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Effect of integrated nutrients management on growth and yield of wheat

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ABSTRACT

Present field experiment was conducted in the Agricultural Science Research Area, Prabhu Dayal Memorial University, between 2020-21 and 2021-22 for the study. For the study to Effect of integrated nutrients management on growth, yield characteristics and yield of wheat. The experiment was done in a randomized block design with three replications and ten treatments. T1. Control, T2.100% RDN (recommended dose Nitrogen) +25% N by FYM, T3.100% RDN+25% N by vermicompost, T4.75% RDN+25% N by FYM, T5.75% RDN+ 25% N by vermicompost, T6.50% RDN+50% N by FYM, T7. By 50% RDN+50% N FYM by vermicompost, T8.25% RDN+75% N by vermicompost and T10. 100% RD. The highest yielding traits and wheat yield were produced with 100 percent of the recommended dose Nitrogen (RDN)+25 percent nitrogen by vermicompost in two consecutive years, but it did not differ By FYM using the recommended dose of 100 percent nitrogen (RDN)+25 percent nitrogen significantly and a treatment that applied 100 percent of the recommended dose of nitrogen. Pooled on a two-year basis data, T3 produced 94.96 percent more effective tillers, 34.14 percent longer spike length, 25.47 percent longer test weight, 165.21 percent higher grain yield and 157.13 percent higher straw yield in wheat over control.

Keywords: *Integrated Nutrient Management, Wheat Yield, Nutrients*

1. INTRODUCTION

Wheat (Triticum aestival L.) is one of the world's leading cereal crops, which can be grown in a broad range of altitudes and latitudes. Wheat is one of the good sources of carbohydrates and unique protein, which is consumed as human as well as animal feed. Wheat is the staple food of nearly 35% of the world population. The total area under wheat cultivation in the world during 2018-19 was 218.2 million hectares with an annual production of 765.5 million tons and average productivity of 3.51 tons ha1 (USDA, 2019). Wheat is globally second to rice in terms of total production. In India wheat is a major crop of northwestern zone and center zone and is the second most important crop next to rice, which contributes nearly 35% to the national food basket. India is the second largest producer of wheat next to China, which produces about 99.9 million tons of wheat from an area of 29.6 million hectare with an average productivity of 3.37 t ha-1. The states which produce a considerable amount of wheat are Haryana, Uttar Pradesh, Punjab, Rajasthan, Gujarat, Madhya Pradesh, Bihar and Maharashtra. Haryana produces 10.8 m t of wheat from 2.4 m ha area with an average productivity of 4.41 t ha-1 (ICAR-IIWBR on Wheat and Barley, Director's Report 2018-19). Due to declining soil fertility, environmental pollution and to sustain plant, animal and human health, the interest for organic production is increasing day by day in the world. In India, sufficient amount of organic manures like crop residues (603.5 mt), animal dung manure (791.6 mt), rural compost (148.3 mt), city compost (12.2 mt) and bio-fertilizer (0.41mt) are available. Therefore, for maintaining soil fertility, producing healthy food, keeping the environment clean and sustaining crop productivity these organic wastes can be a good substitute for chemical fertilizers (Bhattacharya and Chakraborty, 2005). Among different organic manures, farmyard manure (FYM) and vermicompost are the major organic sources which can recoup the soil health. Application of vermicompost and FYM can reduce the ill effect of chemical fertilizers and their incorporation improves the nutrient status and uptake in soil. However, these organic manures contain nutrient in small protreatments. Them pared to chemical fertilizers but besides plant nutrients, presence of growth promoting substances such as enzymes and hormones make them unique for improvement of soil fertility and productivity (Srivastava, 1998). Farmyard manure and vermicompost are most valuable organic manures, which are used as good sources of nutrient for crop production since long. Both these organic sources besides supply macro and micro nutrient to the crop, they also improve soil structure, increase water holding capacity of soil and sustain the soil fertility and crop productivity. Further, these manures stimulate the activity of microorganisms that make the plants to get the macro and micronutrients throughout the biological decomposition (Kale and Banu, 1986 and Khan et al., 2017).

2. MATERIALS AND METHODS

A field experiment was conducted at the Agronomy Research Farm at Prabhu Dayak Memorial University, Bahadurgarh. The experiment consisted of three replications in a randomized block design Ten treatment combinations mean T1-control; T2- 100% Recommended Nitrogen (RDN) + 25% N by FYM; T3- 100% RDN + 25% N by vermicompost; T4- 75% RDN + 25% N by FYM; T5- 75% RDN + 25% N by vermicompost; FYM, T7- through T6- 50% RDN + 50% N 50% RDN + 50% N by vermicompost; T8 by FYM- 25% RDN + 75% N; T9- 25% RDN + 75% N by vermicompost and T10-100% RDN by chemical fertilizers. There were fertilizers Used as a recommended learning package in all treatments except control and extra 25 Percentage of N by FYM and vermicompost were applied in T2 and T3 respectively. Vermicompost and FYM applied two weeks before sowing as per treatments. The initial condition of soil fertility was 172:17:270 kg NPK ha-1 with 0.44 percent organic carbon. Full dose and half of phosphorus Nitrogen, according to treatments, is applied at sowing and the other half is nitrogen top dressing. Data were recorded on plant height, dry matter accumulation and leaf area index, Number of effective tillers, spike length, number of grains/spikes, 1000 grain weight, grain yield and Straw yield was recorded using standard procedure for wheat crop.

3. RESULTS AND DISCUSSION

3. Growth parameters

3.1 Plant height

Significantly taller plant height of wheat was measured with 100% application RDN+25% N by vermicompost (T3) was similar to 100% RDN+25% N application. through FYM (T2) and 100% RDN (T10) application at all observation stages of the crop and at harvest in two growing seasons. T3 produced 89.37 based on two years of pooled data Percent tall plant height of wheat over control at wheat harvest. Considerably tall plant Height of wheat in T3 may be due to faster mineralization of chemical fertilizers supply of nitrogen at early stage of crop and presence of relatively readily available nutrients, Vermicompost contains growth promoting substances and other beneficial microorganisms, viz Participates in nitrogen fixation, glucose decomposition and other beneficial activities for nutrients availability at later stages of wheat crop. These findings are in line with **Hadis et al. (2018) and Kumar et al. (2017)** who concluded that, vermicompost is the source of different essential plant nutrients and hormones with low amount, and its application with inorganic fertilizer increases the growth attributes and yield of wheat.

3.2 Dry matter accumulation

In both years, dry matter (g/meter row length) was significantly higher at harvest. Wheat produced with T3 was similar to T2 and T10 at all observations taken during growth. Stages of crop and during harvest. Application of 100% RDN+25% N was observed by Vermicompost producing 354 percent and 341.24 percent higher dry matter of wheat crop. Control treatment in two consecutive years. The control treatment accumulated minimum dry weight at harvest of wheat during both the growing seasons. These findings are in close confirmation with **Patel et al. (2018), Mohan et al. (2018), and Singh et al. (2017),** stated that, adequate amount of nutrient supply especially nitrogen translocates more photosynthesis from source to sink and increase the dry matter accumulation of wheat crop.

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3.3 Leaf area index

In all treatments, application of 100% RDN+25% N by vermicompost/FYM Significantly higher LAI at crop anthesis was statistically equivalent to 100% application RDN in two years of experiments. Wheat leaf area was found to be an indicator 62.91 percent and 53.93 percent higher with 100% RDN+25% N application. Vermicompost over control treatment in two consecutive years. These results are in conformity with **Patel et al. (2018),** who stated that, supply of adequate amount of nutrient particularly nitrogen at active growth stages of the crop leads to leaf area development and increases LAI

Table 1: Plant height (cm) of wheat as influenced by integrated nutrient management

Treatments	2020-21					2021-22				
	Days after sowing					Days after sowing				
	30	60	90	120	at harvest	30	60	90	120	at harvest
T_1. Control	13.36	20.74	41.89	49.57	52.93	12.93	21.19	42.07	49.68	53.52
T_2. 100% RDN+ 25% N through FYM	22.30	45.59	81.25	91.35	98.17	24.03	46.38	82.79	92.38	101.18
T_3.100%RDN+ 25% N through vermicompost	22.52	46.07	82.50	92.21	99.33	24.37	47.14	84.12	93.55	102.27
T_4. 75% RDN+ 25% N through FYM	20.32	42.57	76.37	85.79	93.03	21.68	43.28	77.69	86.85	94.72
T_5. 75% RDN+ 25% N through vermicompost	20.65	43.25	77.07	87.13	93.88	21.85	43.58	78.65	88.24	95.68
T_6. 50% RDN+ 50% N through FYM	19.65	39.75	72.13	82.65	89.46	20.75	40.19	73.29	83.76	90.12
T_7. 50% RDN+ 50% N through vermicompost	19.88	40.85	74.18	83.61	90.64	21.28	41.16	75.64	85.07	93.22
T_8. 25% RDN+ 75% N through FYM	18.09	37.21	69.49	78.54	84.23	18.67	37.64	70.45	79.36	85.85
T_9. 25% RDN+ 75% N through vermicompost	18.25	38.52	71.35	80.99	86.75	19.17	38.95	72.47	81.92	89.41
T_{10}. 100% RDN	22.26	45.48	80.54	90.43	97.39	23.88	46.06	81.57	91.44	100.33
SEm+	**0.44**	**0.72**	**0.80**	**0.96**	**1.04**	**0.64**	**0.76**	**0.93**	**0.98**	**1.12**
CD at 5%	**1.30**	**2.15**	**2.41**	**2.89**	**3.12**	**1.91**	**2.28**	**2.79**	**2.95**	**3.36**

Table 2: Effect of integrated nutrient management on dry matter accumulation (g m^{-1}) row length of wheat

Treatments	2020-21	2021-22
	Days after sowing	Days after sowing

	30	60	90	120	at harvest	30	60	90	120	at harvest
T_1. Control	5.41	17.45	35.64	46.61	51.93	5.82	19.21	38.47	50.03	55.21
T_2. 100% RDN+ 25% N through FYM	10.58	63.21	167.78	217.58	232.55	11.22	66.78	174.96	223.41	238.17
T_3.100%RDN+ 25% N through vermicompost	10.98	64.06	170.44	219.25	235.77	11.46	68.22	178.32	227.78	243.61
T_4. 75% RDN+ 25% N through FYM	9.28	54.13	157.17	202.25	215.07	10.03	59.19	160.77	207.56	218.17
T_5. 75% RDN+ 25% N through vermicompost	9.49	55.72	159.48	205.34	219.22	10.27	61.08	163.95	210.43	223.25
T_6. 50% RDN+ 50% N through FYM	8.51	48.07	150.78	192.51	203.70	9.02	53.18	151.39	195.32	206.02
T_7. 50% RDN+ 50% N through vermicompost	8.66	50.55	152.16	196.01	207.73	9.21	55.35	155.05	200.11	211.89
T_8. 25% RDN+ 75% N through FYM	7.50	41.85	141.84	182.39	192.04	8.08	46.31	143.29	185.14	192.15
T_9. 25% RDN+ 75% N through vermicompost	7.78	44.54	144.18	185.12	196.20	8.24	49.42	146.83	189.07	197.11
T_{10}. 100% RDN	10.44	62.01	165.78	214.86	229.70	11.09	65.73	171.77	220.14	235.12
SEm+	**0.20**	**1.07**	**1.99**	**2.80**	**3.31**	**0.24**	**1.13**	**2.39**	**3.02**	**3.36**
CD at 5%	**0.59**	**3.19**	**5.96**	**8.39**	**9.91**	**0.73**	**3.39**	**7.16**	**9.05**	**10.07**

Table 3: Leaf area of wheat as affected by integrated nutrient management

Treatments	LAI at anthesis	
	2020-21	2021-22
T_1. Control	3.02	3.05
T_2. 100% RDN+ 25% N through FYM	4.81	4.89
T_3.100%RDN+ 25% N through vermicompost	4.92	5.02
T_4. 75% RDN+ 25% N through FYM	4.46	4.53
T_5. 75% RDN+ 25% N through vermicompost	4.52	4.61
T_6. 50% RDN+ 50% N through FYM	4.16	4.22
T_7. 50% RDN+ 50% N through vermicompost	4.24	4.33
T_8. 25% RDN+ 75% N through FYM	3.95	4.01
T_9. 25% RDN+ 75% N through vermicompost	4.02	4.07
T_{10}. 100% RDN	4.78	4.83
SEm+	**0.06**	**0.08**
CD at 5%	**0.18**	**0.23**

3.4 Yield parameters

1.1 Number of effective tillers, spike length, number of grain per spike and test weight

The highest number of tillers effective for meter row length and wheat test weight was recorded with T3 being equal to T2 and T10 in two consecutive years. However, spike length and grain number were greater with T3, but similar with T2, T4, T5, T6, T7 and T10. Based on two years of pooled data, application of 100% RDN+25 N by vermicompost produced 94.96 percent more effective tillers, 34.14 percent longer spike length and 25.47 percent higher test weight. The significant high yield characteristic of wheat with T3 is due to adequate quantity and balanced proportions of plant nutrients during the growth stages of the crop, which have yield-attributing roles and further increased wheat yield.

1.2 Grain, straw yield

Application of 100% RDN+25% N by vermicompost/FYM significantly increased wheat grain yield, similar to 100% RDN application in both years. Application of 100% RDN+25% N by vermicompost produced 164.82 percent and 165.60 percent higher grain and 157.08 percent and 157.18 percent straw yield in control treatment in two years of experiments respectively.

2. Harvest index

Wheat yield index was not significantly affected by any treatment in two years of experiments.

Table 4: Yield attributes of wheat as influenced by various integrated nutrient management

Treatments	No. of Effective tillers/meter row length		Spike length (cm)		Number of grains perspike		Test weight (g)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T_1. Control	52.67	53.33	8.41	8.49	34.66	36.19	34.39	34.47
T_2. 100% RDN+ 25% N through FYM	99.67	101.67	11.12	11.38	42.73	45.43	39.38	39.84
T_3.100%RDN+ 25% N through vermicompost	101.33	104.33	11.18	11.49	43.06	45.86	39.66	40.11
T_4. 75% RDN+ 25% N through	92.67	94.00	10.98	11.21	41.89	44.53	38.07	38.33

FYM								
T_5. 75% RDN+ 25% N through vermicompost	94.33	95.67	11.05	11.27	42.26	44.66	38.20	38.53
T_6. 50% RDN+ 50% N through FYM	86.67	88.00	10.84	11.12	40.76	43.46	36.68	36.85
T_7. 50% RDN+ 50% N through vermicompost	88.33	90.00	10.88	11.16	40.59	43.83	37.15	37.33
T_8. 25% RDN+ 75% N through FYM	78.33	79.33	10.66	10.97	40.23	42.73	35.40	35.68
T_9. 25% RDN+ 75% N through vermicompost	81.67	83.00	10.72	11.02	40.09	42.96	35.71	35.92
T_{10}. 100% RDN	99.00	100.67	11.07	11.31	42.63	45.13	39.33	39.65
SEm+	**1.44**	**1.25**	**0.13**	**0.14**	**0.85**	**0.83**	**0.23**	**0.29**
CD at 5%	**4.33**	**3.74**	**0.39**	**0.41**	**2.56**	**2.50**	**0.68**	**0.88**

Table 5: Grain and straw yield of wheat as affected by various integrated nutrient management

Treatments	Grain yield (kg ha^{-1})		Straw yield (kg ha^{-1})		Biological yield (kg ha^{-1})		Harvest index (%)	
	2020-21	**2021-22**	**2020-21**	**2021-22**	**2020-21**	**2021-22**	**2020-21**	**2021-22**
T_1. Control	2135	2183	2896	2931	5031	5114	42.50	42.74
T_2. 100% RDN+ 25% N through FYM	5548	5676	7327	7415	12875	13091	43.14	43.35
T_3.100%RDN+ 25% N through vermicompost	5654	5798	7445	7538	13099	13336	43.17	43.44
T_4. 75% RDN+ 25% N through FYM	5102	5200	6808	6841	11910	12041	42.86	43.18
T_5. 75% RDN+ 25% N through vermicompost	5232	5345	6922	6974	12154	12319	43.08	43.37
T_6. 50% RDN+ 50% N through FYM	4690	4799	6320	6357	11010	11156	42.64	43.01
T_7. 50% RDN+ 50% N through vermicompost	4850	4968	6510	6535	11360	11503	42.73	43.27
T_8. 25% RDN+ 75% N through FYM	4275	4371	5803	5829	10078	10200	42.43	42.87
T_9. 25% RDN+ 75% N through vermicompost	4419	4518	6030	6053	10449	10571	42.38	42.78
T_{10}. 100% RDN	5485	5587	7203	7288	12688	12875	43.24	43.41
SEm+	**72**	**73**	**84**	**93**	**141**	**145**	**0.34**	**0.38**
CD at 5%	**216**	**220**	**251**	**279**	**424**	**435**	**NS**	**NS**

4. CONCLUSION

To maintain soil health and obtain significantly higher wheat yield over control, 100 percent recommended nitrogen + 25 percent nitrogen addition through vermicompost/FYM can be recommended to wheat growers.

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