

# EFFECT OF INTEGRATED USE OF FYM AND UREA ON YIELD, NUTRIENT UPTAKE AND PROTEIN CONTENT OF WHEAT (*TRITICUM AESTIVAM* L.)

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## ABSTRACT

The present investigation was conducted for one *rabi* seasons during 2013-14 in a clay loam soil at the Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.), India. To study the effect of integrated use of FYM and urea on yield, nutrient uptake and protein content of wheat (*Triticum aestivum* L.) The result revealed that the highest values of grain yield (4744.11 kg ha<sup>-1</sup>) were obtained from M<sub>1</sub>N<sub>2</sub> (SWI at 75% N from urea and 25% N from FYM) which differed significantly over rest of the treatment combinations. However, the maximum nutrient (N,P and K) uptake by wheat in method of sowing and integrated use of FYM and urea respectively in SWI the maximum nutrient uptake by wheat 63.20,15.79,122.63 in integrated use of FYM and urea 74.77, 24.95,142.37 kg ha<sup>-1</sup> were observed in the treatment receiving at 75% N from urea and 25% N from FYM and also highest protein content in SWI 9.44% and integrated use of FYM and urea 11.05% (100 % N through urea). Thus, integrated use of FYM and urea improve the crop yields, produces quality grain as well as improve the soil fertility.

## INTRODUCTION

Cereals are an important dietary protein source throughout the world, because they constitute the main protein and energy supply in most countries. Wheat (*Triticum aestivum* L.) is one of the major cereal crops with a unique protein (gluten), which is consumed by humans and is grown around the world in diverse environments. In India, wheat is second most important food crop, next only to rice, with an area of 29.8 million hectares and production of 93.90 million tons during 2012-13 (Anon., 2013). The average productivity is 2.96 tons ha<sup>-1</sup>. It occupies 21 per cent of area under food grains and contributes 34 per cent to the total food grain production of the country. The rapid increase in the world population demands parallel increases in food production, particularly of wheat. In India, after the green revolution, intensive agriculture involving exhaustive high-yielding varieties of wheat has led to heavy withdrawal of nutrients from the soil. The imbalanced use of chemical fertilizers by farmers has deteriorated soil health. The integrated use of FYM and urea improving and maintaining soil health for enhancing and sustaining agricultural production. Integrated use of 75% NPK and FYM @ 5 t ha<sup>-1</sup> or poultry manure @1.5 mg ha<sup>-1</sup> to rainy season crops and 75% NPK to wheat significantly improved the yield of wheat over application of 100% NPK in both the season (Bandyopadhyay *et al.* 2009). Similarly, a field experiment conducted by Pandey *et al.*, (2009) at Pusa exhibited that application of FYM at varying fertility levels produced significantly higher values for yield attributing characters than as well as grain and straw yield than the

application of chemical fertilizers alone due to adequate quantities and balanced proportion of plant nutrients supplied to the crop. Adoption of integrated plant nutrient supply and management strategies for enhancing soil quality, input use efficiency and crop productivity is extremely important for food and nutritional security in Indian agriculture (Swarup, 2010).

The effect of integrated use of organic and inorganic fertilizers on the yield of wheat was evaluated by Shah *et al.*, (2010) at NIFA, Peshawar. The results showed that integrated use in different proportion increased the plant height, spike length, grain per spike and 1000-grain weight. Maximum grain yield of 3.5 t ha<sup>-1</sup> was obtained from treatments where 25% N was applied from FYM 25% N from poultry manure or city waste and 50% from mineral source and in treatment where 25% N was applied from FYM, 25% from city waste and 50% from mineral fertilizer. Application of half N from urea with 25% N from either FYM and 25% poultry manure or city waste proved beneficial and reduced 50% fertilizer cost. Nutrients are one of the most important inputs, required by the plants for their growth and yield. The N, P and K are major nutrients and are supplied through fertilizers and manures. Farm yard manure is considered as the promising renewable, nutrient rich source and can be served as a substitute to cut down the cost of fertilizer input and to increase the productivity of wheat in addition to maintain soil productivity, improve the eco-system and ultimately resulting in improved soil-plant-health in a sustainable agricultural eco-system. Keeping this in view, the present investigation was planned to study the impact of

integrated use of FYM and urea on yield, nutrient uptake and protein content of wheat (*Triticum aestivum* L.)

## MATERIALS AND METHODS

A field experiment was conducted during rabi season of 2013-14 at Instructional Farm, Indira Gandhi Krishi Vishwa vidyalaya, Raipur located at between 21°16'N latitude and 81°26'E longitude with an altitude of 289.56 m above mean sea level. During the investigation cumulative rainfall was 89.2 mm while mean maximum and minimum temperature of 42.6°C and 9.6°C respectively. The soil of experiment site was clay loam (25.41% sand, 22.72% silt, 52.86% clay), with a pH of 7.6, 0.37% organic carbon, low in available nitrogen (188.16 kg ha<sup>-1</sup>), medium in available phosphorus (19 kg ha<sup>-1</sup>) and potash (220.11 kg ha<sup>-1</sup>). The experiment using split plot design where the main plot were sowing methods and the sub plot were integrated use of nitrogen. Treatments comprised of three methods of sowing viz. SWI (M<sub>1</sub>), line sowing (M<sub>2</sub>) and broadcasting (M<sub>3</sub>) and six levels of N fertilizers viz. urea and FYM were combined in a way to supply N at 120 kg ha<sup>-1</sup> from both sources in 0:0 (N<sub>0</sub>), 100:0 (N<sub>1</sub>), 75:25 (N<sub>2</sub>), 50:50 (N<sub>3</sub>), 25:75 (N<sub>4</sub>) and 0:100 (N<sub>5</sub>) ratios arranged in a split plot design with three replications. The wheat (variety *Ratan*) was planted using a seed rate of 25, 100 and 125 kg ha<sup>-1</sup> in SWI, line sowing and broadcast methods of sowing, respectively. In case of line sowing seeds were sown at a row spacing of 22 cm apart, while seeds were spread uniformly in broadcast method. The weeds were eliminated from each plot by hand weeding. An intercultural operation was performed in SWI method with the help of hand wheel-hoe in order to facilitate better aeration in the root zone. The required quantity of wheat seeds for different methods, were treated with Bavistin @ 2.5 g/kg of seed before sowing. Standard procedures were adopted for recording the data on various growth and yield parameters.

The grain and straw yield of wheat were recorded and soil samples (0-15cm) were collected from each plot after harvest of wheat. The sample were analyzed for Organic by rapid titration method (Walkley and Black, 1936). Available N was estimated by alkaline permanganate method (Subbiah and Asija, 1956), available phosphorus by Olsen's method (Olsen et al., 1954), available K by ammonium acetate extraction method (Jackson, 1967). Data collected were statistically analyzed by using Fisher's analysis of variance technique.

## RESULTS AND DISCUSSION

The data on effective tillers m<sup>-2</sup>, length of ear head (cm), no. of grains ear<sup>-1</sup> head, weight of grains ear<sup>-1</sup> head (g), grain yield, straw yield and protein content (%) of wheat at harvest as influenced by different treatments are presented in Table 1. The number of effective tillers in wheat varied significantly due to methods of sowing and integrated use of nitrogen at harvest number of effective tillers were recorded in SWI treatment, being significantly higher (330.17) over other methods of sowing. The broadcast method resulted in lesser number of effective tillers (234.06 m<sup>-2</sup>) compared to those recorded in SWI and line sowing treatments. Similar trend also found in number of length of ear head (cm), no. of grains ear<sup>-1</sup> head, no. of grains ear<sup>-1</sup> head (g). The broadcasting method resulted

less effective tillers due to greater intra-specific competition between plant populations than line sown crop. Similarly, the ear length of wheat was also found higher in SWI compared to conventional broadcasting as well as line sowing by Adhikari et al. (2013). Similarly Singh et al. (2011) who reported marked increase in number of grains per ear of wheat by applying organic manures and mineral fertilizer in combination. Similarly data reported Tanveer et al. (2003) and Khan et al. (2007) who reported minimum 1000-grain weight for broadcast planted wheat as compared to wheat planted with other planting methods. Similar trend also found in grain yield and straw yield at harvest. Protein content in grain (%) wheat was significantly influenced by methods of sowing and integrated use of nitrogen. The crop planted through SWI had significantly higher (9.44 %) followed by line sowing (8.06 %) and significant difference existed in between these two treatments. The minimum protein content in grain (6.34 %) was recorded in plants sown through broadcasting method.

As regards to integrated use of nitrogen, results showed that application of nitrogen increased effective tillers m<sup>-2</sup>, significantly over absolute control treatment. Maximum no. of effective tillers of (307.47m<sup>-2</sup>) at harvest, were observed in treatment where 75 % RDN was applied through urea and 25 % N through farm yard manure (N<sub>2</sub>), being significantly superior over rest of the treatment combinations. Similar trend also found in length of ear head (cm), no. of grains ear<sup>-1</sup> head, no. of grains ear<sup>-1</sup> head (g), grain yield and straw yield but in non significant variation are also observed in no. of grains ear<sup>-1</sup> head (g) and protein content in grain due to methods of sowing and integrated use of nitrogen at harvest. The interaction between sowing methods and integrated use of nitrogen on number of effective tillers, length of ear head (cm), no. of grains ear<sup>-1</sup> head, 1000-seed weight (g), grain yield and straw yield of wheat was found significantly at harvest.

The interaction between sowing method and integrated use of nitrogen had a significant effect on grain yield of wheat (Table 2). The highest values of grain yield (4744.11 kg ha<sup>-1</sup>) were obtained from M<sub>1</sub>N<sub>2</sub> (SWI at 75% N from urea and 25% N from FYM) which differed significantly over rest of the treatment combinations. The lowest values of grain yield (1138.24 kg ha<sup>-1</sup>) were obtained from M<sub>3</sub>N<sub>0</sub> (broadcasting method without N fertilization) which was proved to be significantly lowest compared to other treatment combinations. Therefore, the combination of M<sub>1</sub>N<sub>2</sub> is recommended as the treatment that maximizes grain yield of wheat under this study. Similarly, Abbas and Fadul (8) also showed significant interaction of the planting methods and manures for the grain yield. Similar trend also found in number of effective tillers, length of ear head (cm), no. of grains ear<sup>-1</sup> head, 1000-seed weight (g), straw yield at harvest. Application of N solely from urea (N<sub>1</sub>) gave maximum grain protein content (11.05 %), being significantly superior over other treatment combinations followed by protein content of 9.93 % observed in treatment receiving 75% N from urea and 25% N from FYM (N<sub>2</sub>). Absolute control (N<sub>0</sub>) devoid of nitrogen addition remained inferior most with respect to protein content in wheat grain. These results are in close conformity with the previous findings of Kumar et al. (2013) who found that reduction in nitrogen doses significantly reduced the protein content in

**Table 1: No. of Effective Tillers m<sup>-2</sup>, Length of Ear head (cm), No. of grains Ear<sup>-1</sup> head, weight of grains Ear<sup>-1</sup> head (g), 1000-seed weight (g), Grain yield, Straw yield and protein content (%) of wheat as influenced by effect of integrated use of FYM and urea**

Treatment	No. of Effective Tillers m <sup>-2</sup>	Length of Ear head (cm)	No. of grains Ear <sup>-1</sup> head	Wt. of (g) grains Ear <sup>-1</sup> head	1000-seed weight (g)	Grain yield (kg ha <sup>-1</sup> )	Straw yield (kg ha <sup>-1</sup> )	Protein content in grain (%)
Method of sowing								
SWI	320.17	9.83	47	2.84	44.54	3336.04	4456.83	9.44
Line Sowing	262.55	8.66	40.02	2.54	40.05	2450.60	3646.28	8.06
Broadcasting	234.06	8.04	36.66	2.31	37.59	2067.75	3059.90	6.34
SEm ±	2.27	0.12	0.85	0.04	0.84	27.76	47.69	0.28
CD (P=0.05)	8.89	0.48	3.35	0.15	3.28	109.01	187.25	1.13
Nitrogen level								
N <sub>0</sub>	198.48	6.73	30.91	1.77	32.57	1581.92	2477.30	3.69
N <sub>1</sub>	279.32	9.7	46.09	3.13	44.97	3267.71	4508.38	11.05
N <sub>2</sub>	307.47	10.17	50.48	3.57	50.83	3638.96	4926.15	9.93
N <sub>3</sub>	260.98	9.27	43.99	2.69	42.33	2786.49	3996.95	9.04
N <sub>4</sub>	244.73	8.98	39.35	2.32	39.47	2445.39	3446.21	7.99
N <sub>5</sub>	216.57	8.39	36.54	2.12	36.19	1988.31	2971.03	5.98
SEm ±	4.75	0.14	0.68	0.12	0.9	90.931	80.29	0.27
CD (P=0.05)	13.72	0.39	1.97	0.34	2.61	262.62	231.9	0.78
Interaction	24.02	0.69	3.44	NS	4.56	459.72	405.93	NS

**Table 2: Grain yield (kg ha<sup>-1</sup>) of wheat as influenced by interaction between methods of sowing and integrated use of nitrogen**

Treatments	M <sub>1</sub> (SWI)	M <sub>2</sub> (Line sowing)	M <sub>3</sub> (Broadcasting)
N <sub>0</sub> -RDN (100%N from urea)	2283.07	1324.44	1138.24
N <sub>1</sub> -RDN(75% urea + 25% FYM)	4441.83	2984.70	2376.58
N <sub>2</sub> - RDN(50% urea + 50% FYM)	4744.11	3579.34	2593.44
N <sub>3</sub> - RDN(25% urea + 75% FYM)	3317.86	2812.27	2229.34
N <sub>4</sub> - RDN(100 % FYM)	3019.94	2079.77	2236.47
N <sub>5</sub> -RDN (100%N from urea)	2209.45	1923.08	1832.41

For comparing means of SEm ± CD<sub>5%</sub> M x N at the same level of M 157.50 459.73 M x N at the same or different level of N 148.57 471.53

**Table 3: N, P, K and organic carbon availability as influenced by integrated use of FYM and urea on wheat**

Treatment	Available N Kg ha <sup>-1</sup>	Available P Kg ha <sup>-1</sup>	Available K Kg ha <sup>-1</sup>
Method of sowing			
M <sub>1</sub> (SWI)	237.21	24.88	264.32
M <sub>2</sub> (Line sowing)	237.2	23.65	262.91
M <sub>3</sub> (Broadcasting)	229.56	23.1	262.18
SEm ±	1.48	0.2	2.18
CD (P=0.05)	5.81	0.79	8.58
Integrated use of Nitrogen			
N <sub>0</sub> (Absolute control)	177.78	17.73	182.51
N <sub>1</sub> (100% through Urea)	248.53	22.39	281.68
N <sub>2</sub> (75% Urea + 25% FYM)	253.73	25.53	284.36
N <sub>3</sub> (50% Urea + 50% FYM)	248.51	24.62	278.38
N <sub>4</sub> (25% Urea + 75% FYM)	242.65	25.42	278.35
N <sub>5</sub> (100% through FYM)	236.74	27.55	273.54
SEm ±	2.68	0.62	2.22
CD (P=0.05)	7.75	1.81	6.41
Interaction	NS	NS	NS

wheat grain.

#### Nutrient status of soil after harvest of crop

The data on available N, P, and K of soil kg ha<sup>-1</sup> after harvesting of crop was analysed and embodied in table 3. The available nitrogen in wheat varied significantly due to methods of sowing and integrated use of nitrogen after harvest of crop available nitrogen were recorded in SWI treatment, being significantly higher (237.21 kg ha<sup>-1</sup>) over other methods of sowing. The

broadcast method resulted in lesser available nitrogen (229.56 kg ha<sup>-1</sup>) compared to those recorded in SWI and line sowing treatments. Similar trend also found in Available P and K kg ha<sup>-1</sup>. This kind of sowing with proper plant density allows plant to grow in its full potential on account of sufficient aeration, moisture, sunlight and nutrient availability leading to proper root system development resulting in healthier growth and higher yield (Dash and Pal, 2011).

The interaction between sowing method and integrated use of

**Table 4: N, P and K uptakes as influenced by integrated use of FYM and urea on wheat**

Treatment	Nitrogen uptake kg ha <sup>-1</sup>			Phosphorus uptake kg ha <sup>-1</sup>			Potassium uptake kg ha <sup>-1</sup>		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
Method of sowing									
M <sub>1</sub> (SWI)	47.99	15.21	63.20	12.71	3.08	15.79	48.8	73.83	122.63
M <sub>2</sub> (Line sowing)	45.01	14.88	59.89	10.97	2.26	13.23	45.77	69.46	115.23
M <sub>3</sub> (Broadcasting)	43.88	14.25	58.13	9.89	1.54	11.43	35.31	66.65	101.96
SEm ±	0.34	0.07	0.41	0.31	0.09	0.4	0.39	0.67	1.06
CD (P=0.05)	1.34	0.27	1.61	1.22	0.36	1.58	1.53	2.64	4.17
Integrated use of Nitrogen									
N <sub>0</sub> (Absolute control)	32.62	10.89	43.51	3.15	0.59	3.74	33.44	50.05	83.49
N <sub>1</sub> (100% through Urea)	49.73	16.57	66.30	14.74	3.34	18.08	46.6	81.33	127.93
N <sub>2</sub> (75% Urea + 25% FYM)	55.89	18.88	74.77	20.15	4.8	24.95	51.43	90.94	142.37
N <sub>3</sub> (50% Urea + 50% FYM)	47.43	15.44	62.87	13.2	2.37	15.57	44.82	71.90	116.72
N <sub>4</sub> (25% Urea + 75% FYM)	45.21	14.01	59.22	9.56	1.58	11.14	42.88	66.47	109.35
N <sub>5</sub> (100% through FYM)	42.88	12.88	55.76	6.35	1.09	7.44	40.6	59.19	99.79
SEm ±	0.53	0.32	0.85	0.25	0.16	0.41	0.46	1.20	1.66
CD (P=0.05)	1.55	0.93	2.48	0.74	0.46	1.2	1.33	3.46	4.79
Interaction	2.72	1.62	4.34	1.3	0.81	2.11	2.32	6.05	8.37

**Table 5: N, P and K uptake (kg ha<sup>-1</sup>) of wheat as influenced by interaction between methods of sowing and integrated use of nitrogen**

Treatment	Nitrogen uptake kg ha <sup>-1</sup>		Phosphorus uptake kg ha <sup>-1</sup>		Potassium uptake kg ha <sup>-1</sup>	
	Grain	Straw	Grain	Straw	Grain	Straw
M <sub>1</sub> N <sub>0</sub>	37.20	10.37	4.14	0.75	36.75	53.70
M <sub>1</sub> N <sub>1</sub>	49.85	18.22	17.40	4.25	51.05	86.08
M <sub>1</sub> N <sub>2</sub>	62.63	21.15	22.37	6.90	56.01	100.99
M <sub>1</sub> N <sub>3</sub>	47.37	15.70	15.17	2.97	50.89	74.07
M <sub>1</sub> N <sub>4</sub>	46.26	14.22	10.00	1.90	49.33	66.78
M <sub>1</sub> N <sub>5</sub>	44.63	11.59	7.20	1.72	48.77	61.34
M <sub>2</sub> N <sub>0</sub>	31.90	11.69	3.06	0.57	32.95	50.87
M <sub>2</sub> N <sub>1</sub>	49.41	15.67	13.70	3.36	50.40	82.01
M <sub>2</sub> N <sub>2</sub>	52.77	18.58	21.39	4.49	53.46	92.89
M <sub>2</sub> N <sub>3</sub>	47.60	15.82	12.51	2.44	48.51	68.67
M <sub>2</sub> N <sub>4</sub>	45.06	13.90	9.23	1.70	46.47	63.59
M <sub>2</sub> N <sub>5</sub>	43.30	13.62	5.94	0.97	42.86	58.74
M <sub>3</sub> N <sub>0</sub>	28.75	10.61	2.24	0.45	30.64	45.59
M <sub>3</sub> N <sub>1</sub>	49.94	15.82	13.11	2.40	38.36	75.89
M <sub>3</sub> N <sub>2</sub>	52.26	16.91	16.68	3.01	44.81	78.93
M <sub>3</sub> N <sub>3</sub>	47.32	14.81	11.92	1.71	35.06	72.97
M <sub>3</sub> N <sub>4</sub>	44.32	13.92	9.46	1.13	32.83	69.04
M <sub>3</sub> N <sub>5</sub>	40.70	13.45	5.92	0.56	30.16	57.49

nitrogen had a significant effect on available N, P and K (Table 3). The higher availability of nitrogen (253.73 kg ha<sup>-1</sup>) were obtained from N<sub>2</sub> (75% N from urea and 25% N from FYM) which differed significantly over rest of the treatment combinations. The lowest availability of nitrogen (177.78 kg ha<sup>-1</sup>) were obtained from N<sub>0</sub> (without N fertilization) which was proved to be significantly lowest compared to other treatment combinations. Similar trend also found in Available P and K kg ha<sup>-1</sup>. The available nutrient in soil was non-significant influenced due to method of sowing and integrated use of nitrogen. Increase in available nitrogen in soil due to addition of organics was observed in wheat (Singh *et al.*, 2006). The available P was either maintained or slightly improved due to addition of farm yard manure. The similar result was also found by (Panwar, 2008).

The data on nutrient uptakes of N, P and K (kg ha<sup>-1</sup>) in grain and straw of wheat at harvest as influenced by different treatments are presented in Table 4. The nutrient uptake in wheat varied significantly due to methods of sowing and

integrated use of nitrogen at harvest N uptake by grain and straw were recorded in SWI treatment, being significantly higher (48.1, 15.43 and total 63.20 kg ha<sup>-1</sup>) over other methods of sowing. The broadcast method resulted in lesser nitrogen uptake in grain and straw (44.21, 14.35 and total 58.13 kg ha<sup>-1</sup>) compared to those recorded in SWI and line sowing treatments. Similar trend also found in phosphorus uptake, potassium uptake, the nitrogen uptake by wheat increased with the integrated use of FYM and urea. The higher nutrient uptake with organic manure might be attributed to solubilization of native nutrients, chelation of complex intermediate organic molecules produced during decomposition of added organic manures, their mobilization and accumulation of different nutrients in different plant parts. The results are in agreement with the findings of (Mitra *et al.*, 2010).

Phosphorus uptake by wheat was also influenced by combined application of inorganic fertilizers, organic manure and produced during decomposition of organic resources. Similar

results were also observed by (Mohapatra *et al.*, 2008) in rice–potato (*Solanum tuberosum* L.) cropping system and (Sawarkar *et al.*, 2013) under soybean-wheat cropping sequence in a Vertisol. The increase in grain and straw yield in integrated use of FYM and urea could be due to enhanced nutrient availability which improved nitrogen and other macro- and micro-elements absorption as well as enhancing the production and translocation of the dry matter content from source to sink. Specifically the higher organic matter and available N, P and K (Table 3) provided an improved soil quality leading to improved crop productivity. Soil productivity is closely linked with soil organic matter status as it plays an important role in the improvement of soil structure and organic matter status. Mukhopadhyay *et al.* (2008) and Siavoshi *et al.* (2011).

The interaction between sowing method and integrated use of nitrogen had a significant effect on nutrient uptake of wheat nitrogen grain and straw (Table 2). The highest values nutrient uptake of (55.89, 18.88 and total 74.77 kg ha<sup>-1</sup>) were obtained from M<sub>1</sub>N<sub>2</sub> (SWI at 75% N from urea and 25% N from FYM) which differed significantly over rest of the treatment combinations. The lowest values of grain and straw nitrogen uptake (32.62, 10.89 and total 43.31 kg ha<sup>-1</sup>) were obtained from N<sub>0</sub> absolute control which was proved to be significantly lowest compared to other treatment combinations. Therefore, the combination of M<sub>1</sub>N<sub>2</sub> is recommended as the treatment that maximizes nutrient uptake of wheat under this study. Similar trend also found in phosphorus and potassium grain and straw uptakes in wheat. similar finding were reported by Kumpawat (2010), Vadgave (2010), Anandan and Natarajan (2012) and Prajapati (2014). Beneficial effects of integration of inorganic fertilizers and organic manures along with biofertilizers on nutrient uptake in wheat and sesame crops were also noticed by Sharma *et al.* (2013) and Nayek *et al.* (2014), respectively.

As regards to different treatment combinations interaction between methods of sowing and integrated use of nitrogen (Table 5) the SWI along with 75:25 RDN from urea (M<sub>1</sub>N<sub>2</sub>) maximum nitrogen uptake in grain and straw (62.62, 21.15 kg ha<sup>-1</sup>). Among all the treatment combinations, M<sub>3</sub>N<sub>0</sub> had the lowest nitrogen uptake in grain and straw (28.75, 10.61 kg ha<sup>-1</sup>)<sup>1</sup> compared to others. Similar trend also found in phosphorus and potassium grain and straw uptakes of different treatment combinations in wheat. These observations are in accordance with those of Metwally and Khamis (1998) who reported that combination of organic and inorganic N resulted in greater values of apparent net N release than those obtained when each was applied singly. These results are in line with the findings of Shah *et al.* (2006).

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