International Journal of Chemical Studies

**P-ISSN: 2349–8528**
**E-ISSN: 2321–4902**
IJCS 2018; 6(5): 2468-2471

Received: 02-07-2018
Accepted: 04-08-2018

**Vipul Singh**
Department of Agronomy, Narendra Deva University of Agriculture and Technology, Faizabad, Uttar Pradesh, India

**Ravi Shanker Singh**
Department of Agronomy, Narendra Deva University of Agriculture and Technology, Faizabad, Uttar Pradesh, India

**Ghanshyam Singh**
Department of Agronomy, Narendra Deva University of Agriculture and Technology, Faizabad, Uttar Pradesh, India

**BN Singh**
Department of Agronomy, Narendra Deva University of Agriculture and Technology, Faizabad, Uttar Pradesh, India

**Raghvendra Singh**
Department of Agronomy, Narendra Deva University of Agriculture and Technology, Faizabad, Uttar Pradesh, India

**Correspondence**
**Vipul Singh**
Department of Agronomy, Narendra Deva University of Agriculture and Technology, Faizabad, Uttar Pradesh, India

# Effect of phosphorus levels on the growth characters and yield of wheat (*Triticum aestivum* L.) varieties grown under late sown condition

**Vipul Singh, Ravi Shanker Singh, Ghanshyam Singh, BN Singh and Raghvendra Singh**

**Abstract**
A field experiment was carried out at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during Rabi season of 2013-14 to study the response of late sown wheat varieties to different phosphorus levels. Sixteen treatment combinations and consisted of four levels of phosphorus (0 kg $P_2O_5$ $ha^{-1}$, 30 kg $P_2O_5$ $ha^{-1}$, 60 kg $P_2O_5$ $ha^{-1}$, 90 kg $P_2O_5$ $ha^{-1}$) and four varieties of wheat (HUW-234, NW-2036, HD-2643 and DBW-14). The experiment was conducted in Split Plot Design (S.P.D.) with three replications on silt loam having organic carbon (3.8%), nitrogen (203 kg $ha^{-1}$), phosphorus (12.25 kg $ha^{-1}$) and potassium (265 kg $ha^{-1}$). The growth characters like plant height (cm), number of shoots ($m^{-2}$), leaf area index, dry matter accumulation (g $m^{-2}$) were significantly higher under 90 kg $P_2O_5$ $ha^{-1}$ but which was at par with 60 kg $P_2O_5$ $ha^{-1}$ over rest of the levels and among the varieties DBW-14 was at par with NW-2036 while significantly superior over HUW-234 and HD-2643. The yield components like grain yield (q $ha^{-1}$) were maximum under 90 kg $P_2O_5$ $ha^{-1}$ and among the varieties DBW-14 being at par with NW-2036. Thus it may be concluded that phosphorus levels of 60 kg $P_2O_5$ $ha^{-1}$ proved as the most suitable practice for the growth and yield potential of late sown wheat. Among the varieties DBW-14 was found most suitable for cultivation under late sown condition for achieving higher growth and yield.

**Keywords:** Wheat crop, wheat varieties, phosphorus levels, late sown condition

## Introduction

Wheat (*Triticum aestivum* L.) is one of the the most important cereal crops for the majority of World's populations. Wheat belongs to family Poaceae (Gramineae). It is most important staple food of about two billion people (36% of the World population). About 55% of the world population depends on wheat for intake of about 20% of food calories. Wheat contains more protein than other cereals. Wheat has a relatively high content of niacin & thiamine. Wheat proteins are of special significance.

The major wheat producing states are states are Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar, Maharashtra, Gujarat, Karnataka, West Bengal, Uttarakhand, Himachal Pradesh and Jammu Kashmir. These states contribute about 99.5 percent of total wheat production in the country. Uttar Pradesh ranks first with an area 9.13 million hectare and production of 24.57 million tonnes with an average productivity of 26.91 q $ha^{-1}$ (Anonymous, 2012-13). The productivity of wheat in other states is comparatively lower than that of Punjab (45q $ha^{-1}$) and Haryana.

The late sown rice or use of long duration varieties of rice in low land area delays the sowing of wheat from mid November to December. The preceding crops such as sugarcane, potato, toria etc. and other factors forced to late sown wheat in the month of December and January. Due to delayed sowing wheat yield is declined drastically. Low temperature, poor mineral accumulation, less translocation of photosynthates from source to sink, hot desiccating wind during milking stage deals to premature drying, unsuitable location specific varieties, imbalanced nutrient management are the causes for low yield under late sown wheat. Balanced fertilizer improves the soil health as well as boost the productivity of wheat. The overall varietal response to phosphorus application was noted significant in case of all yield attributes, yields and economics.

Phosphorus plays a key role in energy transfer and protein metabolism. It is an important structural component of many bio-chemical including nucleic acids. DNA and RNA associated with control of hereditary processes. Phosphorus is basic input to obtain high yield of wheat. It promotes healthy root growth, early maturity of crop and seed development and translocation of photosynthesis from source to sink. Therefore, phosphorus is very important element to enhance the production of wheat. Deficiency of phosphorus may cause premature leaf fall and dead necrotic areas may be developed on leaves or fruits and leaves may turn dark to blue green colour. Phosphorus being an energizer element is considered beneficial for late sown wheat (Singh and Prasad 1996) [12].

## Materials and Methods

The field experiment was conducted at Agronomy Research Farm, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.), during *rabi* season of 2013-2014. The experiment was laid out in split plot design with four varieties (HUW-234, NW-2036, HD-2643 and DBW-14) in main plots and four phosphorus levels (0, 30, 60 and 90 kg $P_2O_5$ $ha^{-1}$) in sub plots. The treatments was replicated three times. Sowing was done on 30 December 2013 using 125 kg seed $ha^{-1}$ in row 20 cm apart. An uniform dose of 150 kg N + 40 kg $K_2O$ $ha^{-1}$ was applied to all treatments. Full dose of phosphorus as per treatments and potassium along with half of the nitrogen were applied as basal while remaining half dose of nitrogen was top-dressed at first irrigation.

**Table 1:** Growth characters and yield of late sown wheat as influenced by different wheat varieties and phosphorus levels.

| Treatments | Plant height (cm) at harvest | Number of shoots ($m^{-2}$) at harvest | Leaf area index at 90 DAS | Dry matter accumulation (g $m^{-2}$) at harvest | Grain yield (q $ha^{-1}$) |
|---|---|---|---|---|---|
| **Varieties** | | | | | |
| HUW-234 | 89.39 | 411.35 | 4.23 | 735.48 | 29.80 |
| NW-2036 | 88.58 | 457.38 | 4.95 | 845.28 | 34.50 |
| HD-2643 | 79.29 | 424.22 | 4.30 | 746.18 | 30.20 |
| DBW-14 | 73.02 | 465.30 | 5.00 | 868.38 | 35.10 |
| SEm± | 2.03 | 6.50 | 0.10 | 17.32 | 0.69 |
| CD (P=0.05) | 7.03 | 22.50 | 0.34 | 59.93 | 2.39 |
| **Phosphorus levels (kg $ha^{-1}$)** | | | | | |
| 0 | 76.46 | 391.05 | 4.13 | 709.03 | 28.50 |
| 30 | 80.60 | 406.89 | 4.40 | 756.35 | 30.60 |
| 60 | 85.75 | 465.30 | 4.85 | 861.00 | 35.00 |
| 90 | 87.47 | 495.00 | 5.11 | 868.93 | 35.50 |
| SEm± | 1.56 | 10.13 | 0.09 | 16.58 | 0.55 |
| CD (P=0.05) | 4.52 | 29.26 | 0.27 | 47.89 | 1.59 |

## Results and Discussion

### Growth Characters

### Plant height (cm)

In general, plant height have been presented in Table 1 and showed an increasing trend from at all the crop growth stage. Among varieties variety HUW-234 produced taller plant being at par with variety NW-2036 than rest varieties at all stages of growth.

As regards phosphorus levels, maximum height was noted with application of 90 kg $P_2O_5$ $ha^{-1}$ which was at par with 60 kg $P_2O_5$ $ha^{-1}$ and significant with rest levels at all stages of growth. Interaction effect due to varieties and phosphorus levels was not significant.

Variation in plant height among varieties might also be probably due to their genetic characters. Similar finding in respect to varieties reported by Brijkishor (1998) [1]. Different doses of phosphorus levels had significant effect on plant height at all the stages of crop growth (Table 1). Phosphorus doses profoundly affected the plant height with age of group. Plant height was initially slow due to slow crop growth and thereafter increased rapidly till 90 DAS due to more nutrient absorption from the soil. Significantly tallest plants were measured under 90 kg $P_2O_5$ $ha^{-1}$ and at par with 60 kg $P_2O_5$ $ha^{-1}$ at all the growth stages. Tallest plants under the treatment was mainly due to rapid growth caused by maintenance of adequate and continuous nutrient supply to the crops which maintained good establishment of the roots and various metabolic process which performed higher nutrient mobilization and uptake which contributed to rapid cell division, cell elongation and thus resulted in higher plant height. The smallest plants were measured under 0 kg $P_2O_5$ $ha^{-1}$ at all the growth stages due to poor root growth caused by nutrient deficit condition. The results are in close conformity with the findings of Deshmukh *et al.* (1994) [2] and Patel *et al.* (1991) [4, 5].

### Number of shoots ($m^{-2}$)

Revealed that number of shoots ($m^{-2}$) was found maximum at 90 days after sowing and thereafter, decreased till maturity and presented in Table 1.

Among varieties variety DBW-14 being at par with NW-2036 produced significantly more number of shoots $m^{-2}$ than rest cultivars at all the stages of growth.

Number of shoots significantly affected by various varieties and phosphorus levels at all the stages of crop growth.

As regards phosphorus levels, increasing levels of phosphorus increased the number of shoots $m^{-2}$ and maximum shoots were noted with application of 90 kg $P_2O_5$ $ha^{-1}$ at all the stages of growth which was significantly higher than rest levels of phosphorus. Interaction effect between variety and phosphorus levels was not significant. It might be due to their own genetic capability. The results were in close conformity with those of Singh (1998) [10].

The number of shoots ($m^{-2}$) were affected significantly due to various phosphorus levels at all stages of crop growth (Table 1). The application of phosphorus consistently increased the number of shoots ($m^{-2}$). The maximum number of shoots ($m^{-2}$) was recorded under 90 kg $P_2O_5$ $ha^{-1}$ being at par with 60 kg $P_2O_5$ $ha^{-1}$ and significantly superior over 60 and 30 kg $P_2O_5$ $ha^{-1}$. The increased number of shoots ($m^{-2}$) under phosphorus doses might be due to profused and effective root system, better nutrient absorption from soil. On the other hand lowest number of shoots ($m^{-2}$) were obtained with 0 kg $P_2O_5$ $ha^{-1}$, possibly because of poor root system and poor root nutrient absorption from soil. The favourable effect of higher dose of phosphorus on the number of shoots per unit area also observed by Rai *et al.* (1982) [6] and Singh *et al*. (1980) [11].

**Leaf area index**

The data presented in Table 1 revealed that leaf area index influenced significantly by varieties and phosphorus levels at all the stages of crop growth. In general, leaf area increased faster rates reaching the maximum at 90 days after sowing.

A perusal of data revealed that the leaf area index at influenced significantly by varieties and phosphorus levels, while variety DBW-14 was found at par with variety NW-2036 and superior over rest of the varieties at 60 and 90 days after sowing.

Leaf area index increased significantly upto 90 kg $P_2O_5$ $ha^{-1}$. The maximum leaf area index was recorded at 90 kg $P_2O_5$ $ha^{-1}$ which was significantly superior over 0 kg $P_2O_5$ $ha^{-1}$ and at par with 60 kg $P_2O_5$ $ha^{-1}$ at 30 DAS, while it was at par with 60 kg $P_2O_5$ $ha^{-1}$ and significantly superior over rest of the phosphorus levels at 60 DAS. Again, at 90 days after sowing 90 kg $P_2O_5$ $ha^{-1}$ which was at par with 60 kg $P_2O_5$ $ha^{-1}$, while significantly superior over rest of the phosphorus levels. Interaction effect between varieties and phosphorus levels was not significant.

The maximum and minimum leaf area index (1.09 and 0.99) at 30, 60 and 90 days after sowing was credited to DBW-14 and HUW-234, respectively. It might be probably due to their genetic characters of varieties. Leaf area index was decreased after 90 days after sowing due to decreasing growth rate and senescence stage which showed drying and shattering of the leaves. It might be due to their own genetic capability. The results were in close conformity with those of Singh (1998) [10].

**Dry matter accumulation (g $m^{-2}$)**

The data have been presented in Table 1 and revealed that dry matter accumulation was significantly influenced by varieties and phosphorus levels. In general, the dry matter accumulation increased with advancement in stages.

A perusal of data revealed that variety DBW-14 recorded maximum dry matter accumulation and which was at par with NW-2036 and significantly superior over rest of the varieties at harvest stage.

Phosphorus levels 90 kg $P_2O_5$ $ha^{-1}$ being at with 60 kg $P_2O_5$ $ha^{-1}$ recorded significantly more dry matter as compared to other phosphorus levels at all the stages of crop growth. Interaction effect between varieties and phosphorus levels was not significant.

Significant dry matter accumulation by plants was because of more number of shoots ($m^{-2}$). Healthy shoots due to higher nutrients absorption capacity, more number of spikes bearing shoots due to less mortality resulted higher dry matter production. Minimum dry matter accumulation 100.97 (g $m^{-2}$) recorded with variety HUW-234 at 30 days after sowing to harvest stage. However, which reflected due to less number of spikes bearing shoots $m^{-2}$ row length resulted less dry matter production. Similar findings were reported by Singh (1998) [10] and Sardana *et al.* (1999) [9].

The various doses of phosphorus consistently affected the dry matter accumulation (Table 1). The maximum dry matter accumulation was obtained under 90 kg $P_2O_5$ $ha^{-1}$ and at par with 60 kg $P_2O_5$ $ha^{-1}$ while, it was found significantly superior over 0 and 30 kg $P_2O_5$ $ha^{-1}$. This might be due to increased plant height, number of shoots and increased in nutrient absorption through effective roots system cause efficient utilization of applied phosphorus. All these in turn, resulted for increase in photosynthetic activity of the crop which possibly resulted in higher dry matter accumulation. The lowest dry matter was accumulated under 0 kg $P_2O_5$ $ha^{-1}$ at all the growth stages might be due to poor nutrient supply which resulted in reduced absorption from the soil and led to decline in photosynthetic activity which ultimately reflected lowest dry matter accumulation. Beneficial effect of higher doses of phosphorus was also supported by Regmi *et al.* (1985) [7] and Singh (1980) [11].

**Yield**

**Grain yield (q $ha^{-1}$)**

The perusal of data are presented in Table 1 and revealed that the grain yield had significant effect by varieties and phosphorus levels. The highest grain yield of 35.10 q $ha^{-1}$ was obtained with DBW-14 which was at par with NW-2036 and significantly superior to other varieties. However, the lowest grain yield was recorded with HUW-234.

Phosphorus levels had significant effect on the grain yield. The maximum grain yield was obtained of 35.50 q $ha^{-1}$ with 90 kg $P_2O_5$ $ha^{-1}$ which was significantly superior to 0 kg $P_2O_5$ $ha^{-1}$ and 30 kg $P_2O_5$ $ha^{-1}$. However, the lowest grain yield was recorded with 0 kg $P_2O_5$ $ha^{-1}$, which was at par with 60 kg $P_2O_5$ $ha^{-1}$. The interaction between variety and phosphorus levels did not influence grain yield significantly.

The grain yield obtained under the variety DBW-14 and phosphorus level 90 kg $P_2O_5$ $ha^{-1}$ was higher by 17.79% and 24.56% over the variety HUW-234 and phosphorus level 0 kg $P_2O_5$ $ha^{-1}$.

The highest grain yield was credited to variety DBW-14 followed by variety NW-2036 (Table 1). The reason behind this may be because of good plant stand, more number of spike bearing shoots, long spike head and more number of grains $spike^{-1}$ with more test weight. Minimum grain yield recorded with variety HUW-234, might be due to less number of spike bearing shoots, small spike head and less number of grains $spike^{-1}$ and poor grain development. The results obtained in the present investigation in accordance with those obtained by Singh (1998) [10] and Sardana *et al.* (1999) [9]. The varieties did not differ significantly in harvest index.

Varying doses of phosphorus had significant effect on the yield (Table 1). The higher grain yield were obtained with the application of 90 kg $P_2O_5$ $ha^{-1}$ followed by 60 kg $P_2O_5$ $ha^{-1}$. The magnitude of difference was computed to the tune of 10%. Higher yield was weighed with the higher phosphorus levels might be due to adequate nutrient availability which contributed to increased dry matter accumulation, higher yield attributes and thus led to the higher yield under the treatment. Productivity of a crop is collectively determined by vigour of the vegetative growth and yield attributes. Better, vegetative growth coupled with higher yield attributes resulted in grain yield. Reduced phosphorus dose of 0 kg $ha^{-1}$ produced lowest yield due to poor growth, metabolic process and yield attributes. Similar findings were reported by Rai *et al.* (1982) [6]; Sandhu *et al*. (1985) [8] and Nitis (1987) [3].

**References**

1. Brijkishor. To assess the performance of newly developed strains of wheat under zero tillage condition with varying nitrogen levels. M.Sc. (Ag.) thesis submitted to N.D.U.A & T., Kumarganj, Faizabad, 1998.
2. Deshmukh SC, Rathore AZ, Sinha NK. Efficiency of split application of nitrogen and phosphorus in irrigated wheat. Crop Res. 1994; 8(3):493-498.

3. Nitis IT. Fertilizers application to winter wheat with different sowing dates. Agrokhimiya, 1987; 4:46-50.
4. Patel NM, Patel RB, Patel KK. Response of wheat varieties to nitrogen and phosphorus. Indian J Agron. 1991; 36(4):255-256.
5. Patel NM, Patel RB, Patel KK. Response of wheat (*Triticum aestivum* L.) varieties & nitrogen & phosphorus. Indian J Agron. 1991; 35(3):302-303.
6. Rai RK, Sinha MN, Singh M. Studies on direct & residual effect of P on growth & yield of maize & wheat sequences. Indian J Agron. 1982; 27(4):354-362.
7. Regmi KR, Sharma, Pal M. Dry matter accumulation & nutrients uptake in wheat as influenced by cluster bean residual & direct fertilization of wheat. Indian J Agron. 1985; 30(2):254-256.
8. Sandhu HS, Brar SS, Gogoi NN, Singh G. Phosphorus needs of wheat sown on different dates & after different kharif. Crops J Res. P.A.U. 1985; 22(2):206-212.
9. Sardana V, Sharma SK, Randhawa AS. Performance of wheat cultivars under different sowing dates and levels of nitrogen under rainfed conditions. Ann. Agri. Res. 1999; 20(1):60-63.
10. Singh B. To assess the performance of new wheat varieties under late-sown condition with different nitrogen levels. M.Sc. (Ag) thesis submitted to N.D.U.A.&T., Kumarganj, Faizabad, 1998.
11. Singh RP. Effect of dry accumulation on grain yield of wheat due to time of N & P application. Indian J Agron. 1980; 25(2):166-168.
12. Singh Virendra, Prasad K. Response of wheat varieties to phosphorus under delayed conditions. Haryana J Agron. 1996; 12:64-65.
13.