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Short Article

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Effect of Integrated Nitrogen Management on Growth, Yield and Economics of Wheat (*Triticum aestivum* L.)

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Abstract

The present investigation entitled "Effect of integrated nitrogen management on growth, yield and economics of wheat (*Triticum aestivum* L.)" was carried out during the *rabi* season of 2016–17 at the B.T.C.CARS (IGKV), Bilaspur (Chhattisgarh). The experiment was laid out in 3 times replicated R.B.D. The treatment consists of 10 nitrogen management practices for study of character associated with yield and yield contributing traits viz. recommended dose (RD) of nitrogen through fertilizer (120, 60, 40 kg NPK ha^{-1}), 75% RDFN, 50% RDFN+50% N through farm yard manure (FYM), 50% RDFN+50% N through Vermi-compost (VC), 50% RDFN+50% N through FYM+*Azospirillum* @ 5g kg^{-1} Seed, 50% RDFN+50% N through FYM+*Azotobacter* @ 5 g kg^{-1} seed, 50% RDFN+50% N through FYM+PSB @ 5 g kg^{-1} seed, 50% RDFN+50% N through VC+*Azospirillum* @ 5 g kg^{-1} seed, 50% RDFN+50% N through VC+*Azotobacter* @ 5 g kg^{-1} seed and 50% RDFN+50% N through VC+PSB @ 5 g kg^{-1} seed. The results revealed that the growth attributes and yield attributes was observed to be significantly higher under recommended application of nitrogen through inorganic fertilizer, closely followed by 50% RDFN+50% N through VC+*Azotobacter* @ 5 g kg^{-1} seed. The 75% RD of N through fertilizer showed significantly inferior values for most of the above stated parameters.

Keywords: Wheat, fertilizer, fym, vermicompost, azotobacter, azospirilum, PSB, yield

1. Introduction

Wheat (*Triticum aestivum* L.) is the most popular staple and second most important food crop after rice in India, which contributes nearly one-third of the total food grains production. It is grown across a wide range of environments around the country and has the highest adaptation among all the crop species. In India, wheat is cultivated in an area of 30.23 million hectares with the annual production of 93.50 mt and average productivity of 3093 kg ha^{-1} (Anonymous, 2016).

India has the largest area in the World under wheat cultivation (31.3 mha) and 95.8 mt production but due to low productivity (3059 kg ha^{-1}) it has only 13.1% global share of wheat production) it was the third largest producer after EU-27 and China which ranked to second wheat growing country after China in the world in term of individual country. The major wheat producing states of India are Uttar Pradesh, Punjab, Madhya Pradesh and Haryana with production of 30.3, 16.6, 13.4, 11.1 mt in 2012–13, respectively The first rank is U.P. (32.23%), second is Punjab (17.65%), third is Madhya Pradesh (13.971%) and fourth is Haryana (11.826%) out of total wheat production, but productivity is maximum in the Punjab. In Chhattisgarh, wheat is grown in typical semi arid climate which is characterized by high temperature during crop growth. The area under wheat in state is 182 t ha with total production of 252.98 thousand tons with an average productivity of the state is 1390 kg ha^{-1}, which is much lower than the national average (3059 kg) because of high temperature and low humidity coupled with rainfed cultivation of the crop.

2. Materials and Methods

The present research was conducted during the *rabi* season of 2016-17 at the B.T.C. College of Agriculture and Research Station (IGKV), Bilaspur (Chhattisgarh). The soil of the experimental site was clayey in texture (sand 24.32%, silt 22.72% and clay 51.86%) with pH 6.9 and EC 0.21 dS/m in the top 15 cm of soil. The soil was low in available N (275 kg ha^{-1}) and medium in organic carbon (0.75%), available P (13.75 kg ha^{-1}) and available K (268 kg ha^{-1}).The experiment was laid out in 3 times replicated Randomized Block Design. The treatment consists of 10 nitrogen management practices. Wheat (cv. Ratan) was sown on 29th November, 2016 and harvesting was done on 30th March, 2017. FYM and Vermicompost was applied before sowing and well mixed in soil as per treatment plot. respectively. *Azotobacter, Azospirilium and PSB* was used as seed treatment. Half of the nitrogen as per treatment and full dose of phosphorus, potassium were applied at the sowing as basal application and remaining nitrogen as per treatment was top dressed in two split. N, P and K were applied through urea, Single Super Phosphate and muriate of potash, respectively.

3. Results and Discussion

The experimental findings pertaining to yield attributes of wheat, viz., number of effective tillers m^{-2}, spike length, grains ear^{-1} and grain weight ear^{-1} as influenced by integrated nitrogen management practices application of RD of N through inorganic fertilizer (T_1) recorded significantly higher number of effective tillers (348.1) over T_2, although rest of the treatments exhibited on par performance for number of effective tillers. The increase in the number of effective tillers in T_1 was by 1.88% compared to T_2.

That number of grains ear $head^{-1}$ was significantly affected due integrated use of nitrogen. The number of grains $earhead^{-1}$ was recorded to be significantly higher (47.0 grains $earhead^{-1}$) in the plots where wheat crop was fertilized with RD of N through inorganic source. T_9 (46.4 grains $earhead^{-1}$) was second most effective in attaining higher number of grains $earhead^{-1}$ and showed on par result with T1 along with T_5, T_6, T_7, T_8 and T_{10}. Application of 75% RDFN proved to be most inferior treatment in terms of grains $earhead^{-1}$. This treatment produced 12.8% lesser grains $earhead^{-1}$ compared to T_1. Present study is in line with the findings of Chaudhry et al. (2014) who reported highest number of grains $spike^{-1}$ in the treatment where recommended dose of nitrogen was applied through fertilizers attributing to fertility of spikelets which This treatment produced 12.8% lesser grains $earhead^{-1}$ compared to T_1. Present study is in line with the findings of Chaudhry et al. (2014) who reported highest number of grains $spike^{-1}$ in the treatment where recommended dose of nitrogen was applied through fertilizers attributing to fertility of spikelets which may improve due to proper uptake of plant nutrients under nutrients application treatments.

It is evident that nitrogen management did not exert any significant variation in number of grains $earhead^{-1}$, although highest spike length (12.30 cm) was recorded with RDFN (T_1) followed by application of 50% RDFN+50% N through VC+*Azotobacter* @ 5g kg^{-1} seed (T_9). Lowest spike length (8.90 cm) was measured with 75% RDFN (T_2). Results showed that either mineral N or organic N; both helped the plants to produce well developed ear heads. Application of adequate amount and utilization of nitrogen leads to high photosynthetic efficiency and accumulation of high dry matter which ultimately increases ear (spike) length. Similar results were also reported by Shah et al. (2010) (Table 1).

The weight of grains ear $head^{-1}$ pertaining to different treatments has been Similar to spike length, nitrogen management may improve due to proper uptake of plant nutrients under nutrients application treatments.

Table 1: Effect of integrated nitrogen management on growth and yield attributing characters of wheat

Treatment	Effective tillers (m^{-2})	Spike length (cm)	Grains ear^{-1}	Grains weight ear^{-1} (g)
T_1	348.1	12.30	47.0	2.46
T_2	341.7	8.90	41.7	1.86
T_3	342.6	9.67	42.4	1.90
T_4	343.3	9.83	42.8	1.92
T_5	346.0	10.19	45.0	2.08
T_6	346.7	10.26	45.3	2.14
T_7	344.4	9.93	43.7	1.96
T_8	347.3	11.00	46.0	2.20
T_9	347.7	11.20	46.4	2.38
T_{10}	345.0	10.17	44.1	1.99
SEm±	1.94	1.21	1.15	0.34
CD (p=0.05)	5.76	3.59	3.42	1.02

T_1: 100 % RDF-120:60:40 kg NPK ha^{-1}; T_2: 75 % RDFN; T_3: 50 % RDFN+50% N through FYM; T_4: 50% RDFN+50% N through VC; T_5: 50 % RDFN+50% N through FYM+azospirillum @ 5 g kg^{-1} Seed; T_6: 50 % RDFN+50% N through FYM+Azotobacter @ 5 g kg^{-1} seed; T_7: 50 % RDFN+50% N through FYM+PSB @ 5 g kg^{-1} seed; T_8: 50 % RDFN+50% N through VC+Azospirillum @ 5 g kg^{-1} seed; T_9: 50% RDFN+50% N through VC+Azotobacter @ 5 g kg^{-1} seed; T_{10}: 50% RDFN+50% N through VC+PSB @ 5 g kg^{-1} seed

practices in wheat failed to induce marked deviation in grain weight $earhead^{-1}$. Maximum grain weight (2.46 g ear^{-1}) was observed in T_1 closely followed by T_9, T_8, T_6 and T_5. Treatment comprising application of 75% recommended nitrogen through fertilizer recorded lowest grain weight (1.86 g ear^{-1}). Highest grain weight ear^{-1} resulting from the 100% application of nitrogen through fertilizers could be attributed to increased number of grains $spike^{-1}$ and spike weight. The average grain yield varied from 1976 to 2703 kg ha^{-1}. Application of RD of nitrogen through inorganic source (urea) (T_1) exhibited significantly higher grain yield (2703 kg ha^{-1}) compared to 75% RDFN (T_2). The yield increase following the recommended application of nitrogen through urea was to the tune of 36.8% over T_2. Higher effective tillers m^{-2}, spike length, grains ear^{-1} and grain weight $earhead^{-1}$ had favourable effects on culminating higher grain yield. Such higher grain yield under 100% of RDF and other integrated nutrients treatments might be attributed to more number of productive tillers per unit area and improved yield attributes particularly the grain weight $spike^{-1}$. Sufficient availability of plant nutrients in soil and their proper uptake by crop which produced more crop canopy thereby production, accumulation and translocation of more photosynthates from source to sink. These results are in agreement to the findings of Gill and Rathore (2004), Rather and Sharma (2009); Chaudhry et al. (2014). Singh et al. (2003) also observed that any reduction in NP even with integration of 5 t ha^{-1} FYM caused significant reduction in grain yield of wheat. It may thus, be inferred from grain yield results that to get higher grain yield the use of 100% RDF is necessary.

The maximum straw yield of 3672 kg ha^{-1} was obtained in treatment provided with recommended nitrogen through inorganic fertilizer (T_1) followed by 3633 kg ha^{-1} in treatment (T_9) receiving 50% RD of N through fertilizer+50% RD of N through VC+*Azotobacter* @ 5 g kg^{-1} seed. Lowest straw yield (2989 kg ha^{-1}) was recorded from T_2 treatment where 75% RD of N was provided through urea. 100% N application through fertilizer (T_1) showed an increase of 22.9% in the straw yield compared to T_2, although, T_9, T_8, T_6 and T_5 showed at par result with T_1. The ability of a crop to convert the total dry matter into economic yield is indicated by its harvest index value. The maximum harvest index of 42.4% was registered where 100% N was supplied to wheat crop from urea (T_1), which was significantly superior over application of 75% RD of nitrogen through fertilizer (T_2) and 50% RDFN+50% N through FYM (T_3). Significantly lower harvest index (39.8%) was reported from T_2 (Table 2).

Table 2: Effect of integrated nitrogen management on grain yield, straw yield and harvest index of wheat

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
T_1	348.1	12.30	47.0
T_2	341.7	8.90	41.7
T_3	342.6	9.67	42.4
T_4	343.3	9.83	42.8
T_5	346.0	10.19	45.0
T_6	346.7	10.26	45.3
T_7	344.4	9.93	43.7
T_8	347.3	11.00	46.0
T_9	347.7	11.20	46.4
T_{10}	345.0	10.17	44.1
SEm±	1.94	1.21	1.15
CD (p=0.05)	5.76	3.59	3.42

4. Conclusion

Recommended application of N through fertilizer (T_1) closely followed by the use of 50% RD of N through fertilizer + 50% RD of N through VC+*Azotobacter* @ 5 g kg^{-1} seed (T_9) exhibited significantly higher grain (2703 kg ha^{-1}) and straw yield (3672 kg ha^{-1}). This treatment earmarked yield advantage of 36.8% and 22.9% in grain and straw yield respectively as compared to 75% RDFN application (T_2).

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