Original Research Article
***Influence of phosphorus and sulphur on growth and yield of wheat (Triticum aestivum* L.)**

Abstract

Background: Wheat is grown on more land area than any other food crop, World trade in wheat is greater than for all other crops combined. world production of wheat and other grain crops has tripled and is expected to grow further through the middle of the 21st century. In 2020, making it the second most-produced cereal after maize Since 1960.

Objectives: Effect of phosphorus and sulphur on growth parameters and yield of wheat

Methods: : With the goal of studying the effect of phosphorus and sulphur on growth and yield of wheat (Triticum aestivum L.) Var. DBW-187 under a Randomized block design with 9 treatments (T1-T9) The experimental results revealed that 80 kg p/ha + 40 kg s/ha produced maximum plant height (96.47), Tillers/hill (10.47), plant dry weight (18.54) and yield parameters Grains/spike (47.36), Test weight (38.59), Grain yield (6.25t/ha), straw yield (9.54t/ha), Harvest index (39.58%)

Conclusion: On the basis of one season experim it can be concluded that with the application of Phosphorus 80 kg/ha + Sulphur 40 kg/ha was found significantly superior in plant height (96.47cm), tillers/hill (10.47), dry weight (18.54 g/plant), grains/spike (47.36), Test weight (38.59 g), Grain yield (6.25 t/ha), Stover yield (9.54t/ha) and harvest index (39.58 %). Because the findings are based on research conducted during one single season, they may be repeated for further confirmation

Key words: Wheat, Phosphorus, Sulphur, Growth parameter and yield parameters.

Introduction

"Wheat (*Triticum aestivum* L.), which triggered green revolution in the Indian subcontinent, is an important food grain providing nourishment nearly to 35 per cent people of the world. On global scale, the crop is grown over an area of 220 million hectare with a production of 763.06 million tonnes" (Anonymous, 2019-2020). "India is the second largest producer of wheat in the world next only to China and the crop has provided the fastest pace of growth to Indian agriculture. Among cereals, wheat is next to rice in area (24.23 million ha) and production (75.6 million tonnes)" **(6).** Wheat contributes about 60 per cent of daily protein requirement and more calories to world diet than any other food crop**.** As main staple food, wheat continues to assume greater significance in the years to come both from grain productivity as well as quality point of view. Wheat is one of the most important cereal crops of India with diverse uses. Intensive cultivation has resulted in the depletion of soil nutrients to a great extent thus nutrients requirement of crops has increased considerably during the last few years.

"Phosphorus is the second most essential plant nutrient which plays a major role for achieving maximum crop production. It plays a vital role in several physiological processes *viz*. photosynthesis, respiration, energy storage and cell division/ enlargement. It is also an important structural component of many biochemicals viz. nucleic acid (DNA and RNA enzymes and co-enzymes) and also stimulates root growth and associated with early maturity of crops" **(8).**

"Sulphur is another one of the essential nutrients in all plant nutrients and component of amino acids which are the building block of protein. In the cereal crops, sulphur-containing the ranges from 0.16-0.20%. Sulphur performs many physiological functions like synthesis of sulphur containing amino acids which have a positive role in improving the quality of grain" **(Chaudhary *et al*., 2003) (1).** "Sulphur is a structural constituent of organic compounds, some of which are uniquely synthesized by plants, providing human and animals with essential amino acids (methionine cystine and cysteine). . Sulphur deficiency in the soil allows toxicnitrates and arnides to accumulate, which retards protein formation and also decreases the quality of protein in bothgrain and straw" (**Hegde D.M., Babu 2007**) **(3)**

Materials and Methods

The experiment was carried out during *Rabi* season of 2021 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (Allahabad) which is located at 25o 24' 42" N latitude, 81o50' 56" E longitude and 98 m altitude above the mean sea level. The experiment laid out in Randomized Block Design with three replications. which consisting of nine treatments with T_1: Phosphorus 40 kg/ha + Sulphur 20 kg/ha, T_2: Phosphorus 40 kg/ha + Sulphur 30 kg/ha, T_3: Phosphorus 40 kg/ha + Sulphur 40 kg/ha, T_4: Phosphorus 60 kg/ha + Sulphur 20 kg/ha, T_5: Phosphorus 60 kg/ha + Sulphur 30 kg/ha, T_6: Phosphorus 60 kg/ha + Sulphur 40 kg/ha, T_7: Phosphorus 80 kg/ha + Sulphur 20 kg/ha, T_8: Phosphorus 80 kg/ha + Sulphur 30 kg/ha, T_9: Phosphorus 80 kg/ha + Sulphur 40 kg/ha are used. Plant height (cm) and dry weight accumulation(g/plant) were manually recorded on five randomly selected consultant plants from each plot of each replication one at a time, and seeds were isolated from each individual plot and dried under sun for three days after harvesting. Later, the seeds were winnowed, washed, and the seed yield per hectare was calculated and expressed in tonnes per hectare.The statistics were calculated and analysed using the Gomez and Gomez statistical approach **(2)** . The benefit:cost ratio was reworked after the fee value of seed was replaced with straw and the general value of crop cultivation was protected

RESULTS & DISCUSSIONS

Effects on Growth Parameters

Plant height

Maximum plant height (96.47 cm) was recorded in treatment (t9) with application of Phosphorus 80 kg / ha + Sulfur 40 kg / ha as compared to all other treatments. whereas, treatment (t6) with application of phosphorus 60 kg / ha + sulfur 40 kg / ha (96.02 cm) and treatment (t8)phosphorus 80 kg / ha + sulfur 30 kg / ha (96.28 cm) was found to be statistically at per with treatment(t9) with application of Phosphorus 80 kg / ha + Sulfur 40 kg / ha. Phosphorus encourages formation of new cells, promote plant vigour and hastens leaf development, which help in harvesting more solar energy and better utilization of nitrogen, which help towards higher growth attributes. The results were in accordance to (9)

Number of tillers/plants

Most number of tillers/plant was recorded in treatment (t_9) with application of Phosphorus 80 kg / ha + Sulfur 40 kg / ha , the highest tiller / hill (10.47) was reported to be significantly higher than all treatments. However, treatment (t_6) with phosphorus 60 kg / ha + sulfur 40 kg / ha (10.25) and treatment (t_8) with application of phosphorus 80 kg / ha + sulfur 30 kg / ha (10.36) which was found to be statistically equivalent to phosphorus 80 kg / ha + sulfur 40 kg / ha. The number of tillers were increased due to the greater availability of nutrients in soil due to increasing application of phosphorus doses might have enhanced multiplication and elongation of cells leading to increased number of tillers as reported by **sharma (10)**

Plant dry weight (g/plant)

Maximum plant dry weight was recorded in Treatment (t9) with application of Phosphorus 80 kg/ha + Sulphur 40 kg/ha, maximum dry weight (18.54 g/plant) over all the treatments. However, the treatment (t6) with application of Phosphorus 60 kg/ha + Sulphur 40 kg/ha (18.14 g/plant) and in treatment (t8) with application of Phosphorus 80 kg/ha + Sulphur 30 kg/ha (18.36 g/plant) which were found to be statistically at par with Phosphorus 80 kg/ha + Sulphur 40 kg/ha. The application of Phosphorus 80 kg/ha to wheat significantly increased dry matter production. The plants attained more vigour with phosphorus, due to adequate supply and availability of nitrogen, phosphorus, potassium and spacing in a balanced combination, resulting in increased dry weight of the plant. The results were found to be similar to (Khan, W. and Singh, V. 2017) (7).

Yield attributes and Yield

Number of grains/spikes

Significant number of grains / spikes (47.36) were reported using phosphorus 80 kg / ha + sulfur 40 kg / ha on all treatments. However, phosphorus 60 kg / ha + sulfur 40 kg / ha (46.89) and phosphorus 80 kg / ha + sulfur 30 kg / ha (47.15) treatment which was found to be statistically equal to phosphorus 80 kg / ha + sulfur 40. Kg / ha. Application of Phosphorus 90kg/ha increased the number of grains/spikes might be due to the enhanced early vegetative growth in terms of higher leaf area, dry matter accumulation and vigorous root system resulted in more tillers which consequently increased the number of grains bearing tillers significantly. Similar findings were observed by **Islam *et al. (5)***

Grain yield (t/ha)

Significantly higher grain yield (6.25 ton / ha) was reported using phosphorus 80 kg / ha + sulfur 40 kg / ha in all treatments. However, in phosphorus (6.02 ton / ha) 60 kg / ha + sulfur 40 kg / ha and in (6.18 ton / ha) phosphorus 80 kg / ha + sulfur 30 kg / ha was found to be - statistically treated. Phosphorus 80 kg / ha + Sulfur 40 kg / ha. Under present investigation higher uptake of phosphorus from soil and its reallocation in grain and stover yield. The higher availability of phosphorus seems to have promoted development of morphological structure by virtue of multiplication of cell division which is well reflected through grain yield. (Hemesh et al., 2020) (4)

Stover yield (t/ha)

Significantly higher straw yield (9.54 ton / ha) was reported using phosphorus 80 kg / ha + sulfur 40 kg / ha on all treatments. However, treatment with phosphorus (9.22 t / ha) 60 kg / ha + sulfur 40 kg / ha and (9.44 t / ha) phosphorus 80 kg / ha + sulfur 30 kg / ha which was found on statistical level. Phosphorus 80 kg / ha + Sulfur 40 kg / ha. Under present. investigation higher uptake of phosphorus from soil and its reallocation in grain and stover yield **(4)**

CONCLUSION

Based on one season of experimentation, it can be concluded that the application of Phosphorus 80 kg/ha + Sulphur 40 kg/ha resulted in significantly superior plant height (96.47cm), tillers/hill (10.47), dry weight (18.54 g/plant), grains/spike (47.36), Test weight (38.59 g), grain yield (6.25 t/ha), and stover yield (9.54t/ha). Because the findings are based on research conducted during one single season, they may be repeated for further confirmation.

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Table 1: Effect of Phosphorus and Sulphur on Growth attributes of Wheat

Sr.No	Treatments	Plant height (cm)	No.of Tillers/hill	Dry weight (g/plant)
1.	Phosphorus 40 kg/ha + Sulphur 20 kg/ha	94.51	9.55	16.63
2.	Phosphorus 40 kg/ha + Sulphur 30 kg/ha	94.66	9.66	16.84
3.	Phosphorus 40 kg/ha + Sulphur 40 kg/ha	95.47	10.02	17.47
4.	Phosphorus 60 kg/ha + Sulphur 20 kg/ha	94.92	9.84	17.02
5.	Phosphorus 60 kg/ha + Sulphur 30 kg/ha	95.74	10.12	17.90
6.	Phosphorus 60 kg/ha + Sulphur 40 kg/ha	**96.02**	**10.25**	**18.14**
7.	Phosphorus 80 kg/ha + Sulphur 20 kg/ha	95.27	9.96	17.24
8.	Phosphorus 80 kg/ha + Sulphur 30 kg/ha	**96.28**	**10.36**	**18.36**
9.	Phosphorus 80 kg/ha + Sulphur 40 kg/ha	96.47	10.47	18.54
	F test	S	S	S
	SEm (±)	0.19	0.11	0.18
	CD (P = 0.05)	0.57	0.33	0.54

Table 2. Effect of Phosphorus and Sulphur on Yield attributes and Yield of Wheat

Sr.No	Treatments	Grains/spike	Grain yield (t/ha)	Straw yield (t/ha)
1.	Phosphorus 40 kg/ha + Sulphur 20 kg/ha	45.17	5.23	8.39
2.	Phosphorus 40 kg/ha + Sulphur 30 kg/ha	45.43	5.35	8.54
3.	Phosphorus 40 kg/ha + Sulphur 40 kg/ha	46.28	5.63	8.91
4.	Phosphorus 60 kg/ha + Sulphur 20 kg/ha	45.60	5.47	8.65
5.	Phosphorus 60 kg/ha + Sulphur 30 kg/ha	46.54	5.80	9.04
6.	Phosphorus 60 kg/ha + Sulphur 40 kg/ha	**46.89**	**6.02**	**9.22**
7.	Phosphorus 80 kg/ha + Sulphur 20 kg/ha	45.89	5.53	8.74
8.	Phosphorus 80 kg/ha + Sulphur 30 kg/ha	**47.15**	**6.18**	**9.44**
9.	Phosphorus 80 kg/ha + Sulphur 40 kg/ha	47.**36**	6.25	9.54
	F test	S	S	S
	SEm (±)	0.18	0.11	0.07
	CD (P = 0.05)	0.53	0.32	0.21