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Ram Bharose
Krishi Vigyan Kendra, Shravasti, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

SP Singh
Krishi Vigyan Kendra, Shravasti, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

APS Dohare
Krishi Vigyan Kendra, Shravasti, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Sanjeev Kumar
Krishi Vigyan Kendra, Shravasti, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Umesh Babu
Krishi Vigyan Kendra, Shravasti, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Corresponding Author:
APS Dohare
Krishi Vigyan Kendra, Shravasti, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Effect of foliar application of zinc, mg and urea on growth, yield and economics of wheat (*Triticum aestivum* L.) crop

Ram Bharose, SP Singh, APS Dohare, Sanjeev Kumar and Umesh Babu

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Abstract
Field experiment was conducted at farmers filed was conducted during *Rabi* season of 2022-23 on Integrated Farming System. The experiment was laid out in the Randomized Block Design (RBD) with 9 treatments. The treatments were T_1 -RDF (120: 60: 60 NPK kg ha^{-1}), T_2 -75% RDF, T_3 -50% RDF, T_4 -75% RDF + Zinc + Urea Foliar spraying, T_5 –75% RDF + + Zinc +Mg+ Urea Foliar spraying, T_6 -50% RDF + Zinc + Urea Foliar spraying, T_7 -50% RDF + +Zinc +Mg+ Urea Foliar spraying, T_8 –5 t FYM+ Zinc + Urea Foliar spraying, T_9- 5t FYM+ Zinc +Mg+ Urea Foliar spraying replicated thrice respectively. Variety DBW-187 of wheat was sowing on 23th November, 2022 and 20th November 2023 from the result it can be concluded that growth factors *viz.* Plant Height at Maturity (cm), No. effective tillers $plant^{-1}$, length of spike (cm) and yield attributing character *viz.* number of grain $spike^{-1}$, number of spikelet $spike^{-1}$, Number of Grain/spike, Test weight (g) and Yield (q/ha) of wheat was recorded in highest in treatment T_5- 75%RDF + Zinc +Mg+ Urea Foliar spraying. The highest grain yield (45.47 q ha^{-1}) was recorded in treatment T_5- 75% RDF + Zinc +Mg+ Urea Foliar spraying, whereas the lowest grain, straw and biological yield recorded in treatment T_3 -50% RDF.

Keywords: Recommended Dose of Fertilizer (RDF), zinc, mg and wheat crop

Introduction
Wheat (*Triticum aestivum* L.*)* is the world most widely cultivated food crop. In India it is second important staple food, rice being the first. Wheat compares well with other important cereals in its nutritive value. It contains more protein than other cereals and besides their significance in nutrition they are principally concerned in providing the characteristic substance “gluten” which is a very essential for bakers. Integrated nutrient supply and management system aimed at sustainable crop production by orchestrating the combined use of inorganic fertilizers. Balanced and efficient fertilizer application is essential to compensate the increased yield and hence greater removal of soil nutrients. The recent concept of integrated use of various sources (organic, inorganic and bio-fertilizer) of nutrient in crop production has started gaining ground. The basic concept underline the principal of integrated nutrient supply system is the improved of soil fertility for sustainable crop production on long term basis. It may be achieved through integrated use of all the possible sources of plant nutrient and their scientific management in different crops and cropping system. But there is limited work on the integrated nutrient management.

Organic matter like FYM has supplied available nutrients to the plants provided favorable soil environment and increase water holding capacity of soil for longer time. Application of FYM helps to increase the DMP, yield and nutrient uptake by wheat. The application of FYM (5t/ha) resulted in increase in grain and straw yield over chemical fertilizer, respectively also reported that soil density undergoes greater reduction with the use of FYM than chemical fertilizers. Application of FYM @ 5 tones ha^{-1} increased the grain yield and the total N P and K uptake in wheat crop. Was conducted at farmer’s field in Shravasti districts for Two years further confirmed that integrated nutrient management is the best option as far as productivity and profitability of the wheat.

Application of organic amendments improves soil physical properties using them in conjunction with organic fertilizers augments the beneficial effects. Soil organic matter imparts desirable physical environments to soils by favorably affected soil structure expressed through soil porosity, aggregation, bulk density and soil water storage have shown that use of inorganic fertilizers in combination with FYM plays an important role in improving the damaged soil structure by reducing bulk density and increasing infiltration rate and the mean weight diameter of the aggregates.

Zinc is involved in many physiological processes of plants, and high intrinsic Zn concentrations may help wheat tolerance to a biotic stresses. Sufficient Zn may help improve wheat tolerance to drought in different ways, including detoxifying reactive oxygen species, reducing the production of free radicals by superoxide radical-producing enzymes and having protective effects on photo oxidative damage catalyzed by ROS in chloroplasts. This suggests that the sensitivity of plants to Zn deficiency is usually more pronounced under water-limited conditions and developing new wheat cultivars combining improved tolerance to Zn deficiency in soils and increased Zn concentration in grain is a high priority. This study examined the reaction of a broad genetic wheat base, including several species with different ploidy levels to foliar application of Zn and Mg under two water regimes. The applying these combinations of treatments have not been previously reported in wheat (Sharma et al. 2013) [17].

Materials and Methods

The present investigation was conducted at farmer field of district Shravasti during Rabi seasons 2022 and 2023. The experimental site was sandy Lome soil non-saline. The experimental field soil was sandy loam with pH- 7.80, EC-0.97 dSm^{-1}, organic carbon- 2.65 (g kg^{-1}), Available Nitrogen- 135.51 kg ha^{-1}, Phosphorus- 20.51 kg ha^{-1}, Potassium- 170.51 kg ha^{-1}, Sulphur- 7.84 kg ha^{-1}, Boron-0.65 (ppm) and zinc-30 (ppm) and Mn- 3.35 (ppm). The experiment was laid out in randomized complete block design having three factors with three replications. The treatment consisting of chemical fertilizer with different combination of organics RDF, FYM, Zinc, Mg and Urea *viz*. T_1-RDF (120: 60: 50 NPK kg ha^{-1}), T_2- 75% RDF, T_3-50% RDF, T_4-75% RDF + Zinc+ Urea Foliar spraying, T_5-75% RDF + Zinc +Mg+ Urea Foliar spraying, T_6-50% RDF + Zinc+ Urea Foliar spraying, T_7-50% RDF + Zinc +Mg+ Urea Foliar spraying, T_8- 5 t FYM + Zinc+ Urea Foliar spraying and T_9- 5 t FYM + Zinc+ Mg +Urea Foliar spraying. 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. In manure treatments FYM were applied before field preparation or before sowing of crop as per treatments. The foliar application of Zn, Mg and Urea was applied 45 and 60 DAS according to the mentioned treatments. All other agronomic practices were kept uniform for all treatments. All data related to growth and yield of wheat crop collected were statistically analyzed by using the analysis of variance technique. The crop was sown during November, 2022-23 when autumn in toward its end of and the month end gradually welcome winter. The growth and yield attributes were recorded *viz*. Plant height (cm), Number of effective tillers $plant^{-1}$, Number of $Spikelet^{-1}$, number of grain spike, test weight, Grain yield and Straw yield to know the influence of the inoculation. The Soil samples from 0-15 cm depth were collected in plastic bag from individual plots at before sowing and after harvest of the crop. Soil sample of each plot was air-dried, processed to pass through 2 mm round hole sieve and analyzed for oxidizable organic carbon (*Walkley and Black*), available Nitrogen (*Subbiah and Asija*), Phosphorus (*Olsen's*), Potassium (*Hanway and Heidel*), Sulphure (*Williams and Steinbergs*) and Micronutrient Zn, Boron and Mg (*AAS*) respectively. Soil pH was determined in 2:1 soil: water suspension with the help of glass electrode in digital pH meter and electrical conductivity of soil was measured in the supernatant liquid of soil water suspension (1:2) by conductivity bridge.

Results and Discussion

Yield attributes

The results of all yield attributes characters of crop are summarized in Table 1 and 2. The growth of wheat crop in general could be understood if series of physiological processes are observed critically during various growth stages. The crop has six growth stages *viz.* seedling, tillering, jointing, heading, flowering and ripening. Each stages takes about 15-20 days. The application of Foliar spray which show that plant height at the initial stages of crop stand did not have any significant effect of foliar application of Zinc, Mg and Urea. However, during the later stages there was a significant effect of foliar spray of Zinc, Mg and Urea on plant height at maturity stage of the crop, where highest plant height was observed in the treatment T_5 where we applied recommended 75% RDF along with foliar application of Zinc, Mg and Urea 45 and 60 days after sowing. In the previous studies also it has been observed that wheat crop is affected by foliar spray of two doses of Zinc, Mg and Urea (2% foliar spray). foliar application resulted in the greatest significant increase in The highest plant height at maturity (98.25 cm), Number of effective tillers $plant^{-1}$(1.91), Length of spike (8.57 cm), Number of $Spikelet^{-1}$(17.79), number of grain spike (50.14) and test weight (38.12 g) highest recorded the treatment T_5- 75% RDF + Zinc+ Mg+ Urea Foliar spraying followed by treatment T_4-75% RDF + Zinc+ Urea Foliar spraying, T_7-50% RDF + Zinc+ Mg+ Urea Foliar spraying, T_1-RDF (120 : 60 : 50 NPK kg ha^{-1}), T_2- 75% RDF, T_9- 5 t FYM + Zinc+ Mg+ Urea Foliar spraying, T_8- 5 t FYM + Zinc+ Urea Foliar spraying and T_3-50% RDF. Significantly highest grain and straw yield was observed with T_5-75% RDF + Zinc+ Mg+ Urea Foliar spraying (2% spray) (45.47 and 66.51 q ha^{-1}). It was followed by T_4-75% RDF+ Zinc+ Urea Foliar spraying (42.27 and 60.32 q ha-1), T_7-50% RDF + Zinc+ Mg+ Urea Foliar spraying (36.98 and 52.31 q ha^{-1}) and T_9- 5 t FYM + Zinc+ Mg+ Urea Foliar spraying (35.72 and 58.62) Increase in grain yield of wheat due to foliar application of Zinc, Mg and Urea gives highest grain and straw yield q ha^{-1}. The maximum Net return of Rs.77170 ha^{-1} was recorded under T_5 (75% RDF + Zinc+ Mg+ Urea Foliar spraying) followed by T_4-75% RDF + Zinc+ Urea Foliar spraying and minimum Net return (Rs. 40670 ha^{-1}) under T_3-50% RDF treatment. However, The maximum benefit cost ratio of 1.64 was recorded with T_5 (75% RDF + Zinc+ Mg+ Urea Foliar spraying) treatment followed by T_4 (75% RDF + Zinc+ Urea Foliar spraying) with B:C ratio of 1.46. Minimum B: C ratio (0.94) was obtained in T_2 (T_2- 75% RDF) treatment.

Available Nutrient status in Soil

Among the treatments conjunctive applications of organic and inorganic fertilizers in different combinations get influenced over treatment consideration of available organic carbon content in soil in presented Table 3 and 4. Higher organic carbon content

was recorded in soil under the treatment T_9 (5 t FYM + Zinc+ Mg+ Urea Foliar spraying) higher (3.97 g kg^{-1}) and the lowest treatment T_{-1} RDF (120: 60: 50 NPK kg ha^{-1}) (2.68 g kg^{-1}). Increasing the available N, P, K and Organic Carbon content in the soil. The significant effect of 5 t FYM+ Zinc+ Mg on available N, P, K, S, Zn, B and Mn was found in soil after harvest of wheat crop. The treatment T_9- 5 t FYM + Zinc+ Mg+ Urea Foliar spraying recorded higher values of nutrient status of soil after harvest, but it was statistically at par with the treatment T_8, T_5, T_4, T_7, T_6, T_3, T_2 and T_1 case of all nutrient status of soil. The observed that long time application of FYM increased the nutrient status of soil the soil over chemical fertilizer. This might be due to higher quantity of organic manure along with FYM which accumulated in soil resulting in buildup of nutrients in the soil. Increase in micronutrient in the soil, greater multiplication of soil microbes, which could convert organically bound inorganic form (Jackson 1958) [9].

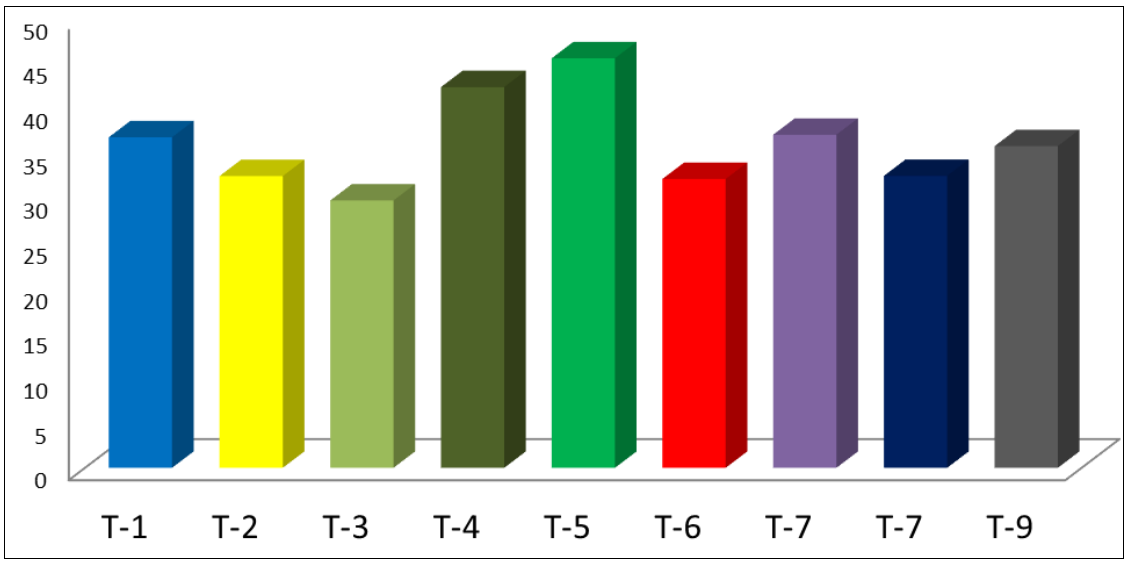

Fig 1: Yield q/ha

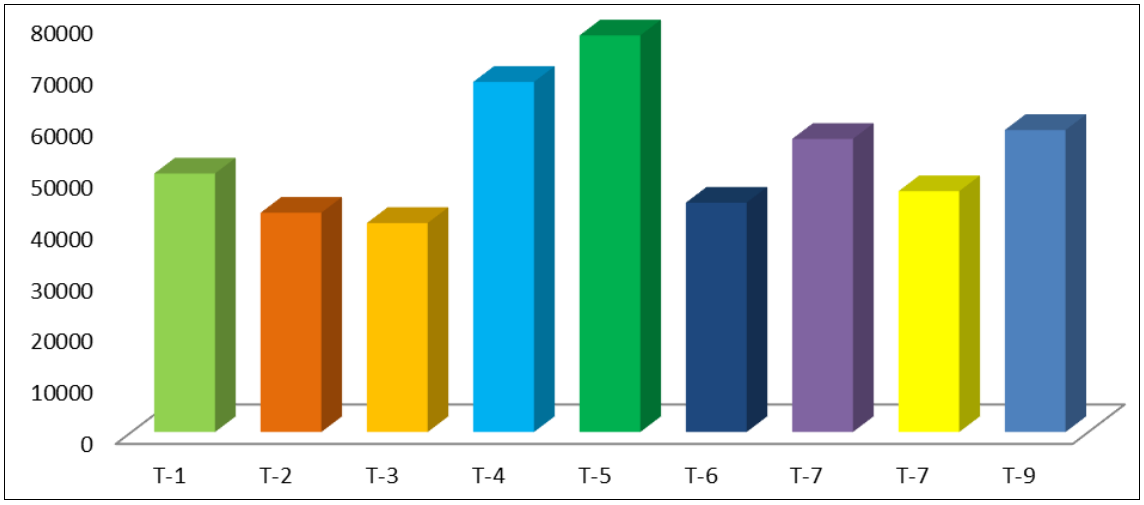

Fig 2: Net Return (Rs. ha^{-1})

Table 1: Effect of Chemical fertilizer, FYM, and Foliar application of Zinc, Mg and Urea spraying on yield and yield attributes characters Wheat (2022-2023).

Treatments	**Plant height at maturity**	**No. of effective tillers $plant^{-1}$**	**Length of spike (cm)**	**Number of spikelet's $spike^{-1}$**	**No. of grains spike**	**Test weight (g)**
T_1-RDF (120: 60: 50 NPK kg ha^{-1})	94.64	1.81	8.32	17.45	49.41	37.80
T_2- 75% RDF	93.87	1.76	8.01	17.36	48.12	37.08
T_3- 50% RDF	92.65	1.72	7.85	15.65	46.75	35.12
T_4-75% RDF + Zinc+ Urea Foliar spraying	95.72	1.85	8.46	17.56	49.62	37.01
T_5-75% RDF + Zinc+ Mg+ Urea Foliar spraying	98.25	1.91	8.57	17.79	50.14	38.12
T_6-50% RDF + Zinc+ Urea Foliar spraying	93.91	1.77	8.12	17.39	47.32	36.52
T_7-50% RDF + Zinc+ Mg+ Urea Foliar spraying	94.71	1.82	8.35	17.46	47.98	37.01
T_8- 5 t FYM + Zinc+ Urea Foliar spraying	92.91	1.73	7.95	16.98	46.98	35.54
T_9- 5 t FYM + Zinc+ Mg+ Urea Foliar spraying	93.21	1.75	7.99	17.35	47.85	36.08
S.E. ±	1.36	0.31	0.69	0.83	1.75	0.98
C.D. at 5%	4.08	0.94	2.07	2.48	5.24	2.93

Table 2: Effect of Chemical fertilizer, FYM, and Foliar application of Zinc, Mg and Urea spraying on cost of cultivation in Wheat (2022-2023).

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Cost of Cultivation (Rs. ha^{-1})	Net Return (Rs. ha^{-1})	B:C Ratio (Rs. Rupee^{-1} invested)	Protein content in Grain (%)
T_1-RDF (120: 60: 50 NPK kg ha^{-1})	36.70	50.32	48251	50309	1.04	11.80
T_2- 75% RDF	32.39	46.20	45213	42667	0.94	11.78
T_3- 50% RDF	29.68	43.05	40215	40670	1.01	11.76
T_4-75% RDF + Zinc+ Urea Foliar spraying	42.27	60.32	46581	68119	1.46	11.83
T_5-75% RDF + Zinc+ Mg+ Urea Foliar spraying	45.47	66.51	47025	77170	1.64	11.84
T_6-50% RDF + Zinc+ Urea Foliar spraying	32.07	46.01	42517	44628	1.04	11.77
T_7-50% RDF + Zinc+ Mg+ Urea Foliar spraying	36.98	52.31	43084	57031	1.32	11.79
T_8- 5 t FYM + Zinc+ Urea Foliar spraying	32.41	46.81	41365	46860	1.13	11.80
T_9- 5 t FYM + Zinc+ Mg+ Urea Foliar spraying	35.72	58.62	41987	58763	1.39	11.81
S.E. ±	0.73	0.86	-	-	-	-
C.D. at 5%	2.12	2.58	-	-	-	-

Table 3: Effect of Chemical fertilizer, FYM, and Foliar application of Zinc, Mg and Urea spraying on Wheat Crop in Chemical Properties of soil (2022-2023).

Treatment	pH	EC (dSm^{-1})	OC (g kg^{-1})	N (kg ha^{-1})	P (kg ha^{-1})
T_1-RDF (120: 60: 50 NPK kg ha^{-1})	7.83	1.12	2.68	159.12	32.35
T_2- 75% RDF	7.81	1.08	2.70	153.51	30.62
T_3- 50% RDF	7.80	1.05	2.82	149.36	28.36
T_4-75% RDF + Zinc+ Urea Foliar spraying	7.77	0.97	2.86	159.53	33.92
T_5-75% RDF + Zinc+ Mg+ Urea Foliar spraying	7.77	0.99	2.87	162.66	34.84
T_6-50% RDF + Zinc+ Urea Foliar spraying	7.76	0.93	2.95	155.24	34.32
T_7-50% RDF + Zinc+ Mg+ Urea Foliar spraying	7.76	0.94	3.01	158.30	34.81
T_8- 5 t FYM + Zinc+ Urea Foliar spraying	7.74	0.90	3.95	170.62	38.66
T_9- 5 t FYM + Zinc+ Mg+ Urea Foliar spraying	7.74	0.90	3.97	173.14	39.41
SEm±	0.26	0.042	0.14	2.70	1.56
C.D. at 5%	0.77	0.12	0.42	7.94	4.565

Table 4: Effect of Chemical fertilizer, FYM, and Foliyar application of Zinc, Mg and Urea spraying on Wheat Crop in Chemical Properties of soil (2022-2023).

Treatment	K (kg ha^{-1})	Sulphur (kg ha^{-1})	Zn (ppm)	B (ppm)	Mn (ppm)
T_1-RDF (120: 60: 50 NPK kg ha^{-1})	220.28	12.08	0.372	**0.75**	3.63
T_2- 75% RDF	208.14	10.06	0.356	0.70	3.51
T_3- 50% RDF	174.80	08.62	0.345	0.69	3.48
T_4-75% RDF + Zinc+ Urea Foliar spraying	215.86	13.78	0.398	0.79	3.89
T_5-75% RDF + Zinc+ Mg+ Urea Foliar spraying	222.14	13.86	0.416	0.82	3.90
T_6-50% RDF + Zinc+ Urea Foliar spraying	195.65	10.97	0.370	0.70	3.94
T_7-50% RDF + Zinc+ Mg+ Urea Foliar spraying	216.81	11.98	0. 389	0.72	3.92
T_8- 5 t FYM + Zinc+ Urea Foliar spraying	221.08	14.05	0.415	0.96	3.96
T_9- 5 t FYM + Zinc+ Mg+ Urea Foliar spraying	225.21	14.62	0.465	0.99	3.98
SEm±	3.78	0.42	0.051	0.036	0.15
C.D. at 5%	11.11	1.25	0.12	1.05	0.44

Conclusion

On the basis of economical yield of wheat (benefit cost ratio) under different treatment, from the present study, we can concluded that application of 75% RDF+ Zinc, Mg and Urea Foliar spray was applied 45 and 60 DAS according to the mentioned treatments. Produced higher growth and economic yield of wheat.

Foliar application of urea+ Zinc and Mg increased the productivity and quality of crops and the N fertilizer efficiency can be increased with foliar application it can be safely concluded that 2% foliar application of urea enhanced yield and yield parameters of wheat. This treatment gave more net returns and higher benefit cost ratio in wheat under Sandy soil soils of Shravasti District U.P.

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