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Effect of nitrogen and phosphorus on growth and yield of wheat crop

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Abstract

An experiment entitled “Effect of Nitrogen and Phosphorus on the Growth and Yield of Wheat (*Triticum aestivum* L.)” was conducted at Shradhya Bhagwati Singh Agriculture Research Farm (Hajipur), Chandra Bhanu Gupta Krishi Snatkottar Mahavidyalaya, B.K.T., Lucknow (Uttar Pradesh) during Rabi season 2023. The treatment consisted of the four nitrogen levels practices (0, 50, 100 and 150 kg/ha) and four levels of phosphorus (0, 30, 60 and 90 kg/ha) on silty loam soils having low organic carbon (0.45%) and medium in available nitrogen (376.6 kg/ha) phosphorus (26.59 kg/ha) and potassium (165.89 kg/ha). The value of yield attributes like number of effective tillers m⁻², spike length (cm) number of grain/spike, grain weight/spike (g), 1000 grain weight (g), grain, straw, biological (q/ha) and harvest index (%) of wheat increased with increasing levels of nitrogen and phosphorus. Crop fertilized with 150 kg N/ha has given highest grain yield (49.49 q/ha), straw yield (74.33 q/ha) and biological yield (123.88 q/ha) was recorded with the application of 150 kg N/ha. However, highest grain yield (45.50 q/ha), straw yield (68.49 q/ha) and biological yield (114.14 q/ha) was recorded with the application of 90 kg P/ha. On the basis of this study it may be concluded that the different level of nitrogen and phosphorus resulted higher growth, yield attributes, uptake of nutrients and yield of wheat through its favorable effects on nutrient supply. The magnitude of response to wheat yield was more in case of nitrogen compared to phosphorus.

Keywords: Magnitude, phosphorous, nutrient, fertilized, organic

Introduction

Wheat (*Triticum aestivum* L.) belongs to the family poaceae. In India, wheat is an important cereal crop grown in diverse agro-climate regions and its cultivation has a long history of a series of technological breakthroughs. Wheat was the major crop instrumental in ushering the “green revolution” in India which is one of the biggest success stories of India cited globally and which enabled the country to status of “self-sufficiency”. It also brought about an element of resilience in agriculture toward the threat of famines.

Wheat content 55% carbohydrate and 20% of food calories are in the wheat grain, protein 14%, fat 2%, minerals 2.5% and vitamin such as thiamine and vitamin B, additionally, wheat is a wonder source of trace minerals like selenium and magnesium, which are essential for overall health. Wheat grains are also rich in pantothenic acid, riboflavin and a few minerals, sugars and so forth. Furthermore, bran is a dietary source of fibre, potassium, phosphorus, magnesium, calcium, and niacin in small amount, as well as a niacin source. (Alemu 2017) [1].

Materials and Methods

The present investigation entitled “Effect of Nitrogen and Phosphorus on the Growth and Yield of Wheat Crop (*Triticum aestivum* L.)” was conducted during Rabi Season 2023-2024. The treatment consisted of the four nitrogen levels practices (0, 50, 100 and 150 kg/ha) and four levels of phosphorus (0, 30, 60 and 90 kg/ha) on silty loam soils having low organic carbon (0.45%) and medium in available nitrogen (376.6 kg/ha) phosphorus (26.59 kg/ha) and potassium (165.89 kg/ha).

Results and Discussion

Yield attributes

Effective tillers

Level of Nitrogen

A perusal of data revealed that level of nitrogen and phosphorus affected the effective tillers significantly. Application of 150 kg ha⁻¹ nitrogen recorded the highest fertile or effective tillers as compared to rest level of nitrogen.

Level of Phosphorus

Increasing level of phosphorus from 0 to 90 kg ha⁻¹ was increase the number of effective tillers significantly over control. Application of 90 kg ha⁻² phosphorus recorded the highest effective tillers at all stage of crop growth as compared to rest level of phosphorus. However, the difference between 60 to 90 kg N/ha was found significantly of all stage of crop growth.

Length of spike (cm)

Level of Nitrogen

Application of nitrogen significantly affected length of spike (10.70cm) with the application of 150 kg N/ha as compared to rest of all other treatment crop without nitrogen recorded the lowest value of length of spike (8.30cm). However, application of 150 and 100 kg N/ha were found significantly compared to other treatment.

Level of Phosphorus

Phosphorus affected the length of spike statistically. Length of spike increased with increasing the levels of phosphorus. The maximum length of spike (9.90cm) was observed under 90 kg P/ha followed by 60, 30 and 0 kg P/ha. Application of 90 kg p/ha given significantly higher value of length of spike as compared to 30 kg P/ha and 0kg P/ha. However application of 90 and 60 kg P/ha were found at par with each other.

Number of grain/spike

A perusal data revealed that the level of nitrogen affected the number of grain/spike significantly over control at all stage of

crop growth. Significantly, the higher values of number of grains/spike (64.83), was recorded with the application of 150 kg N/ha as compared to rest of all other treatment except 100 kg N/ha. Crop without nitrogen recorded the lowest values of number of grain/spike (61.08). Application of 90 kg ha⁻² P₂O₅ recorded maximum number of grain/spike (63.08) and the lowest value was recorded with 0kgP/ha. These results were in conformity with finding of Ali *et al.* (2020) [2]. Application of 90 kg ha⁻² P₂O₅ recorded maximum number of grain/spike (63.08) was significantly highest as compared to rest level. The results of the present study corroborate the finding of Khan *et al.* (2008) [6].

Grain weight/spike

A perusal of data revealed that the level of nitrogen and phosphorus affected the grain weight/spike (g) significantly over control at harvest of wheat. Application of nitrogen significantly affected the grain weight/spike (3.63), was recorded with the application of 150 kg/ha as compared to rest of all other treatment except 100 kg N/ha. Crop without nitrogen recorded the lowest values of grain weight/spike (2.55). Application of 90 kg ha⁻² phosphorus recorded maximum weight of grain/spike (3.15) was significantly highest as compared to rest of the treatment over control. However, the difference between 60 to 90 kg ha⁻² P₂O₅ was found significantly at harvest of wheat.

Test weight

A perusal data revealed that the level of nitrogen and phosphorus affected the test weight of 1000 grain (g) significantly over control at crop harvest. Maximum test weight was recorded with the application of 150 kg N/ha (39.92) as compared to rest of all other treatment except 100 kg N/ha (39.60). Crop without nitrogen recorded the lowest values of (38.27). Application of 90 kg ha⁻² phosphorus recorded the maximum grain test weight (39.29) was significantly highest as compared to rest level of phosphorus. However, the difference between 60 to 90 kg ha⁻² phosphorus was found significantly at crop harvest.

Table 1: Effect of different levels of nitrogen and phosphorus on yield attributes of wheat crop.

| Treatments | No. of effective tillers m ⁻² | Spike length (cm) | No. of grain/spike | Grain weight/spike (g) | 1000 grain weight (g) |
|-----------------------------|--|-------------------|--------------------|------------------------|-----------------------|
| Levels of nitrogen | | | | | |
| N ₀ | 299.25 | 8.3 | 61.08 | 2.55 | 38.27 |
| N ₁ | 329.58 | 9.10 | 61.91 | 2.74 | 38.91 |
| N ₂ | 356.25 | 10.11 | 63.16 | 3.02 | 39.60 |
| N ₃ | 383.25 | 10.70 | 64.83 | 3.63 | 39.92 |
| SE(m)± | 0.35 | 0.08 | 0.27 | 0.02 | 0.02 |
| CD. (P=0.05%) | 1.03 | 0.25 | 0.80 | 0.08 | 0.07 |
| Levels of phosphorus | | | | | |
| P ₀ | 331.08 | 9.02 | 62.41 | 2.84 | 38.97 |
| P ₁ | 338.41 | 9.46 | 62.66 | 2.91 | 39.18 |
| P ₂ | 347.33 | 9.82 | 62.83 | 3.04 | 39.26 |
| P ₃ | 351.50 | 9.90 | 63.08 | 3.15 | 39.29 |
| SE(m)± | 0.35 | 0.08 | 0.27 | 0.02 | 0.02 |
| CD. (P=0.05%) | 1.03 | 0.25 | NS | 0.08 | 0.07 |

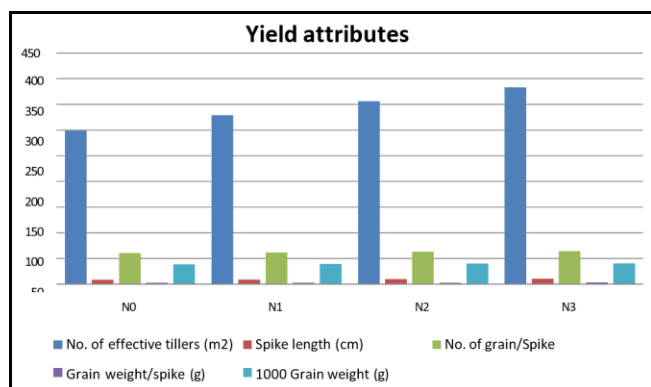


Fig 1: Effect of different levels of nitrogen on yield attributes of wheat crop.

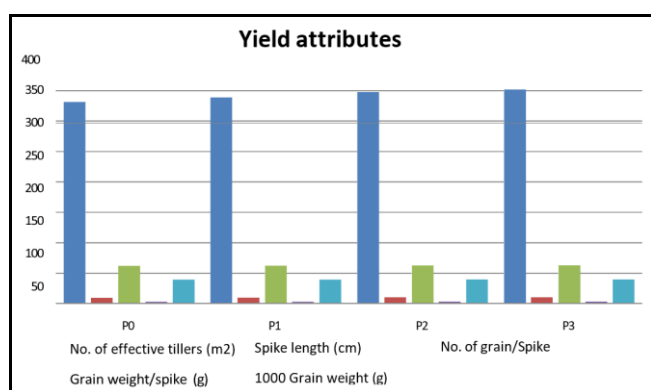


Fig 2: Effect of different levels phosphorus on yield attributes of wheat crop.

1.2 Yield studies

Grain yield

A perusal data revealed that the level of nitrogen and phosphorus affected the grain yield of wheat q/ha significantly over control at harvest of wheat crop. The yield was affected statistically due to different levels of nitrogen. Result further revealed that application of nitrogen increased significantly the grain yield over control. However the highest grain yield (49.49 q/ha), was recorded with the application of 150 kg N/ha and the minimum grain yield was recorded with (39.41 q/ha). However, maximum grain yield (45.50 q/ha) was recorded with application of 90 kg P/ha and the minimum value (42.31 q/ha) recorded with 0 kg P/ha at harvest stage. Application of nitrogen to crop enhanced the growth and yield attributes due to continuous supply of nitrogen and its uptake by crop. The higher photosynthetic efficiency resulted higher production of photosynthates and its translocation to reproductive parts of plant improved the yield attributes and finally the yield of crop. The results were in corroboration with finding of Sharma and Manohar (2000) [8] that increase in yield was up to 150 kg N/ha. The similar results were reported by Khan *et al.* (2008) [6].

Straw yield

Application of nitrogen increased significantly the straw yield as compared to rest of the treatments. Highest value of straw yield (74.33 q/ha) was recorded with the application of 150 kg N/ha and lowest value (59.18 q/ha) of straw yield was recorded with 0 kg N/ha. Increasing level of phosphorus from 0 to 90 kg P/ha was increased the straw yield at harvest of wheat crop. Highest value of straw was found with application of 90 kg P/ha (68.49 q/ha) and lowest value recorded with 0 kg P/ha (63.46 q/ha). Phosphorus plays an important role in enhancing the yield of

wheat. Phosphorus fertilization exhibited its ultimate influence on the grain and straw yield of wheat. Grain and straw yield increased significantly with an increase in the levels of phosphorus up to 90 kg/ha. The response to phosphorus levels in respect of various yield contributing characters is likely to be reflected in the grain and straw yield. The results are corroborates with the finding of Jain and Dhama (2006) [3], Jat *et al.* (2007) [5] and Mehdi *et al.* (2007) [7].

Biological yield (q/ha)

A perusal data revealed that the level of nitrogen and phosphorus affected the grain yield of wheat q/ha significantly over control at harvest of wheat crop. Among level of nitrogen treatments, maximum biological yield (123.88q/ha) was observed with 150 kg N/ha and the lowest yield (98.63 q/ha) observed with 0 kg N/ha. Increasing levels of phosphorus from 0 to 90 kg P/ha affected the biological yield of wheat crop. Maximum values observed at 90 kg P/ha (114.16 q/ha) and lowest values observed at 0 kg P/ha (105.77 q/ha).

Harvest index (%)

Effect of different levels of nitrogen and phosphorus showed non-significant effect on harvest index. However, highest harvest index (40.00%) was recorded with the application of 0 and 50 kg N/ha and the minimum harvest index (39.80%) was recorded with application of 100 kg N/ha. However, highest harvest index value (40.28%) recorded with 60 kg P/ha and the lowest value recorded with (39.78 %) recorded with 30 kg P/ha.

Table 2: Effect of different levels of nitrogen and phosphorus on yield studies of wheat crop.

| Treatments | Grain yield (q/ha) | Straw yield (q/ha) | Biological yield (q/ha) | Harvest index (%) |
|-----------------------------|--------------------|--------------------|-------------------------|-------------------|
| Levels of nitrogen | | | | |
| N ₀ | 39.41 | 59.18 | 98.63 | 40.00 |
| N ₁ | 42.54 | 63.81 | 106.35 | 40.00 |
| N ₂ | 45.73 | 68.85 | 114.76 | 39.92 |
| N ₃ | 49.49 | 74.33 | 123.88 | 39.80 |
| SE(m)± | 0.09 | 0.11 | 0.18 | 0.21 |
| CD. (P= 0.05%) | 0.28 | 0.32 | 0.53 | NS |
| Levels of phosphorus | | | | |
| P ₀ | 42.31 | 63.46 | 105.77 | 39.70 |
| P ₁ | 44.41 | 66.74 | 111.24 | 39.78 |
| P ₂ | 44.96 | 67.46 | 112.44 | 40.28 |
| P ₃ | 45.50 | 68.49 | 114.16 | 39.79 |
| SE(m)± | 0.09 | 0.11 | 0.18 | 0.21 |
| CD. (P= 0.05%) | 0.28 | 0.32 | 0.53 | NS |

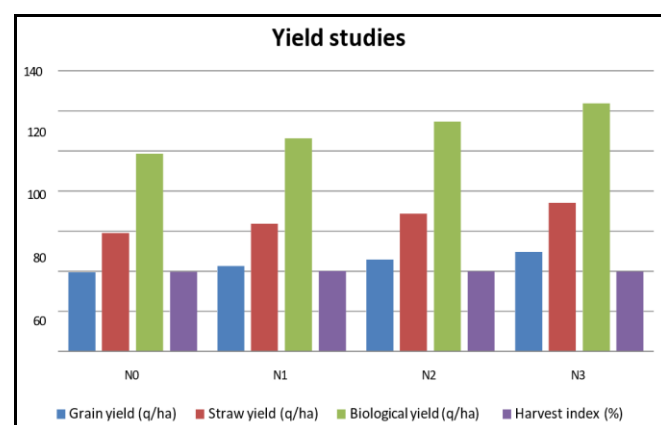


Fig 3: Effect of different levels of nitrogen on yield studies of wheat crop.

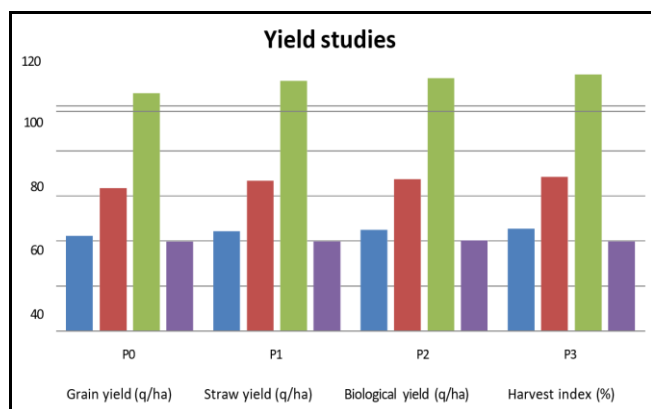


Fig 4: Effect of different levels of phosphorus on yield studies of wheat crop.

Conclusion

Nitrogen and phosphorus application significantly influenced wheat growth and yield parameters. Nitrogen application at 150 kg/ha recorded the highest values for effective tillers, spike length, grain number per spike, grain weight, test weight, and both grain and straw yield. Similarly, phosphorus application at 90 kg/ha positively affected tillers, spike length, grain number, and yield traits. Overall, the highest biological yield was achieved with 150 kg N/ha and 90 kg P/ha. While nitrogen and phosphorus influenced yield, harvest index showed non-significant variation, indicating minimal impact of these nutrients on the partitioning of biomass into grain.

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