

EFFECT OF PHOSPHORUS ON THE YIELD AND YIELD COMPONENTS OF WHEAT VARIETY "INQLAB-91" UNDER RAINFED CONDITIONS

SHUAIB KALEEM*, MUHAMMAD ANSAR*, MUHAMMAD ANJUM ALI**, AHMAD SHER*, GHULAM AHMAD* and MUHAMMAD RASHID*

* Pir Mehr Ali Shah, Arid Agriculture University Rawalpindi, Pakistan

** Directorate General of Agriculture (Extension and Adaptive Research) Punjab, Lahore, Pakistan

ABSTRACT

A field experiment to determine the judicious use of phosphorus was conducted at Adaptive Research Farm, Dera Ghazi Khan (D.G. Khan) during winter 2001-02 to find out the effect of best phosphorus level on wheat variety Inqlab-91. Five different phosphatic fertilizer levels i.e. 32, 42, 84, 96 and 128 kg P ha⁻¹ keeping 128 kg N ha⁻¹ constant, were studied in randomized complete block design to evaluate their effect on germination count per unit area, number of fertile tillers m⁻², 1000 grain weight, number of grains spike⁻¹ and grain yield ha⁻¹ of the crop. The results showed that maximum wheat yield of 3557 kg ha⁻¹ was obtained in the plots where NP ratio was 1:1 i.e. 128-128 kg ha⁻¹ indicating importance of phosphorus at its highest dose in achieving maximum wheat productivity. Maximum germination count and fertile tillers m⁻² were obtained in plots treated with NP 128-84 kg ha⁻¹ indicates that at germination stage seed uses its internal resources and does not depend largely upon external material. Similarly, maximum dose of phosphorus combined with fix N, yielded maximum number of grains spike⁻¹ i.e. 26 in plots treated with 128-128 kg NP ha⁻¹. Maximum phosphorus dose contributed in achieving highest 1000 grain weight and finally resulted in statistically significant grain yield ha⁻¹. These findings indicate that application of the highest dose of phosphorus in combination with fix nitrogen, i.e. in 1:1 ratio contributed maximum to translocate dry matter and physiological attributes towards the yield attributes in wheat variety, Inqlab-91 and therefore maximum phosphorus dose helped in achieving highest number of grains spike⁻¹, 1000 grain weight and ultimately wheat yield.

Key Words: Wheat, *Triticum aestivum*, Phosphorus fertilizer, Yield and yield components, Rainfed conditions.

Citation: Kaleem, S., M. Ansar, M.A. Ali and M. Rashid. 2009. Effect of phosphorus on the yield and yield components of wheat variety "Inqlab-91" under rainfed conditions. Sarhad J. Agric. 25(1): 21-24.

INTRODUCTION

Fertilizer is the most important input which contributes significantly towards final grain yield of wheat and to exploit the inherited potential of a cultivar. Phosphorus is an essential nutrient for plant growth and development. Nitrogen affects the vegetative as well as quality yield whereas phosphorus plays a fundamental role in metabolism and energy producing reaction and can withstand the adverse environmental effects, thus causing boost in yield (Azink and Kajfez, 1983). Phosphorus is also essential for cellular respiration, metabolism of starch and fats which has been investigated by many researchers. Appropriate and balanced fertilization on wheat and rice not only causes yield enhancement but also has good impact on phosphorus uptake by these crop plants (Rehman *et al.* 2006). Field studies conducted to determine the critical levels of phosphorus application in rainfed wheat along with basal dose of N and K has showed that the critical levels of P for 95 percent yield for wheat grain and straw were 105 and 104 mg kg⁻¹ soil, respectively (Yousaf, 2004) which clearly indicates that our soils are deficient in P.

Wheat is the most important and widely cultivated crop of the entire world. It is principal food of human beings and Pakistan is one of the important wheat producing countries in the world. Wheat responds well to fertilizer application with balance N:P ratio for increased wheat productivity (David *et al.*, 2003 and Blaga *et al.*, 1989). This crop is a vital food commodity of Pakistan in the sense that its demand is increasing day by day as mouths to be fed are also increasing. Fertilizers especially N and P increased percent yield of wheat in Malakand Division with the increasing rates of phosphorus (P₂O₅) from 0, 30, 60 and 120 kg ha⁻¹ along with the basal dose of N i.e. 120 kg ha⁻¹ and K i.e. 60 kg ha⁻¹ (Rehman *et al.*, 1992). Alam *et al.* (2003) has shown that the application of phosphorus fertilizer (SSP) to wheat crop has significantly increased the plant height, number of tillers plant⁻¹, straw and grain yield as well as P-uptake in grain over control.

Keeping in view the beneficial effect of phosphorus on yield and yield attributes of wheat crop, the present study was conducted to find out the most appropriate level of phosphorus fertilizer with constant nitrogen application for obtaining maximum wheat yield under the agro-climatic conditions of D. G. Khan.

MATERIALS AND METHODS

The studies were conducted on a well drained medium land at Adaptive Research Farm, D. G. Khan during Rabi 2001-02. Experiment was conducted on a sandy clay loam soil having phosphorus level of 6.48 mg kg^{-1} and potash level of 172 mg kg^{-1} . Total rainfall from November 2001 to April 2002 was 46 mm. The mean monthly maximum and minimum temperatures were 25.5 and 14.6°C respectively during the crop growth period. The trial was laid out in randomized complete block design (RCBD) having three replications. Good quality seed of variety Inqilab-91 @ 125 kg ha^{-1} was broadcast keeping plot size of $12.2 \text{ m} \times 26.0 \text{ m}$. The whole of the P in the form of single super phosphate (SSP) @ of 32, 42, 84, 96 and 128 kg ha^{-1} , with constant rate of nitrogen in the form of urea @ 128 kg ha^{-1} was broadcast and incorporated into the soil during land preparation. All other agronomic practices were kept normal and uniform. Crop was harvested on 20-04-2002. The respective data were analyzed statistically by using Fishers Analysis of Variance Techniques and compared the difference of means by using Duncan's New Multiple Range Test at 5% level of probability (James *et al.*, 1997). Mean monthly rainfall (mm) and temperature ($^\circ\text{C}$) data recorded during the crop growth period is presented in Fig. 1.

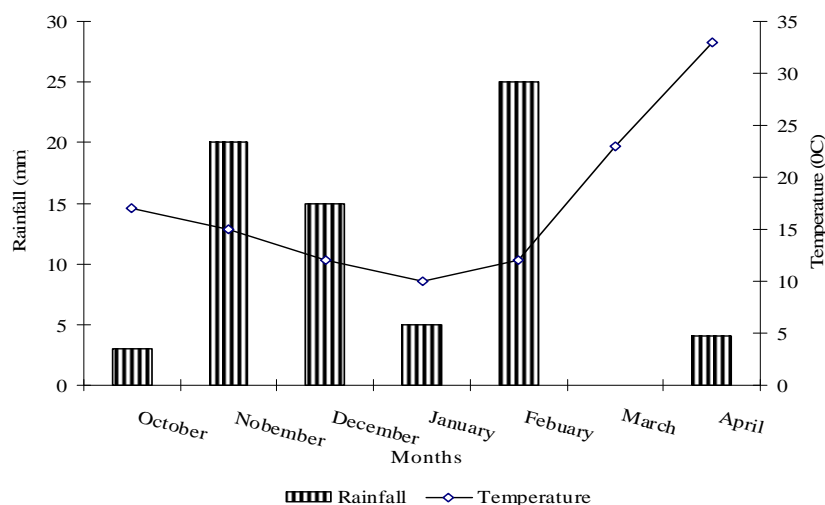


Fig.1. Mean rainfall and temperature prevailed during crop growth period

Following plant parameters were recorded during the course of study;

- i. Germination count m^{-2}
- ii. Number of productive tillers m^{-2}
- iii. Number of grains spike⁻¹
- iv. 1000 grain weight (g)
- v. Grain yield (kg ha^{-1})

Germination Count m^{-2}

Seedlings were counted 30 days after the sowing when germination was completed from the tagged area of one meter square randomly selected at three locations in each plot and then average was worked out.

Number of Productive Tillers m^{-2}

At the physiological maturity, total number of productive tillers m^{-2} were counted randomly, selected at three locations in each plot and then average was calculated.

Number of Grains Spike⁻¹

Ten spikes were selected randomly from each plot and grains spike⁻¹ were counted. The values were averaged to obtain the mean value.

Thousand Grain Weight (g)

A sample of 1000 seeds was taken randomly from the total seed lot of each plot and then weighed using the triple beam balance.

Grain Yield (kg ha⁻¹)

Grain yield was recorded by harvesting 2m² per plot. Grains were threshed and weighed manually. Grain yield was then converted to get the final grain yield in Kg ha⁻¹.

RESULTS AND DISCUSSION**Germination Count m⁻²**

It is evident from the table that germination count m⁻² was not affected significantly by any of the fertilizer treatment. Maximum germination count m⁻² was recorded in treatment where NP was applied at the rate of 128-84 kg ha⁻¹ (1.5:1), whereas minimum count was recorded in treatment where NP dose was 128-96 kg ha⁻¹. This indicates that during germination seed did not depend upon the external nutrition much and used their own reserved food materials.

Fertile Tillers m⁻²

Data showed non significant differences among treatment means regarding fertile tillers m⁻². Maximum fertile tillers (328 m⁻²) were achieved in treatment where 128-84 NP kg ha⁻¹ was applied followed by 319.50 tillers m⁻² in T₅ (128-128 NP kg ha⁻¹). It was depicted from the results that NP up to a certain level increased fertile tillers m⁻² but beyond the level of NP ratio (128:84 NP kg ha⁻¹), fertile tillers m⁻² were decreased. Similarly, minimum fertile tillers m⁻² i.e. 292.50 were achieved in T₁ where NP 128-32 (4:1) kg ha⁻¹ was applied. Alam *et al.*, (2003) found that with the increase of single super phosphate (SSP) level from 0, to 150 mg P kg⁻¹ of soil significantly increased the number of tillers plant⁻¹ and grain yield over control treatment.

Number of Grains Spike⁻¹

Highest dose of phosphorus application 128-128 NP kg ha⁻¹ (1:1) produced maximum number of grains per spike (26.00) as against minimum count of 22.50 under phosphorus dose of 84 kg ha⁻¹. The results showed very clear impact of phosphorus fertilizer applied at the time of sowing on the number of grains spike⁻¹ leading towards increased wheat yield. The results also depicted that balance ratio of NP is essential to obtain higher yield of wheat against the common farmer's practice in the area who do not bother to keep in mind the balance of different fertilizers at the time of sowing.

Thousand Grains Weight

Maximum 1000 grain weight (44.00g) was obtained in plots treated with NP at 128-128 kg ha⁻¹ as against the minimum (40.03 g) in treatment where NP rate was 128-32 kg ha⁻¹. Rest of the treatments fall in between them. It is clear from the results that increasing the ratio of NP also increased in 1000 grain weight. These results are similar to findings of Brennan (1992) and Samad (1984) who reported that maximum NP fertilizer utilization recorded the highest yield effects due to maximum accumulation of photosynthates.

Grains Yield

Fertilizer treatment, showed significant difference for grain yield of wheat. Highest grain yield of 3557.50 kg ha⁻¹ was obtained in plots treated with NP @ 128-128 kg ha⁻¹ (1:1) as compared to minimum yield of 3142.15 kg ha⁻¹ in treatment where NP dose was 128-32 kg ha⁻¹ (4:1) ratio. These results are in confirmation with the findings of Islam and Baten (1987) and Petal *et al.* (1991) who recorded maximum yield by the application of appropriate NP ratios, which was reduced in treatments receiving NP in inappropriate ratios. This could be the result of reduced plant senescence rate at the grain filling stage and longer duration of green leaf area duration with the application of

phosphorus as observed by Colomb *et al.* (2000). These results do not agree with the findings of Kulhare *et al.* (1991) who studied NP doses effect on late sown wheat crop and reported that increase in NP rate, does not increased wheat yield.

Table. Mean yield and yield components of wheat variety Inqlab-91 as affected by different levels of phosphorus

Treatments	NP Kg ha ⁻¹	Germination Count m ⁻²	Fertile Tillers m ⁻²	Grains per spike	1000 grains wt. (g)	Yield (kg ha ⁻¹)
T1	128-32	148.50	292.50	24.00	40.03	3142 c
T2	128-42	156.00	304.00	25.50	40.78	3286 b
T3	128-84	176.50	328.00	22.50	42.49	3251 b
T4	128-96	155.00	302.50	25.50	40.31	3204 b
T5	128-128	162.50	319.50	26.00	44.03	3558 a
		NS	NS	NS	NS	

NS=Non significant, means having the same letters do not differ significantly at 5% level of significance.

CONCLUSION

From the results of the study, it is evident that increase in phosphorus level increased the germination count and number of fertile tillers m⁻² up to certain level (84 kg ha⁻¹) but further increase in P failed to contribute further towards both the said yield components. However the rest of yield components i.e. number of grains spike⁻¹ and thousand grain weight increased with the increase of phosphorus fertilizer level. (128 kg ha⁻¹) and thus contributed toward the final grain yield of wheat variety Inqlab-91 under the rainfed condition of D. G. Khan.

REFERENCES

- Alam, S. M., S. Azam, S. Ali and M. Iqbal. 2003. Wheat yield and P fertilizer efficiency as influenced by rate and integrated use of chemical and organic fertilizers. Pak. J. Soil Sci. 22(2): 72-76.
- Azink, M. and L. Kajfez. 1983. A nine year fertilizer experiments in maize. Kmetystvo, 39 7-21 (Field Crop Absts, 38 (3): 1101; 1985).
- Bлага, G. V. Micalus and T. Lechintan. 1989. Investigations on the effect of organic and minerals fertilizers on yield of maize and oats grown at sterile waste dumps. Buletinul Institutului Agronomic Cluj Napoca Seria Agric. Romania, 43: 5-9 (Field Crop Absts, 43 (11): 7715:1990).
- Brennan, R. F. 1992. Effect of super Phosphate and N on yield of wheat. Fert. Res. 31(1): 43-49 (Field Crop Absts, 46 (3): 1991-1993 Soil and Fert. 56 (5):5188:1993).
- Colomb, B., J. R. Kiniry and P. Deback. 2000. Effect of soil phosphorus on leaf development and senescence dynamics of field grown maize. Agron. J. 92: 428-435.
- David, H., A. Speirs, P. Flavel, K. Motley and C. Dyson. 2003. Phosphorus-yield in wheat, canola and field peas grown at different soil P and levels. Austr. J. Agron. 20: 1-6.
- Islam, M. A. and M. A. Baten. 1987. Growth and yield of wheat as affected by different levels of N and P. Thai J. Agric. Sci. 20 (3) Absts. 42(6): 3886:1989).
- James T. M., H. D. Frank and S. Terry. 1997. Statistics. 7th Ed. Prentice-Hall, Int. Inc. Co. New Jersey. pp. 429-443.
- Kulhare, P. S., K. K. Agarwal and S. K. Padihar. 1991. Response of N. P. and Zn by late sown wheat in deep vertisoles. Curreny Res. Univ. Agric. Sci. Banglor. 20 (10): 217-218 (Field Crop Absts., 45(7): 4143:1993).
- Patel, N. M., R. B. Patel and K. K. Patel. 1991. Response of wheat varieties to N and P. Ind. J. Agron. 36: 255-256. (Field Crop Absts. 46(9): 5450:1993)
- Rehman, H., A. Ghani. G. A. Shah and J. Khan. 1992. Relating soil test values of NaHCO₃ extractable phosphorus with yield of wheat and rice. Proc. Symposium on the "Role of Phosphorus in Crop Production. July 15-17, Islamabad. NFDC, Islamabad. pp. 331-344.
- Rehman, O., M. A. Zaka, H. U. Rafa and N. M. Hassan. 2006. Effect of balanced fertilization on yield and phosphorus uptake in what-rice rotation. J. Agric. Res. 44 (2): 105-113.
- Smad, A. 1984. Developing a co-efficient of cost benefit ratio for wheat on fertilizer receptive soils. M.Sc Thesis, Agron. Deptt. Univ. of Agric. Faisalabad.
- Yousaf, M. 2004. Application of Langmuir adsorption isotherm to describe phosphorus adsorption in arid lands soils. PJAA. 7(1): 43-47.