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Effect of Integrated Nutrient Management on Growth Attributes of Wheat Varieties in North Haryana

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ABSTRACT

A field experiment entitled "Performance of different varieties of wheat under integrated nutrient management system" was carried out during winter 2017-18 and 2018-19 at RRS (Rice), Kaul, Haryana. The experiment comprising of 4 varieties in main plots (WH 1080, WH 1025, WH 1142 and WH 711) and 5 levels of nutrient combination in subplots (N_1: Control, N_2: 100% RDF, N_3: 50% RDF + 50% RDF through FYM, N_4: 50% RDF + 50% RDF through Vermicompost and N_5: 50% RDF + 50% RDF through FYM + 50% RDF through Vermicompost + Biofertlizers) was carried out in split plot design with three replications. The pooled mean analysis results revealed that wheat variety WH 1142 resulted in significantly higher plant height (97.9 and 99.8 cm, respectively), dry matter accumulation (21.9 and 25.5 g plant^{-1}, respectively) at 120 DAS and at harvest over other varieties. Pooled mean LAI at 90 DAS (6.3), at 120 DAS (3.2), LAD at 90 DAS (161.5), at 120 DAS (131.3) and grain yield (4806 kg ha^{-1}) at harvest in WH 1142 was significantly higher than other wheat varieties studied. Shoot length (77.9 cm) at 90 DAS in WH 1142 was significant over WH 1080 and WH 1025. Plant height at 120 DAS (99.2 cm) and at harvest (101.7 cm), dry matter accumulation at 120 DAS (22.9 g plant^{-1}), LAI at 90 DAS (6.1), at 120 DAS (3.0), LAD at 90 DAS (162.8) and grain yield (4747 kg ha^{-1}) at harvest was significant with 100% RDF over other nutrient sources. INM practice N_5: 50% RDF + 50% RDF through FYM + 50% through VC + Biofertilizer resulted into significant higher plant height, dry matter accumulation, LAI, LAD and shoot length over N_3: 50% RDF + 50% RDF through FYM and N_4:50% RDF + 50% through VC.

Keywords: Dry matter, INM, Shoot length, Varieties and Yield.

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INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important crop of northern and central India. It has highest protein among all cereals, ranging from 10 to 12%, which is known as gluten and is important for the bakery purpose. Wheat also has a high amount of niacin and thiamine amino acids (Morris *et al,* 2016). Wheat flour is exceptional as sources of the proteins in gluten that help dough come together. The many dishes made from wheat, including leavened breads, pasta, noodles, flat/pocket breads, steamed breads, biscuits, cakes, and pastries, require certain qualities that these gluten proteins possess. As a result, wheat, a crucial component of the diets of the majority of people on Earth, plays a significant role in international trade. Of all the grains, their qualitative characteristics are the most important. In the world, wheat is grown on 220.8 million ha area, with production of 775.71 M metrics tonnes and productivity of 3.5 t ha^{-1} (FAO, 2020). In India wheat has an area of 31.45 million ha and production of 107.59 M tonnes and productivity of 3.53 t ha^{-1}, while Haryana produced 11.88 M tonnes of wheat from 2.5 M ha area with productivity 4.6 kg ha^{-1} during 2019-20 which accounted 11.04% of total wheat production in India (DOES, 2020). India accounts for even less than 1% in world wheat export. However, its share has increased from 0.14% in 2016 to 0.54% in 2020. India is the second largest producer of wheat with a share of around 13.53% of world total production. India produces around 107.59 MT of wheat annually while a major chunk of it goes towards domestic consumption (APEDA, 2020). As the crop has a high nutrient requirement and responds positively to increased levels of chemical fertilisers, nutrient management is important for maintaining this system's productivity. However, the decline in soil and environmental health as a result of indiscriminate use of chemical fertilizers, as well as the rise in the cost of chemical fertilisers as a result of rising input costs and transportation costs as a result of rising global oil prices in the international market. Supplementing or replacing chemical fertilizers with less expensive nutrient sources like organic and biofertilizers helps to reduce the import burden and energy crisis. Globally, wheat yields have increased considerably as a result of breeding programmes that have incorporated the short-straw trait from Mexican varieties. Such varieties are more responsive to applied nutrients and are also more resistant to lodging as compared with the local wheat varieties Buchi *et al.* (2016).

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Prasanna *et al*. (2014) found that *Azotobacter and Azospirillum* can fix15-20 kg and 20-30 kg ha^{-1}, respectively, under field conditions, thus, saving the cost of fertilizers. Since organic sources of nutrients are important constituents of integrated nutrient management, understanding of their chemical composition, decomposition, and the rate of nitrogen mineralization is of utmost importance. It is necessary to use the right combination of organic and inorganic fertiliser in this endeavour to increase output while also maintaining the soil health.

MATERIAL AND METHODS

A field experiment entitled "Performance of different varieties of wheat (*Triticum aestivum* L.) under integrated nutrient management system" was carried out during winter 2017-18 and 2018-19 at Regional Rice Research Station, Kaul situated at 29.84°98 N latitude, 76.66°15 E longitude in district Kaithal, Haryana. The experiment comprising of 4 varieties in main plots (WH 1080, WH 1025, WH 1142 and WH 711) and 5 levels of nutrient combination in subplots (N_1: Control, N_2: 100% RDF, N_3: 50% RDF + 50% RDF through FYM, N_4: 50% RDF + 50% RDF through Vermicompost and N_5: 50% RDF + 50% RDF through FYM + 50% RDF through Vermicompost + Biofertlizers) was carried out in split plot design with three replications.The soil of the experimental plot was clay loam in texture and slightly alkaline in reaction with pH 7.8 and EC of 0.17 dS m^{-1}. The soil was low in available nitrogen (107.8 kg ha^{-}) and medium in available phosphorus (25.4 kg ha^{-1}), iron (13.45 ppm), manganese (2.85 ppm), zinc (1.76 ppm), copper (1.37 ppm) and high in available potassium (313.2 kg ha^{-1}) (Table 1).

Table 1: Physico-chemical properties of the experimental site

Properties	Contents	Method employed
A. Mechanical Composition		
1. Sand (%)	41.2	International pipette method (Piper, 1950)
2. Silt (%)	32.3	
3. Clay (%)	26.3	
4. Texture class	Loam	
5. Bulk density (Mg M^{-3})	1.41	Core sampler (Piper, 1950)
B. Chemical Composition		
1. Soil pH (1:2.5)	7.9	pH meter (Richards,1954)
2. Electrical conductivity (dS m^{-1}) at 25°C (1:2.5)	0.27	EC meter (Jackson, 1974)
3. Organic carbon (%)	0.41	Walkley and Black wet oxidation method (Jackson,1974)
4. Available N (kg ha^{-1})	107.8	Alkaline $KMnO_4$ method (Subbiah and Asija, 1956)
5. Available P_2O_5 (kg ha^{-1})	25.4	Olsen's method (Olsen *et. al*., 1954)
6. Available K_2O (kg ha^{-1})	313.2	Flame photometric method (Jackson, 1974)
7. Fe (ppm)	13.45	DTPA extractable by AAS method (Lindsay & Norvell,1978)
8. Mn (ppm)	2.85	
9. Zn (ppm)	1.76	
10. Cu (ppm)	1.37	

RESULTS AND DISCUSSION

Effect of varieties

The pooled mean of plant height (97.9 and 99.8 cm) and dry matter accumulation per plant (21.9 and 25.6 g plant^{-1}) at 120 DAS and at harvest, respectively were found significantly higher in variety WH 1142 over all the varieties (Table 2). The minimum pooled mean plant height (93.2 and 95.8 cm) and dry matter accumulation per plant (20.4 and 24.2 g plant^{-1}, respectively) at 120 DAS and at harvest were recorded in variety WH 1025. The varietal difference with different varieties were also reported by Khan *et al.* (2017). Wheat variety WH 1142 resulted significantly higher LAI at 90 (6.3) and 120 DAS (3.2), respectively. Similarly, the shoot length was found significantly higher in wheat variety WH 1142 (77.9 cm) at 90 DAS. WH 1142 attained significantly higher pooled mean gain yield (4871 kg ha^{-1}) than WH 1080 (4725 kg ha^{-1}), WH 1025 (3602 kg ha^{-1}) and WH 711 (4806 kg ha^{-1}), respectively (Table 2). The higher values in the growth parameters and grain yield of WH 1142 might be due to its genetic makeup making it competitive for inception of solar radiation, water, space and nutrient necessary for growth over other wheat varieties. These results are in line with findings of Ajay *et al*. (2022).

Effect of nutrient managements

The pooled means of leaf area index and leaf area duration during 2017-18 and 2018-19 at 120 DAS and at harvest were observed significantly higher with 100% RDF @ 150:60:60 kg ha^{-1} (Table 2). The application of 100% RDF was found significantly higher in terms of plant height at 120 (99.15 cm) and at harvest (101.7 cm), respectively. Similarly, LAI (6.1 and 3.0, at 90 and 120 DAS, respectively), LAD (162.8 and 132.5 at 90 and 120 DAS, respectively) and shoot length (79.1 cm) at 90 DAS were found significantly higher in treatment receiving 100% RDF. Treatment of nutrient management differed significantly for grain yield in pooled mean in both years. Application of 100% RDF through inorganic source resulted in significantly higher grain yield (4747 kg ha^{-1}) than all other treatments of nutrient application (Table 2). This might be attributed to quick release of nutrients in sufficient quantity by fertilizers (100% RDF) during early stage of plants when nutrients are required for proper root growth and establishment. These results are in line with findings of Hasim *et al.* (2015) and Gadisa and Wakgari (2021).

Among integrated nutrient management approach treatment N_5: 50% RDF + 50% RDF through FYM + 50% RDF through Vermicompost + Biofertlizers gives better result over treatment N_3: 50% RDF + 50% RDF through FYM and N_4: 50% RDF + 50% RDF through Vermicompost respectively. This might be attributed to supply of both macro and micronutrients to plants through FYM and vermicompost during the entire growth period. Besides, FYM as well as vermicompost also help in improving the physical, chemical and biological properties of soil which favour better plant growth and development. Biofertlizers mineralize the fixed nutrient by releasing organic acid, thus providing nitrogen and phosphorus to the wheat plant. The result are in close vicinity with the finding of Mayer *et al.* (2015) .

Table 2: Effect of varieties and integrated nutrient management on growth and grain yield of wheat (Pooled mean of 2017-18 & 2018-19).

Treatments	Plant height (cm)		Dry matter accumulation (g/plant)		Leaf area index		Leaf area duration		Shoot length at 90 DAS (cm)	Grain yield (Kg ha^{-1})
	120 DAS	At Harvest	120 DAS	At Harvest	90 DAS	120 DAS	90 DAS	120 DAS		
Varieties (V)										
WH 1080	94.8	97.3	21.0	24.8	5.7	2.7	157.5	128.5	75.4	4725
WH 1025	93.2	95.8	20.4	24.2	5.5	2.5	156.0	127.1	74.5	3602
WH 1142	97.9	99.8	21.9	25.6	6.3	3.2	161.5	131.3	77.9	4871
WH 711	96.3	98.5	21.4	25.0	6.0	3.0	159.3	129.9	76.9	4806
SEm±	0.17	0.11	0.1	0.14	0.02	0.01	0.45	0.68	0.53	23.70
C.D. (p = 0.05)	0.59	0.39	0.36	0.48	0.08	0.03	1.58	2.40	1.87	71.00
Nutrient sources (N)										
Control	90.8	93.8	18.2	23.2	5.5	2.6	151.5	121.9	70.6	4394
100% RDF	99.2	101.7	22.9	26.0	6.1	3.0	162.8	132.5	79.1	4747
50% RDF + 50% RDF through FYM	94.9	97.0	21.3	24.7	5.8	2.8	158.3	129.8	76.4	4413
50% RDF + 50% RDF throughVC	96.0	97.7	21.4	25.0	5.9	2.9	159.6	130.6	76.9	4448
50% RDF + 50% RDF through FYM + 50% RDF through VC + Biofertilizers	97.0	99.0	22.1	25.5	6.0	2.9	160.7	131.3	77.8	4504
SEm±	0.19	0.18	0.12	0.21	0.02	0.01	0.58	0.52	0.50	17.90
C.D. (p = 0.05)	0.56	0.53	0.36	0.61	0.07	0.03	1.67	1.51	1.44	51.90

CONCLUSION

Based on two-year pooled mean experimental results it was found that significantly highest growth attributes (plant height, leaf area index, leaf area duration, dry matter accumulation and shoot length) and grain yield was observed in wheat variety WH 1142 over all other wheat varieties. Among treatment of nutrient management the application of 100% RDF @ 150:60:60 kg ha^{-1} of NPK through inorganic source resulted into higher growth parameters and grain yield in pooled mean of 2017-18 and 2018-19, respectively.

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