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Effect of soil test crop response basis integrated nitrogen management on yield, quality and profitability of wheat (*Triticum aestivum* L.)

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Abstract
A field experiment was conducted during the *rabi* season of 2017 in wheat crop (var. HUW-234) at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Allahabad (U.P.). The experiment was laid out in a Randomized Block Design with 12 treatment combinations, consisting of three nitrogen levels (100,125 and 150 kg N/ha) on soil test basis (STB) compared to farmer practice (FP) and nitrogen management viz., 100% N through urea, 75% N through urea + 25% N through vermicompost with seed inoculation by *Azotobacter*. The experimental result reveals this saving of nitrogen by 16.5 to 31.7 kg/ha without any significant effect on yield, quality and economics of wheat was noticed. Significantly higher grain yield (4.57 t/ha), net returns (□ 55685.83 ha) and B:C ratio (2.98) was found with 150 kg N/ha (Farmer Practice) when applied 100% N through Urea where as higher straw yield (7.63 t/ha) and protein content (10.93%) was found with 150 kg N/ha (Farmer Practice) when applied 75% N through urea + 25% N through vermicompost + *Azotobacter* (seed inoculation).

Keywords: wheat, integrated nitrogen management, yield, protein content and economics

Introduction

Wheat (*Triticum aestivum* L.) is the most important staple food of about 36% of the world population and improvement in its productivity has played a key role in making the country self-sufficient in food grains. Worldwide this crop provides nearly 55% of the carbohydrates and 20% of the food calories. USDA, 2017 report shows that it is grown in all the continents of the world covering an area of 225.07 million hectares with production of 736.98 million tonnes. In India, total area under wheat is 31.72 million hectares with the production and productivity of 96.0 million tonnes and 3.13 tonnes hectares, respectively (Tiwari *et al.,* 2017) [11].

Nitrogen is subjected to different kinds of losses like denitrification, volatilization and leaching which causes environmental threats. Nitrous oxide has contributed 310 times to the global warming potential of carbon dioxide, and its emissions are affected by poor nitrogen management in intensive crop production which is major source for it (Jat *et al.,* 2014) [5]. The basic concept underlying the principles of integrated nutrient management (INM) is the maintenance and possibly improvement of soil fertility for sustaining crop productivity on long term basis. This may be achieved through combine use of all possible sources of nutrients and their scientific management for optimum growth, yield and quality of different crops and cropping systems (Patel *et al.,* 2017) [9]. Nambiar and Abrol (1989) and Gupta *et al.,* (2000) also reported that under continuous and high intensive farming, the nutrient supplying power of most of the soils has been found to be decline particularly when rice based cropping systems are followed. The excessive and imbalance use of inorganic fertilizer was reported to be the major constraint of declining productivity of rice–wheat cropping system (Hobbs, 1994). When these crops are grown under good management conditions, they remove large quantities of nutrients.

Ensuring optimum nutrient availability through effective nutrient-management practices requires knowledge of the interactions between the soil, plant and environment. In the experiment use of some tools for in season nitrogen management like Site-specific nutrient management (SSNM) through soil-test crop response (STCR) in fulfilling the crop nutrient requirement with less environmental footprints (Jat *et al.*, 2014; Kumar *et al.*, 2014) [5] was planned to see the effect of integrated management on soil test basis on profitability of wheat.

Materials and Methods

A experiment was conducted during the *Rabi* season of 2017 in wheat crop (var. HUW-234) at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Allahabad (U.P.). The experiment consisting of three nitrogen levels, viz. 100, 125 and 150 kg N/ha through nitrogen management by 100% N through urea, 75% N through urea + 25% N through vermicompost with seed inoculation by *Azotobacter*, laid out in a Randomized Block Design with twelve treatment combinations which replicated thrice. The soil of the experimental field was sandy loam in texture with pH 7.6, low in organic carbon 0.42%, available P 13.50 kg/ha and available K 257.04 kg/ha. Wheat 'HUW 234' variety was sown 23rd of November in 2017. Nitrogen, Phosphorus and Potassium were applied through urea, single super phosphate and muriate of potash, respectively. Half of nitrogen as per treatment and full dose of phosphorus, potassium and remaining nitrogen as per treatment was top dressed after the soil test analysis. The crop received five uniform irrigations. All the growth and yield attributes were recorded using standard procedure and grain yield was calculated at 12% moisture content.

Result and Discussion

Effect on Yields and Protein content

Application of 150 kg N/ha (Farmer Practices) when applied 100% N through Urea was significantly higher grain yield (4.57 t/ha) that may be due to cumulative effect of growth and yield-attributing characters owing to fertilization. Greater availability of metabolites (photosynthates) and nutrients to developing reproductive structures seems to have resulted in increase in all the yield-attributing characters which ultimately improved the yield of the crop. Similar findings were also reported by Singh *et al.* (2010), Tripathi *et al.* (2013) [12] and Pandey *et al*. (2006).The straw yield (7.63 t/ha) and protein content (10.93%) was significantly higher with 150 kg N/ha (Farmer Practice) when applied 75% N through urea + 25% N through vermicompost + *Azotobacter* (Seed inoculation).The integrated use of organic and inorganic source of nutrients might have supplied readily available nutrients to crop which resulted in greater assimilation, production and partitioning of dry- matter to yield. Similar findings also reported were found by Verma *et al*. (2016) [13] and Singh *et al*. (2016) [10]. The increase of protein content (wheat grain) in different treatments might be due to increase nitrogen uptake. Similar findings was reported by Randhe *et al.* (2009). The El-Lattief (2014) [6] and Abedi *et al.*, (2010) [1] also concluded that grain protein contents responded to organic and inorganic fertilizer application.

Table 1: Effect of soil test crop response basis integrated nitrogen management on yield and grains protein content in wheat.

	Treatments	Grain yield (t/ha)	Straw yield (t/ha)	Protein content (%)
T_1	[100 kg N/ha (STB)] 100% N through Urea	2.70	5.03	8.31
T_2	[100 kg N/ha (STB)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	3.18	5.77	9.18
T_3	[125 kg N/ha (STB)] 100% N through Urea	2.97	6.15	8.42
T_4	[125 kg N/ha (STB)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	3.97	7.02	10.03
T_5	[150 kg N/ha (STB)] 100% N through Urea	4.23	7.55	9.69
T_6	[150 kg N/ha (STB)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	4.27	7.57	10.20
T_7	[100 kg N/ha (FP)] 100% N through Urea	3.43	5.10	8.74
T_8	[100 kg N/ha (FP)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	4.20	5.73	9.61
T_9	[125 kg N/ha (FP)] 100% N through Urea	3.82	6.55	8.83
T_{10}	[125 kg N/ha (FP)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	4.27	6.50	9.89
T_{11}	[150 kg N/ha (FP)] 100% N through Urea	4.57	5.75	10.44
T_{12}	[150 kg N/ha (FP)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	4.50	7.63	10.93
SEd (±)		0.30	0.62	-
CD (P=0.05)		0.62	1.28	-

*STB-Soil Test Basis, FP-Farmer Practices, VC-Vermicompost, SI- Seed inoculation

Table 2: Economics of different treatment combinations in soil test crop response basis integrated nitrogen management of wheat.

	Treatments	Cost of cultivation (□/ha)	Gross return (□/ha)	Net return (□/ha)	B:C ratio
T_1	[100 kg N/ha (STB)] 100% N through Urea	28564.18	54395.00	25830.82	1.90
T_2	[100 kg N/ha (STB)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	37553.3	63880.83	26327.53	1.70
T_3	[125 kg N/ha (STB)] 100% N through Urea	28798.54	60696.67	31898.13	2.11
T_4	[125 kg N/ha (STB)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	39759.26	79346.67	39587.41	2.00
T_5	[150 kg N/ha (STB)] 100% N through Urea	29087.50	84773.33	55685.83	2.93
T_6	[150 kg N/ha (STB)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	43389.38	85376.67	41987.29	1.89
T_7	[100 kg N/ha (FP)] 100% N through Urea	28811.00	67218.33	38407.33	2.33
T_8	[100 kg N/ha (FP)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	39685.28	81470.00	41784.72	2.08
T_9	[125 kg N/ha (FP)] 100% N through Urea	29190.75	76044.17	46853.42	2.64
T_{10}	[125 kg N/ha (FP)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	42466.6	83776.67	41310.07	1.97
T_{11}	[150 kg N/ha (FP)] 100% N through Urea	29570.50	87856.67	58286.17	2.97
T_{12}	[150 kg N/ha (FP)] 75% N through Urea + 25% N through VC + *Azotobacter* (SI)	45253.99	89525.00	44271.01	1.90

*STB-Soil Test Basis, FP-Farmer Practices, VC-Vermicompost, SI- Seed inoculation

Effect on economics

Significantly higher net returns (□58286.17 ha) and B:C ratio (2.97) was with 150 kg N/ha (Farmer Practices) when applied 100% N through Urea. It is because of the appropriate dose of NPK could make better combination for completion of prominent process like chlorophyll synthesis, promotion of healthy root growth, translocation of photosynthates, enzymes activation for biochemical reaction within plant tissue, wherein the plant get good opportunity for nutrient uptake which results in higher plant growth and development as well as yield. Similar results were also reported by Pandey and Sinha (2006). Net returns increased with increase in fertilizer dose and maximum net returns were observed at recommended fertilizer dose similar report was found by Gupta *et al.* (2011) [4], Yadav and Kumar (2009) [14] and Gupta *et al.* (2007) [3].

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