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Enhancement of wheat productivity through efficient nutrient management practices

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ABSTRACT

A field experiment was conducted during the winter season of 2014 and 2015 at the AB block farm of Bidhan Chandra Krishi Viswavidayalaya, Kalyani, to find out effect of different organic source of nutrient along with nitrogen levels with its application time on growth and yield of wheat (*Triticum aestivum* (L.) emend. Fiori & Paol.). Application of FYM @10 t/ha produced maximum grain (4.12 t/ha) and biological yield (8.93 t/ha), and was at par with FYM @15 t/ha and significantly superior to other treatment of main plot. In subplot treatments, the grain and biological yield of wheat increased significantly with recommended nitrogen application before irrigation (BI), and was at par with the site specific nutrient management (SSNM) treatment. This treatment recorded 127.1 and 13.4% more grain and biological yield, respectively over the control. Further, with subplot treatment, more harvest index noted with the recommended N (BI) and significantly better to other treatments. More benefit: cost ratio registered with the FYM @10 t/ha (1.61) along with the SSNM practice (1.65).

Key words: FYM, SSNM, wheat, yield.

In dawn of new millennium, challenges in the agriculture sector are quite different from those met in previous decade. Wheat production had set an all time highest 95.9 millon tones (mt) in 2013-14. Due to unfavorable weather and subsequent year's production had witnessed a major quantum fall of 9.3 mt registered at 86.5 mt in wheat productions (Anonymous, 2016). The Indian population has increased more than 1.15 billion mark. Population has been increasing at the rate of 2.1% per annum. This account for the enormous pressure to produce more food from less land. It is high time to transform the Indian agriculture scenario to meet the food demand for the growing population and simultaneously conserve the environment (Anonymous, 2016). This call for special effort to manage natural resources of agriculture and the need for sustainable agriculture. Different source of organic nutrient are available, but optimum amount utilization become a question mark. Farmer generally uses organic manure from their local available sources to different crops. FYM (farmyard manure) although not useful as a sole source of nutrients, is however a good complementary and supplementary source with mineral fertilizer (Chandhary *et al.*, 2004). Further, usually farmer's are unaware about the effective dose of nitrogen application. Primary nutrient applications vary from place to place and sometime within same district also. Keeping this aspect in mind present investigation was conducted with an idea that role of FYM along with various dose of nitrogen. based on site specific nutrient management (SSNM), leaf colour chart (LCC) and its time of application.

MATERIALS AND METHODS

Present investigation was conducted Bidhan Chandra Krishi Viswavidyalaya during winter

season of 2014-15 and 2015-16 in upland situation. The farm is situated at 22° 56´ N latitude and 88° 32´ E longitude with an average altitude of 9.75 m above mean sea level (MSL). The soil of the experimental field was loamy in texture and almost neutral in reaction having pH 7.2, organic carbon 0.43%, available nitrogen 238 kg, available phosphorus 23.2 kg and available potassium 234 kg/ha. The experiment was carried out in a split plot design with five levels of FYM (*viz.* 0, 5,10,15 and 20 t/ha) in main plot, and five nitrogen levels based on (i) leaf color chart, (ii)site specific nutrient management (SSNM) based on wheat nutrient expert (125: 63: 82) (iii) recommended NPK (150:60:40) where 1/3 N and full P and K was applied as basal and the remaining N top dressed in two equal splits after first and second irrigation. (AI), (iv) recommended NPK (150:60:40) where 1/3 N and full P and K was applied as basal and the remaining N top dressed in two equal splits before first and second irrigation. (BI) and (v) control. Wheat variety "PBW -343" was sown in 22nd and 26th Nov, during 2014 and 2015, respectively with seed rate of 100 kg /ha. Sowing of wheat was done at 3 cm depth in line at 20 cm row spacing. Wheat crop was harvested in the 3rd weak of April in both the years. The crop was subjected to recommended package of agronomic and plant protection practices to obtain a healthy crop. Levels of phosphorus and potassium was fixed for 3 sub plot treatment *viz.* LCC based, recommended NPK (BI) and recommended NPK (AI) at 60 kg P_2O_5 and 40 kg K_2O/ha. Nitrogen levels were applied as per the treatments. Data on growth, yield components, yield and crop nutrient uptakes were recorded as per standard procedure. The experimental data were analyzed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of overall difference among treatments by the F test and conclusions were drawn at 5% probability level. Benefit: cost ratio (B:C) was obtained by dividing the gross income with cost of cultivation. The effect of treatments on yield attributes and yields were evaluated on pooled mean basis.

Results and Discussion

Plant growth parameters

Growth characters :

Significant differences were recorded with FYM levels on various growth parameters (Table 1). Growth characteristics *viz*. plant height and dry matter accumulation significantly increased

Table 1. Effect of FYM and N levels on growth and yield attributes of wheat (Mean data of two years).

Treatment	Plant height (cm)	Dry matter (g/plant)	Spike length (cm)	Grains/ spike	Effective tillers/ m row length	1000 grain weight (g)
FYM levels (t/ha)						
0	73.68	64.65	8.09	34.01	49.32	39.11
5	71.30	63.91	9.03	40.91	51.63	40.63
10	92.16	109.28	8.91	43.12	53.71	39.95
15	91.14	101.35	9.04	42.36	58.84	41.08
20	87.23	93.74	8.08	41.40	61.93	39.12
SEm±	1.36	2.46	0.03	0.23	0.12	0.98
CD (P=0.05)	4.01	6.32	0.06	0.61	0.31	NS
Nitrogen levels						
Control	63.21	41.02	7.67	36.02	57.02	38.81
LCC based N	89.73	64.3.4	7.81	41.39	59.27	38.91
SSNM	94.21	101.36	9.92	40.36	63.15	41.71
Recomended- N (BI)	98.65	98.5	9.16	42.46	64.84	40.39
Recomended - N (AI)	91.24	83.2	8.88	40.32	60.22	39.83
SEm±	1.25	1.64	0.21	0.21	1.55	0.83
CD (p=0.05)	3.69	4.53	0.63	0.53	4.21	NS

NS : Non significant.

Table 2. Effect of FYM and Nitrogen levels on yield, nutrient uptake and economics of wheat (Mean data of two years).

Treatment	Grain yield (t/ha)	Biological yield (t/ha)	Harvest index (%)	Nutrient uptake (kg/ha)			B:C ratio
				N	P	K	
FYM levels (t/ha)							
0	2.11	7.02	30.08	79.68	12.54	98.54	1.48
5	2.94	6.73	43.74	91.09	14.11	106.18	1.58
10	4.12	8.93	46.12	151.23	22.37	164.95	1.61
15	3.88	10.19	38.03	130.06	18.69	132.36	1.36
20	3.69	11.44	32.28	118.19	17.06	116.48	1.25
SEm±	0.09	0.18	0.16	3.68	1.38	7.32	-
CD (P=0.05)	0.29	0.53	0.48	11.05	4.05	18.07	-
Nitrogen levels (kg/ha)							
Control	1.81	8.99	20.08	87.03	15.16	136.06	0.98
LCC based N	3.52	9.68	36.31	139.98	20.08	189.06	1.29
SSNM	3.92	12.54	31.24	151.85	22.06	243.09	1.65
Recomended - N (BI)	4.11	10.23	40.18	160.06	23.36	264.36	1.55
Recomended - N (AI)	3.43	10.56	32.15	128.58	19.31	180.36	1.43
SEm±	0.14	0.38	0.11	4.35	0.74	3.69	-
CD (p=0.05)	0.21	1.14	0.29	13.06	2.11	11.08	-

with the levels of organic manure. Application 10 t/ha of FYM produced maximum plant height and significantly better to other treatments and was at par with the FYM @ 15 t/ha. Amongst different nitrogen levels, highest plant height was recorded with recommended nitrogen levels (BI) and was followed by SSNM. Dry matter accumulation was more with the FYM @ 10 t/ha and statistically better to rest of the treatments. Further, with N levels, this parameter was higher with the SSNM and was at par with the recommended nitrogen level (BI), and considerably enhanced to rest of the treatments.

Yield attributes :

The data on pooled mean basis revealed that yield attributes *viz.* grains/spike and effective tillers/m row length were increased significantly with FYM and nitrogen levels (Table 1). Higher spike length was observed with the incorporation of FYM @ 15 t/ha, and significantly superior to rest of the main plot treatments. With subplot treatment highest spike length recorded with the SSNM and statistically superior to other set of treatments. Highest number of grains/spike was observed with the FYM @20 t/ha and was followed by FYM @ 15 t/ha, and significantly superior to other treatment. These results are akin to the findings of Sushila and Giri (2000). Chandhary *et al.* (2004) reported that application of FYM to wheat increased the plant height, yield attributes and dry matter accumulation per unit area than control. Dry matter accumulation was 86.7% more with FYM @ 10 t/ha application over the control. Further, more number of effective tiller/m row length was observed with the FYM @ 15 t/ha, and was closely followed by FYM @ 10 t/ha, and significantly superior to other treatment. Application of recommended nitrogen (BI) registered more number of effective tiller/m row length and was closely followed by SSNM, and better to rest of the sub plot treatments. Increase in no. of grains/spike and effective tillers/m row length over the control was 18.78% and 58.13%, respectively. Improvement was mainly owing to the fact that FYM application would help in conversion of unavailable nutrients to available form through increased microbial activities and enabled the crop to remove plant nutrient in high quantity resulting in higher grains/spike and more effective tillers/m row length. 1000 grain weight failed to produce any significant response either in main or in sub plot treatments.

Yield parameters and economics :

Grain yield, biological yield and B:C ratio of wheat were significantly influenced by FYM and N levels (Table 2). Application of FYM @10 t/ha produced maximum grain (4.12 t/ha) and biological yield (8.93 t/ha), and was at par with FYM @15 t/ha and significantly superior to other treatment of main plot. The increase in yield was mainly owing to the improvement in growth as well as yield attributing characters, as the application of FYM and nitrogen improve the fertility status, which results in the better utilization of nutrients by the wheat crop. With various subplot treatments, the grain and biological yield of wheat increased significantly with recommended nitrogen application (BI), and was at par with the SSNM treatment. This treatment recorded 127.13 and 13.43% more grain and biological yield, respectively, over the control. Adequate supply of organic source along with better nitrogen level with good application measures might have increased the photo-synthetic activity resulting, increased in ancillary characters and ultimately enhance economical and biological yield of wheat crop (Mukherjee, 2016). Significantly better harvest index was recorded with the FYM@ 10 t/ha, and was closely followed by FYM @ 5t/ha under various main plot treatments. Further, with subplot treatment, higher harvest index noted with the recommended N (BI) and statistically superior to other treatments. Higher benefit: cost ratio was observed with the FYM @10 t/ha (1.61) along with the SSNM practice (1.65), this is mainly due to more economic and biological yield per unit of investment cost.

Nutrient uptake

The nutrient uptake pattern varies distinctly with various treatments and produced significant response with main plot and sub plot treatments (Table 2). Amongst all FYM levels maximum uptake of primary nutrient was with incorporation of FYM @ 10 t/ha. This was mainly due to higher biomass production per unit area. Total nutrient uptake pattern is directly related to growth and yield pattern of plant. Amongst various main plot treatment, more NPK uptake were observed with the FYM@10 t/ha, and was at par with the FYM @ 15t/ha for phosphorus and potassium uptake of wheat crop. Further, with various subplot treatments, maximum NPK uptake was recorded with the recommended nitrogen (BI) and was followed by SSNM. Nitrogen and phosphorus uptake showed parity with the above two treatments, and significantly better to other subplot treatments.

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