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Research Article

Compensating Nitrogen Fertilizer Requirement of *desi* Wheat by Vermicompost and *Azotobacter*

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ABSTRACT

The aim of the present study was compensating nitrogen fertilizer requirement of desi wheat by vermicompost and Azotobacter. The experiment was conducted during the rabi season of 2017-2018 at the Agronomy Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar. The soil of the experimental field is sandy loam in texture, slightly alkaline in reaction, low in organic carbon and nitrogen, medium in available phosphorus and potassium. The experiment was laid out in Randomized Block Design replicated thrice with ten treatments viz. T_1 (Control) , T_2 (Vermicompost @ 6 t ha^{-1}) , T_3 (Azotobacter + Vermicompost @ 6 t ha^{-1}), T_4 (30 kg N ha^{-1} + Vermicompost @ 3 t ha^{-1}), T_5 (40 kg N ha^{-1} + Vermicompost @ 2 t ha^{-1}), T_6 (50 kg N ha^{-1} + Vermicompost @ 1 t ha^{-1}), T_7 (30 kg N ha^{-1} + Azotobacter + Vermicompost @ 3 t ha^{-1}) , T_8 (40 kg N ha^{-1} + Azotobacter + Vermicompost @ 2 t ha^{-1}), T_9 (50 kg N ha^{-1} + Azotobacter + Vermicompost @ 1 t ha^{-1}) and T_{10} (60 kg N ha^{-1}). Among various combinations of nitrogen fertilizer, vermicompost and Azotobacter treatments T_{10} recorded significantly higher yield attributing characters like number of grains per spike, number of spikelets per spike and spike length, grain, straw and biological yield of desi wheat. But various treatments failed to produce any significant variation in 1000 grain weight of desi wheat.

Keywords: *Desi wheat, Nitrogen, Yield, vermicompost, Azotobacter.*

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second *most important* food *crop* and strategic cereal crop for the majority of the world's population. It is known as '*King of cereals'* and India is the second largest producer of wheat in the world next to China. It is the most important staple food of about 2 billion people (around 36% of the world population). The *Triticum* species is evolved from wild grasses and it thought to be first cultivated between 15,000 and 10,000 BC (Sheikh & Dwivedi, 2018). In India, the cultivation of wheat is spread between 10º N to 37º N latitude. The continuous use of high analysis chemical fertilizers in imbalanced and indiscriminate manner has developed many problems like decline of soil organic matter, increase in salinity and sodicity, deterioration in the quality of crop produce, increase in hazardous pests and diseases and increase in soil pollutants (Chakarborti & Singh, 2004).

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In order to find out some alternative for fertilizer economy, the use of diazotrophic bacteria has been evaluated. *Azotobacter* is a well known free-living heterotrophic bacterium which plays a beneficial role in crop production. Bio-fertilizer usually contains microorganisms having specific function such as *Azospirillum* to fix N_2 and P solubilizing bacteria to solubiliser's phosphorus from the soil and fertilizer to be available to the plants (Saraswati & Sumarno, 2008).

The use of organics largely excludes the use of synthetic fertilizers, pesticides, growth regulators and livestock feed additives, enriches the soil, encourages bio-diversity, reduce the toxic bodies, improves water quality, creates a safe environment for people and wild life, produces nutritious food of high quality, supply micronutrients in soil and maintains soil fertility and crop productivity (Sawrup, 2010). Keeping the above aspects in view, the present investigation "Compensating nitrogen fertilizer requirement of *desi* wheat by vermicompost and *Azotobacter*" has been planned with the objective to study the effect of vermicompost and *Azotobacter* on yield of *desi* wheat.

MATERIALS AND METHODS

Field experiment was conducted during *rabi* 2017-2018 at the Agronomy Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar which is situated at latitude of 29°10' North, longitude of 75°46' East and elevation of 215.2 m above mean sea level in the semi-arid, subtropical climate zone of India. The experiment was laid out in Randomized Block on sandy loam (63.5% sand, 17.3% silt and 19.2% clay) soil which is slightly alkaline in reaction, low in organic carbon and nitrogen, medium in available phosphorus and potassium. The treatment were comprised of ten treatments viz. T_1 (Control) , T_2 (Vermicompost @ 6 t ha^{-1}) , T_3 (*Azotobacter* + Vermicompost @ 6 t ha^{-1}), T_4 (30 kg N ha^{-1} + *Vermicompost* @ 3 t ha^{-1}), T_5 (40 kg N ha^{-1} + *Vermicompost* @ 2 t ha^{-1}), T_6 (50 kg N ha^{-1} + *Vermicompost* @ 1 t ha^{-1}), T_7 (30 kg N ha^{-1} + *Azotobacter* + Vermicompost @ 3 t ha^{-1}) , T_8 (40 kg N ha^{-1} + *Azotobacter* + Vermicompost @ 2 t ha^{-1}), T_9 (50 kg N ha^{-1} + *Azotobacter* + Vermicompost @ 1 t ha^{-1}) and T_{10} (60 kg N ha^{-1}). *Azotobacter* was. Prior to sowing, the seed pertaining to inoculated plots was treated with *Azotobacter* culture obtained from Department of Microbiology, CCS Haryana Agricultural University, Hisar, as per treatment. The seed was wetted with sugar solution and 50 ml of bio inoculants was used as per the recommendation. The treated seed was kept in shade for the completion of inoculation. Both treated and untreated seeds were sown as per the treatments. Sowing of *Desi* wheat C 306 was done on 10th November 2017 at about 5.0 cm depth by drilling in rows using 120 kg seed ha^{-1}and spacing of 20 cm between rows.Pre-sown irrigation of 5 cm depth was applied on 3th November 2017. Three post sown irrigations were applied on 04.12.2017, 27.02.2018 and 13.03.2018. Harvesting was done with the help of sickles manually by cutting the plants from the net area of each plot separately on 11th April 2018. Full dose of phosphorus (62.5 kg P_2O_5 ha^{-1}) and half nitrogen as per treatments were applied at the time of sowing and remaining half of the nitrogen was top dressed at 23 DAS.

Full dose of P and half dose of N as per treatments were applied to the field before sowing and rest of N was top dressed after first irrigation. Urea (46%), Diammonium phosphate (18% N, 46% P_2O_5), and *Azotobacter* were used as source of N and P. Five representative plants from each plot were selected randomly and tagged for recording the effect of different treatments on yield attributes. All yield attributes were recorded periodically on these randomly selected and tagged plants.

RESULTS AND DISCUSSION

Yield attributes

Grain yield of *desi* wheat as influenced by nitrogen fertilizer, vermicompost and *Azotobacter* is presented in Table 11 and fig 3.

Perusal of data indicated that spike length, number of spikelets per spike were highest in treatment T_{10} (8.82cm), being significantly higher than other treatments but statically at par with treatment T_8 (8.57 cm) and T_9 (8.65 cm). Treatment T_1 (7.14 cm) recorded significantly lowest spike length. Number of grains per spike was also recorded highest in treatment T_{10} (41.5), which was significantly higher than other treatments but statically at par with treatment T_8 (40.7) and T_9 (40.8). Difference in number of grains per spike in treatment T_5, T_6, T_7 and T_8 were also not significant. This may be due to the fact that higher nitrogen application resulted in taller plants, more dry matter production and more crop growth rate and hence more photosynthates are produced at higher nitrogen levels, which ultimately resulted in increase in yield attributes of wheat. The findings confirmed with the results found by Singh & Singh (1999) who reported that integration of vermicompost at 10 t ha^{-1} or 7.45 t ha^{-1} or FYM 10 t ha^{-1} with 100 kg N ha^{-1} produced grain, straw as well as biological yields at par to recommended dose of fertilizers. Similar results were reported by Gopinath et al. (2008). Number of spikelets per spike also increased significantly due to various combinations of nitrogen fertilizer, vermicompost and *Azotobacter*. However, 1000 grain weight of *desi* wheat was not affected significantly due to various treatments.

Yield

A thorough look on data indicated that grain yield of *desi* wheat was significantly higher in treatment T_{10} (100% RDN). But, the differences in grain yield in treatments T_{10} (28.2 q ha^{-1}), T_9 (27.8 q ha^{-1}) and T_8 (26.3 q ha^{-1}) were not significant. Among various combinations of nitrogen fertilizer, vermicompost and *Azotobacter* treatment T_1 produced significantly lower grain yield (15.1q ha^{-1}). The grain yield in treatment T_4 (22.7 q ha^{-1}) and T_5 (24.4 q ha^{-1}) was statistically at par with each other. Similarly, the difference in grain yield in treatment T_5 (24.4 q ha^{-1}), T_6 (25.5 q ha^{-1}), T_7 (24.6 q ha^{-1}) and T_8 (26.3 q ha^{-1}) were also not significant. This might be due to combined effect of fertilizer and *vermicompost* which might have resulted in easy release of different nutrients and their uptake by wheat crop which led to higher better growth and higher yield parameters, which in turn resulted into higher grain yield. These results are in complete agreement with those of Ram & Mir (2006) and Kakraliya et al. (2017).

Straw yield was highest in treatment T_{10} (76.4 q ha^{-1}), being significantly higher than other treatments but statically at par with treatment T_9 (74.6 q ha^{-1}). The straw yield in treatments T_5 (68.3 q ha^{-1}) and T_6 (70.6 q ha^{-1}), T_7 (68.7 q ha^{-1}) and T_8 (71.2 q ha^{-1}) were also at par with each other. In the present investigation various biological yield was recorded highest with treatment T_{10} with biological yield of 104.60 q ha^{-1}. But, the difference in biological yield in treatment T_8, T_9 and T_{10} were not significant. Significantly lower value for biological yield was recorded in treatment T_1 (53.60 q ha^{-1}) which was statistically lower than rest of the treatments. The biological yield in treatment T_4 (84.90 q ha^{-1}) and T_5 (92.73 q ha^{-1}) was statistically at par with each other. Similarly, the difference in biological yield in treatment T_5 (92.73 q ha^{-1}), T_6 (96.10 q ha^{-1}), T_7 (93.30 q ha^{-1}) and T_8 (97.50 q ha^{-1}) were also not significant. Improvement in yield of wheat might have resulted from favourable influence of fertilizers, *Azotobacter* and vermicompost on the growth attributes and efficient and greater partitioning of metabolites and adequate translocation of photosynthates and nutrients to developing reproductive structures. These results confirm the findings of Singh & Kumar (2010).

Table 1: Effect of nitrogen fertilizer, *Azotobacter* and vermicompost on yield attributes of *desi* wheat

Treatments	Spike length (cm)	Number of spikelets per spike	Number of grains per spike	1000 grain weight (g)
T_1 : Control	7.14	16.66	31.30	39.21
T_2 : Vermicompost @ 6 t/ha	7.72	17.88	34.96	40.56
T_3 : *Azotobacter* + Vermicompost @ 6 t/ha	7.92	18.16	37.43	40.98
T_4 : 30 kg N /ha + Vermicompost @ 3 t/ha	8.01	18.34	38.66	40.06
T_5 : 40 kg N /ha + Vermicompost @ 2 t/ha	8.23	18.58	39.83	40.22
T_6 : 50 kg N /ha + Vermicompost @ 1 t/ha	8.42	18.84	40.03	41.09
T_7 : 30 kg N /ha + *Azotobacter* + Vermicompost @ 3 t/ha	8.27	18.66	39.96	40.67
T_8 : 40 kg N /ha + *Azotobacter*+ Vermicompost @ 2 t/ha	8.57	18.89	40.73	42.49
T_9 : 50 kg N /ha + *Azotobacter*+ Vermicompost @ 1 t/ha	8.65	18.96	40.80	42.72
T_{10} : RDN (60 kg N ha^{-1})	8.82	19.12	41.46	43.78
SEm ±	0.13	0.35	0.32	0.35
CD at 5 %	0.39	1.04	0.96	NS

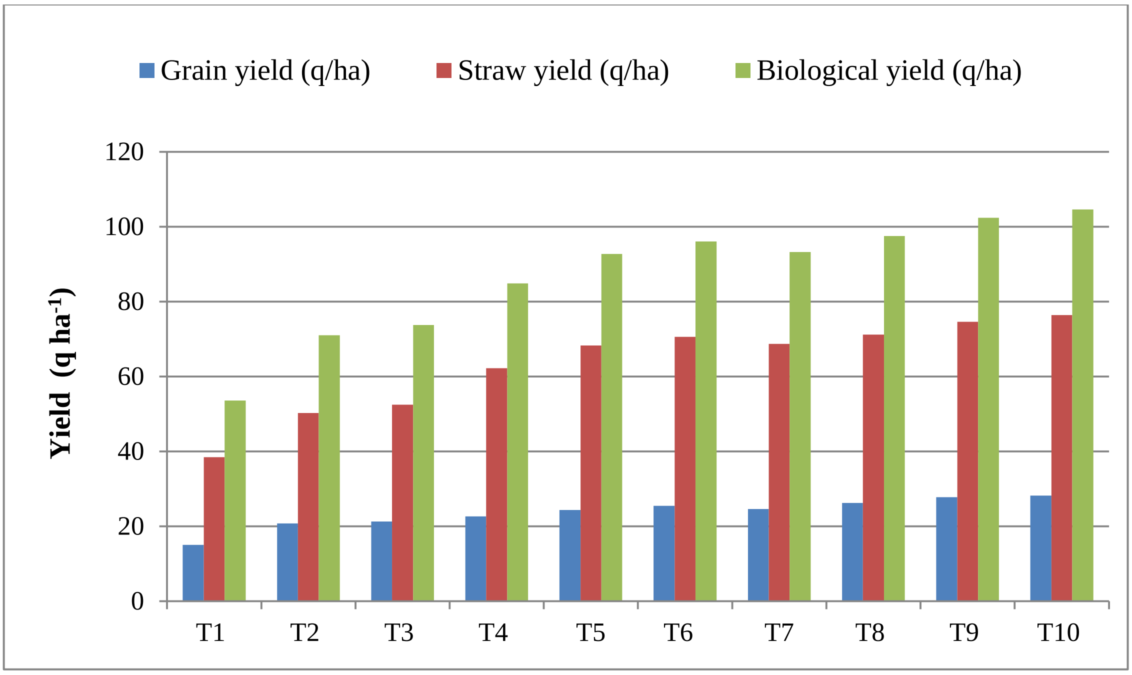

Fig. 1: Grain, straw and biological yield (kg ha^{-1}) of *desi* wheat as influenced by nitrogen fertilizer, *Azotobacter* and vermicompost

CONCLUSION

Application of 50 kg N ha^{-1} + *Azotobacter* + Vermicompost @ 1 t ha^{-1} or 40 kg N ha^{-1} + *Azotobacter* + vermicompost @ 2 t ha^{-1} or 100% RDN to sandy loam, low in available N, medium in available P soils is required for optimum yields of *desi* wheat.

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