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Effect of enhanced doses of phosphorous and zinc fertilizers over recommended doses of fertilizers (RDF) on grain yield and its attributes in wheat (*Triticum durum* L.)

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Abstract
The present investigation entitled "Effect of enhanced doses of Phosphorous and Zinc fertilizers over recommended doses of fertilizers (RDF) on grain yield and its attributes in wheat (*Triticum durum* L.) was conducted at field research farm of Department of Agriculture, MM(DU), Mullana, Ambala, Haryana during winter season of 2023. The field experiment was laid out in a Factorial Randomized Block Design (FRBD) with three replications and four treatments applied to three durum wheat varieties WHD 943, WHD 965 and WHD 948. The treatments were control (T_1), (T_2) 100% RDF (recommended doses of fertilizers) i.e., Nitrogen-150 kg/ha through Urea (50% basal dose + urea 25% at after 25 days of sowing + 25% at pre flowering), Phosphorous-60 kg/ha through SSP (100% basal dose), Potassium- 60 kg/ha through Muriate of Potash (100% as basal dose) and $ZnSo_4$-25 kg/ha, (T_3) 25% higher $ZnSo_4$ + RDF, (T_4) 25% higher P_2O_5 + RDF. The data were recorded on plant growth parameters, grain yield and its components namely plant height, dry weight accumulation per meter row length, total no. of tillers running per meter row length, number of spikes per meter row length, number of grains per spike, test weight, grain yield, straw yield and biological yield. Indices namely harvest index, cost of cultivation, gross return, net returns and benefit cost ratio were computed. The comparative evaluation of various treatments revealed that 25% enhanced doses of Phosphatic and Zinc fertilizers gave good response and higher yield as compared to RDF. The increase in yield due to application of 25% higher phosphorous (46.3 q/ha) as well as zinc (42.4 q/ha) was significantly higher over RDF (39.0 q/ha) and control (27.6 q/ha). Treatments T_4 showed highest gross returns (Rs. 139970/ha) and net returns (Rs. 73152.44/ha) as well as higher benefit cost ratio (2.09).

Keywords: Wheat, *Triticum durum*, grain yield, phosphorous, zinc

Introduction
Among cereals, durum wheat (*Triticum durum* L.) is globally grown as most important cereal crop. It is grown in varied climatic conditions worldwide, with a recorded production of 40 million tonnes globally. As per estimates of International Grains council IGC 2023-24, it is expected to attain durum wheat production ranging from 3.0 million to 2.295 tonne during the year 2023/24. India's wheat production area was 304.69 lakh hectares in 2021–2022, with average yield 3507 kg/ha and total production 106.84 million tonnes (GOI annual report, 2022–2023) [5]. India contributes approximately 12% of the total wheat production of world. In Haryana, wheat is cultivated on 2533 thousand hectare with 11876 thousand tones production with average grain yield productivity 4678 kg/ha (Swati, 2024) [16].

Durum wheat is preferred by the farmers for cultivation for high profitability especially in those areas where governmental subsidies on other crops are non existing and as long as the market trends are favourable for high profit. Cultivation of durum wheat is suited in the dry and hot condition of peninsular and central India, including Gujarat, Maharashtra, Karnataka, Madhya Pradesh, and Southern Rajasthan. The durum wheat is derived from Latin which means hard. It is the hardest species among cereals especially wheat. Durum or macaroni wheat is called as Malvi gehu in India as its highest cultivation is in Malva of MP.

In many ecosystems globally, insufficient phosphorus availability is one of the most important yield-limiting variables. Consequently, large amounts of phosphate based fertilizer are commonly required for sustaining crop production (Gadaleta *et al.* 2022) [8]. Plant nutrients like nitrogen, phosphorous and potassium are predominantly macronutrients which are taken up by plants in higher quantities. Among these, nitrogen is an essential nutrient required by the crop for higher vegetative growth and reproduction which determines the productivity and quality of grains. Balanced and appropriate doses of fertilizers providing macronutrients are needed for sustainable production of durum wheat. Akhtar *et al.* (2022) [3] reported that the nitrogen application at the rate of 100 kg/ha showed good result in terms of grain yield and quality.

Phosphorous is known to be helpful in enhancing tillering and plant growth. It also promotes growth and development of roots and metabolic activities in protein synthesis. The amount of P taken from crops must be replaced through application of P fertilizer or manure to maintain the P balance in the soil (Gadaleta *et al.* 2022) [8]. Ali and Kumar *et al.* (2015) [1] recorded beneficial effects of higher doses of potassium on attributes of plant growth and grain yield. They suggested that potassium plays an important role in determining higher grain and straw yield. Gu *et al.* (2021) [7] observed significant positive effects of potassium on grain yield and quality in wheat. Messaoudi *et al.* (2023) [12] hypothesised that low to moderate potassium application is helpful in maintaining both yield and potassium uptake by durum wheat.

Among micronutrients, Zinc is considered to be most important as it affects many plant functions including germination, enhanced growth through activation of enzymes, regulation of enzyme activities during photosynthesis and the general development of plants (Bashir *et al.* 2023) [4].

Besides favourable effects on growth and development in wheat, zinc is found to be associated with storage proteins in wheat grains. It is integrated in gluten fractions and consequently it increases the extractable (SDS) polymeric proteins, reduces the yellow berry content thereby improving dough quality of durum wheat (Singh *et al.* 2013) [15].

Survey of literature reveals that higher doses of P, K and Zn over recommended dose of fertilizers (RDF) are beneficial as most wheat genotypes respond favourably to these additional doses. Therefore, present study is planned to investigate the "Effect of enhanced doses of phosphorus and Zinc fertilizers over RDF on grain yield and its attributes in wheat (*Triticum durum* L.)*"* with following objectives.

Objectives

1. To determine effects of enhanced doses of phosphatic and zinc fertilizers over RDF (recommended dose of fertilizer) on plant growth, grain and straw yield and their attributes.
2. To work out the economics of different fertilizer treatments.

Materials and Methods

he field experiment entitled "Effect of enhanced doses of phosphatic and zinc over RDF on grain yield and its attributes in wheat (*Triticum durum* L.)" was conducted at research farm of Department of Agriculture, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana through *Rabi* season of 2022-2023. Research farm of Department of Agriculture, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala is located at 300 17'0"N latitude, 7703'0"E. and at an altitude of 264 meters above average sea level. the soil was moderately alkaline, contained less organic matter, sandy soil, sandy loam in texture and had medium quantities of accessible phosphate. Factorial FRBD (Factorial Randomized Block Design) was used in the experiment. Three durum wheat varieties (WHD 943, WHD 965, and WHD 948) made up Factor A and four treatments made up Factor B. The treatments were control (T_1), (T_2) 100% RDF (recommended doses of fertilizers) i.e., Nitrogen-150 kg/ha through Urea (50% basal dose + urea 25% at after 25 days of sowing + 25% at pre flowering), Phosphorous-60 kg/ha through SSP (100% basal dose), Potassium- 60 kg/ha through Muriate of Potash (100% as basal dose) and $ZnSo_4$-25 kg/ha, (T_3) 25% higher $ZnSo_4$ + RDF, (T_4) 25% higher P_2O_5 + RDF. All investigational data (means) for different growth and yield contributing characters, grain, straw and biological yield were recorded and statistically analysed by means of the variances partition (ANOVA) method as stated by Panse and Sukhatme (1985) [13].

Results and Discussions

Growth parameters

The information about growth parameters is presented in Table 1. Among treatments, T_4 (25% higher P_2O_5 + RDF) observed the highest plant height (106.1cm), dry matter accumulation per meter row length (116.7g), total number of tillers per running meter row length (57.7) which was statistically higher than T_3 followed by T_2 and the lowest growth parameters were observed in T_1 control. Among varieties, WHD 943 recorded the highest plant height (104.2cm), dry matter accumulation per meter row length (247.4g), total number of tillers per running meter row length (60.9) followed by WHD 965 and the lowest was observed in WHD 948. The increased growth may be the result of more advantageous weather conditions, such as temperature, daylight hours, and rainfall. Increases in P and Zn fertilizer aid in the plant's improved vegetative development and raise the plant's parameter photosynthesis, cell division, elongation and turbidity (Jat *et al.* (2020) [9]. Application of Zn significantly increased Zn concentration in shoot (36.5%) over the control (Keshavarz *et al.* 2016) [10].

Yield and Yield contributing characters

The data regarding yield and yield attributes is presented in Table 2. Among treatments, T_4 (25% higher P_2O_5 + RDF) observed the highest total number of spikes per meter row length (76.5), number of grains per spike (45.0), 1000 grain weight (43.6g) and grain yield (46.3 q/ha), straw yield (57.4 q/ha), biological yield (104.0 q/ha), harvest index (44.4%) which was statistically higher than T3 followed by T2 and the lowest yield and yield attributes were observed in T1 control. Among varieties, WHD 943 recorded the highest total number of spikes per meter row length (68.5), number of grains per spike (42.1), 1000 grain weight (42.2g) and grain yield (43.1 q/ha), straw yield (57.4 q/ha), biological yield (100.5 q/ha), harvest index (42.7%) followed by WHD 965 and the lowest was observed in WHD 948. Increasing the phosphorous levels produced significantly higher number of grain per spike and test weight as compare to lower level. Similar finding were observed by Rahim *et al.* (2010) [14]. The highest grain yield due to 25% higher phosphorous fertilizer in addition to RDF was observed. This significant increase in grain yield may be due to increased biological yield. The increase in biological yield could be attributed to better source and sink relationships. In the control group, the plants' growth and development were hindered by an uneven absorption of critical nutrients, leading to low yield qualities and the lowest grain yield in the end. Similar findings were observed by Arif *et al.* (2017) [2].

Economics

The data regarding economics of wheat varieties affected by treatments and their interactions are reported in Table 3. Among treatments, T_4 (25% higher P_2O_5 + RDF) showed the highest cost of cultivation (66817.56 Rs/ha), gross return (139970 Rs/ha), net return (73152.44 Rs/ha) and benefit cost ratio (2.09) and the lowest was observed in T1 (control) where no fertilizer were used. Whining varieties, all three varieties had the same cost of cultivation (57300Rs/ha), the maximum gross return (132140 Rs/ha), net return (47110 Rs/ha) and benefit cost ratio (1.82) was observed in WHD 943 followed by WHD 965 and the lowest was observed in WHD 948. The highest gross return and net return was found in T_4 and the lowest in control. This collaborates the finding of Mishra *et al*. (2017) [11].

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Table 1: Effect of enhanced doses of phosphorous and zinc fertilizers over recommended dose of fertilizers (RDF) on growth parameters in wheat (*Triticum durum* L.)

Treatments	Plant Height (cm)				Dry matter accumulation per meter row length (g)				Number of tillers per running meter row length			
	30 DAS	60 DAS	90 DAS	At Harvest	30 DAS	60 DAS	90 DAS	At Harvest	30 DAS	60 DAS	90 DAS	At Harvest
Varieties												
V_1	20.1	42.8	95.6	104.2	9.0	63.0	111.7	247.4	22.5	35.2	64.0	60.9
V_2	19.3	41.9	93.0	101.8	8.3	61.1	109.5	242.7	21.6	39.9	57.9	54.0
V_3	18.4	40.6	95.6	98.0	9.0	59.4	111.7	231.4	20.4	41.7	43.8	40.4
SEm±	0.23	0.33	0.44	0.59	0.19	0.51	0.63	0.76	0.18	0.23	0.34	0.46
C.D at 5%	0.68	0.97	1.31	1.72	0.57	1.52	1.87	2.26	0.55	0.70	1.03	1.37
Fertility levels												
T_1	14.3	36.6	87.6	94.7	5.6	41.7	95.8	220.8	17.6	34.0	46.7	42.9
T_2	18.6	40.7	92.9	100.9	7.3	64.8	112.1	244.4	21.5	37.7	55.1	52.0
T_3	20.6	44.0	95.1	103.6	9.0	67.3	113.4	246.8	22.5	40.1	57.4	54.4
T_4	23.6	46.6	97.1	106.1	10.3	70.9	116.7	250.5	24.5	43.9	61.7	57.7
SEm±	0.26	0.38	0.51	0.68	0.22	0.59	0.73	0.88	0.21	0.27	0.40	0.53
C.D at 5%	0.78	1.12	1.51	2.01	0.66	1.75	2.16	2.61	0.63	0.81	1.19	1.58
V×F Interactions												
SEm±	0.46	0.66	0.89	1.18	0.39	1.03	1.26	1.53	0.37	0.47	0.69	0.93
C.D at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.06	2.74

Table 2: Effect of enhanced doses of phosphorous and zinc fertilizers over recommended dose of fertilizers (RDF) on yield attributes and yield in wheat (*Triticum durum* L.)

Treatments	Total number of spike per meter row length	Number of grains per spike	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvest index (%)
Varieties							
V_1-WHD943	68.5	42.1	42.2	43.1	57.4	100.5	42.7
V_2-WHD965	66.6	40.8	40.7	39.4	52.8	92.2	42.3
V_3-WHD948	65.0	39.3	39.8	33.9	46.1	80.0	41.7
SEm±	0.32	0.41	0.15	0.44	0.49	0.91	0.11
C.D at 5%	0.95	1.22	0.45	1.31	1.46	2.70	0.34
Fertility levels							
T_1	54.8	34.8	37.6	27.6	44.9	72.5	37.9
T_2	66.4	40.5	40.9	39.0	51.8	90.9	42.8
T_3	69.2	42.7	42.1	42.4	53.8	96.3	44.0
T_4	76.5	45.0	43.6	46.3	57.7	104.0	44.4
SEm±	0.37	0.48	0.17	0.51	0.57	1.05	0.13
C.D at 5%	1.10	1.41	0.53	1.51	1.68	3.11	0.39
V×F Interactions							
SEm±	0.64	0.83	0.31	0.89	0.98	1.82	0.23
C.D at 5%	NS	NS	0.91	2.62	2.92	5.39	NS

Table 3: Effect of enhanced doses of phosphorous and zinc fertilizers over recommended dose of fertilizers (RDF) on economics in wheat (*Triticum durum* L.)

Treatments	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Benefit: Cost ratio
Varieties				
V_1- WHD-943	57,300	132140	47,110	2.31
V_2- WHD-965	57,300	120960	63,660	2.11
V_3- WHD-948	57,300	104410	74,840	1.82
Fertility levels				
T_1- Control	57,300	88690	31390	1.55
T_2- 100% RDF	65917.56	119500	53582.44	1.81
T_3- 25% higher $ZnSo_4$ over RDF	65963.81	128660	62696.90	1.95
T_4- 25% higher P_2O_5 over RDF	66817.56	139970	73152.44	2.09

Conclusion

Therefore, from the result of the present investigation it is concluded that farmers may adopt 25% higher P and Zn application especially in calcareous soils of north east Haryana rich in carbonates and bicarbonates. Both P and Zn bind with Ca to form a complex and both these nutrients become non available. Therefore, in such soils application of higher doses of P and Zn may compensate some of the nutrients fixed in complex form and thus the crop may not manifest P and Zn deficiency. The economic analysis also confirms that application of higher doses of P and Zn are economically viable and farmers can follow recommendation of using 25% higher P and Zn over and above recommended doses of fertilizers.

Among varieties WHD 943 significantly out yielded other varieties WHD 965 and WHD 948 and recorded highest grain yield (43.1 q/ha), straw yield (57.5 q/ha), biological yield (100.5 q/ha) and harvest index as (42.7%). Hence, this variety can be recommended to farmers for cultivation of durum wheat.

References

1. Ali J, Kumar A, Chauhan TM. Productivity, nutrients uptake and economics of wheat (*Triticum aestivum*) under potassium and zinc nutrition. Indian Journal of Agriculture. 2015;60(3):426-430.
2. Arif M, Tasneem M, Anwar A. Evaluation of different levels of potassium and zinc fertilizer on the growth and yield of wheat. International Journal of Biosensors and Bioelectronics. 2017;3(2):1-5.
3. Akhtar N, Arshad M, Ahmad P. The impact of calcium, potassium, and boron application on the growth and yield characteristics of durum wheat under drought conditions. Agronomy. 2022;12(8):1917.
4. Bashir A, Alem A, Zaman U. Zinc and potassium fertilizer synergizes plant nutrient availability and affects growth, yield, and quality of wheat genotypes. Journal of Plants. 2023;12(12):2241.
5. Government of India. Annual report 2022-2023, Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare.
6. Giunta F, Mefleh M. Role of nitrogen uptake and grain number on the determination of grain nitrogen content in old durum wheat cultivars. Journal of Agronomy. 2021;11(1):42.
7. Gu X, Liu Y, Li N. Effect of the foliar application of Potassium fertilizer on the grain protein and dough quality of wheat. Journal of Agronomy. 2021;11(9):1749.
8. Gadaleta A, Lacolla G, Fortunato S. Durum wheat response to organic and mineral fertilization with application of different levels and types of phosphorus – based fertilizers. Agronomy. 2022;12(8):1861.
9. Jat A, Kumar S, Kumar R. Assessment of different levels of N P K and Zn on different growth parameters and yield of wheat (*Triticum aestivum* L). The Pharma Innovation Journal. 2020;9(2):423-426.
10. Keshavarz P, Forouhar M. Investigation of Zn use efficiency and Zn fertilization efficiency in some genotypes of wheat. Water and Soil. 2016;29(6):1711-1720.
11. Mishra S, Ali A. Response of late sown wheat to phosphorous and zinc nutrition in eastern Uttar Pradesh. Annals of Plants and Soil Research. 2017;19(1):23-28.
12. Messaoudi A, Latati M. Investigating the potassium fertilization effect on morphological and agro-physiological indicators of durum wheat under mediterranean rain-fed conditions. Journal of Agriculture. 2023;13(6):114.
13. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Indian Council of Agricultural Research Publication. 1985:87-89.
14. Rahim A, Ranjah AM. Effect of phosphorous application and irrigation scheduling on wheat yield and phosphorous use efficiency. Soil Environment. 2010;29:15-22.
15. Singh A, Shivay YS. Residual effect of summer green manure crops and Zn fertilization on quality and Zn concentration of durum wheat (Triticum durum) under a basmati rice-durum cropping system. International Journal for Sustainable Production Systems. 2013;29:271-287.
16. Swati. An assessment of wheat crop in Haryana. International Journal for Multidisciplinary Research. 2024;6(1).