Effect of FYM, Vermi- compost, Azotobacter inoculation and Chemical fertilizers on Growth and Yield in Wheat (*Triticum aestivum* L.)

ABSTRACT: In *rabi* 2018-19, a field experiment using wheat cultivar K 1006 was carried out at the Students Instructional Farm of C. S. Azad University of Agriculture and Technology, Kanpur (U.P.). The location of the experiment is between 25° 56' and 28° 58' North and 79° 31' to 80° 34' East longitude.The study location was described as having a sandy loam texture, being alkaline (pH 8.19), containing 0.41% organic carbon, 187 kg/ha of available nitrogen, 11 kg/ha of available phosphorus, and 177 kg/ha of available ~~potash~~ potassium. Eight treatments (RDF-120:60:40 NPK k~~K~~g ha^{-1} as the recommended dose of ~~fertiliser~~fertilizer), RDF + Azotobacter, RDF + Azotobacter + Vermicompost @ 3.0 t ha^{-1}, RDF + Azotobacter + Vermicompost @ 4.0 t ha^{-1}, RDF + Azotobacter + Vermicompost @ 5.0 t ha^{-1}, RDF + Azotobacter + FYM @ 4.0 t ha^{-1}, RDF + Azotobacter + FYM @ 8.0 t ha^{-1}, and RDF + Azotobacter + FYM @ 12.0 t ha^{-1} were setup in a ~~randomised~~randomized block design with three replications. The highest plant height at 30 DAS (21.67 cm) and 90 DAS (99.50 cm), the number of total (5.52) and productive (5.15) tillers /plant, the initial (115.25) and final (459) plant population /m^2, the spike length (11.15 cm), the number of grains /spike (54.60), the grain weight /spike (2.26 g) and test weight (41.45 g), biological yield (131.25 q/ha), grain yield (56.40 q/ha), straw yield (74.85 q/ha), and harvest index (42.98)were found to be most effectively affected by the combination of RDF + Azotobacter + Vermi-compost @ 5.0 t ha^{-1}.Therefore, the growth and yieldof wheat might be increased by up to 16–18% beyond the prescribed fertilizer dosages when the seed was infected with Azotobacter @ 1 packet Azotobacter with 10 kg seed and soil amended with Vermi–compost @ 5 t/ha in addition to RDF.

Keywords: Wheat, FYM, vermicompost, *Azotobacter*, fertilizers, ~~frowth~~growth, yield, economics

INTRODUCTION

Wheat (*Triticum aestivum* L.) being an important staple cereal crop is grown under diverse agro-climatic conditions. It is grown in more than 240 million ~~hectare~~hectares with a production amounted to over 781 million metric tons (Statista, 2023). In India, wheat is grown in around 34 million ~~hectare~~hectares with a total production of about 112 million metric tons. By 2050, the

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world population will increase 9.1 billion and of India about 148 -179 million under low and high fertility assumptions. To meet the demand of such bourgeoning population, as per FAO (2013), wheat will have to increase to about 900 million metric tons and 140 million tons for world and India, respectively. Although plant nutrient sources differ significantly in terms of their nutrient contents, release efficiency or fixation, positional availability, farmer acceptability, etc., it is necessary to carefully reevaluate recommendations for crop nutrition, particularly the balanced nutrient supply that could improve soil fertility and soil health and also sustain high productivity over the long term. This is in addition to keeping in mind the prudent uses of chemical fertilisers, irrigations, plant protection measures, impacts of socioeconomic and climate change, plateauing yield of high yielding varieties, and weathering of soil characteristics. By pointing to a number of mechanisms, including the production of phytohormones like Indol-3-acetic acid, the avoidance of various stressors, nitrogen fixation, the breakdown of pesticides and oil globules, the metabolization of heavy metals, and its possible role in converting barren land to fertile land, ~~azotobactor~~azotobacter has been identified as a potential biofertilizer for managing soil and plant health.(Sumbul*et al*.,2020).

Earthworm species are generally employed in vermicomposting, an organic and biological process that turns organic materials or biodegradable wastes into manure. Because of their high nutritional content, the vermicomposts that are generated are frequently utilised as biofertilizers in agriculture (Lim et al., 2015). A degraded combination of dung, urine, litter, and residual elements from roughages and feed provided to livestock is known as farmyard manure (FYM). The composition of a well-decomposed FYM is 0.2-0.4% P2O5, 0.5-1.0% K2O, and 0.5-2.5% N. FYM is an excellent source of organic carbon, which stimulates soil flora and fauna to thrive. (Kumar *et al*., 2021).Nonetheless, there is no research on the incorporation of biofertilizers and manure in wheat at the necessary dosages. Thus, the goal of the current experiment was to determine if it would be possible to combine vermi-compost, farm yard manure and suitable amounts of chemical fertilisers in a way that would be more affordable while still increasing wheat yield.

MATERIAL AND METHODS

The experiment took place at C. S. Azad University of Agriculture and Technology, Kanpur (U.P.) Students Instructional Farm in *rabi* 2018-19 at 25° 56' to 28° 58' North and 79° 31' to 80° 34' East, 125.9 metres above sea level. The experimental soil was sandy loam, alkaline (pH 8.19), with 0.41% organic carbon, 187 kg/ha nitrogen, 11 kg/ha phosphorus, and 177kg/ha potash. The experiment comprising 8 treatments *viz*., $T_{1=}$ RDF(120:60:40NPKKg ha^{-1}), $T_{2=}$RDFAzotobacter,

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$T_{3=}$ RDF + Azotobacter +Vermicompost@3.0 tha^{-1}, $T_{4=}$ RDF + Azotobacter +Vermicompost@4.0 tha^{-1} $T_{5=}$ RDF + Azotobacter +Vermicompost@5.0 tha^{-1}, T6=RDF+Azotobacter+FYM@4.0tha^{-1}, $T_{7=}$RDF+Azotobacter+FYM@8.0tha^{-1} $T_{8=}$RDF+Azotobacter+FYM@8.0tha^{-1} $T_{8=}$RDF+Azotobacter+FYM@12$tha^{-1}$was laid out in randomized block design in 3 replications in a plot size of 5 x 3 m^2 with spacing of 20 cm apart.Irrigated the field before planting. After soil turning, two cross ploughings with cultivator and planking made the soil solid, friable, and level for seed germination. Twenty days before sowing, FYM @4.0, 8.0, and12.0 t ha^{-1} was applied. 20 days before sowing, Vermi compost @ 3.0, 4.0, and 5.0 t/ha was treated. Prior to planting, half nitrogen, full phosphorus, and full potash were applied as basal in the form of Urea, DAP, and MOP. The remaining nitrogen was top-dressed in two equal dosages at 32 and 56 days post-sowing. Seed of wheat variety K-1006 was ~~utilised~~utilized at 100 kg ha^{-1}. After heating and cooling 500 ml water and 50 g gur, 1 packet Azotobacter was mixed with 10 kg wheat seed. After drying in shade, infected seeds were sowed. After 21 days of seeding, CRI stage was irrigated, and 4 more irrigations were given after 20-25 days to complete crop. At 30–35 days after seeding, Khurpi helped hand-weed the patch. Ten plants from net area were randomly selected to record plant height, spike length, and spikelet count.

The harvest index was computed with the help of formula as suggested by Singh and Staskofif (1971).

$$\text{Harvest Index} = Economic yield\ (q/\ h\ a)/Biological yield(\text{q/ h a})\ X100$$

Fisher and Yates (1957) provided statistical analysis of growth characteristics, yield attributing qualities, yields, gross revenue, net income, and rupee return.

RESULTS AND DISCUSSION

Growth parameters

Knowing how any critical element affects wheat crop growth and development is essential. Wheat growth has numerous stages: germination/emergence, tillering, stem elongation, boot, heading/flowering, and grain fill/ripening. However, FYM, Vermi compost, Azotobactor, and chemical fertilisers were tested on plant height at 30 and 90 DAS, number of total and productive tillers per plant, plant population per square metre, and dry weight accumulation at 60 and 90 DAS. Table 1 shows the results.Treatments had a substantial influence on all growth indices except initial plant population, which was expected as plant development, especially tillering,

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differs after crop stage. The treatment combination ofRDF + Azotobacter +Vermicompost@5.0 tha^{-1} was found most effective to cause the highest plant height at 30 DAS (21.67 cm) and 90 DAS (99.50 CM), number of total (5.52) and productive (5.15) tillers /plant, initial (115.25) and final (459) plant population /m^2, and dry weight/ plant at 60 DAS (11.15 g) and 90 DAS (24.45 g) followed by treatment combination of RDF + Azotobacter +Vermicompost@4.0 tha^{-1} and RDF + Azotobacter +Vermicompost@3.0 tha^{-1}.Therefore, even above the suggested fertiliser dosages, the growth characteristics were considerably enhanced by the combination of both bio fertilisers, namely Vermi compost and Azotobacter. Lim et al. (2015) and Sumbul et al. (2020) have also reported on the positive effects of biofertilizers.

Table 1: Effect of FYM, Vermi compost, Azotobactor and chemical fertilizers on growth parameters in wheat

Treatment	Plant height (cm)		Number of tiller / plants		Plant population/ m^2		Dry weight/ plant (g)	
	30 DAS	90 DAS	Totaltillers	Productivetillers	Initial	Final	60 DAS	90 DAS
T_1	17.15	92.65	3.45	3.00	112.30	367	7.95	17.75
T_2	17.85	93.60	3.63	3.19	112.33	380	8.16	18.36
T_3	20.16	98.45	4.85	4.42	114.37	446	10.25	23.40
T_4	20.65	99.40	5.18	4.75	114.45	453	10.75	23.97
T_5	21.67	99.50	5.52	5.15	115.25	459	11.15	24.45
T_6	18.15	94.55	3.80	3.40	112.45	402	8.85	19.75
T_7	18.96	96.40	4.15	3.75	112.67	429	9.60	21.39
T_8	19.66	97.31	4.50	4.08	113.33	438	10.03	22.40
S.Em±	0.99	2.11	0.20	0.16	2.20	6.98	0.45	0.87
C.D. at 5%	2.14	4.53	0.43	0.34	N.S.	14.98	0.98	1.87

Yield and its contributing traits

Grain yield, biological yield, straw yield, and the conversion of photosynthetic production into commercial yield are all complicated processes that depend on a variety of characteristics. The study devoted to examining how these therapies affect these characteristics is therefore valuable. Table 2 made it abundantly evident that the treatments had a considerable impact on the test weight, spike length, number of grains/spikes, and grain weight/spike. The treatment combination of RDF + Azotobacter + Vermi compost @ 5.0 t ha^{-1} produced the maximum spike length (11.15 cm), the highest number of grains / spike (54.60), the highest grain weight / spike (2.26 g), and the highest test weight (41.45 g). These treatments were followed by RDF + Azotobacter + Vermi compost @ 4.0 t ha^{-1} and RDF + Azotobacter + Vermi compost @ 3.0 t ha^{-1}. Together, these characteristics increased the yield. As a result, the greatest biological yield (131.25 q/ha),

grain yield (56.40 q/ha), straw yield (74.85 q/ha), and harvest index (42.98) were all obtained by the same treatment combination (RDF + Azotobacter + Vermi compost @ 5.0 t ha^{-1}). According to Table 3, RDF + Azotobacter + Vermi compost @ 4.0 t ha^{-1} was the second best treatment combination, and it was followed by RDF + Azotobacter + Vermi compost @ 3.0 t ha^{-1}. These biofertilizers have been identified by Singh et al. (2004) and Kachroo and Razdon (2006) as critical components in achieving a high wheat yield.

Table 2: Effect of FYM, Vermi compost, Azotobactor and chemical fertilizers onyieldattributingtraits in wheat

Treatment	Spike Length(cm)	Numbe of grain/spike	Grainweight/ spike (g)	Testweight (g)
T_1	8.41	44.35	1.84	37.15
T_2	8.66	45.80	1.90	37.30
T_3	10.67	52.27	2.17	38.70
T_4	10.85	53.15	2.21	39.15
T_5	11.15	54.60	2.26	41.45
T_6	9.35	46.70	1.94	37.49
T_7	9.80	48.00	1.99	38.10
T_8	10.50	49.70	2.06	38.65
S. Em±	0.11	1.68	0.05	0.57
C.D.at5%	0.25	3.62	0.12	1.23

Table 3: Effect of FYM, Vermi compost, Azotobactor inoculation and chemical fertilizers on biological yield, grain yield,strawyieldandharvest indexin wheat.

Treatment	Biologicalyield(q/ha)	Grainyield (q/ha)	Strawyield(q/ha)	HarvestIndex(%)
T_1	115.55	47.55	68.00	41.15
T_2	116.95	48.26	68.69	41.27
T_3	124.65	52.30	72.35	41.96
T_4	128.90	54.41	74.49	42.21
T_5	131.25	56.40	74.85	42.98
T_6	118.70	49.57	69.13	41.76
T_7	121.48	50.78	70.70	41.80
T_8	123.12	51.60	71.52	41.91
S.Em±	4.33	1.44	1.73	0.33
C.D. at 5%	9.28	3.09	3.71s	0.71

Conclusion

It is concluded that wheatseed inoculated with Azotobacter@ 1 packet Azotobacter with 10 kg seed and soil amendment with Vermi- compost @ 5 t/ha could along with RDF increased significantly the growth parameters viz., plant height, number of total and productive tillers /plant, initial and final plant population /m^2, and dry weight/ plant; yields viz., biological yield , grain yield , straw yield and harvest index and their important contributing traitssuch as, spike length , number of number of grains / spike , grain weight / spike and test weight. Thus, the wheat seed inoculated with Azotobacter @ 1 packet Azotobacter with 10 kg seed and soil amendment with Vermi- compost @ 5 t/ha in addition to RDFcould increase the growth and yield up to 16-18 per cent more over the recommended doses of fertilizers in wheat.

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