

## RESPONSE OF WHEAT TO INTEGRATED NUTRIENT MANAGEMENT IN TYPIC USTIPSAMMENT

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### ABSTRACT

A field experiment was conducted to find out the effect of integrated nutrient management on wheat at Agronomy farm, Agricultural Research Station, Durgapura, Jaipur during rabi seasons of 2006-07 and 2007-08. The results indicated that application of 120 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> recorded the higher grain and straw yield to the extent of 49.5 and 46.6 % over lowest level. Application of poultry manures @ 6 t ha<sup>-1</sup> by broadcasting as well as drilling recorded the higher grain and straw yield to the extent of 57.8, 49.5, 42.8 and 42.5 per cent over control, respectively. The higher uptake of nitrogen and phosphorus and status of organic carbon and available phosphorus in soil was recorded with 120 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> to the extent of 68.8, 68.3, 5.1 and 19.2 % and with 6 t ha<sup>-1</sup> poultry manure application to the extent of 69.7, 74.0, 42.8 and 36.8 % as compared to lower dose and control, respectively.

**Key words:** Wheat, integrated nutrient management, poultry manure

### INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important staple food crop of India and occupies a notable position among the foodgrain crops not only in terms of hectare and production, but also in its versatility in adaptation to a wide range of agroclimatic conditions. The area, productions and productivity of wheat in India were 29.25 million ha, 85.93 million tones and 2937 kg ha<sup>-1</sup> during 2010-11, respectively (Anonymous, 2011a). In Rajasthan, wheat is an important *rabi* crop and is grown almost through out the state. The area, production and productivity of crop in Rajasthan were 3.04 million ha, 10.42 million tones and 3427 kg ha<sup>-1</sup>, respectively during the 2010-11 (Anonymous, 2011b). An integrated approach to plant nutrient management gained momentum and importance in recent years. The objective of this approach is efficient, judicious and economic use of all major sources of plant nutrients in an integrated manner so as to maximize / optimize yield of a crop or cropping system without any adverse effect on the agri-ecosystem. Poultry manure has been picking up as a very good alternative to the existing organic source of nutrients in the zone III a in recent years. It has, therefore, become necessary to develop an integrated plant nutrient management system involving the use of inorganic fertilizers on one hand and the poultry manure as an organic source on the other hand for optimizing wheat productivity in the semi-arid western plain zone.

### MATERIALS AND METHODS

The field experiment was conducted with wheat variety Raj-3077 during *rabi* seasons of 2006-

07 and 2007-08 at Agronomy Farm Agricultural Research Station, Durgapura (Jaipur). The soil is loamy sand in texture, alkaline in reaction, (pH 7.8), EC 0.16 dSm<sup>-1</sup>, low in available nitrogen (151 kg ha<sup>-1</sup>), phosphorus (21 kg ha<sup>-1</sup>) and medium in potassium (194 kg ha<sup>-1</sup>). The experiment was laid out in split plot design with four replications keeping fertilizer levels in main plots and poultry manure in sub plot. Treatments comprised four doses of fertilizers, 30 kg N + 10 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>, 60 kg N + 20 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>, 90 kg N + 30 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> and 120 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>, and six levels of poultry manure (control, 2 t ha<sup>-1</sup> broadcasting, 2 t ha<sup>-1</sup> by drilling, 4 t ha<sup>-1</sup> broadcasting, 4 t ha<sup>-1</sup> by drilling, 6 t ha<sup>-1</sup> broadcasting, 6 t ha<sup>-1</sup> by drilling). The crop was sown and irrigated timely at different stages as per its requirement to obtain good plant growth and yield. In all, six irrigations were applied to crop after sowing. To assess the biological, grain and straw yield, net area of 4 m x 2.7 m was harvested separately from each plot. The N and P content in grain and straw were analysed by adopting the standard procedure (Jackson, 1973). After harvest of the crop, the soil samples were taken and analysed for organic carbon and available phosphorus by following the standard methods.

### RESULTS AND DISCUSSION

Application of 120 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> increased the grain and straw yield by 49.5 and 46.6, % respectively over lowest application of fertilizer (Table 1). Increased supply of nitrogen promoted plant flowering and fruiting, higher manufacture of food. Thus, adequate supply of nitrogen and phosphorus to plant in balanced proportion improved the yield. Similar results were recorded by Nehra

*et al.* (2001). Drilling of poultry manure (6t ha<sup>-1</sup>) recorded the highest grain and straw yield to the extent of 57.8 and 42.8 per cent, respectively over control. The significant increase in grain and straw yield under the influence of poultry manure was largely a function of improved growth and consequent increase in different yield attributes. Similar results were also reported by Ramesh *et al.* (2006) and Gowela *et al.* (2008). Increasing levels of N, P and poultry manure increased protein content of

Table 1: Effect of fertilizer and poultry manure on grain and straw yields, content and yield of protein in wheat

Treatments	Grain yield (q/ha)			Straw yield (q/ha)			Protein content (%)			Protein yield Kg ha <sup>-1</sup>		
	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled
<b>Fertilizers</b>												
F <sub>1</sub> 30 kg N + 10 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	32.33	34.11	33.22	45.45	46.13	45.79	10.06	10.18	10.12	325.2	347.2	336.2
F <sub>2</sub> 60 kg N + 20 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	38.92	41.07	40.00	54.02	54.83	54.43	10.87	10.95	10.91	423.0	449.7	436.3
F <sub>3</sub> 90 kg N + 30 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	43.98	46.41	45.20	60.92	61.83	61.38	11.31	11.43	11.37	497.4	530.4	513.9
F <sub>4</sub> 120 kg N + 40 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	48.33	51.01	49.67	66.65	67.65	67.15	11.76	11.68	11.72	567.8	595.7	581.8
S.Em±	0.73	0.82	0.55	1.04	1.43	0.89	0.12	0.15	0.10	9.00	11.00	7.10
CD (P=0.05)	2.33	2.61	1.63	3.31	4.58	2.62	0.40	0.46	0.28	28.70	35.10	21.00
<b>Poultry manure</b>												
M <sub>0</sub> Control	30.62	32.11	31.37	44.66	45.96	45.31	10.05	10.11	10.08	309.0	325.2	317.1
M <sub>1</sub> 2 t ha <sup>-1</sup> as broadcast	36.43	38.87	37.65	52.42	53.14	52.78	10.74	10.80	10.77	392.6	422.1	407.3
M <sub>2</sub> 2 t ha <sup>-1</sup> drilling	37.38	39.61	38.50	52.70	53.56	53.13	10.86	10.94	10.90	407.3	433.3	420.3
M <sub>3</sub> 4 t ha <sup>-1</sup> as broadcast	42.60	44.87	43.74	59.45	60.31	59.88	11.31	11.37	11.34	482.8	510.0	496.4
M <sub>4</sub> 4 t ha <sup>-1</sup> drilling	43.57	45.79	44.68	59.58	60.35	59.97	11.30	11.40	11.35	492.7	522.0	507.4
M <sub>5</sub> 6 t ha <sup>-1</sup> as broadcast	47.46	49.98	48.72	64.22	64.87	64.55	11.37	11.35	11.36	541.3	570.3	555.8
M <sub>6</sub> 6 t ha <sup>-1</sup> drilling	48.18	50.83	49.51	64.29	65.10	64.70	11.37	11.45	11.41	547.8	582.5	565.1
S.Em±	0.71	0.75	0.52	1.33	1.35	0.95	0.15	0.15	0.10	10.00	11.00	7.4
CD (P=0.05)	1.99	2.11	1.44	3.73	3.80	2.64	0.44	0.42	0.30	28.10	30.09	20.6

wheat in pooled analysis and both the years. Application of 120 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> and 6 t ha<sup>-1</sup> poultry manure recorded an increase of 15.8 and 73.0 % protein content and protein yield, respectively in wheat grain over lowest application. The increase in protein content with increasing level of N and P might be due to improved nutritional environment in the rhizosphere as well as in plant system leading to enhanced translocation of N and P to reproductive parts. These observations are in conformity with the

findings of Naphade *et al.* (1993). The application of 6 t ha<sup>-1</sup> poultry manure by drilling increased the protein content and protein yield to the extent of 13.1 and 78.2 % respectively over control. This increase is owing to the fact of increased availability of the nutrients. Similar results were also reported by Ramesh *et al.* (2006). Pooled analysis of N and P uptake by grain and straw (Table 2) indicated that 120 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> resulted in 68.8 and 67.3 % higher N and P uptake over lowest level of N and P,

Table 2: Effect of fertilizer and poultry manure on nitrogen and phosphorus uptake by the crop

Treatments	Nitrogen uptake (kg ha <sup>-1</sup> )			Phosphorus uptake (kg ha <sup>-1</sup> )		
	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled
<b>Fertilizers</b>						
F <sub>1</sub> 30 kg N + 10 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	84.0	88.7	86.3	13.7	14.7	14.2
F <sub>2</sub> 60 kg N + 20 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	107.4	112.6	110.0	17.5	18.7	18.2
F <sub>3</sub> 90 kg N + 30 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	126.6	132.7	129.6	20.6	22.1	21.3
F <sub>4</sub> 120 kg N + 40 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	142.9	148.7	145.8	23.1	24.7	23.9
S.Em±	2.75	3.46	2.21	0.4	0.54	0.35
CD (P=0.05)	8.78	11.03	6.55	1.43	1.73	1.04
<b>Poultry manure</b>						
M <sub>0</sub> Control	80.8	84.9	82.9	13.1	14.0	13.5
M <sub>1</sub> 2 t ha <sup>-1</sup> as broadcast	101.0	106.3	103.7	16.2	17.5	16.9
M <sub>2</sub> 2 t ha <sup>-1</sup> drilling	104.2	109.2	106.7	16.8	18.1	17.5
M <sub>3</sub> 4 t ha <sup>-1</sup> as broadcast	122.3	127.9	125.1	19.6	21.1	20.3
M <sub>4</sub> 4 t ha <sup>-1</sup> drilling	124.5	130.0	127.3	20.1	21.6	20.9
M <sub>5</sub> 6 t ha <sup>-1</sup> as broadcast	136.2	142.3	139.2	22.3	23.8	23.1
M <sub>6</sub> 6 t ha <sup>-1</sup> drilling	137.5	144.0	140.7	22.7	24.3	23.5
S.Em±	2.97	3.03	2.12	0.47	0.49	0.34
CD (P=0.05)	8.36	8.51	5.91	1.33	1.38	0.95

respectively. The nutrient uptake is a function of their content in crop. The increase in these parameters due to N P fertilizer led to an increased uptake of the nutrient. These results are in conformity with those of Singh and Agarwal (2004). Application of poultry manure (6 t ha<sup>-1</sup>) proved superior to the extent of 69.8

and 73.5 % in terms of N and P uptake over control, respectively. This might be the result of increased availability of N and P nutrient to plant with the application of poultry manure. Similar results were also reported by Clark and Mullins (2004).

Table 3: Effect of fertilizer and poultry manure on organic carbon and available phosphorus after harvest

Treatments	Organic carbon (g kg <sup>-1</sup> )			Available phosphorus (kg ha <sup>-1</sup> )		
	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled
<b>Fertilizers</b>						
F <sub>1</sub> 30 kg N + 10 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	2.33	2.28	2.31	21.56	23.62	22.59
F <sub>2</sub> 60 kg N + 20 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	2.38	2.31	2.33	23.19	25.49	24.34
F <sub>3</sub> 90 kg N + 30 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	3.45	2.38	2.42	24.48	27.04	25.76
F <sub>4</sub> 120 kg N + 40 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup>	2.47	2.39	2.43	25.68	28.19	26.94
S.Em±	0.04	0.04	0.03	0.32	0.37	0.24
CD (P=0.05)	NS	NS	NS	1.02	1.17	0.72
<b>Poultry manure</b>						
M <sub>0</sub> Control	1.91	1.87	1.89	19.90	21.10	20.50
M <sub>1</sub> 2 t ha <sup>-1</sup> as broadcast	2.24	2.19	2.22	21.70	24.30	23.00
M <sub>2</sub> 2 t ha <sup>-1</sup> drilling	2.26	2.22	2.24	22.00	24.80	23.40
M <sub>3</sub> 4 t ha <sup>-1</sup> as broadcast	2.48	2.38	2.43	24.50	26.70	25.60
M <sub>4</sub> 4 t ha <sup>-1</sup> drilling	2.51	2.41	2.46	24.90	27.10	26.00
M <sub>5</sub> 6 t ha <sup>-1</sup> as broadcast	2.72	2.65	2.69	26.40	29.20	27.80
M <sub>6</sub> 6 t ha <sup>-1</sup> drilling	2.73	2.67	2.70	26.70	29.40	28.05
S.Em±	0.05	0.03	0.03	0.67	0.69	0.23
CD (P=0.05)	0.14	0.10	0.09	1.88	1.93	0.73

Available phosphorus content (Table 3) in soil was significantly affected due to fertilizer application. The maximum available phosphorus content was observed under the treatment where 120 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> was applied. Application of poultry manure significantly enhanced organic carbon

and available phosphorus. The highest organic carbon (2.70 g kg<sup>-1</sup>) and available phosphorus (28.05 kg P<sub>2</sub>O<sub>5</sub>) was observed with 6 t ha<sup>-1</sup> poultry manure application by drilling and found at par with the application of poultry manure as broadcasting. Similar results were also reported by Gowela *et al.* (2008).

Table 4: Effect of fertilizer and poultry manure application on net returns (₹/ha) and B:C ratio

Treatments	Net returns (₹/ha)			B:C ratio		
	2006-07	2007-08	Pooled	2006-07	2007-08	Pooled
<b>Fertilizer</b>						
30 kg N + 10 kg P <sub>2</sub> O <sub>5</sub> /ha	21,479	23,043	22,261	1.5	1.6	1.6
60 kg N + 20 kg P <sub>2</sub> O <sub>5</sub> /ha	28,217	30,099	29,158	2.0	2.1	2.1
90 kg N + 30 kg P <sub>2</sub> O <sub>5</sub> /ha	33,397	35,521	34,459	2.3	2.5	2.4
120 kg N + 40 kg P <sub>2</sub> O <sub>5</sub> /ha	37,772	40,115	38,944	2.6	2.8	2.7
S.Em.±	735	879	573	0.06	0.70	0.04
C.D. (P = 0.05)	2346	2805	1698	0.18	0.21	0.13
<b>Poultry manure</b>						
Control	22,322	23,774	23,048	2.0	2.1	2.0
2 t / ha broadcasting	26,822	28,918	27,870	2.0	2.2	2.1
2 t / ha drilling	27,438	29,394	28,416	2.1	2.2	2.1
4 t / ha broadcasting	31,764	33,752	32,758	2.2	2.3	2.3
4 t / ha drilling	32,366	34,296	33,331	2.2	2.3	2.3
6 t / ha broadcasting	35,206	37,352	36,279	2.2	2.3	2.3
6 t / ha drilling	35,596	37,878	36,737	2.2	2.3	2.3
S Em±	750	792	545	0.05	0.06	0.04
CD (P = 0.05)	2107	2227	1520	0.15	0.16	0.11

**Economics:** Data (Table 4) reveal that increasing levels of N and P increased the net returns significantly over lower levels during both the years and the maximum B:C ratio (2.7) was recorded with the application of 120 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> followed by 90 kg N + 30 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> (2.45). Application of poultry manure 6 t ha<sup>-1</sup> by drilling significantly increased the net returns and B:C ratio of the wheat crop as compared to control. The application of poultry manure 6 t ha<sup>-1</sup> by drilling as well as broadcast recorded B:C ratio 2.3 followed by

application of 4 t ha<sup>-1</sup> poultry manure by drilling (2.31).

### Conclusion

From the results, it is concluded that the application of 120 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> and poultry manures @ 6 t ha<sup>-1</sup> by broadcasting as well as drilling recorded the higher grain yield, straw yield, protein content, protein yield, nitrogen uptake, phosphorus uptake by the plant, organic carbon and available phosphorus in the soil and net return and B:C ratio.

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