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Impact of different treatment on yield and yield attributes of wheat (*Triticum aestivum* L.) in central Uttar Pradesh

Kushal Sachan, Anil Kumar, Ajmul Hasan and Amar Kant Verma

Abstract
A field experiment was carried out in the pot culture of Soil Science and Agricultural Chemistry, C. S. Azad University of Agriculture & Technology during 2018-19. The experiment consisted 13 treatments *viz*, T_1: Control, T_2: 75% RDF, T_3: 75% RDF + FYM, T_4: 75% RDF + FYM + S_{30}, T_5: 75% RDF + FYM + S_{30} + Zn_{20}, T_6: 75% RDF + FYM + Zn_{20}, T_7: 100% RDF, T_8: 100% RDF + FYM and T_9: 100% RDF + FYM + S_{30}, T_{10}: 100% RDF + FYM + S_{30} + Zn_{20}, T_{11}: 100% RDF + FYM + Zn_{20}, T_{12}: 100% RDF + FYM + S_{30} + Zn_{20} + Azotobacter and T_{13}: 125% RDF and assigned in randomized block design replicated thrice during *rabi* season of 2018-19. The wheat cv HD-2967 was used in the experiment. The soil of the experimental plot was sandy loam in texture, medium in fertility and slightly alkaline in reaction. The weather during the experimental period was by and large normal and devoid of any extreme conditions. The results indicated that application of 100% RDF + FYM + S_{30} + Zn_{20} + Azotobacter showed that the highest grain yield (57.82 q ha^{-1}), stover yield (61.12 q ha^{-1}), biological yield (118.94 q ha^{-1}) and harvest index (48.61%) and lowest in control. Application of treatments T_{12} (100% RDF + FYM + S_{30} + Zn_{20} + Azotobacter) gave the highest grain yield of wheat crop. It is strongly recommended that farmer of the central Uttar Pradesh adopt the dose of T_{12} (100% RDF + FYM + S_{30} + Zn_{20} + Azotobacter) doses for better crop yield.

Keywords: Plant stand, plant height, yield, RDF, FYM and Azotobacter

Introduction
Wheat (*Triticum aestivum* L.) is one of the most important cereal crops which ranks first among the world food crops, in terms of cultivated area (223.56 m ha) or production (689.95 mt) and with productivity of (3086 kg ha^{-1}) Wheat, with its root ramifying into the depth of human culture has an evolutionary history parallel with history of human civilization itself. Even today it decides the feast or famine for millions of people.

In India, wheat is the second most important cereal crop next only to rice and a key crop of the green revolution and post green revolution era. India stands second among wheat production countries after China. During the crop year 2020-21, wheat was grown over an area of 31.7 m ha with the production of 95.17 m t with an average productivity of 3.09 t ha^{-1}. The demand of wheat in India by 2025 has been projected to be between 105-109 million tonnes as against 94.88 million tones production of present day. The productivity of a crop is controlled by many factors of which the mineral nutrition especially of nitrogen, phosphorus and potassium are by and large Anonymous, (2021) [1].

On accounting of continuing world energy crisis and spiraling price of chemical fertilizer, the use of organic manure as a renewable source of plant nutrient is assuming importance. In this endeavor proper blend of organic and inorganic fertilizer is important not only for increasing yield but also for sustaining soil health. Wheat is an important cereal crop and requires a good supply of nutrients especially nitrogen for its growth and yield. Application of farm manure ameliorates the soil permeability and improve soil fertility. Soil compaction can be decreased with the use of soil organic matter. Application of organic materials alone or in combination with inorganic fertilizers helped in the proper nutrition and maintenance of soil fertility Singh *et al.,* (2019) [6] reported that the efficiency of chemical fertilizers increased with the use of organic manures.

Materials and Methods
A field experiment was carried out in the pot culture of Soil Science and Agricultural Chemistry, C. S. Azad University of Agriculture & Technology during 2018-19.

The soil of the experimental field was sandy loam in texture and slightly calcareous having organic carbon 0.33%, total nitrogen 0.03%, available P_2O_5 16.3 kg ha^{-1}, available K_2O 174.7 kg ha^{-1}, pH 7.76, electrical conductivity 0.36 dS m^{-1}, wilting point 6.3%, field capacity 18.4%, water holding capacity 29.5%, Bulk density 1.46 Mg m^{-1}, Particle density 2.56 Mg m^{-1} and porosity 42.9%. The experiment comprising 13 treatment laid out in a Randomized Block Design (RBD) with 3 replications. The experiment consisted 13 treatments *viz*, T_1: Control, T_2: 75% RDF, T_3: 75% RDF + FYM, T_4: 75% RDF + FYM + S_{30}, T_5: 75% RDF + FYM + S_{30} + Zn_{20}, T_6: 75% RDF + FYM + Zn_{20}, T_7: 100% RDF, T_8: 100% RDF + FYM and T_9: 100% RDF + FYM + S_{30}, T_{10}: 100% RDF + FYM + S_{30} + Zn_{20}, T_{11}: 100% RDF + FYM + Zn_{20}, T_{12}: 100% RDF + FYM + S_{30} + Zn_{20} + Azotobacter and T_{13}: 125% RDF. Wheat cv HD-2967 was grown 25 cm apart. Crops were sown on 18.09.2019. Available moisture at sowing time up to 100 cm soil profile was measured which was 281.7 mm. The amount and distribution of rainfall received during cropping season was 69.2 mm against the average annual rainfall of about 800 mm. Recommended package of practices and fertilizers doses were applied in different treatments.

Results and Discussion

Plant Stand (000 ha^{-1}): The plant stand varied from 111.76 - 149.62 (000 ha^{-1}). The treatment combination T_{12} (*100% RDF + FYM + S_{30} + Zn_{20}* + Azotobacter) given the highest final plant stand followed by T_{10} (100% RDF + FYM + S_{30} + Zn_{20}). The similar results were reported by Skudra and Ruza (2017) [7].

Plant height (cm): The results of plant height in (cm) of 30, 60, 90 and at harvest of different days. T_{12} (*100% RDF + FYM + S_{30} + Zn_{20}* + Azotobacter) given the highest final plant stand followed by T_{10} (100% RDF + FYM + S_{30} + Zn_{20}) and lowest found in treatment combination T_1 (Control) under the course of investigation. Many scientists reported that the results on conformity with the results of present study which included Rossini *et al.*, (2018) [3] and Aula *et al.*, (2019) [2].

Yield Attributes: The results of yield attributes like No. of tiller $plant^{-1}$, No. of ear $plant^{-1}$, No. of seeds ear^{-1}, Weight of ear^{-1} (g), Grain weight ear^{-1} (g), 1000-seed weight (g), Spike lenght (cm) and Number of spikelets $spike^{-1}$ maximum found in significantly all the treatment combination of T_{12} (*100% RDF + FYM + S_{30} + Zn_{20}* + Azotobacter) given the highest final plant stand followed by T_{10} (100% RDF + FYM + S_{30} + Zn_{20}) and lowest found in treatment combination T_1 (Control) under the course of investigation. Similar results were reported by Singh *et al.*, (2020) [5].

Grain yield (q ha^{-1}): The grain yield varied from 32.55-57.82 q ha^{-1}. The treatment combination T_{12} (*100% RDF + FYM + S_{30} + Zn_{20}* + Azotobacter) gave the highest grain yield followed by T_{10} (100% RDF + FYM + S_{30} + Zn_{20}). The result of present investigation clearly showed that all the treatment gave significantly higher yield in comparison to control. The soil of experiment fields are low in nitrogen and phosphorus and medium in potassium. The zinc and sulphur content is also low. The addition of any nutrients in soil gave positive effect on crop yield. Similar results were reported by Patel *et al.*, (2018) [9].

Straw yield (q ha^{-1}): The straw yield varied from 42.98-61.12 q ha^{-1}. The treatment combination T_{12} (*100% RDF + FYM + S_{30} + Zn_{20}* + Azotobacter) gave the highest straw yield. Like all grains all the treatment gave significantly higher yield in comparison to control. The addition of any nutrient in soil gave positive effect on crop yield. The increase in the yield due to addition of N, P, K, S and Zn containing fertilizers has been reported by several workers like Ghaffar *et al.*, (2013) [10] and Mishra *et al.*, (2017) [11].

Biomass yield (q ha^{-1}): The biomass yield (q ha^{-1}) ranged from 75.53-118.94 q ha^{-1}. The treatment combination T_{12} (*100% RDF + FYM + S_{30} + Zn_{20}* + Azotobacter) given the highest biomass yield (q ha^{-1}) in present investigation. The data clearly shows that all the treatments gave significantly higher biomass yield (q ha^{-1}) in comparison to control. Similar results were reported by Bairwa *et al.*, (2020) [5].

Harvest index (%): The harvest index (%) ranged from 43.09-48.61%. The treatment combination T_{12} (*100% RDF + FYM + S_{30} + Zn_{20}* + Azotobacter) given the highest harvest index (%) in present investigation. The data clearly shows that all the treatments gave significantly higher harvest index (%) in comparison to control. Similar results were reported by Akhtar *et al.*, (2018) [4].

Table 1: Effect on Initial & Final Plant stand and Plant height of wheat crop under different treatments.

Treatments	Initial plant stand (000 ha^{-1})	Final plant stand (000 ha^{-1})	Plant Height (cm)			
			30 DAS	60 DAS	90 DAS	At Harvest
T_1: Control	114.54	111.76	22.3	64.9	95.0	97.4
T_2: 75% RDF	118.38	115.87	24.1	66.7	98.6	99.5
T_3: 75% RDF + FYM	132.13	130.29	25.3	70.6	106.7	108.7
T_4: 75% RDF + FYM + S_{30}	139.51	135.09	26.7	72.9	110.6	111.5
T_5: 75% RDF + FYM + S_{30} + Zn_{20}	117.12	115.23	28.6	76.8	116.7	117.5
T_6: 75% RDF + FYM + Zn_{20}	143.93	142.61	27.5	75.1	115.2	115.7
T_7: 100% RDF	124.90	122.07	24.5	68.7	102.7	105.6
T_8: 100% RDF + FYM	135.04	133.59	26.0	71.3	109.4	110.0
T_9: 100% RDF + FYM + S_{30}	141.87	138.63	27.0	74.6	112.9	113.6
T_{10}: 100% RDF + FYM + S_{30} + Zn_{20}	147.71	144.86	29.6	77.3	117.5	118.0
T_{11}: 100% RDF + FYM + Zn_{20}	144.53	143.76	28.0	75.7	115.8	116.6
T_{12}: 100% RDF + FYM + S_{30} + Zn_{20} + Azotobacter	151.30	149.62	31.7	80.6	120.2	121.7
T_{13}: 125% RDF	128.64	126.78	25.0	69.8	105.3	107.2
SE (d)	1.76	1.72	0.65	0.71	0.99	1.56
CD (P=0.05)	2.67	2.59	1.29	1.98	2.07	2.78

Table 2: Effect on No. of tiller plant^{-1}, No. of ear plant^{-1}, No. of seeds ear^{-1}, Weight of ear^{-1}, Grain weight ear^{-1} and 1000-seed weight of wheat crop under different treatments.

Treatments	No. of tiller plant^{-1}	No. of ear plant^{-1}	No. of seeds ear^{-1}	Weight of ear^{-1} (g)	Grain weight ear^{-1} (g)	1000-seed Weight (g)
T_1: Control	4.80	4.16	17.69	2.17	1.93	36.69
T_2: 75% RDF	6.56	4.37	19.05	2.40	2.07	37.56
T_3: 75% RDF + FYM	6.89	5.76	20.27	2.67	2.30	38.26
T_4: 75% RDF + FYM + S_{30}	7.56	5.87	21.00	2.84	2.59	38.31
T_5: 75% RDF + FYM + S_{30} + Zn_{20}	7.82	6.01	23.13	2.98	2.80	38.58
T_6: 75% RDF + FYM + Zn_{20}	7.78	5.92	22.25	2.92	2.71	38.45
T_7: 100% RDF	6.92	4.89	19.59	2.54	2.13	37.84
T_8: 100% RDF + FYM	7.32	5.80	20.76	2.73	2.46	38.29
T_9: 100% RDF + FYM + S_{30}	7.69	5.90	21.36	2.89	2.65	38.39
T_{10}: 100% RDF + FYM + S_{30} + Zn_{20}	7.86	6.04	23.66	3.05	2.83	38.67
T_{11}: 100% RDF + FYM + Zn_{20}	7.80	5.98	22.57	2.95	2.76	38.51
T_{12}: 100% RDF + FYM + S_{30} + Zn_{20} + Azotobacter	7.90	6.10	24.10	3.14	2.98	38.98
T_{13}: 125% RDF	6.05	5.98	19.84	2.62	2.25	37.91
SE (d)	0.89	0.78	1.02	0.14	0.38	0.87
CD (P=0.05)	1.93	1.67	2.09	0.31	0.75	1.73

Table 3: Effect on Spike length, Number of spikelets spike^{-1}, Grain, straw & Biomass yield and Harvest index of wheat crop under different treatments.

Treatments	Spike length (cm)	Number of spikelets spike^{-1}	Grain yield (q ha^{-1})	Straw Yield (q ha^{-1})	Biomass Yield (q ha^{-1})	Harvest index (%)
T_1: Control	9.33	18.50	32.55	42.98	75.53	43.09
T_2: 75% RDF	9.84	18.79	38.94	43.78	82.72	47.07
T_3: 75% RDF + FYM	10.73	19.27	43.44	49.06	92.50	46.96
T_4: 75% RDF + FYM + S_{30}	11.04	19.98	49.65	53.60	103.25	48.08
T_5: 75% RDF + FYM + S_{30} + Zn_{20}	11.57	21.95	51.28	59.07	110.35	46.47
T_6: 75% RDF + FYM + Zn_{20}	11.29	20.70	50.12	57.87	107.99	46.41
T_7: 100% RDF	10.05	19.00	40.12	46.78	86.90	46.16
T_8: 100% RDF + FYM	10.92	19.94	48.85	51.54	100.39	48.66
T_9: 100% RDF + FYM + S_{30}	11.15	20.36	49.95	55.31	105.26	47.45
T_{10}: 100% RDF + FYM + S_{30} + Zn_{20}	12.13	22.15	56.76	60.43	117.19	48.43
T_{11}: 100% RDF + FYM + Zn_{20}	11.42	21.38	50.95	58.48	109.43	46.55
T_{12}: 100% RDF + FYM + S_{30} + Zn_{20} + Azotobacter	13.07	22.74	57.82	61.12	118.94	48.61
T_{13}: 125% RDF	10.49	19.08	40.58	48.97	89.55	45.31
SE (d)	0.76	0.81	1.34	1.54	2.15	1.98
CD (P=0.05)	1.69	1.74	3.76	2.09	4.43	3.90

Conclusion

Based on one years of experiment it may be inferred that application of treatments T_{12} (*100% RDF + FYM + S_{30} + Zn_{20}* + Azotobacter) gave the highest grain yield value of wheat crop showed good potential for sustainable production and proved to be quite remunerative in alluvial tract of Uttar Pradesh.

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