



Integrated nutrient management with cow urine foliar application in wheat (*Triticum aestivum*)

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Wheat (*Triticum aestivum* L.) is the major staple food crop of world as well as India and sustaining its productivity from continuously shrinking land poses a formidable challenge. Use of synthetic fertilizers had sustained the productivity level for quite some time. However, indiscriminate use of chemical fertilizers led to severe deterioration of soil health in major wheat growing areas. Thus, adoption of integrated nutrient management can increase productivity without compromising soil fertility (Mishra *et al.* 2017). Integrated use of inorganic fertilizers along with liquid organic manures can help in reducing fertilizer use and sustaining crop yield by maintaining optimum soil fertility. Cow urine is a rich source of nutrients (especially nitrogen and potassium), but usually washed out as waste material. Being organic in nature, it can be used in crops without any adverse effect on environment and human health (Rajanna *et al.* 2012, Singh *et al.* 2012). On an average, it contains 95% water, 2.5% urea, 24 types of salts, hormones, 2.5% enzymes, essential minerals like phosphorus, calcium, sulphur, iron and manganese, organic compounds like amino acids, carbonic acid, uric acid, cytokinin, lactose, etc. (Bhadauria 2002). Beneficial effects of cow urine application have been demonstrated in mustard (Pradhan *et al.* 2016), maize (Devakumar *et al.* 2014), rice (Gopakali *et al.* 2012, Rajanna *et al.* 2012) and lablab bean (Maheswari *et al.* 2017). But, such information on wheat is still lacking. Therefore, an experiment was conducted to evaluate the performance of wheat under graded fertilizer doses and foliar spray of cow urine.

The field experiment was conducted during the winter season, 2015–16 at the Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (25°18' N, 83°03' E and 128.9 MAMSL). The climate of experimental site is semi-arid to sub-humid with moisture deficit index of 20–40%. Average annual rainfall was 1100 mm and of which 88% was received during June to September. The soil of the experimental site was low

(0.49%) in organic carbon (wet digestion method) with slightly alkaline in reaction (pH 8.2). The available N (alkaline permanganate oxidisable), P (0.5 M NaHCO₃ extractable), K (1 M ammonium acetate exchangeable K) and Zn (DTPA extractable) were 136.0 (low), 20.5 (medium), 136.2 (medium) and 1.15 (low) kg/ha, respectively.

The experiment was laid out in a split plot design keeping three levels of recommended fertilizer dose (120: 60: 60 kg N: P₂O₅: K₂O/ha) in main plots [60% RDF; 80% RDF and 100% RDF] and four cow urine (CU) foliar application [control (CU: water- 0: 600 litre/ha); 50% cow urine spray (CU: water- 300: 300 litre/ha); 75% cow urine spray (CU: water- 450: 150 litre/ha) and 100% cow urine spray (CU: water- 600: 0 litre/ha)] in sub-plots with three replications. Sowing of wheat (*cv.* HUW 234) was done (21st December, 2015) with a spacing of 20 cm, using seed rate of 120 kg/ha. For nutrient management, half dose of N (urea), and full doses of P (diammonium phosphate) and K (muriate of potash) were applied as basal and remaining half dose of N was applied in two equal splits at 30 and 60 days after sowing (DAS). Cow urine was collected from the cross-breed of Holstein-Friesian and indigenous cow and kept for one week for fermentation. Cow urine was applied as foliar spray at 30, 50, 70 and 90 DAS which contained 0.978% N (Kjeldahl method), 0.093% P (Vanado-molybdophosphoric acid yellow colour method) and 1.15% K (Flame photometer method). Various biometric observations pertaining to growth and yield of wheat were recorded and their significance was tested by variance ratio (~F-value) at 5% level (Gomez and Gomez 1984). Treatment means were compared using critical differences (CD) at the 5% level of significance. Relative economics was calculated as per the prevailing market prices of the inputs and produce during the year of experiment.

Number of tillers/m², green leaves/m², dry matter accumulation (DMA)/m², leaf chlorophyll content (SPAD value) and spike length (cm) of wheat varied significantly due to varying fertility levels and cow urine application. Significantly higher number of tillers (329.8/m²), green leaves (1319.5/m²), DMA (1.18 kg/m²), SPAD value

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Table 1 Growth attributes of wheat as influenced by fertilizer levels and cow urine spray

Treatment	Tillers/ m ² at harvest	Green leaves/m ² at 70 DAS	Chlorophyll value at 70 DAS	DMA (kg/m ²) at harvest	Spike length (cm)
<i>Fertility levels</i>					
60% RDF	304.7	1218.8	38.0	0.87	8.7
80% RDF	312.6	1250.3	41.0	1.03	8.7
100% RDF	329.8	1319.5	43.3	1.18	8.9
SEm±	3.97	17.25	0.32	0.03	0.03
CD(P=0.05)	15.61	67.74	1.27	0.13	0.14
<i>Cow urine spray</i>					
Control	297.1	1189.7	38.8	0.93	8.6
50% CU	309.6	1238.3	40.5	0.97	8.7
75% CU	218.9	1274.4	41.4	1.05	8.8
100% CU	337.1	1349.1	42.0	1.15	8.9
SEm±	5.61	18.84	0.55	0.03	0.06
CD(P=0.05)	16.67	55.97	1.64	0.09	0.19

(43.3) and spike length (8.9 cm) were observed with 100% RDF over others (Table 1). Evidently wheat supplied with adequate amount of major nutrients (100% RDF) resulted in better crop growth which led to greater accumulation of photosynthates (Sepat *et al.* 2010, Rajanna *et al.* 2011). Among the CU foliar spray applications, 100% CU resulted in significantly higher number of tillers at harvest (337.1/m²), green leaves/m² (1349.1/m²), DMA (1.15 kg/m²), SPAD value (42.0) and spike length (8.9 cm) over others CU applications (Table 1). The growth attributing characters progressed presumably because of better supply of nitrogen and other major, secondary and micronutrient at higher rate of CU application. Similar beneficial effects of CU application on rice have been reported by Gopakkali *et al.* (2012) and Rajanna *et al.* (2011, 2012).

The results revealed that 100% RDF in combination with 100% CU increased DMA and spike length of wheat markedly than other combinations (Fig 1a and b).

Table 2 Yield and economics of wheat as influenced by different fertilizer levels and cow urine spray

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	Cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net return (₹/ha)	B:C ratio
<i>Fertility levels</i>						
60% RDF	2.75	4.05	25842	54574	28732	1.11
80% RDF	3.03	4.15	27535	59920	32385	1.18
100% RDF	3.31	4.52	28220	65383	37163	1.32
SEm±	0.11	0.06	-	2080	1990	0.05
CD (P=0.05)	0.41	0.25	-	7870	5960	0.18
<i>Cow urine spray</i>						
Control	2.71	4.04	25814	53914	28110	1.09
50% CU	2.78	4.16	26256	55302	29046	1.11
75% CU	3.19	4.31	26870	63006	36136	1.34
100% CU	3.44	4.44	27793	67736	39943	1.44
SEm±	0.12	0.09	-	2290	2470	0.07
CD (P=0.05)	0.35	0.26	-	6700	7390	0.22

Application of 100% RDF resulted in 35.6% and 14.6% increase in DMA of wheat at harvest over 60% and 80% RDF, respectively. Likewise, the extent of increase in DMA due to 100% CU was 23.7%, 18.6% and 9.5% over control, 50% and 75% CU spray, respectively. Application of both 80% and 100% RDF increased the spike length of wheat by 2.3% compared to 60% RDF. Similarly, application of 50%, 75% and 100% CU resulted in 1.2%, 2.3% and 3.5% increase in wheat spike length over control, respectively.

Grain yield of wheat varied considerably with graded fertilizer levels (Table 2). Application of 80% and 100% RDF enhanced grain yield by 10.2% and 20.4%, respectively, as compared to 60% RDF. Likewise, 100% RDF exhibited 11.6% higher straw yield over 60% RDF. Increasing concentration of CU applications from control to 100% CU showed significant variation in grain yield. Applications of 50%, 75% and 100% CU inflicted 2.5%, 17.7% and 26.9% higher grain yield over control. Thus, supplementation of

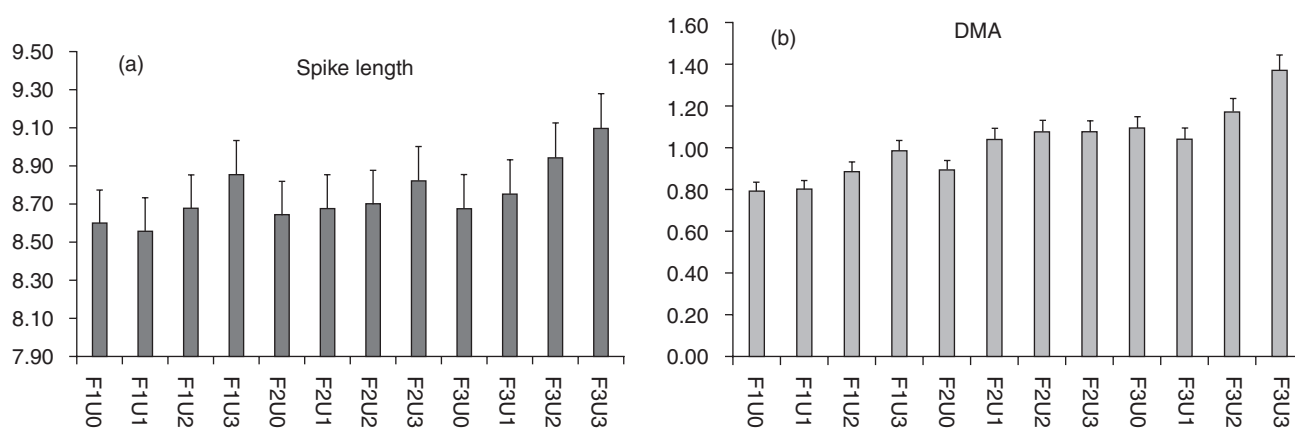


Fig 1 Interactive effects of varying fertility levels and cow urine application on (a) spike length and (b) dry matter of wheat (F1, 60% RDF; F2, 80% RDF; F3, 100% RDF; U0, No CU; U1, 50% CU; U2, 75% CU; U3, 100% CU)

100% RDF with CU exhibited the highest grain yield of wheat. Better availability of nutrients under 100% RDF along with CU enhanced uptake of nutrients which resulted in higher crop growth and grain yield (Arif *et al.* 2006, Pandey *et al.* 2009).

Cost of cultivation varied considerably across the treatments, viz. fertility levels and CU foliar spray, primarily due to differential costs involved in different treatments (Table 2) and these values were highest with 100% RDF and 100% CU. The gross and net returns varied significantly with variable RDF levels. Significantly higher gross returns (₹ 65383/ha), net returns (₹ 37163/ha) and benefit-cost ratio (1.32) were recorded with 100% RDF applied plots than the others but remained at par with 80% RDF. Collectively, the gross and net returns were increased by 19.8% and 29.3% with 100% RDF over 60% RDF, respectively. Similarly, 100% CU being at par with 75% CU resulted in significantly higher gross returns (₹ 67736/ha), net returns (₹ 39943/ha) and benefit-cost ratio (1.44) than those observed with other CU treatments. Total increment in net returns with 100% and 75% CU were 42.1% and 28.6% over control, respectively. This could be due to higher grain and straw yields recorded with these treatments. Similar trend was also observed by Desai *et al.* (2015) in wheat.

SUMMARY

The combination of inorganic fertilizers (100% RDF) with foliar application of 100% concentration of cow urine as organic source of nutrients enhanced growth and yield parameters of wheat. Hence, cow urine application with variable RDF levels could be an effective combination as integrated nutrient management tool for enhancing yields of field crops.

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