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Assessment of yield and quality parameters of irrigated wheat under soil and foliar application of nutrients

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ABSTRACT

The present experiment was conducted during the *Rabi* –2020-21 at experimental Farm, Faculty of Agricultural Sciences, ITM University, Gwalior Madhya Pradesh to evaluated the combined effect of soil and foliar applications of nutrients on the growth, yield, protein content and its economics in wheat (Variety, RVW-4106).The experiment was laid out in Randomized Block Design (RBD) having three replications. The experiment consisted of eight treatment *viz.* T_1 :Control, T_2 : RDF(120 : 60 : 40 kg NPK ha^{-1}), T_3 : 50% RDF + foliar spray of 19:19:19 (1%) at 40 & 75 DAS, T_4 : 75% RDF + foliar spray of 19:19:19 (1%) at 40 & 75 DAS, T_5 : 50% RDF + foliar spray of 19:19:19 (1%) + $ZnSO_4$ (0.5%) at 40 & 75 DAS, T_6 : 75% RDF+ foliar spray of 19:19:19 (1%) + $ZnSO_4$ (0.5%) at 40 & 75 DAS, T_7 : RDF+ foliar spray of $ZnSO_4$ (0.5%) at 40 & 75 DAS and T_8 : RDF + foliar spray of $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5%) at 40 & 75 DAS. The findings of the present study indicated that foliar application of either $ZnSO_4$ or $ZnSO_4$ + $FeSO_4$ at 40 & 75 DAS with RDF recorded significantly higher growth and yield attributes characters of wheat as compared to alone RDF which was comparable to 75% RDF+ foliar spray of 19:19:19 + $ZnSO_4$ and 75% RDF+ foliar spray of 19:19:19 treatment. The maximum grain yield (44.00 q ha^{-1}) recorded with treatment T_8 (RDF + foliar spray of $ZnSO_4$ + $FeSO_4$) closely followed by T_7 (RDF+ foliar spray of $ZnSO_4$) and T_6 (75% RDF+ foliar spray of 19:19:19 + $ZnSO_4$) treatments with 43.52 and 42.57 q ha^{-1} grain yield. Whereas, The maximum net return of Rs. 69746 ha^{-1} was recorded under T_7 (RDF+ 0.5% foliar spray of $ZnSO_4$) followed by T_8 (RDF + foliar spray of $ZnSO_4$ + $FeSO_4$) with Rs. 68908 ha^{-1}The maximum benefit cost ratio of 3.10 was recorded with T_7 ((RDF+ 0.5% foliar spray of $ZnSO_4$) treatment followed by T_6 (75% RDF+ foliar spray of 19:19:19 + $ZnSO_4$) with B:C ratio of 3.09.

Figure : 00 References : 16 Tables : 03
KEY WORDS : Foliar spray of $ZnSO_4$, RDF, Wheat

Introduction

Wheat (*Triticum aestivum*) is the second most important staple food crop of the world after rice and cultivated in almost all countries. In India, it is one of the most important staple food crops and occupies a notable position among the food grain crops not only in area and production but also in its versatility in adaptation to a wide range of agro-climatic conditions. It grown in diverse agro-climatic conditions from 11°N- 35°N latitude and 72°E-92°E longitudes. Its productivity has played a key role in making the country self-sufficient in food grain. This crop occupies an area of about 30.0 million hectare with total production of 98.6million tonnes and a productivity of 2.89 tonnes/ha during 2018-19 which share about 12.72% of total production of the world[3] .

The main causes of low productivity are prevailing abiotic stresses like drought, poor soil fertility, high soil pH and high temperature. These factors limit the uptake of applied nutrients by roots and also do not able to turn over the nutrients commensurate with crop nutritional requirement at different growth stages. Balanced nutrition played an imported role in boosting the productivity of crops. Soil application is most common method to supply essential nutrients to plant. However, foliar spray of one or more nutrients to supplement soil application of fertilizers is gaining more attention in recent years to overcome the problem of low fertilizer nutrient supply from soil to plant[16].

Supplemental foliar nutrition of nutrients is more advantageous than soil application due to better translocation from the leaves to the developing seeds and efficient utilization of nutrients. Recently, new generation water soluble fertilizers have been introduced specially for foliar sprays. NPK 19:19:19 fertilizer is available as hundred percent water soluble complete fertilizer containing nitrogen, phosphorus and potassium each 19 per cent with low salt index and its foliar fertilizers can provide the plant nutrient at critical stages of plant growth where the nutrient requirement of plant exceeds the normal uptake for certain nutrients[4] . As macro and micro-nutrients

TABLE-1: Effect of different treatments on growth and yield attributed characters of wheat

Treatments	Plant height (cm)	Number tillers of plant^{-1}	Spike Length (cm)	Number of grains spike^{-1}	Test weight (g)
T_1 : Control	80.42	12.69	8.03	32.12	37.13
T_2 : RDF (120 : 60 : 40 kg NPK ha^{-1})	101.66	17.94	10.50	42.89	41.69
T_3 : 50% RDF + foliar spray of 19:19:19 at 40 & 75 DAS	93.03	16.07	9.66	36.38	38.31
T_4 : 75% RDF + foliar spray of 19:19:19 at 40 & 75 DAS	100.90	17.59	10.41	39.73	40.55
T_5 : 50% RDF + foliar spray of 19:19:19 + $ZnSO_4$ at 40 & 75 DAS	97.13	17.29	10.18	39.51	41.64
T_6 : 75% RDF+ foliar spray of 19:19:19 + $ZnSO_4$ at 40 & 75 DAS	104.55	18.43	10.78	40.41	41.68
T_7 : RDF+ foliar spray of $ZnSO_4$ at 40 & 75 DAS	108.17	19.16	10.91	42.11	42.78
T_8 : RDF + foliar spray of $ZnSO_4$ + $FeSO_4$ at 40 & 75 DAS	110.18	19.35	11.19	42.17	42.81
S.Em. (±)	2.04	0.44	0.17	1.01	0.63
C.D. at 5%	**5.98**	**1.29**	**0.49**	**2.95**	**1.84**

added to the soil, their availability will be affected by soil environmental factors. Foliar application techniques, as a particular way to supply macro and micro-nutrients could avoid these factors and results in rapid absorption[2]. In view of these facts; the present study was conducted.

Material and Methods

The present experiment was conducted during the *Rabi* – 2020-21 at experimental Farm, Faculty of Agricultural Sciences, ITM University, Gwalior Madhya Pradesh to evaluate the combined effect of soil and foliar applications of nutrients on the growth, yield and quality parameters of wheat (Variety, RVW-4106). The experiment was laid out in Randomized Block Design (RBD) having three replications. The experiment consisted of eight treatment viz. T_1 :Control, T_2 : RDF (120 : 60 : 40 kg NPK ha^{-1}), T_3 : 50% RDF + foliar spray of 19:19:19 (1%) at 40 & 75 DAS, T_4 : 75% RDF + foliar spray of 19:19:19 (1%) at 40 & 75 DAS, T_5 : 50% RDF + foliar spray of 19:19:19 (1%) + $ZnSO_4$ (0.5%) at 40 & 75 DAS, T_6 : 75% RDF+ foliar spray of 19:19:19 (1%) + $ZnSO_4$ (0.5%) at 40 & 75 DAS, T_7 : RDF+ foliar spray of $ZnSO_4$ (0.5%) at 40 & 75 DAS and T_8 : RDF + foliar spray of $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5%) at 40 & 75 DAS. The soil of the experimental site was Sandy Loam in texture, low in available nitrogen and medium in phosphorus and potash. The nitrogen, phosphorus and potassium were applied through urea, DAP and MOP. The full dose of phosphorus, potassium and half dose of nitrogen were given below the seed at the time of sowing as basal. Whereas, the remaining half dose of nitrogen was top-dressed after first irrigation. Foliar applications were applied @ 1% of 19:19:19 and 0.5% of $ZnSO_4$ + $FeSO_4$ at 40 & 75 DAS. All other agronomic practices except those under study were kept normal and uniform for all the treatments. All data related to growth and yield of wheat crop collected were statistically analysed by using the analysis of variance technique[6].

TABLE-2 : Effect of different treatments on yield and quality parameters of wheat

Treatments	Yield parameters		Quality parameters	
	Grain yield (q ha^{-1})	Harvest index (%)	Protein content (%)	Protein yield (q ha^{-1})
T_1 : Control	23.44	34.11	10.22	3.42
T_2 : RDF (120 : 60 : 40 kg NPK ha_{-1})	41.30	42.46	10.98	4.52
T_3 : 50% RDF + foliar spray of 19:19:19 at 40 & 75 DAS	38.78	42.13	10.83	4.20
T_4 : 75% RDF + foliar spray of 19:19:19 at 40 & 75 DAS	40.18	42.65	10.89	4.38
T_5 : 50% RDF + foliar spray of 19:19:19 + $ZnSO_4$ at 40 & 75 DAS	40.58	44.31	10.93	4.44
T_6 : 75% RDF+ foliar spray of 19:19:19 + $ZnSO_4$ at 40 & 75 DAS	42.57	44.39	11.13	4.74
T_7 : RDF+ foliar spray of $ZnSO_4$ at 40 & 75 DAS	43.92	44.93	11.43	5.03
T_8 : RDF + foliar spray of $ZnSO_4$ + $FeSO_4$ at 40 & 75 DAS	44.00	45.54	11.55	5.08
S. Em. (±)	0.92	0.67	0.23	0.17
C.D. at 5%	**2.70**	**1.96**	**0.68**	**0.50**

Result and Discussion

Growth and yield attributed characters

It is clear from results that all the growth parameters (*viz;* plant height, number of tillers per plant) were found to be influenced significantly due to different treatments of soil and foliar applications of nutrients at all growth stages. Maximum value of these growth parameters was recorded with treatment T_8 (RDF + foliar spray of $ZnSO_4$ + $FeSO_4$ at 40 & 75 DAS) which was at par with T_7 (RDF+ foliar spray of $ZnSO_4$ at 40 & 75 DAS) and T_6 (75% RDF+ foliar spray of 19:19:19 + $ZnSO_4$ at 40 & 75 DAS) . Similarly all the yield attributing parameters *viz;* number of spike per meter square, spike length, grains $spike^{-1}$, grain weight of spike (g) and the test weight were found significantly superior due to different treatments of soil and foliar applications of nutrients as compared to control. Maximum value was recorded with treatment T_8 which was at par with T_7 and T_6 treatments. It is evident from results that foliar application of 19:19:19 + $ZnSO_4$ with 75% RDF in soil applied produced similar yield attributing characters as equal to alone RDF treatments. On the other hand foliar application of either $ZnSO_4$ alone or with $FeSO_4$ combination with RDF recorded significantly higher yield attributing characters as compared to RDF alone treatment. The probable reason may be that adequate supply of all the nutrients, resulted in greater accumulation of carbohydrates, amino acids and their translocation to the productive organs, which, in-turn improved all the growth and yield attributing characters. Results confirm the earlier finding[5]. Workers[12] also reported marked increase in number of grains $spike^{-1}$ of wheat for foliar application Zn. The tendency of increasing number of grains ear^{-1} with Zn application was also in line with the

TABLE-3 : Economics of wheat as influenced by different treatments

Treatments	Economics					
	Cost of cultivation (Rs ha^{-1})			income - Rs ha^{-1}		B:C
	Common	Treatment	Total	Gross	Net	ratio
T_1 : Control	25950	0	25950	59878	33928	2.31
T_2 : RDF (120 : 60 : 40 kg NPK ha$_{-1}$)	25950	5928	31878	98359	66481	3.08
T_3 : 50% RDF + foliar spray of 19:19:19 at 40 & 75 DAS	25950	5264	31214	92572	61358	2.97
T_4 : 75% RDF + foliar spray of 19:19:19 at 40 & 75 DAS	25950	6746	32696	95562	62866	2.92
T_5 : 50% RDF + foliar spray of 19:19:19 + $ZnSO_4$ at 40 & 75 DAS	25950	4914	30864	95446	64582	3.07
T_6 : 75% RDF+ foliar spray of 19:19:19 + $ZnSO_4$ at 40 & 75 DAS	25950	6396	32346	100078	67732	3.09
T_7 : RDF+ foliar spray of $ZnSO_4$ at 40 & 75 DAS	25950	7228	33178	102894	69716	3.10
T_8 : RDF + foliar spray of $ZnSO_4$ + $FeSO_4$ at 40 & 75 DAS	25950	7828	33778	102686	68908	3.04

previous findings[7]. The combined application of soil and foliar applied NPK increased test weight over control and sole application of soil were also reported[9,14].

Yield and quality parameters

The results (Table-2) revealed that grain yield varied from 23.44 to 44.00 q ha^{-1} under different treatments and the magnitude of increase in yield due to various in organic fertilizers treatments was 65.4 to 87.7 percent over control treatment. The maximum grain yield (44.00 q ha^{-1}) recorded with treatment T_8 closely followed by T_7 and T_6 treatments with 43.52 and 42.57 q ha^{-1} grain yield. Minimum grain yield (23.44 q ha^{-1}) was observed in control treatment. The increase in grain yield with combined application of nutrients as soil and foliar application might be due to adequate quantities and balanced proportions of all the essential plant nutrients supplied to the crop as per need during the growth period resulting in favourable increase in yield attributing characters which ultimately led towards an increase in economic yield. Similar results were reported[1] in maize and in wheat[8]. Foliar application of either $ZnSO_4$ or combination of $ZnSO_4$ + $FeSO_4$ along with RDF increased the yield components due to foliar spray as it facilitates the higher photosynthetic translocation to sink by increasing the photosynthesizing area and its capacity of particular crop[15].

Under present study, protein content ranged from 10.22 to 11.57 percent under different treatments. Maximum value (11.57%) was observed with T_8 (RDF + foliar spray of $ZnSO_4$ + $FeSO_4$ at 40 & 75 DAS) which were statistically at par with all the treatments except T_3 and control treatments. It is clear from results (Table-2) that foliar application of $ZnSO_4$ produced more protein content and protein yield which applied in different RDF treatments. This might be due to that foliar applications of $ZnSO_4$ supplied Zn and increased N-metabolism, which enhanced accumulation of amino acids and drastically increased the rate of protein synthesis and consequently, protein content in grain. Foliar applications of $ZnSO_4$ increased Zn concentration in the plant which associated with RNA and ribosome induction the result of which

accelerates protein synthesis[13].

Economics

The results (Table-3) revealed that all foliar fertilized treatment exhibited significantly greater net returns over control. The maximum net return of Rs. 69746 ha^{-1} was recorded under T_7 (RDF+ 0.5% foliar spray of $ZnSO_4$ at 40 and 75 DAS) followed by T_8 (RDF + foliar spray of $ZnSO_4$ + $FeSO_4$ at 40 & 75 DAS) with Rs. 68908 ha^{-1} and minimum (Rs. 33928 ha^{-1}) under control. This increase was due to significantly higher value of grain and straw yield as compared to cost of cultivation of concerning treatment. The results were supported[11]. The maximum benefit cost ratio of 3.10 was recorded with T_7 ((RDF+ 0.5% foliar spray of $ZnSO_4$ at 40 and 75 DAS) treatment followed by T_6 (75% RDF+ foliar spray of 19:19:19 (1%) + $ZnSO_4$ (0.5%) at 40 & 75 DAS) with B:C ratio of 3.09. Minimum B: C ratio (2.31) was obtained in control treatment. Overall B:C ratio were also found higher in foliar applied treatment over local check which clearly indicates that foliar application of water soluble NPK in wheat might be economically feasible and profitable techniques. Earlier investigator[10] reported NPK 19:19:19 to be economical in wheat crop at farmer's fields in Rajasthan.

Conclusion and Recommendation

From the present study it can be concluded, that application of 100% RDF (120: 60:40 kg ha^{-1}) along with 0.5% foliar spray of $ZnSO_4$ at 40 and 75 DAS produced higher growth and economic yield of wheat. This treatment gave higher net returns and benefit cost ratio in wheat under sandy loam soils of Northern Madhya Pradesh.

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