proper row spacing, which besides facilitating inter-culture and herbicide application for effective and effective weed control; help in intercropping and reducing the seed rate per hector with no adverse effect on the ultimate grain yield (Narayan *et al.*, 2019).

The system of Wheat Intensification method encompasses a great potential to extend wheat productivity and creates a really good growing condition through modified soil, water, plant and nutrient management. SWI interventions may give 54% more yield than the available best practices (Uphoff *et al.*, 2011; Adhikari 2012) [20, 3] and showed better economic returns (Raol, 2012) [16]. This is a system of modified agronomic practices like lower seed rate, seed

treatment, sowing of seeds at proper spacing, control of water within the crop field, weeding or hoeing outputs which lead to a higher ratio of tillers to mother seedlings, increased number of effective tillers/hill, enhance panicle length and bolder grains and eventually enhance the yield of wheat (Rakib *et al.*, 2016) [15].

Phosphorus (P) is that the second essential plant nutrient required by plants in great quantity after Nitrogen for growth. It's the primary constituent of plant and animal life. It always plays a vital role in several metabolic processes. It's a structural function in macromolecules, metabolic pathways and degradation. The specified amount of P for the wheat crop is more as compared to other crops, however, the recovery is as low as 15-20% of the applied P while the remaining is fixed as insoluble P in the soil's matrix. Furthermore, 0.1% out of the total whole P exists during a soluble form to available for plant and therefore the fixations occurred as an unreachable form to plant for growth. Wheat is that the most generally cultivated crop around the world. Wheat responds well to fertilizer application with a balance N: P ratio for increased (Noonari *et al.*, 2014).

## 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 Technology and Sciences (SHUATS), Prayagraj which is found at 25º24'42" N latitude, 810 50' 56" E longitude and 98 m altitude above the mean sea level (MSL). To assess the influence of different methods of sowing and Phosphorus levels on wheat (*Triticum aestivum* L.). The experiment was laid move into in Randomized Block Design with Nine treatments which was replicated thrice. The treatment combination has two factors. The primary comprises of three methods of sowing i.e., Broadcasting, Line sowing (20 x 10), System of Wheat Intensification (SWI) (22.5 x 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 60kg/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. Nine treatments are replicated thrice within the Randomized Block Design. As fertilizers are applied as basal dose to fulfil 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 analysed for organic carbon by rapid titration method by Nelson (1975) [12]. The type of soil in the experiment field is sandy clay with a pH of 7.3, EC of 0.47dSm-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). Growth parameters *viz.*, plant height (cm), No. of tillers per plant, dry weight (g/plant) were recorded manually on five randomized selected representative plants from each plot of each replication separately as likewise as yield and yield attributing characters *viz.*, grain yield (t/ha) and straw yield (t/ha) recorded as per the quality method. Soil texture by Bouyoucos Hydrometer Method (Gee and Baudev, 1986) [6]. Available nitrogen was estimated by alkaline permanganate method by Subbiah and Asija (1956) [19], available phosphorous by Olsen *et al.*, (1954) and available potash was decided by Flame photometric method (Jackson 1973) [9].

## Statistical analysis

The data recorded were different characteristics were subjected to stastical 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.

## Result and Discussion

### Effect on growth parameters

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 however ($T_9$) 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) [2] which enhanced the plant height. At harvest, maximum no. 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 however ($T_6$) 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) [17]. 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) [10]. 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 however ($T_6$) 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) [4].

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

| Treatment Combinations | Growth attributes | | |
|---|---|---|---|
| | Plant height (cm) | No 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 |
| S.Em(±) | 0.62 | 0.19 | 0.28 |
| CD (p=0.05) | 1.84 | 0.59 | 0.84 |

**Yield attributes on wheat**

Observations regarding yield attributes are given in Table 2. Maximum number of effective tillers per plant was recorded with application of ($T_9$) SWI + Phosphorus 80 kg/ha (9.33) which was significantly superior over all other treatments however ($T_6$) SWI + Phosphorus 60 kg/ha (9.20) and ($T_3$) SWI + Phosphorus 40 kg/ha (8.93) was found statistically at par to ($T_9$).

Maximum spike length was recorded with the application of ($T_9$) SWI + Phosphorus 80 kg/ha (11.46) which was significantly superior over all other treatments however ($T_3$) SWI + Phosphorus 40 kg/ha (11.16) and ($T_6$) SWI + Phosphorus 60 kg/ha (11.15) was found statistically at par to ($T_9$).

Maximum number of grains per spike was recorded with application of ($T_9$) SWI + Phosphorus 80 kg/ha (56) was recorded which was significantly superior over all the treatments however ($T_6$) SWI + Phosphorus 60 kg/ha (53) was found statistically at par to ($T_9$).

Maximum test weight was recorded with application of ($T_9$) SWI + Phosphorus 80 kg/ha (36.99 gm) which was significantly superior over all the treatments however ($T_6$) SWI + Phosphorus 60 kg/ha (36.03) which was found statistically at par to ($T_9$). Wider spacing facilitated better utilization of resource for plant under SWI technique. Wider spacing reduced competition between plants for water, nutrient, light and space that lead better growth of plants, yield and yield attributes *i.e.*, length of ear head and number grains per ear head. This was in conformity with the findings of (Hussain *et al.*, 2012) [8].

**Table 2:** Influence on yield attributes of wheat by different methods of sowing and phosphorus levels.

| Treatment Combinations | Yield attributes | | | |
|---|---|---|---|---|
| | Effective tillers/plant | Length of spike (cm) | No of grains/spike | Test weight (gm) |
| $T_1$- Broadcasting + Phosphorus 40 kg/ha | 4.76 | 9.58 | 35.66 | 25.44 |
| $T_2$ - Line sowing + phosphorus 40 kg/ha | 6.20 | 10.44 | 40.66 | 29.80 |
| $T_3$ - SWI + Phosphorus 40 kg/ha | 8.93 | 11.16 | 48.66 | 33.27 |
| $T_4$ - Broadcasting + Phosphorus 60 kg/ha | 5.00 | 10.03 | 38.00 | 25.86 |
| $T_5$ - Line sowing + Phosphorus 60 kg/ha | 6.50 | 10.47 | 42.66 | 32.10 |
| $T_6$ - SWI + Phosphorus 60 kg/ha | 9.20 | 11.15 | 53.00 | 36.03 |
| $T_7$ - Broadcasting + Phosphorus 80 kg/ha | 4.73 | 10.38 | 39.66 | 27.31 |
| $T_8$ - Line sowing + Phosphorus 80 kg/ha | 7.03 | 10.75 | 45.00 | 32.84 |
| $T_9$ - SWI + Phosphorus 80 kg/ha | 9.33 | 11.46 | 56.00 | 36.99 |
| S.Em(±) | 0.20 | 0.17 | 0.81 | 0.43 |
| CD (p=0.05) | 0.61 | 0.53 | 2.44 | 1.30 |

**Yield**

Data pertaining to grain yield are recorded after harvest and embodies in Table 3. Grain yield significantly increased with treatment combinations. The maximum yield was recorded with ($T_8$) Line sowing + Phosphorous 80 kg/ha, due to high plant population producing more grain yield (3.37 t/ha) which was significantly superior over all the treatments and which was found statistically at par with treatment combination of ($T_9$) SWI + Phosphorous 80 kg/ha with grain yield (3.28 t/ha). Straw yield was maximum recorded in the application of ($T_8$) Line sowing + Phosphorous 80 kg/ha with (4.56 t/ha) which were significantly superior over all the treatments however ($T_9$) SWI + Phosphorous 80 kg/ha with straw yield (4.29 t/ha) was found statistically at par to ($T_8$) Line sowing + Phosphorous 80 kg/ha. Similar findings were found in the (Singh *et al.*, 2008) [18] the positive impact of availability of individual plant nutrients and humic substances from balanced supplement of NKP through inorganic fertilizers might have induced cell division, expansion of cell wall, meristematic activity, photosynthetic efficiency and regulation of water intake into the cells, resulting of water intake into the cell, resulting in the enhancement of yield parameter. Maximum harvest index found with treatment ($T_5$) Line sowing + Phosphorous 60 kg/ha (44.65%) which were significantly superior over all the treatments however ($T_8$) Line sowing + Phosphorous 80 kg/ha (42.49%) and ($T_9$) SWI + Phosphorous 80 kg/ha (42.91%) was found statistically at par to ($T_5$) Line sowing + Phosphorous 60 kg/ha. Due to increase in grain yield and straw yield the harvest index increases.

**Table 3:** Influence on yield of wheat by different methods of sowing and phosphorus levels.

| Treatment Combinations | 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 | 41.3 |
| $T_7$ - 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 |
| S.Em(±) | 0.03 | 0.13 | 0.7 |
| CD (p=0.05) | 0.10 | 0.40 | 2.1 |

## Conclusion

In conclusion, it is inferred from the present investigation that application of ($T_8$) Line sowing + Phosphorus 80 kg/ha was found to be more productive (3.37 t/ha).

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