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Response of nutrients on dynamics of shoots and root growth of wheat [*Triticum aestivum* L.]

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Abstract
The experiment conducted during *Rabi* season of 2015-16 at student instructional farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur to study the Response of nutrients on dynamics of shoots and root growth of Wheat [*Triticum aestivum* L.]. The experiment consist 10 treatments in randomized block design *viz*.T_1 NPK (150:60:40kg/ha) only, T_2 NPK + Sulphur (25kg/ha), T_3 NPK + Zinc (5kg/ha), T_4 NPK + Boron (1.0kg/ha), T_5 NPK + Iron (5kg/ha), T_6 NPK + FYM (10t/ha), T_7 NPK + Azotobacter + PSB, T_8 NPK + FYM + Azotobacter + PSB, T_9 NPK + S + B + Zn + Fe, T_{10} NPK + FYM + S + B + Zn + Fe. The application of NPK + FYM + S + Zn + Bo + Fe was recorded significantly better growth in term of shoot and root due to balance nutrition and check nutritional loses in this treatment.

Keywords: Azotobactor, FYM, PSB, root, shoot growth and zinc

1. Introduction
Wheat (*Triticum aestivum* L.) represents about 30% of the bread wheat is the major staple food source for a large part of global population. The global significance of wheat could be simply realized in the way that more food is made with wheat than any other cereals. Indian soil are generally deficient in nutrients particularly nitrogen. It has been universally observed that nitrogen use efficiency which is low as about 30-37% is utilized while rest is lost through volatilization, denitrification and leaching. The phosphorus and potash use efficiency is 15-20% and 20-40% respectively while rest is fixed in the soil and not available to the plant easily. The relationship between fertilizer and food security is most clearly shown in the case of N, the dominant nutrient in terms of global use. The use of three major nutrients as chemical fertilizer is necessary to achieve production target of wheat. Micro nutrient are also necessary to achieve sustainability in production and to improve quality of wheat. During last one decade the practice of reducing inorganic fertilizer doses by 25-50% with complimentary doses of organic manures did not achieve sustainability in wheat production. The integration of supper imposed quantity of micronutrient, organic manures, microbial supplements along with 100% dose of inorganic fertilizers (NPK only) catching attention of scientific communities, now days. Organic and mineral fertilizers are complementary often the best yields are only achieved when inorganic and organic nutrients are applied together. The role of micronutrients along with major nutrients has their important role in improvement of dynamics of shoots and root growth of Wheat.

2. Materials and Methods
The experiment was conducted in field number 6 at student instructional farm [SIF] of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.), India, during Rabi season 2015-16. The soil was silt loam in texture with 7.8 pH. The experiment was conducted in RBD design and experiment consisted of 10 treatments *viz*. T_1 NPK (150:60:40kg/ha) only, T_2 NPK+Sulphur (25.0kg/ha), T_3 NPK+Zinc (5.0kg/ha), T_4 NPK + Boron (1.0kg/ha), T_5 NPK+Iron (5.0kg/ha),T_6NPK+FYM(10t/ha), T_7NPK+Azotobacter+PSB, T_8NPK+FYM+Azotobacter+PSB, T_9NPK+S+B+Zn+Fe,T_{10}NPK+FYM+S+B+Zn+Fe. The recommended dose of nitrogen, phosphorus and potassium, 150 kg, 60 kg and 40 kg ha^{-1}, respectively. Neem coated urea (46 %), DAP (18 % N, 46 % P2O5), MOP (60 % K2O), FYM (0.5 % N, 0.25 % P2O5, 0.5 K2O).

3. Results and Discussion

The data related to root length of wheat plant were summarized in table 1. The root length of wheat recorded minimum (12.88 cm, 18.05 cm and 21.44cm at 45 DAS, 90 DAS and harvesting stage, respectively) under NPK only treatment and maximum root length (16.18 cm, 21.98 cm, 27.01 cm at 45 DAS, 90 DAS and harvesting stage, respectively) under NPK + FYM + S + Zn + B + Fe treatment found significantly superior over control treatment. The other treatments were found significantly at par. Similar results reported by Baligar *et al.,* (1998) [1] and Muhmood *et al.* (2014) [6]. The data related to fresh weight of shoot (g) recorded at 45 and 90 DAS stage and at harvesting stage were summarized in table 2. Fresh weight of shoot recorded minimum (7.50g, 50.86 g and 53.33 g recorded at 45 DAS, 90 DAS and at harvesting stage, respectively) under NPK only (Control treatment).The fresh weight of shoot increased significantly at different stages under integrated doses of NPK + FYM, NPK + Azotobacter and PSB and NPK + all micronutrient and FYM treatments. The maximum fresh weight (9.70g, 90.33g and 65.11g at 45 DAS, 90 DAS and at harvesting stage, respectively) recorded under NPK+FYM+S+Zn+B+Fe treatment, which evaluated significantly superior among all the treatments. The data pertaining to dry weight of shoot were summarized in table 2 and the dry weight of shoot recorded at different stages shown increasing trends form 45 DAS stage till harvesting stage under different treatment. The minimum shoot dry weight (1.53g) under NPK only and maximum (1.95 g) shoot dry weight recorded under NPK + FYM + S + Zn + B + Fe treatment which found significantly at par at 45 DAS stage. The shoot dry weight increased significantly at 90 DAS stage and harvesting stage. The minimum shoot dry weight (9.11 g and 23.39 g at 90 DAS & at harvesting stage, respectively) under NPK only treatment and maximum shoot dry weight (10.85 g and 29.04 g at 90 DAS and harvesting stage, respectively) under NPK + FYM + S + Zn + B + Fe treatment found significantly superior. The improvement in above growth characters under integrated doses of treatment may be due to balance nutrition provided through this treatment. Similar findings were reported by Fageria (2000) [3], Bindia, *et al.* (2005) [2], and Muhmood, *et al.* (2014) [6].

Table 1: Effect of treatment on root length (cm) at different intervals

Treatment	Root length (45 DAS)	Root length (90 DAS)	Root length (at harvesting)
NPK(150:60:40)	12.88	18.05	21.44
NPK + S(25 Kg/ha)	12.99	18.54	22.34
NPK + Zn(5 Kg/ha)	13.85	18.88	23.04
NPK + Bo(1 Kg/ha)	13.88	19.10	23.77
NPK + Fe(5 Kg/ha)	13.88	19.42	24.46
NPK + FYM(10 tonne/ha)	14.18	19.42	25.27
NPK + Azoto+PSB	14.33	19.55	25.58
NPK +FYM+ Azoto+PSB	14.44	19.88	26.27
NPK + S+Zn+Bo+Fe	14.79	19.90	26.92
NPK +FYM+ S+Zn+Bo+Fe	16.18	21.98	27.01
SE(d)±	0.75	1.27	1.32
CD at 5%	1.59	2.67	2.78

Table 2: Effect of treatments on shoot and root at different intervals

Treatments	Shoot						Root					
	Fresh weight(g) /plant			Dry weight(g) /plant			Fresh weight(g) /plant			Dry weight(g) /plant		
	(45 DAS)	(90 DAS)	Harvesting	(45 DAS)	(90 DAS)	Harvesting	(45 DAS)	(90 DAS)	Harvesting	(45 DAS)	(90 DAS)	Harvesting
NPK(150:60:40)	7.50	50.86	55.33	1.53	9.11	23.39	1.07	2.83	3.98	0.23	1.31	2.28
NPK + S(25 Kg/ha)	7.61	52.32	55.10	1.55	9.85	24.67	1.18	3.15	4.37	0.26	1.65	2.30
NPK + Zn(5 Kg/ha)	7.66	56.32	59.49	1.55	9.98	25.45	1.21	3.38	4.39	0.27	1.78	2.33
NPK + Bo(1 Kg/ha)	7.70	57.97	59.60	1.57	10.14	25.53	1.23	3.42	4.39	0.29	1.79	2.38
NPK + Fe(5 Kg/ha)	8.05	61.10	59.95	1.61	10.16	25.61	1.25	3.55	4.54	0.32	1.81	2.39
NPK + YM(10Tonne/ha)	8.28	64.90	60.32	1.64	10.21	25.89	1.30	3.57	4.64	0.32	1.96	2.42
NPK + Azoto + PSB	8.51	68.13	60.53	1.72	10.33	26.08	1.32	3.67	4.75	0.33	2.03	2.43
NPK+FYM+Azoto+PSB	8.57	77.16	60.92	1.73	10.48	26.75	1.34	3.77	4.77	0.34	2.10	2.43
NPK + S+Zn+Bo+Fe	9.63	81.68	61.55	1.86	10.76	26.84	1.44	4.00	4.81	0.35	2.10	2.48
NPK+FYM+S+Zn+Bo+Fe	9.70	90.33	65.11	1.95	10.85	29.04	1.62	4.44	4.82	0.37	2.19	2.55
SE(d)±	1.07	1.46	1.86	0.25	0.79	1.75	0.16	0.42	0.32	0.06	0.43	0.20
CD at 5%	2.26	3.08	3.91	0.54	1.66	3.68	0.34	0.88	0.67	0.14	0.90	0.42

The data related to fresh weight of root (g) recorded at 45 and 90 DAS and at harvesting stage were summarized in table 2 and the fresh weight of root recorded of different stage under different treatments shown significant improvement. The application of NPK only recorded minimum fresh weight of root (1.07g, 2.83g and 3.98g at 45 DAS, 90 DAS and at harvesting stage, respectively). The fresh weight of root increased significantly under combined application of micronutrients FYM, micro organism along with NPK doses treatments and maximum fresh weight of root (1.62g, 4.44g, 4.82g at 45 DAS, 90 DAS, harvesting stage, respectively), under NPK + FYM + S + Zn + B + Fe treatment found significantly superior over control and all other treatments. The data pertaining to dry weight of root were summarized in table 2. The dry weight of root recorded at different stages under different treatments shown non significant impact. The minimum root dry weight (0.23g, 1.31g and 2.28g at 45 DAS, 90 DAS and harvesting stage, respectively) under NPK only treatment, while maximum root dry weight (0.37g, 2.19g and 2.55g at 45 DAS 90 DAS and harvesting stage, respectively) under NPK + FYM + S + Zn + B + Fe treatment. To improve the efficiency of N uptake and use by crop plants, root systems play an important role reported by (Fageria and Baligar, 2006) [5]. The improvement in root dynamics may be due to balance nutrition provided through the integrated dose treatment. Similar finding were reported by Fageria (2002) [4] and Muhmood, *et al.* (2014) [6].

4. Conclusion
Based on basis of results it may be concluded that the super imposed doses of NPK+FYM+S+Zn+Bo+Fe under treatment 10, recorded better growth in term of shoot and root due to balance nutrition and check nutritional loses in this treatment.

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