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Growth, Nutrient Uptake and Yield of Wheat as Influenced by Foliar Sprays of Cattle Urine and Nitrogen

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Authors' contributions

This work was carried out in collaboration among all authors. Author SVK conducted this study and carried out statistical analysis. Author AVP wrote the first manuscript and materialized the work. Author ABJ designed the study with finalization of treatments and also checked the manuscript. Author STP provided the location to conduct the experiment. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted to study the effect of levels of nitrogen and foliar sprays of cattle urine on growth, yield, nutrient uptake and quality of wheat in Inceptisol at Division of Soil Science and Agricultural Chemistry and Animal Husbandry and Dairy Science, College of Agriculture, Pune during *Rabi* (November) 2018. The experiment was conducted with three levels of nitrogen (0, 75 and 100%) through urea and five levels of cattle urine spray (CUS) (0, 2.5, 5, 7.5 and 10%) (20, 40 and 60 days after sowing (DAS)) replicated thrice in Factorial Completely Randomized Design.
Application of 75% N through urea recorded higher plant height, number of tillers, number of functional leaves, leaf length, leaf width, chlorophyll content. However, application of 7.5% cattle urine foliar sprays (at 20, 40, 60 DAS) recorded significantly higher plant height, number of tillers,

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number of functional leaves, leaf length, leaf width, chlorophyll content. Further, similar both the treatments recorded significantly higher spike length, number of spikelets per spike, number of grains per spike, test weight of wheat. Interaction effect of 75% N through urea along with 7.5% cattle urine foliar sprays (at 20, 40, 60 DAS) recorded significantly higher plant height, number of tillers, number of functional leaves, leaf length, leaf width, chlorophyll content at 30, 50 and 70 DAS of wheat. Significant interaction effect with similar treatment were also recorded significant results for spike length, number of spikelets per spike, number of grains per spike, test weight of wheat.

Application of 75% N through urea recorded significantly higher grain (80.03 g pot^{-1}) and straw (100.00 g pot^{-1}) yield of wheat. While foliar spray of cattle urine @ 5% recorded significantly higher grain (72.06 g pot^{-1}) and straw (92.41 g pot^{-1}) yield of wheat. Significant interaction effect among combine application of 75% N through urea along with foliar spray of cattle urine @ 7.5% taken at 20, 40 and 60 DAS reported significantly higher grain (87.67 g pot^{-1}) and straw (114.50 g pot^{-1}) yield of wheat.

Nitrogen (3.08 gm pot^{-1}), phosphorus (1.12 gm pot^{-1}) and potassium (3.72 gm pot^{-1}) uptake by wheat was found significantly higher with the application of 75% N through urea than 100% N application. While three foliar spray of cattle urine @7.5% taken at 20, 40 and 60 DAS recorded significantly nitrogen (3.15 gm pot^{-1}), phosphorus (1.09 gm pot^{-1}) and potassium (3.54 gm pot^{-1}) uptake by wheat. But interaction effect for combined application was found non significant for the uptake of nitrogen, phosphorus and potassium.

Keywords: Cattle urine; foliar spray; n-levels; growth; yield; nutrient uptake; wheat.

1. INTRODUCTION

Higher fertilizer cost, increased concern for long-term soil productivity and ecological sustainability have stimulated a great deal of research on organic sources as substitute or supplement to chemical fertilizer. Since the amount of N that could be added through different organic sources alone is not sufficient to meet all the N requirement of wheat. Rather than application of N-fertilizers in conjunction with organic manures may be a better alternative than the sole inorganic or organic sources. The decline in the growth rate of productivity of major crops as well as rate of response of crop to added fertilizer under intensive cropping system have possibly resulted from deterioration in physical, chemical and biological quality of soils.

In order to address low crop productivity deteriorating soil health, multinutrient deficiencies, increasing intensity of intensive cultivation etc., balance fertilization is the key to improve soil physical, chemical and biological properties of soil which leads to enhance health of soil. Balanced fertilization means rational use of fertilizers, manures along with biofertilizer for supply of plant nutrients in such a manner that would ensure maximum fertilization efficiency, least adverse effects on environment, minimum nutrient losses etc. Therefore it is very necessary to assess and evaluate use of other alternative nutrient source which can easily available with most of the farmers.

In India farmers pay good attention for collection and utilization of cattle dung in the form of FYM but very little or no attention has been given in the collection and utilization of cattle urine. Cattle urine contains 95% water, 2.5% urea, 2.5% other mineral salts, hormones and enzymes [1]. The nitrogen in the form of urea @ 2.5% is associated with 7.3% allantoin, 5.8% hippuric acid, 3.7% creatinine, 2.5% creatine, 1.3% uric acid and 0.5% xanthin plus hypoxanthin, 1.3% free amino acid nitrogen and 2.8% as ammonia [2]. This nutrient source is available to farmers free of cost in their own house being organic in nature. It is eco-friendly and if used in appropriate concentration on crops has no adverse effects [3].

Globally wheat is cultivated in an area about 220 million hectares with a record production of 763.06 million tonnes of grains. Maximum area under wheat is in India 14 per cent followed by Russia 12.43 per cent, China 11.14 per cent which altogether accounts for about 45 per cent of global area. However China is the major producer of the wheat with a record production of 136 MT, followed by India 98.51 MT, Russia 85 MT. India's wheat production has increased to a record 101.20 MT for the crop year 2018-19 (June- July) up by 1.3 per cent from a year ago. However, Punjab, Haryana, Uttar Pradesh retained the status of higher productivity for many years. The cattle urine was used in agriculture for various crops to control the pest and diseases. The research on the use of cattle

urine as a nitrogen supplementation either through soil or foliar application for different field crops was scanty. Hence, this experiment was undertaken with an objective to study the growth, nutrient uptake and yield of wheat as influenced by foliar sprays of cattle urine along with nitrogen levels.

2. MATERIALS AND METHODS

The pot culture experiment was conducted to study the growth, nutrient uptake and yield of wheat as influenced by foliar sprays of cattle urine along with nitrogen levels at Division of Soil Science and Agricultural Chemistry and Animal Husbandry and Dairy Science during *Rabi* (November) 2018. There were total 15 treatments consisting of three levels of nitrogen @ 0, 75 and 100 kg ha^{-1} and five levels of cattle urine foliar sprays @ 0, 2.5, 5, 7.5, 10 per cent imposed on wheat. The foliar sprays were taken at 20, 40, 60 days after sowing.

Total 45 plastic pots with diameter 41 cm and height 38 cm used for this experiment. These pots were filled with 30 kg dried 2 mm sieved soil. The experimental soil was characterized by black colour dominated by montmorillonite clay with high coefficient of expansion and shrinkage which comes under the *Typic Haplustept* which comes under soil order Inceptisol. The soil was moderately calcareous ($CaCO_3$: 6.37%) [4] in nature with alkaline pH; 8.41, EC; 0.22 d Sm^{-1} and organic carbon : 1.07 %. The alkaline $KMnO_4$- N [5], Olsen's P [6] and NH_4OAc-K [4] in the experimental soil was 151.32, 24.04, 834.27 kg ha^{-1} respectively. The recommended dose of wheat @ 120:60:40 kg ha^{-1} N, P_2O_5 and K_2O were used. Nitrogen levels were formulated as 0%, 75% and 100% RDN. At the time of sowing 50% N+100% P_2O_5 +100% K_2O were applied, however remaining 50% N was applied at 30 DAS. In order to provide 100 % N-3.48 g urea were used, for 75% N-2.60 g urea were used as per the levels of nitrogen. FYM @ 10 t ha^{-1} (135 g per pot) were applied to all the treatment except absolute control.

Table 1. Quantity of cattle urine used for spraying

Cattle urine (%)	First Spray		Total volume of spray (ml)	Second Spray		Total volume of spray (ml)	Third spray		Total volume of spray (ml)
	Cattle urine (ml)	Water (ml)		Cattle urine (ml)	Water (ml)		Cattle urine (ml)	Water (ml)	
0%	0	1500	1500	0	2000	2000	0	2500	2500
2.5%	37.5	1465.5	1500	50	1950	2000	62.5	2437.5	2500
5%	75	1425	1500	100	1900	2000	125	2375	2500
7.5%	112.5	1387.5	1500	150	1850	2000	187.5	2312.5	2500
10%	150	1350	1500	200	1800	2000	250	2250	2500

Table 2. Nutrient composition of cattle urine

Sr. No.	Parameter	Before 1st Spray	Before 2nd Spray	Before 3rd Spray
1.	pH	8.02	8.24	7.89
2.	EC (dSm^{-1})	18.92	17.23	19.65
3.	OC (%)	2.37	1.89	1.58
4.	N (%)	0.68	0.76	0.72
5.	P (%)	0.097	0.081	0.053
6.	K (%)	0.84	0.42	0.89
7.	Ca (%)	0.01	0.013	0.012
8.	Mg (%)	0.053	0.052	0.047
9.	SO_4 (%)	0.032	0.047	0.026
10.	Fe (ppm)	37	26	56
11.	Mn (ppm)	0.013	0.011	0.012
12.	Zn (ppm)	0.011	0.013	0.013
13.	Cu (ppm)	0.015	0.013	0.012
14.	Colour	Indian yellow	Indian yellow	Indian yellow

In order to undertake foliar sprays of cattle urine at 20, 40, 60 DAS, fresh cattle urine was collected early in the morning and accordingly sprays were taken. The quantity of cattle urine required for 0%, 2.5%, 5%, 7.5% and 10% were calculated and sprays were taken at 20, 40 and 60 DAS whereas, water spray taken for control (Table 1). The cattle urine used for foliar spray was analyzed before every spray for its nutrient composition by following standard methods (Table 2). The morphological observations like number of leaves, plant height, number of tillers were taken at 30, 50 and 70 DAS. The spike length and number of spikelets were recorded at the time of harvest. The number of grain per spike and weight of 100 wheat seeds were recorded for six plants and average is calculated. The wheat plants from each pot were harvested, seed and straw weighed in gram pot^{-1}.The composite samples of grain and straw were collected from each pot and air dried, oven dried and dry matter was calculated accordingly.

3. RESULTS AND DISCUSSION

3.1 Growth Characters

Application of N levels @ 75% RDN through urea recorded significantly higher plant height (24.93, 52.78 and 76.87 cm), number of wheat tillers (2.78, 7.82 and 7.89), number of functional leaves (5.03, 19.09 and 21.49), leaf length (12.96, 21.91 and 23.77 cm) and leaf width (1.45, 1.65 and 1.67 cm) at 30, 50 and 70 DAS of wheat respectively (Figs. 1 to 3). This was found to be at par with application of N levels @ 100% RDN through urea. However, lower plant height (21.80, 48.50 and 72.11 cm), wheat tillers (1.63, 4.81 and 4.70), number of functional leaves (3.61, 12.33 and 11.87), leaf length (11.10, 19.96 and 21.56 cm) and leaf width (1.23, 1.35 and 1.45 cm) at 30, 50 and 70 DAS of wheat respectively was recorded in application of 0% N treatment. Foliar sprays of cattle urine @ 7.5% were found significantly superior for wheat plant height (25.84, 53.13 and 78.28 cm), higher number of wheat tillers (2.84, 7.91 and 7.57), higher number of functional leaves (5.33, 18.80 and 19.21), higher leaf length (13.84, 23.17 and 24.59 cm) and higher leaf width (1.48, 1.76 and 1.86 cm) taken at 20, 40 and 60 DAS of wheat respectively. This was found to be at par with application of foliar sprays of cattle urine @ 10%. Combine application of RDN @ 75% along with three cattle urine foliar sprays @ 7.5% taken at 20, 40 and 60 DAS of wheat were recorded significantly higher plant height (28.43, 56.52 and 81.98 cm), number of tillers (3.40, 8.87 and 9.07), number of functional leaves (5.80, 21.23 and 23.04), leaf length (14.37, 24.52 and 25.13 cm) and leaf width (1.76, 1.97 and 2.04 cm) at 30, 50 and 70 DAS of wheat respectively than rest of the interactions.

The increment in the height of wheat with the application of cattle urine along with RDN was found superior which might be due to the presence of growth hormones and other beneficial nutrients in the cattle urine. Similar results were also recorded for higher growth of plant during vegetative period caused by liquid manure (cow urine) which accelerated due to hormone [7]. In cow urine there is also Indole Acetic Acid (IAA) of 704.26 mg L^{-1}. Auxin is very influential in root formation by increasing the number and length of roots. So that the maximum plant in the absorption of nutrients / plant nutrients. Similar results were also recorded by Singh et al. [8]. Nitrogen content, harmones and other enzymes in cattle urine, might have played important role in the plant metabolism thereby enhanced number of functional leaves. As N is the integral component required for photosynthesis and growth of plant. Similar results were also recorded by Rahman et al. [9]. Nitrogen element has an influence in the growth of plant. If the available nitrogen elements are balanced with other elements, leaves can grow wider due to photosynthesis going well. Similar results were also recorded by [10].

3.2 Yield and Yield Contributing Characters

Application of N levels @ 75% RDN through urea recorded significantly higher spike length of wheat (9.77 cm), number of spikelets per spike of wheat (19.87), number of grain per spike (44.63) and seed weight of 100 seeds of wheat (3.97 g) which was closely followed and statistically at par with 100% N (Figs. 4 to 6). Foliar sprays of cattle urine @ 7.5% were found significantly superior for spike length of wheat (10.06 cm), number of spikelets per spike of wheat (20.81), number of grains per spike (42.18) and weight of 100 seeds (4.10 g) which was followed and statistically at par with 10% cattle urine spray. Combine application of RDN @ 75% along with three cattle urine foliar sprays @ 7.5% taken at 20, 40 and 60 DAS of wheat were recorded higher spike length (11.05 cm), number of spikelet per spike (22.49), number of grains per spike (47.17) and weight of 100 seed weight (4.17 g).

Deotale et al. [11] reported effect of two foliar sprays of different concentrations of cow urine (2%, 4%, 6%) at 25 and 40 days after sowing on soybean. Result showed a concentrations of 6% was more effective in enhancing the morpho-physiological, chemical, biochemical, yield and yield contributing parameters when compared with control. Sadhukhan et al. [12] concluded that 100% RDF and four sprayings of cow urine most effective in increasing values of ears m^{-2}, grains ear^{-1}, 1000-grain weight of wheat under the integrated farming system. Application of cow urine on buckwheat recorded higher test weight (22.4 g) [13].

3.3 Grain and Straw Yield

Application of 75% N through urea recorded significantly higher grain yield (80.03 g pot^{-1}) and straw yield (100 g pot^{-1}) of wheat. Application of no urea fertilizer recorded lowest grain yield (57 g pot^{-1}) straw yield (80.79 g pot^{-1}) (Table 3). Significantly higher grain yield of wheat (72.11 g pot^{-1}) and straw yield (99.5 g pot^{-1}) was recorded with three foliar sprays of cattle urine @ 7.5% taken at 20, 40 and 60 DAS which were followed and statistically on par with 5% cattle urine spray (72.06 g pot^{-1}) for grain yield and 10% cattle urine spray (93.96 g pot^{-1}) for straw yield. Combine application of 75% N through urea along with three cattle urine sprays @ 7.5% recorded higher grain yield (87.67 g pot^{-1}) and straw yield (114.50 g pot^{-1}).

The higher grain and straw yield with foliar sprays of cattle urine might be due to timely nutrient absorption from cattle urine sprays taken at growth stages of wheat. Further, this might be the cumulative effect of hormones, essential nutrients and enzymes present in cattle urine which increased growth rate and accumulation of photosynthetes. Similar observations were recorded by Khanal et al., [14] and Nwite et al., [15].

3.4 Nutrient Uptake

Application of 75% N through fertilizers recorded significantly higher N (3.08 g pot^{-1}), P (1.12 g pot^{-1}) and K (3.72 g pot^{-1}) uptake by wheat this was followed by 100% N through fertilizers for N (2.78 g pot^{-1}), P (0.88 g pot^{-1}) and K (3.17 g pot^{-1}) uptake (Table 4). Application of 75% N through fertilizers recorded significantly higher Fe (372.38 mg pot^{-1}) uptake by wheat which found at par with 100% N through fertilizer recorded as Fe (346.18 mg pot^{-1}). Also application of 75% N through fertilizers recorded significantly higher Mn (48.40 mg pot^{-1}), Zn (55.80 mg pot^{-1}) uptake by wheat plant. Also application of 75% N through fertilizers recorded significantly higher Cu (57.26 mg pot^{-1}) uptake by wheat which found at par with 100% N through fertilizer recorded as Cu (51.39 mg pot^{-1}) uptake. No application of N fertilizers recorded significantly lower Fe (312.81 mg pot^{-1}), Mn (34.63 mg pot^{-1}), Zn (42.23 mg pot^{-1}) and Cu (35.63 mg pot^{-1}) uptake by wheat (Table 4).

Foliar sprays of 7.5% CUS recorded significantly higher N (3.15 g pot^{-1}) uptake by wheat which was found at par with 10% CUS (2.82 g pot^{-1}). Higher P uptake by wheat was observed same in 7.5% CUS (1.09 g pot^{-1}) which was found at par with 10% CUS (1.06 g pot^{-1}) however 7.5% cattle urine foliar sprays recorded significantly higher K (3.54 g pot^{-1}) uptake by wheat than rest of treatment. Further three foliar sprays of cattle urine applied at 20, 40 and 60 DAS with 5% CUS concentration recorded significantly superior Fe (386.58 mg pot^{-1}) and on par results for 7.5 % CUS Fe (382.94 mg pot^{-1}) and 10% CUS Fe (351.11 mg pot^{-1}) uptake of wheat. However application of 7.5% of foliar spray recorded

Table 3. a and b : Grain and straw yield of wheat as influenced by foliar sprays of cattle urine and nitrogen

a)Grain

CUS / RDN	Grain yield (g pot^{-1})					Mean
	0 %	2.5 %	5 %	7.5 %	10%	
0 %	56.33	57.83	57.33	58.33	55.17	57.00
75 %	65.00	79.67	87.33	87.67	81.00	80.03
100 %	53.67	58.00	71.50	70.33	63.00	63.30
Mean	58.33	65.00	72.06	72.11	66.39	
	RDN		CUS		RDN × CUS	
S.E. ±	2.00		2.59		4.49	
CD at 5%	5.83		7.53		NS	

b) Straw

CUS / RDN	Straw yield (g pot^{-1}) 0 %	2.5 %	5 %	7.5 %	10%	Mean
0 %	72.80	77.27	81.73	86.30	85.87	80.79
75 %	87.00	97.17	102.00	114.50	99.33	100.00
100 %	83.333	87.30	93.50	97.70	96.67	91.70
Mean	81.044	87.24	92.41	99.50	93.96	
	RDN		**CUS**		**RDN × CUS**	
S.E. ±	2.57		3.32		5.74	
CD at 5%	7.46		9.63		NS	

Table 4. a, b & c : Nutrient uptake by wheat as influenced by foliar sprays of cattle urine and nitrogen

a) Nitrogen

CUS / RDN	Total N uptake (g pot^{-1}) 0 %	2.5 %	5 %	7.5 %	10%	Mean
0 %	1.61	1.87	2.04	2.69	2.00	2.04
75 %	2.47	2.77	2.92	3.65	3.62	3.08
100 %	2.28	2.60	3.05	3.11	2.84	2.78
Mean	2.12	2.41	2.67	3.15	2.82	
	RDN		**CUS**		**RDN × CUS**	
S.E. ±	0.10		0.13		0.23	
CD at 5%	0.30		0.39		NS	

b) Phosphorous

CUS / RDN	Total P uptake (g pot^{-1}) 0 %	2.5 %	5 %	7.5 %	10%	Mean
0 %	0.57	0.70	0.81	0.96	0.89	0.79
75 %	0.76	1.01	1.22	1.37	1.22	1.12
100 %	0.72	0.73	0.95	0.94	1.05	0.88
Mean	0.69	0.81	0.99	1.09	1.06	
	RDN		**CUS**		**RDN × CUS**	
S.E. ±	0.04		0.05		0.08	
CD at 5%	0.11		0.14		NS	

c) Potassium

CUS / RDN	Total K uptake (g pot^{-1}) 0 %	2.5 %	5 %	7.5 %	10%	Mean
0 %	2.10	2.40	2.50	2.90	2.76	2.53
75 %	2.88	3.45	3.83	4.17	4.29	3.72
100 %	2.56	2.85	3.39	3.54	3.49	3.17
Mean	2.52	2.90	3.24	3.54	3.51	
	RDN		**CUS**		**RDN × CUS**	
S.E. ±	0.13		0.17		0.29	
CD at 5%	0.38		0.50		NS	

Table 5. a, b, c & d : Nutrient uptake (micronutrient) by wheat as influenced by foliar sprays of cattle urine and nitrogen

a) Iron

CUS / RDN	Total Fe uptake (mg pot^{-1})					Mean
	0 %	2.5 %	5 %	7.5 %	10%	
0 %	275.06	299.61	323.65	347.12	318.61	312.81
75 %	266.07	327.86	431.57	445.50	390.89	372.38
100 %	270.19	356.13	404.53	356.19	343.83	346.18
Mean	270.44	327.87	386.58	382.94	351.11	
	RDN		CUS		RDN × CUS	
S.E. ±	14.71		18.99		32.89	
CD at 5%	42.69		55.11		NS	

b) Manganese

CUS / RDN	Total Mn uptake (mg pot^{-1})					Mean
	0 %	2.5 %	5 %	7.5 %	10%	
0 %	28.25	29.06	36.74	37.71	41.41	34.63
75 %	40.02	40.06	53.57	57.21	51.14	48.40
100 %	39.53	35.44	39.12	41.85	42.64	39.72
Mean	35.93	34.85	43.14	45.59	45.06	
	RDN		CUS		RDN × CUS	
S.E. ±	2.42		3.23		5.42	
CD at 5%	7.03		9.08		NS	

c) Zinc

CUS / RDN	Total Zn uptake (mg pot^{-1})					Mean
	0 %	2.5 %	5 %	7.5 %	10%	
0 %	27.86	40.10	41.75	45.88	55.54	42.23
75 %	42.54	54.73	51.31	69.63	60.79	55.80
100 %	37.13	38.69	55.07	51.52	59.17	48.32
Mean	35.84	44.51	49.38	55.68	58.50	
	RDN		CUS		RDN × CUS	
S.E. ±	4.21		5.44		9.42	
CD at 5%	NS		15.79		NS	

d) Copper

CUS / RDN	Total Cu uptake (mg pot^{-1})					Mean
	0 %	2.5 %	5 %	7.5 %	10%	
0 %	18.09	23.69	44.21	43.06	49.07	35.63
75 %	32.19	41.71	66.14	84.71	61.55	57.26
100 %	36.64	40.16	56.49	61.69	61.98	51.39
Mean	28.97	35.19	55.62	63.16	57.53	
	RDN		CUS		RDN × CUS	
S.E. ±	5.28		6.82		11.82	
CD at 5%	15.34		19.80		NS	

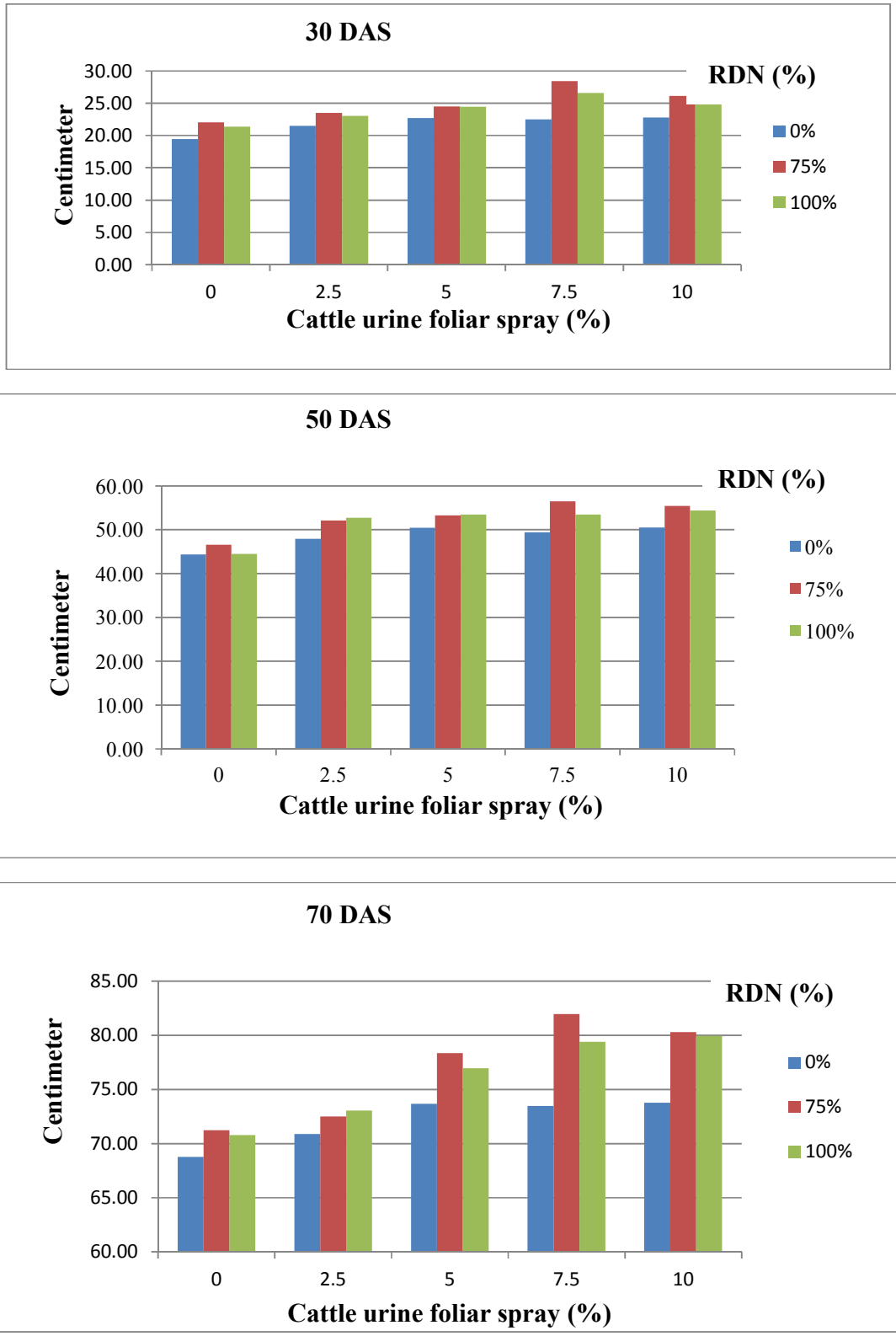
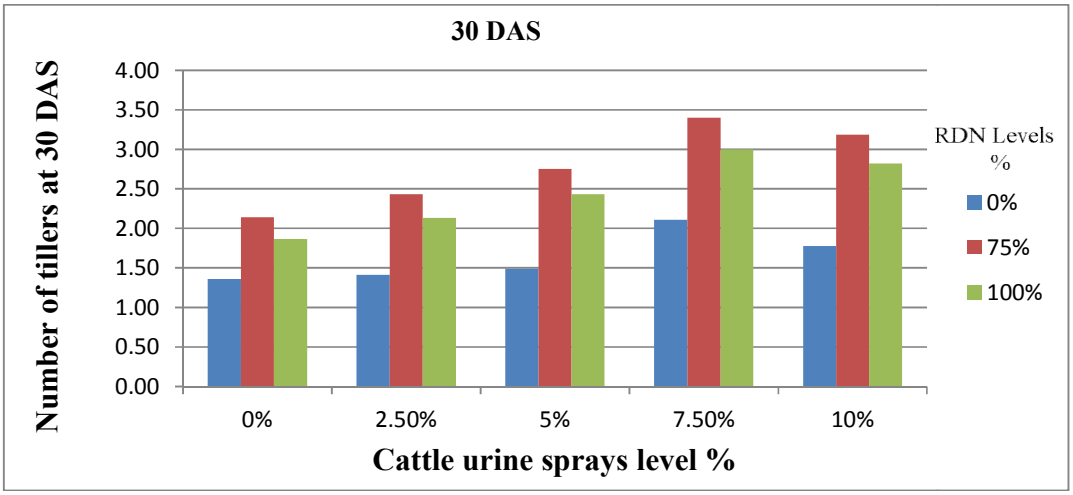
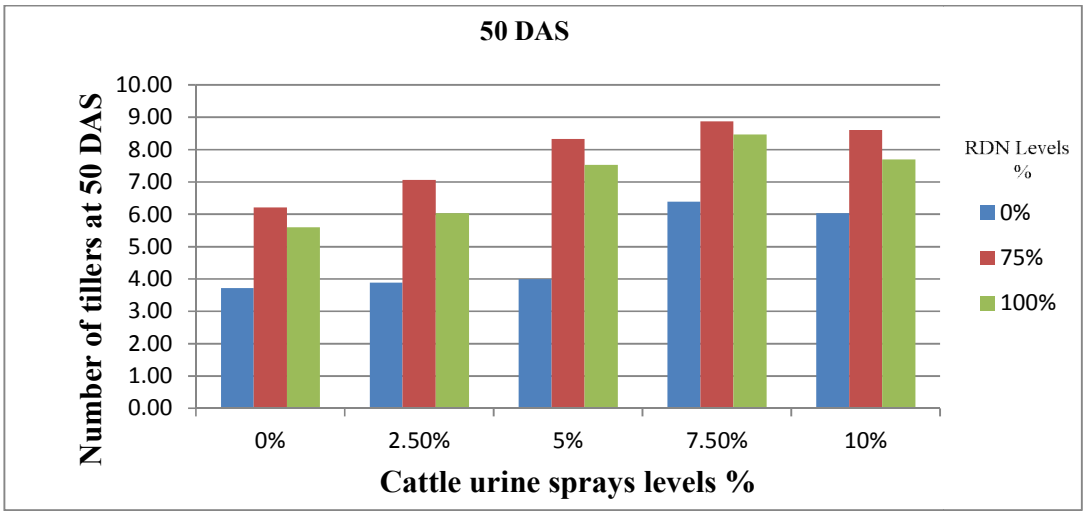


Fig. 1. Height of wheat as influenced by foliar sprays of cattle urine and nitrogen





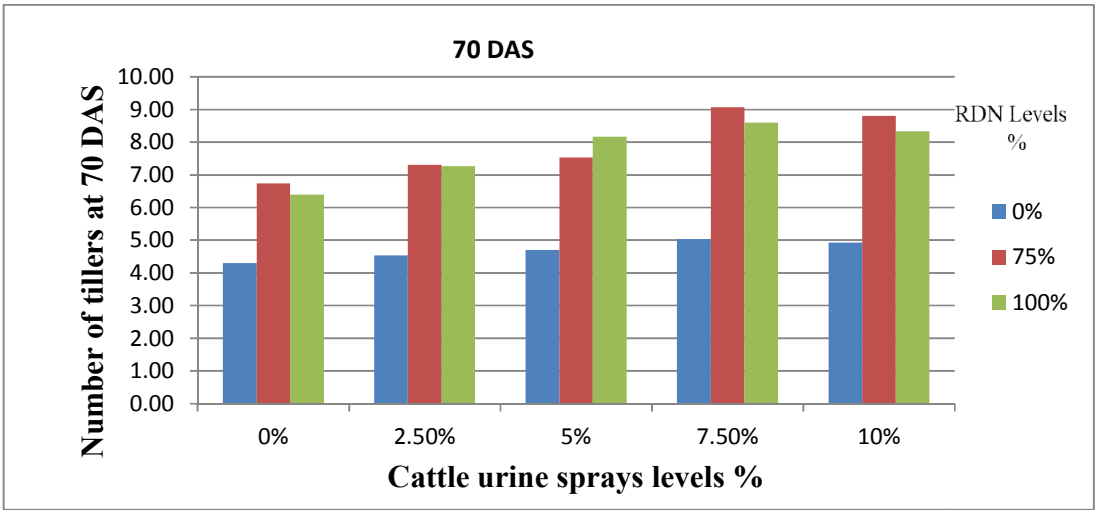
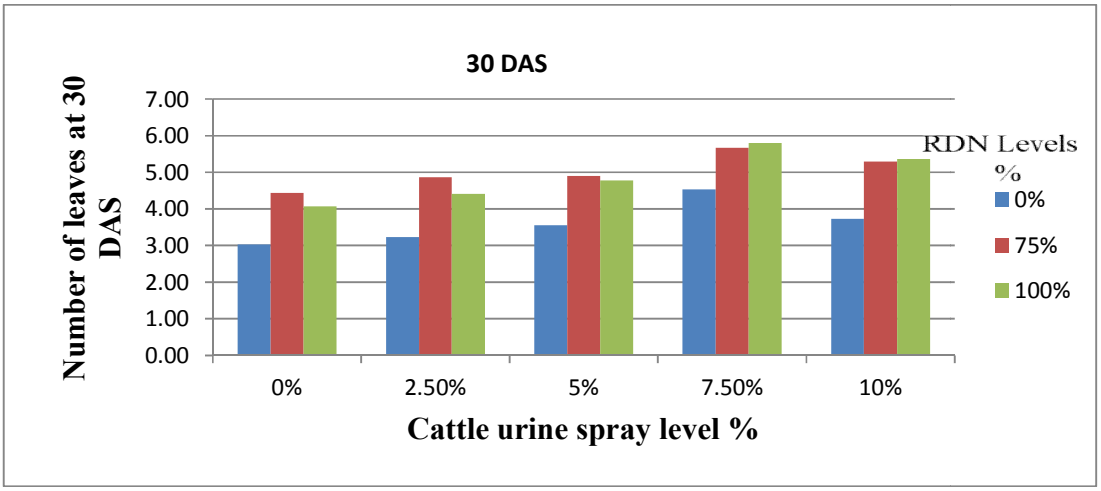
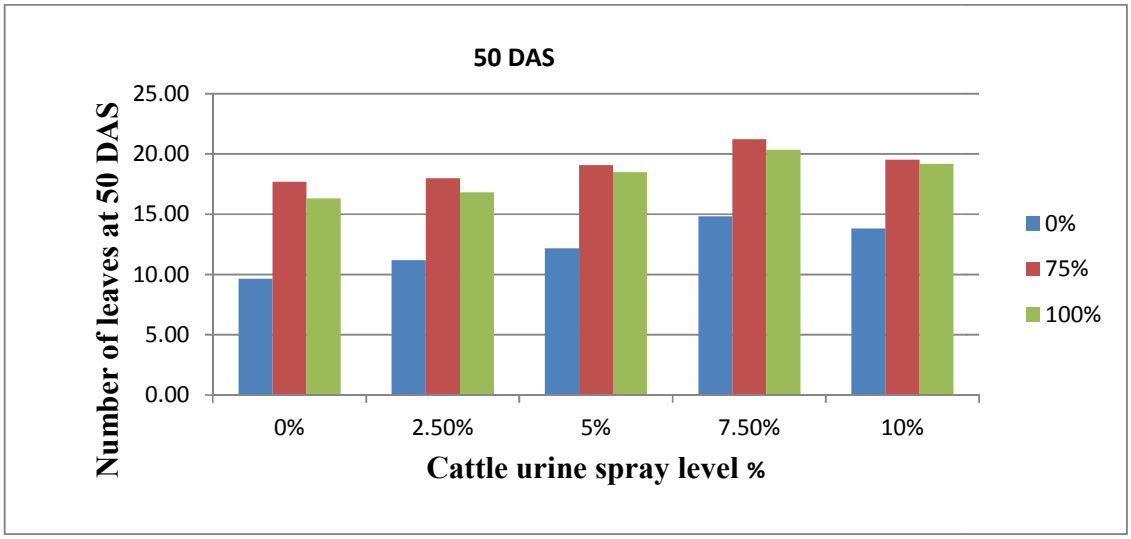


Fig. 2. Number of tillers of wheat as influenced by foliar sprays of cattle urine and nitrogen





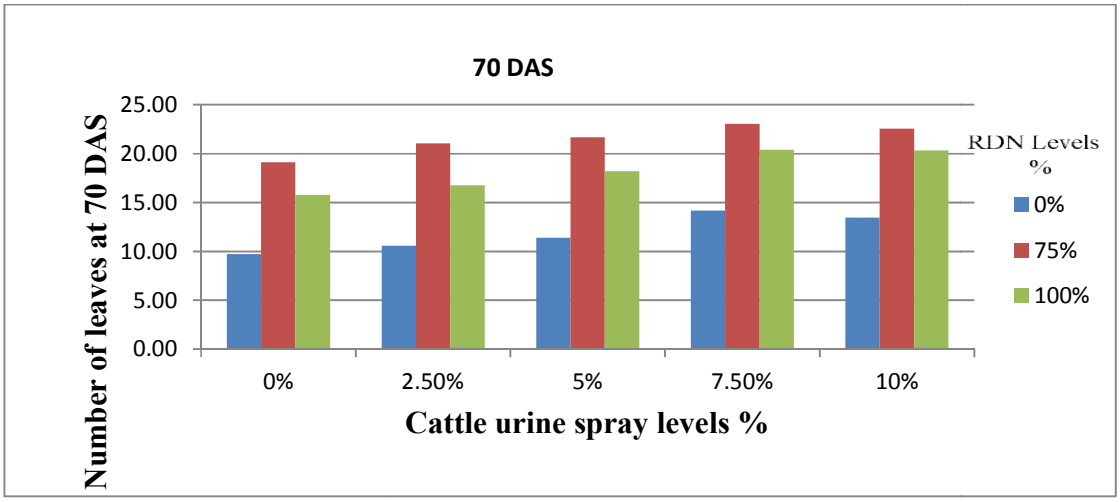


Fig. 3. Number of functional leaves of wheat as influenced by foliar sprays of cattle urine and nitrogen

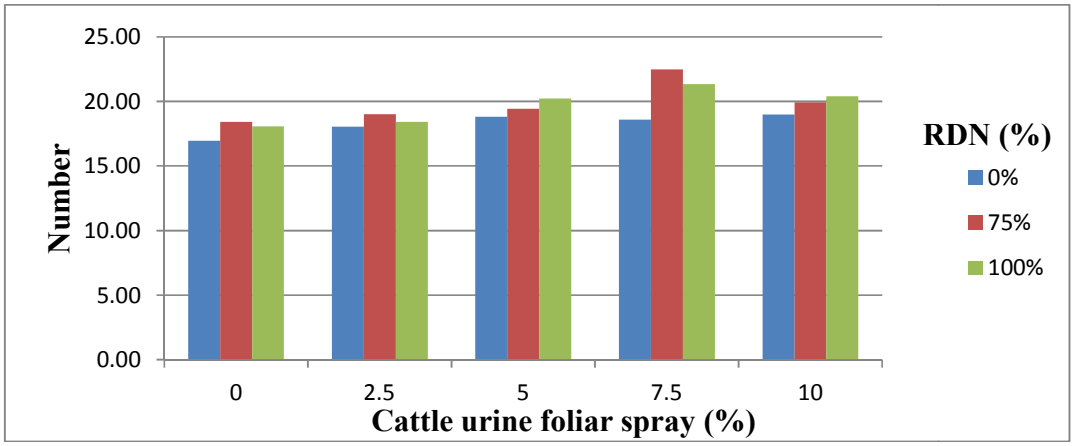


Fig. 4. Number of spikelets per spike of wheat as influenced by foliar sprays of cattle urine and nitrogen

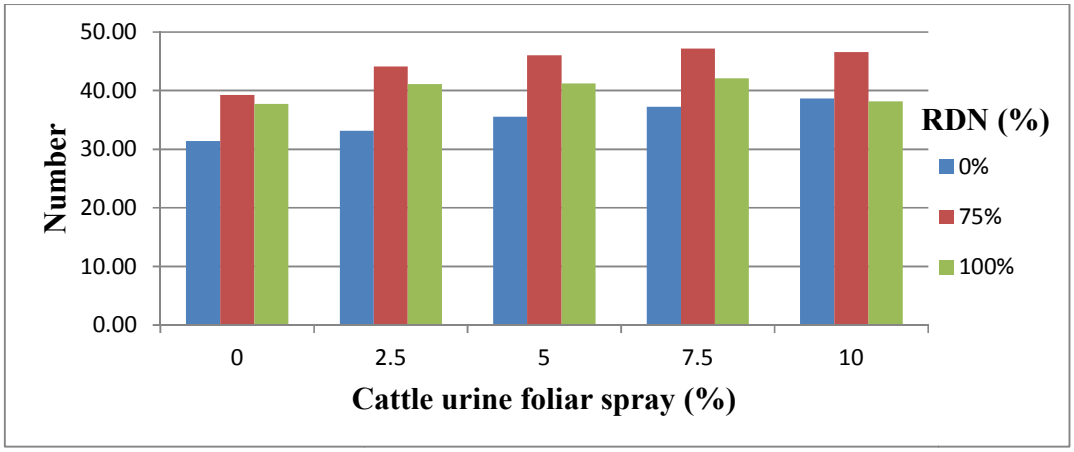


Fig. 5. Number of grains per spike of wheat as influenced by foliar sprays of cattle urine and nitrogen

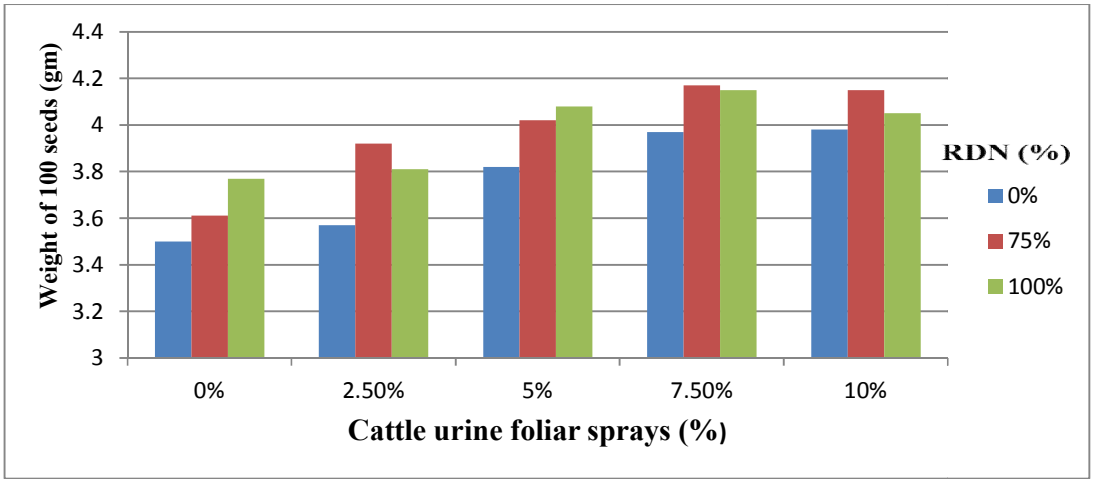


Fig. 6. Weight of 100 seeds of wheat as influenced by foliar sprays of cattle urineand nitrogen

significantly superior Mn uptake (45.59 mg pot^{-1}) which found at par with 10% CUS (45.06 mg pot^{-1}) Mn uptake and also at par with 5% (43.14 mg pot^{-1}) uptake. However application of 10% of foliar spray recorded numerically higher Zn (58.50 mg pot^{-1}) uptake and application of 7.5% of foliar spray recorded significantly superior Cu (63.16 mg pot^{-1}) uptake by wheat than rest of the treatments.

Combine application of N fertilizers along with cattle urine foliar sprays recorded non-significant results for N, P, K uptake. Higher N uptake (3.65 g pot^{-1}) was recorded with 75% N + 7.5% CUS. Also numerically higher Phosphorous uptake (1.37 g pot^{-1}) recorded with 75% N + 7.5% CUS. Further, superior results for Fe (445.50 mg pot^{-1}), Mn (57.21 mg pot^{-1}), Zn (69.63 mg pot^{-1}) and Cu (84.71 mg pot^{-1}) were obtained with 75% N + 7.5% CUS than rest of the treatment combinations. Similar results were also obtained by Ledgard et al. [16] and Pradhan et al. [17].

4. CONCLUSION

It could be concluded from this experiment that combined application of 75% N through urea along with three foliar sprays of cattle urine @ 7.5% taken at 20, 40 and 60 DAS was found beneficial and superior for growth, yield and nutrient uptake by wheat grown in Inceptisol.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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