

Nutrient management in wheat (*Triticum aestivum* L.) for increase grain yield, nutrient-use efficiency and profitability

¹Sandeep Kumar, ²Tejveer Singh Tomar and ³Savita Tomar

¹Assistant Professor Agronomy, R. M.P. (PG) college, Gurukul Narsan, Haridwar (Uttarakhand).

^{2,3}Assistant professor Agronomy, Janta Vedic college, Baraut (Baghpat) U.P.

ARTICLE DETAILS

Article History

Published Online: 14 December 2020

Keywords

optical sensor, precision nitrogen management, NDVI, level of nutrients recommended dose of fertilizer.

ABSTRACT

A field experiment was conducted during the winter (Rabi) season 2015-16 at Agriculture Farm, J. V. Collage Baraut (Baghpat) Uttar Pradesh to study the effect of nutrient management (N.P.K. levels) on growth and yield of wheat (*Triticum aestivum* L.). The experiment was a Randomized complete block design with 3 replication and 8 treatment (control, recommended dose of fertilizer RDF 150 N+60 P₂O₅ + 40 K₂O kg/ha), 150% RDF, 150% PK, 150% NK, 150% NP, Green seeker-guided nitrogen application at the 2nd Irrigation P2O5 and RDF+10t FYM/ha: Various yield attributes of wheat showed significant Variation under different levels of NPK and Green seeker-based precision, nutrient management. It was observed that an application of 150% of RDF 225 N + 90 P₂O₅ + 60 K₂O kg/ha resulted in the highest yield and net return. However Green Seeker-guided nitrogen application saved fertilizer nitrogen (32 kg/ha) without significant reduction in yield than control recommendation of recommended dose of fertilizer in HD 3226 wheat. In terms of grain-yield by 150% NPK compared to RDF and 7.8% yield increase over 150% N P. in case of economic returns, 12.95% profit increase was achieve by 150% RDF over RDF. So 150% NPK application to wheat crop at Baraut (Baghpat) Uttar Pradesh is fruitful for farmer's point of view for improvement of low N-use efficiency.

1. Introduction

Wheat is the most important cereal crop in the world wide cultivated around 220 million ha to ensure food security in 94 countries. Area of wheat in north –eastern plain zone of India is 10.5 million ha which contributes 27% of the total area of Wheat. The production of wheat from this region contributes 24% of total wheat production in India (Annual Report of wheat Directorate 2012-13).The recommended rate of N.P.K under irrigated timely sown condition in north –eastern plain zone is 150-60-40 kg/ha respectively. Nitrogen is the nutrient that most after limits crop production (Pathak et. al., 2003). Worldwide nitrogen use–efficiency for cereal grain and sow crops estimated at only 33% (Ranu and Jonson, 1999). Unaccounted 67% represents a loss of fertilizer nitrogen. Present N:P:K ratio followed in India is 6.7:207:1, where the ideal recommendation is 4:2:1. Indian soil is mostly deficient in nitrogen by 0.02-2.2%. Top dressing of nitrogen by split doses is needed during the period of higher requirement (Dobermann and Fairhaust, 2000). Efficient use of N fertilizer is restricted due to large field to field Variability. When broad-based general fertilizer recommendation are used (Adhikari et. al., 1999, Doberman et. al., 2003). Farmers generally use leaf-colour chart as an indication of nitrogen-application requirement. Optical sensors were used in calculating the fertilizer-nitrogen requirement in wheat (Singh et. al., 2011) and in cereal (Raun et. al., 2002). Farmers can handle it easily fast and real time data can be taken and it can be used as a complementary decision. Green seeker may offer a more efficient and precise way to manage crop nitrogen input and estimates the right amount of N at the critical stages of crop-growth (Sapkata et. al., 2014). It is an integrated optical sensing, variable rate application and

mapping system that measures nitrogen requirement of a crop. Crop-yield potential is identified using a vegetative index known as normalized difference vegetation Index (NDVI) and an environment factor namely growing degree-days (GDD). This technology was developed at the Oklahoma state Union, USA, and licensed to N Tech Industries in 2001. Presently, most of the investigation and crop-nutrient limited approaches only. Need based precision-nutrient limited management in the crop field will greatly increase fertilizer use–efficiency and will save costly fertilizer. So precision–nutrient management should be done with due to objects (i) Study the effect of Green-Seeker based nitrogen management on wheat crop and (ii) The effect of N, P and K on growth and yield of wheat.

2. Material and Methods

The field experiment was conducted during the winter (Rabi) season of 2015-16 at Agriculture Farm, Janta Vedic collage Baraut (Baghpat) U.P. The experimental site has semi-arid to sub–humid types of climate with moisture deficit index between 20 and 40%. The average annual rainfall at Baraut is 900-1000 mm and about 88% of it is received during June-September. The soil of experimental field was sandy clay loam, Moderately fertile, low in available organic carbon (0.40%) and nitrogen (204.5 kg/ha) medium P₂O₅ (21.0 kg/ha) and potassium (227 kg/ha) and having neutral soil reaction (pH 7.53) and EC (0.25 ds/m). The experiment design randomized complete block design with 8 treatments in three replications. The treatment were T₁ RDF T₂ (150-60-40 kg/ha NPK) T₃ 150% RDF, T₄ 150% P&K, T₅ 150% N&K, T₆ 150% N&P, Green Seeker guided nitrogen application, and T₈ RDF + 10 t FYM/ha. The wheat variety 'HD3226' was sown in a well

prepared soil with a row spacing 20 cm x 10 cm and in solid line at a seed rate of 100kg/ha. Sources of fertilizer were urea (46% N), DAP (18% N, 46% P) and muriate of potash (60% K₂O), Nitrogen phosphorus and potash were applied as per the treatment. Nitrogen was applied 3 splits-one-third of the irrigation. Particularly for treatment Green-seeker-guided nitrogen dose was given at the 2nd irrigation was calculate from NDVI readings. Various observations pertaining to yield attributes was tasted by the various ratio at 5% level. Economics was calculated as per the prevailing market prices of the inputs and produce during the year of the experiment.

3. Result and Discussion

Application of 150% RDF resulted highest number of ears/m², grains/ear and test weight over the rest of the treatments of wheat. Green-seeker-guided nitrogen application was found at par with RDF in respect to grain yield of wheat. The control showed lesser number of ears/m², grain/ear, ear head length and test weight which were at par with 150% P and K treatment. All the treatment except 150% P and K showed significantly higher grain and straw yield as compared to the control treatment. RDF provided at per yield with Green-seeker-guided nitrogen application (Table 1). The increase in number of grains might be owing to better assimilation of carbohydrates in ears. (Mohanty et. al., 2015) at New Delhi opined to increase nitrogen dose as RDF. Maximum grain and straw yields were observed in treatment 150% RDF (5.93 t/ha and 9.18 t/ha respectively). Recommended dose of fertilizer showed at par yield result with Green-seeker-guided-nitrogen application (5.21 and 7.38 t/ ha respectively). Minimum grain and straw yield were observed in the control treatment. Similar result was reported by Singh (2014). He observed Green-seeker-based fertilizer N management always resulted substantial savings in as compared to prevalent blanket recommendations with no reduction in yield. Nitrogen supply during reproductive stage (1/4 of total nitrogen dose) as probably the reason for enhancing the yield parameters and ultimately yield. Lower value of yield in control and 150% P and K treatments were mainly due to inadequate nitrogen supply to

meet the crop requirement as per the rate of the nutrient application the source of fertilizers, blanket and Green-seeker-guided nitrogen application, the cost of cultivation varied greatly under different treatment. The cost of cultivation varied greatly under different treatment. The cost of cultivation was the maximum in 150% RDF treatments (34.07 x 10³ Rs/ha). Net returns (77.94 x 10³ Rs/ha) and benefit: cost ratio (2.29) was also significantly higher in 150% N, P, K compared to rest of the treatment. This may be owing to higher grain and straw yield in this treatment. The Green-seeker-guided nitrogen application showed an almost equal cost of cultivation, grass return, net return and benefit: cost ratio with RDF treatment. This may be owing to significantly similar grain and straw yield and amount of nitrogen saved using Green-seeker-guided. The 150% P and K treatment showed the minimum net return benefit: cost ratio and even the cost of cultivation were low as compared to other treatments under study. This may be due to lower grain and straw yield and higher cost of cultivation in term of P and K fertilizer cost. Due to lower dose of nitrogen, yield was poor, thus higher quantity of P and K has sown no beneficial effect. Application of 150% NPK improved the agronomic efficiency considerably but more prominent agronomic efficiency was found in Green-seeker N application + P and K recommended dose. Apparent nutrient recovery and physiological efficiency were found highest with the RDF, and Green seeker N application.

4. Conclusion

Concluded that application of 150% of recommended dose of fertilizer (225 N + 90 P₂O₅ + 60 K₂O/ha) gave the highest yield and net returns and nutrient use-efficiency. Though Green Seeker nitrogen application saved fertilizer nitrogen (32 kg/ha) without significant reduction in yield than recommended of recommended dose of fertilizer in wheat 'HD 3226' under agro-climate condition of Baraut (Baghpat) western U.P. However, 150% NPK enhanced the grain yield. Economics and nutrient use efficiency (AE = 13.27) of wheat as compared to rest of the treatment under study. But Green Seeker N application improved the agronomic efficiency of wheat crop.

Table – Effect of nitrogen management on yield attributes, yield economic and nutrient use efficiency of wheat.

Treatments	Ear length (cm)	Ears/ m ²	Grains/ear	Test weight (g)	Grain Yield (t/ha)	Straw yield (t/ha)	Cost of cultivation (x10 ³ Rs/ha)	Net Returns (x10 ³ Rs/ha)	Benefit cost ratio	Apparent nutrient recovery (kg nutrient uptake/kg applied)	Physiological efficiency (Kg grain yield/Kg nutrient uptake)	Agronomic efficiency (Kg grain yield/kg nutrient applied)	Harvest Index (%)
T ₁ control	7.1	172.6	20.6	39.6	1.60	2.24	24.79	5.06	0.20	-	-	-	41.75
T ₁ RDF (150N+60P+40K/ha)	9.2	314.3	41.3	42.0	5.36	7.85	31.39	69.00	2.20	0.402	37.42	15.03	40.56
T ₁ 150% RDF	9.9	367.6	44.0	43.6	5.93	9.18	34.07	77.94	2.29	0.382	30.27	11.56	39.27
T ₁ 150% P and K	7.9	199.0	22.6	41.0	1.65	2.58	31.56	0.04	0.01	0.028	11.99	0.336	38.96
T ₁ 150% N and K	9.8	303.3	38.6	43.0	5.38	8.89	30.03	72.55	2.42	0.432	30.73	13.27	37.72
T ₁ 150% N and P	9.5	353.3	39.3	42.5	5.50	8.20	32.97	70.34	2.13	0.390	31.82	12.41	40.14
T ₁ Green Seeker nitrogen	9.0	314.3	38.3	41.3	5.21	7.38	31.27	65.94	2.11	0.461	35.95	16.57	41.37
T ₁ RDF+10t FYM/ha	9.3	331.0	37.3	42.0	5.45	8.12	41.39	61.03	1.47	0.290	36.27	10.52	40.18
SEm	0.3	20.4	3.1	0.6	0.06	0.32	0.15	-	0.16	0.06			
CD (P=0.05)	0.9	61.9	9.5	1.9	0.17	0.98	0.47	-	0.49	0.18			

References

1. Adhikari, C. Bronson, K. F. Panuallah, G. M., Regmi, A. P., Saha, P. K., Dobermann, A. and Pasuquin, E. (1999). On-farm soil N supply and N nutrition in the rice-wheat system of Nepal and Bangladesh. *Field crops Research* **64**(3): 273-286.
2. Dobermann, A and Fairhurst, T (2000), Rice Nutrient Disorders and Nutrient Management. *IRRI and PPI & PPIC, Makati city and Singapore*.
3. Dobermann, A, Witt, C. Abdulrehman, S., Gines, H.C., Nagarajan, R, Son, T.T. and Phung, C.V. (2003). Soil fertility and indigenous nutrient supply in irrigated rice domains of Asia. *Agronomy Journal* **95**(4): 913-923.
4. Pathak, H., Aggarwal, P.K., Roetter, R., Kalra, N., Bandyopadhaya, S. K., and Van Keulen, H. (2003). Modelling the quantitative evaluation of soil nutrient supply, Nutrient use efficiency, and fertilizer requirements of wheat in India. *Nutrient cycling in Agroecosystems* **65**(2): 105-113.
5. Ranu, W. R. and Johnson, G.V. (1999). Improving nitrogen use-efficiency for cereal production. *Agronomy Journal* **91** (3): 357-363.
6. Ranu W. R., Solie, J.B., Johnson, G.V., Stone, M. L., Mullen, R.W., Freeman, K.W. and Lukina, E.V. (2002). Improving nitrogen use-efficiency in cereal grain production with optical sensing and variable rate application. *Agronomy Journal* **94**(4): 815-820.
7. Singh, B, (2014). Site specific and need based management of nitrogen fertilizers in cereals in India. *Advances in Fertilizer Technology: Biofertilizers*, vol **2**, pp.576-605 Studium press LLC, New Delhi. India.
8. Singh, B., Sharma, R. K., Kaur, Jaspreet, Jat, M. L., Martin, K. L., Singh, Yadvinder, Singh, Varindarpal, Parvesh, C., Choudhary, O. P., Gupta, R. K., Thind, H.S., Singh, Jagmohan, Uppal, H. S., Khurana, H. S., Kumar, Ajay, Uppal, R. K., Monika, Vashistha, Ranu, W. R., and Gupta, R. (2011). Assessment of the nitrogen management strategy using an optical sensor for irrigated wheat. *Agronomy for sustainable development* **31**: 589-603.
9. Sapkota, T. B., Majumder, K, Jat, M. L., Kumar, A., Brishmoi, D. K., MC Donald A. J., and Pampolino, M. (2014). Precision nutrient management in conservation Agriculture based wheat production of Northwest India. Profitability, nutrient use efficiency and environmental footprint. *Field crops research* **155**: 233-244.