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Effect of Inorganic Fertilizer and Organic Manure on Growth Parameters, Yield Attributes and Yield of Wheat

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Abstract The field experiment were caried out during *rabi* season 2012-2013. Highest height of 49.7, 88.2 and 95.5 cm were recorded at 60, 90 and at harvested stage, respectively in NPK (120:80:40) + 5 tones Vermi compost application. The highest number of tillers pl^{-1} were 7.4, 7.5 and 7.5 respectively at 60, 90 DAS and at harvest, highest plant population ($96.91m^{-2}$), maximum dry matter accumulation 4.165, 13.218 and 17.008 g pl^{-1}, respectively at 60, 90 DAS and at harvest, maximum chlorophyll index (68.52) at 90 DAS maximum ear length 10.08 cm, no of grain/ear 43.8 and test weight 32.73, maximum yield 4964.28 kg/ha and straw yield 7986 kg/ha with NPK (120:80:40) + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ spray at 35 and 55 DAS. The same plant parameter recorded minimum with only NPK (120:80:40) treatment.

Keywords Growth, Parameters, Yield attributes, Yield, wheat.

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Introduction

Wheat (*Triticum aestivum* L.) play an important role in human diet and also provides it strong financial support of the country [1]. This is the most important cereal crop in the world and is the third major cereal produced in the world, following maize and rice [2]. Wheat is considered as king of cereals and it provides foods to 36% of the global population, contributing 20% of the food calories. It is an important staple food of many countries in the world and occupies a unique position as used for preparation of a wide range of food stuffs. Wheat grains are comparatively better source of protein consumed in India. About 10-12% protein requirement is met by wheat. Maneuvering the application of different fertilizers could increase the productivity of the wheat crop and the protein content on account of continuing world energy crisis and spiraling prices of chemical fertilizer.

The word micronutrients represents some essential nutrients that are required in very small quantities for the growth of plants and microorganisms, micronutrients also called as trace elements : are zinc (Zn), copper (Cu), iron (Fe), manganese (Mn), boron (B), molybdenum (Mo), chlorine (CI) and nickel (Ni), the importance of micronutrients has been realized during the past four decades when wide spread micronutrient deficiencies particularly that of Zn were observed in most of the soils in our country, where intensive agriculture is practiced. Micronutrients are not only important for better crop productivity, but also essential for sustaining human and animal health.

The world health organization estimates that globally some two billion people are affected by iron deficiency [3]. Also zinc deficiency is increasingly recognized as an important public health problem.

Organic manures, particularly FYM and Vermicompost not only supply macronutrients but also meet the requirement of micronutrients besides improving soil health. Organic manure influence both yield and plant micronutrients need and thus help to sustain crop productivity [4]. Vermi-composting has proved to be an efficient technology for converting waste materials in to quality manure [5].

Cereal crop are inherently very low in gram Zn and Fe concentrations and growing them on potentially Zn and Fe deficient soils further reduces Fe and Zn concentration in grain [6]. To obtain high yields without deterioration of soil fertility, it is important to work out optimal combination of fertilizers and manures in the cropping system [7].

The Indian soils suffers from different essential nutrient in different situation due to relay eroping or improper use of different chemical fertilizers. The day to day problem is ereated due to the overdose of fertilizer in soil. The proper combination of inorganic fertilizer and organic manure or inorganic fertilizer may be profitable for existing farms to maximize per unit net profit.

The high input application for productivity day to day increase the deficiency of micronutrient which lead to limitation of sustainability of soils. Zn is now regarded as the third most limiting nutrient element in crop production after N and P. The extent of Fe deficiency in India is next to the Zn, Zn and Fe play important role in photosynthesis and growth of plants.

The iron and zinc are valuable micronutrient in living food chains. The adequate quantity of these elements provides the optimum growth and development of plant. The plant if fulfils with the all essential nutrients then it provide full nutrition to its dependent either by grain or staw. The zinc stimulate flow of leaves and stem towards spike which facilitate the reproductive organ and increase the yield of wheat. Zinc is a component of enzyme like carbonic anhydrogenase, alcohol dehydrogenase, lactic dehydrogenase, glutamic carboxypeptidase. It has been found essential for carbon dioxide evolution and utilization, carbohydrate and phosphorus metabolism and synthesis of RNA and auxin. The zinc has close relationship with chlorophyll formation. Iron play a role of catalyst and electron carrier in respiration. Iron is a constituents of cytochromes, ferredoxin, catalase, pyroxidase, globoids of aleurone grain. It is only metal which appears in all enzyme classes. Zinc is also found in brain, muscle, bones, kidney and liver with highest concentration in prostrate and parts of eye. Semen is particularly rich in zinc. Iron play role as electron carrier in respiration.

Materials and Methods

The various combination of treatment apply to know the effect of inorganic fertilizer and organic manure on growth parameters, yield attributes and yield of wheat in *rabi* season 2012-2013 at Agricultural Research Farm College of Agriculture, Gwalior Madhya Pradesh, India. The soil of the experimental field was alluvial, sandy clay loam in texture. The area truly represents the agro-climatic conditions of Indo-gangetic and alluvial plain. The wheat variety MP 1203 selected for experiment. The experiment was conducted in randomized block design in 4×2 m^2 plot size with three replication. The various treatment combination are T_1- NPK (120:80:40), T_1 + 5 tons FYM, T_1+ 5 tons Vermi-compost, T_1 + 25 Kg. $ZnSO_4$/ha as soil application, T_1 + 0.5% $ZnSO_4$ spray at 35 DAS. T_1 + 0.5% $ZnSO_4$ spray at 35 and 55 DAS. T_1 + 40 kg $FeSO_4$/ha as soil application, T_1 + 1% $FeSO_4$ at 35 DAS, T_1 + 1% $FeSO_4$ at 35 and 55 DAS, T_1 + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ spray at 35 DAS and T_1 + 0.5 % $ZnSO_4$ + 0.5% $FeSO_4$ spray at 35 and 55 DAS. Five plants sample were collected randomly from each plot for various observations in the fields and laboratory. The height of plant was measured in centimeter by meter scale from ground level to the collar of the flag leaf. Height was measured at 60, 90 DAS and at harvest stage of the crop. The number of effective tillers/plant was counted at 60 DAS from selected five plant sample from each plot and their average was taken for calculation. For observing population per square meter, area selected randomly at different places in

Table 1. Effect of different treatments on plant height, no of tillers/plant, plant population/m^2 and dry weight (g pl^{-1}) of wheat.

Tr. No.	Treatments	Plant height (cm) 60 DAS	90 DAS	At harvest	No.of tillers/plant 60 DAS	90 DAS	At harvest	Plant popula-tion m^2 at 45 DAS	Dry weight (g pl^{-1}) 60 DAS	90 DAS	At hervest
T_1	NPK (120:80:40) (RDF)	43.6	84.1	86.3	5.2	5.3	5.2	95.20	3.033	9.409	13.367
T_2	T_1 + 5 tones FYM	48.8	88.0	94.7	5.3	5.4	5.4	95.29	3.561	9.913	15.105
T_3	T_1 + 5 tones Vermi-compost	49.7	88.2	95.5	5.6	5.7	5.7	95.38	3.313	9.911	14.707
T_4	T_1 + 25 kg $ZnSO_4$/ha as soil application	48.2	87.8	93.6	6.7	6.8	6.7	96.67	3.320	11.711	15.117
T_5	T_1 + 0.5% $ZnSO_4$ spray at 35 DAS	47.8	87.7	91.5	5.7	5.9	5.9	96.40	3.581	9.789	14.504
T_6	T_1+ 0.5% $ZnSO_4$ spray at 35 & 55 DAS	47.6	87.9	92.5	6.1	6.3	6.2	96.62	4.095	9.546	13.657
T_7	T_1 + 40 kg $FeSO_4$/ha as soil application	48.1	87.0	93.3	6.9	7.0	6.8	96.86	3.859	9.976	15.931
T_8	T_1 + 1% $FeSO_4$ spray at 35 DAS	47.4	87.9	92.5	5.5	5.6	5.6	95.63	3.507	9.644	14.222
T_9	T_1 + 1% $FeSO_4$ spray at 35 & DAS	47.7	87.5	92.7	5.9	6.0	6.0	95.54	3.987	10.429	15.613
T_{10}	T_1+ 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ spray at 35 DAS	47.9	87.9	90.2	6.2	6.2	6.2	96.38	3.367	10.948	15.134
T_{11}	T_1 + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ spray at 35 & 35 DAS	48.1	87.5	91.3	7.4	7.5	7.5	96.91	4.165	13.218	17.008
	SEm ±	1.28	1.28	2.20	0.26	0.23	0.23	0.510	0.327	1.082	0.885
	CD at 5%	3.79	3.79	6.50	0.79	0.68	0.68	1.507	0.968	3.199	2.615

each plot. Later on the number of plants was counted at 60 DAS from each selected place and their average was taken for calculation. Five plant samples were collected randomly from each plot and dried in oven at 70^0C dried samples were weighed through physical balance and expressed in mg $plant^{-1}$ to measure dry weight of plant. The chlorophyll index of the second fully expanded leaf was measured in the morning of day 50 using a portable SPAD 502 chlorophyll meter (Minolta Camera Co., Osaka, Japan). Measurement of ear was made in centimeters from the base of the inflorescence to the tip of the last spikelet. The grain per ear counted by separating the individual grain. The test weight of seeds (1000 seeds) from each plot was also recorded. After threshing, grains and straw were separated and weighed (kg/plot). The yield of grain and straw was computed per hectare in kilograms.

Results and Discussion

The foliar spray of 2% $FeSO_4$ and the recommended dose of fertilizer and combination of zinc with FYM expressed significant effect on plant height, dry matter, tillers, spike length, grain per spike, grain wt, yield of wheat and straw yield [8]. The Table 1 show that plant height is not a yield component especially in grain crops but it indicates influence of various nutrients on plant metabolism. All treatments significantly increased plant height at 60 and 90 DAS with application of chemical fertilizers in combination with organic manure (FYM and Vermi-compost) or micronutrient (zinc and iron) compared to alone inorganic fertilizers for NPK nutrients applied separately. There was highly significant increased in plant height due to T_1 + 5 tones vermi-compost over the NPK (120:80:40) T_1. The results are supported by earlier finding Sarwer et al. [9].

Tillers are most important component of any yield. Number of tillers are positively correlated to yield of wheat, more number of tillers (especially fertile tillers), more will be yield. The highest number of tillers par plant were recorded with NPK (120:80:40)+ 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ spray at 35 and 55 DAS (T_{11}) at all stages of wheat and was significantly superior to rest of treatments. The finding were also supported by earlier observation [10, 11]. The no of panicle higher in NPK+Zn+Fe (0.5%) two spray in rice [12].

Table 2. Effect of different treatments on chlorophyll index, ear and yield of wheat.

Tr. No.	Treatments	Chlorophyll index at 90 DAS	Ear length (cm)	No. of grains Ear^{-1}	Test weight (g)	Grain yield (kg ha^{-1})	% yield increase	Straw yield kg/ha
T_1	NPK (120:80:40) (RDF)	55.86	8.58	32.6	26.53	3589.28		6464.00
T_2	T_1 + 5 tones FYM	61.83	8.75	33.8	26.83	3714.28	3.48	6571.00
T_3	T_1 + 5 tones Vermi-compost	62.25	9.08	34.5	27.58	3964.28	10.44	6732.00
T_4	T_1+25 kg $ZnSO_4$/ha as soil application	60.67	9.59	38.8	29.85	4499.98	25.37	7410.00
T_5	T_1+0.5% $ZnSO_4$ spray at 35 DAS	62.48	9.09	35.6	27.88	4017.85	11.94	6839.00
T_6	T_1+0.5%$ZnSO_4$ spray at 35 & 55 DAS	65.80	9.31	37.7	28.73	4142.85	15.42	7000.00
T_7	T_1+40 kg $FeSO_4$/ha as soil application	67.50	9.69	41.0	31.14	4553.56	26.86	7464.00
T_8	T_1+1% FeSO4 spray at 35 DAS	65.17	8.90	34.4	27.23	3928.56	9.45	6786.00
T_9	T_1+1% FeSO4 spray at 35 & 55 DAS	68.52	9.15	36.8	28.19	4071.42	13.43	6107.00
T_{10}	T_1+0.5% $ZnSO_4$+0.5% $FeSO_4$ spray at 35 DAS	62.83	9.43	38.7	29.41	4339.28	20.89	7250.00
T_{11}	T_1+0.5% $ZnSO_4$+0.5% $FeSO_4$ spray at 35 & 55 DAS	65.23	10.08	43.8	32.73	4964.28	38.30	7986.00
	SEm ±	3.332	0.364	3.169	-	144.53	-	242.52
	CD at 5%	9.847	1.077	9.367	NS	426.35	-	715.40

The chlorophyll index significantly increased with application of chemical fertilizers in combination with organic manures (FYM and VC) as well as micronutrients (Zn and Fe) compared to chemical fertilizers (NPK 120:80:40) (T_1). Chlorophyll index significantly increased with application of NPK (120:80:40) + 1% $FeSO_4$ at spray 35 and 55 DAS over T_1.

Spike length significantly increased with application of NPK (120:80:40) + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ spray at 35 and 55 DAS (T_{11}) and NPK (120:80:40) + 1% $FeSO_4$ spray at 35 DAS (T_7) over T_1 + (NPK 120:80:40). All treatments increased grains ear^{-1} compared to T_1 (NPK 120:80:40). Maximum grains ear^{-1} was recorded in T_{11} followed by T_7, T_4 and T_6 and minimum in T_1, T_{11} (NPK 120:80:40 + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ Sspray at 35 and 55 DAS) significantly increased grains ear^{-1} over T_1 (NPK 120:80:40). Nutrient application treatments did not influence the test weight. Maximum test weight was recorded in T_{11} (NPK 120:80:40 + 0.5% $ZnSO_4$ +0.5% $FeSO_4$ spray at 35 and 55 DAS) and minimum with T_1 (NPK 120:80:40). The similar finding reported by earlier worker [11, 13].

Wheat grain yield significantly increased with application of chemical fertilizers in combination with organic manures (FYM and VC) as well as micronutrients (Zn and Fe) compared to chemical fertilizers alone (NPK 120:80:40) (T_1). T_{11} (T_1 + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ spray at 35 and 55 DAS) gave significantly higher grain yield compared to other treatments except T_1 + 40 kg $FeSO_4$/ha as soil application (T_7). Maximum 38.30% increased grains yield was observed in T_{11} (NPK (120:80:40) + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ spray at 35 and 55 DAS) followed by 26.86%, 25.37% and 20.89 with treatment NPK (120:80:40) + 40 kg $FeSO_4$/ha as soil application (T_7), NPK (120:80:40) + 25 kg $ZnSO_4$/ha as soil application (T_4) and NPK (120:80:40) + 0.5% $ZnSO_4$ 0.5% $FeSO_4$ spray at 35 DAS (T_{10}), respectively and minimum with T_1 (NPK 120:80:40). Similar trend was observed in the straw yield of wheat crop. The result are in close agreement with the earlier observation [14–17].

According to recent report based on the world health organization database, nutritional iron deficiency is the most widespread disorder in the world, affecting more than two billion people, in addition to affecting a large number of preschool children and pregnant women are under most risk of Fe deficiency [18, 19].

So the adapting the practices which enrich the micronutrient iron and zinc in crop field to fulfill the plant demand. The plenty of micronutrient will help the human and animal nutirent very much.

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