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Effect of cow urine on growth, yield attributes and yield in maize crop

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Abstract

Cow urine is rich source of nutrients (Especially nitrogen and potassium) enhance the growth of crops. Accordingly, a field experiment was conducted in the Rabi season of 2022 and 2023 at Krishi Vigyan Kendra, Narayanpur to evaluate the effect of different doses of cow urine on growth, yield attributes and yield in maize crop. The experiment was conducted under the Randomize Block Design (RBD) with thirteen treatments and three replications. However, the response of fertility levels (100% RDF) was highest in yield, growth and yield attributes. The result revealed that the grain and stover yield of maize varied significantly under various cow urine foliar sprays. Application of 50% RDF with 40 - 60% cow urine spray with 10 days interval recorded higher grain and stover yield over 50% RDF only. Moreover, application of 60% cow urine spray with 50 % RDF increased higher growth and yield attributes over only 50% RDF and control. Similar trend also found with nutrients uptake.

Keywords: Maize, Cow urine, Foliar spray, Recommended dose of fertilizer (RDF)

Introduction

Imbalanced and indiscriminate use of agro-inputs (mainly chemical fertilizers) has led to severe deterioration of soil health. Under these circumstances, therefore, adoption of integrated nutrient management (INM) is the most appropriate one that can increase crop production without compromising with soil health (Mishra *et al.*, 2017) [7]. Integrated use of inorganic fertilizers along with the organic manures can help minimizing chemical fertilizer use and sustaining crop yield by maintaining optimum soil-fertility status.

In this context, integrated use of chemical and organic source of nutrients in crop production is becoming very crucial for assurance of food security on sustainable basis, which in turn not only improve the soil fertility for sustained crop productivity but also to reduce the cost of inorganic fertilizers. Different kind of organic materials such as FYM, animal manures, crop residues, composts, cow urine etc. have been used in crops but the amount and availability of nutrients in organic material vary widely, which makes interpretation of the value of nutrient supplied. Livestock wealth is deemed as the oldest wealth resource for mankind. Cow represents the Vedic values of selfless service, strength, dignity and non-violence. The "Cow" occupies the highest place of honor in Indian civilization. The five products of cow (urine, dung, ghee, milk and curd) are used in different organic systems.

Cow is the backbone of Indian culture and rural economy, and sustains our life; represent cattle wealth and bio-diversity. Cow urine is a rich source of nutrients (especially nitrogen and potassium), but usually drains out a waste material. Being organic nature, it can be used in crops without any adverse effect on environment and human health (Singh *et al.*, 2012). Cattle urine is a good source of nitrogen, phosphate, potassium, calcium, magnesium, chlorite and sulphate. It contains 95% water, 2.5% urea, 2.5% enzymes and 24 types of mineral salts, hormones. It also contains several essential minerals like phosphorus, calcium, sulphur, iron and manganese, along with several other organic compounds like amino acids, carbonic acid, uric acid, cytokinin, lactose etc. (Bhadauria, 2002) [1]. Research shows that only one fifth of nitrogenous materials consumed by cattle is absorbed in the body and remaining is excreted through urine and dung (Bhadauria, 2002) [1]. Further organic nutrient spray (cow urine) can be sprayed at critical growth stage of crop to overcome the problem of the slow release nutrients of organic sources affecting crop growth. Cow urine might act as a

stimulator for accumulation of nutrients in the plant biomass, proliferation of plant growth, promoting, phosphate solubilizing, a biotic stress tolerant and antagonism towards plant pathogenic fungi in the rhizosphere of plants, and enhance the total phenolic contents of the plants and controlling plant pathogenic fungi, and also it's effective in the enhancement of plant growth and soil health (Nautiyal *et al.* 2004) ^[7]. Foliar application is credited with the advantage of quick and efficient utilization of nutrients, elimination of losses through leaching and fixation and regulating the uptake of nutrient by plants (Manonmani and Srimathi, 2009) ^[5]. The beneficial effects of cow urine application have been reported on several crops such as mustard (Pradhan *et al.*, 2016), maize (Devakumar *et al.*, 2014), sweet corn (Pande *et al.*, 2015) ^[9] and other vegetable crops such as watermelon (Burubai and Eribo, 2012) ^[2] and lablab bean (Maheswari *et al.*, 2017) ^[4]. It is also reported that application of cow urine to have a favorable impact, for enhancing productivity of different crops viz., mustard, maize and rice etc. Therefore, the objective has been taken to study the effect of cow urine on growth, yield attributes and yield in maize crop.

Material and Methods

The experiment with maize crop was laid out in a Randomized Block Design (RBD) with three replications. The treatment involved three RDN (0, 50% and 100%) + full dose of phosphorus and potash + three cow urine (600 lha⁻¹) foliar spray i.e. (20%, 40% and 60%) at 10, 15 and 20 day interval. There were total thirteen different treatment in combinations such as T₁ - Absolute control (no fertilizers, no cow urine), T₂ - 0% RDN (only water spray) + Phosphorus + Potash, T₃ - 50% Recommended Dose of Nitrogen (RDN) + Phosphorus + Potash, T₄ - 100% RDN + Phosphorus + Potash (Full recommended NPK), T₅ - 50% RDN+20% cow urine foliar spray at 10-day intervals +Phosphorus+ Potash, T₆ - 50% RDN+40% cow urine foliar spray at 10-day intervals +Phosphorus+ Potash, T₇ - 50% RDN+60% cow urine foliar spray at 10-day intervals +Phosphorus+ Potash, T₈ - 50% RDN+20% cow urine foliar spray at 15-day intervals +Phosphorus+ Potash, T₉ - 50% RDN+40% cow urine foliar spray at 15-day intervals +Phosphorus+ Potash, T₁₀ - 50% RDN+60% cow urine foliar spray at 15-day intervals +Phosphorus+ Potash, T₁₁ - 50% RDN+20% cow urine foliar spray at 20-day intervals +Phosphorus+ Potash, T₁₂ - 50% RDN+40% cow urine foliar spray at 20-day intervals +Phosphorus+ Potash and T₁₃ - 50% RDN+60% cow urine foliar spray at 20-day intervals +Phosphorus+ Potash. To counteract the effects of heterogeneity, three replicates of the treatments were executed. According to protocol, the treatments were allocated at random among the plots in each replication. Therefore, there were 39 plots in the experiment as a whole. Urea, di-ammonium phosphate and muriate of potash were used to apply nitrogen, phosphorus and potassium. Fresh cow urine was obtained from the Dairy unit of the KVK Farm of the Krishi Vigyan Kendra, Narayanpur.

Different quantitative and qualitative expressions were used to test the response to cow urine levels applied as a foliar spray. Plant height (cm), days to 50% tasseling, days to 50%

silking, dry weight of plants(g), grain yield, stover yield of maize were observed as growth, yield attributes and yield parameters. The amounts of nitrogen, phosphorus and potassium in grain and straw were determined as well, along with the total nitrogen, phosphorous and potassium uptake.

Results and Discussion

Effect of Cow Urine on Yield (q ha⁻¹) of Maize

The grain and stover yield of maize was significantly influenced by the nutrient management treatments during Rabi 2022–23 and Rabi 2023–24, as well as in the pooled analysis (Table 1.). In both years and in the pooled mean, the lowest yield was recorded under the absolute control (T₁), with values of 32.20, 30.40, and 31.30 q ha⁻¹, respectively. Application of 100% RDN + phosphorus + potash (T₄) produced the highest grain yield across both seasons (65.47 and 66.53 q ha⁻¹) with a pooled mean of 66.00 q ha⁻¹, which was significantly superior to all other treatments(Fig.1).

Among the integrated treatments involving 50% RDN combined with cow urine foliar sprays, the highest yields were obtained with 60% cow urine applied at 10-day intervals (T₇), producing 62.40 and 64.30 q ha⁻¹ during the two years and a pooled mean of 63.35 q ha⁻¹. This treatment was statistically comparable to 40% cow urine at 10-day intervals (T₆), which recorded pooled yields of 62.03 q ha⁻¹. Lower yields were obtained with extended foliar spray intervals (15 or 20 days) and lower cow urine concentrations, although these still out performed the absolute control. The findings of present investigation are in conformity with the findings of Singh *et al.* (2014); Devakumar *et al.* (2014) ^[3] and Sadhukhan *et al.* (2018). Similar trend also following in stover yield.

These findings suggest that 100% RDN with balanced P and K fertilization remains the most effective strategy for maximizing maize yield. However, 50% RDN supplemented with frequent (10-day interval) foliar sprays of 40–60% cow urine can also achieve yields statistically comparable to full RDN application, potentially reducing chemical nitrogen usage while sustaining high productivity.

Table 1: Effect of cow urine on yield (q ha⁻¹) of Maize

Treatments	Grain yield (q ha ⁻¹)			Strover yield (q ha ⁻¹)		
	Rabi 2022-23	Rabi 2023-24	Pooled	Rabi 2022-23	Rabi 2023-24	Pooled
T ₁	32.20	30.40	31.30	55.71	54.47	55.09
T ₂	38.67	36.43	37.55	67.07	63.81	65.44
T ₃	45.63	44.23	44.93	78.31	77.24	77.77
T ₄	65.47	66.53	66.00	97.53	97.73	97.63
T ₅	58.30	58.87	58.58	85.63	85.83	85.73
T ₆	61.57	62.50	62.03	89.63	89.77	89.70
T ₇	62.40	64.30	63.35	90.27	93.49	91.88
T ₈	52.52	53.23	52.88	84.03	85.13	84.58
T ₉	56.40	56.60	56.50	85.83	86.00	85.92
T ₁₀	58.74	59.00	58.87	86.43	86.93	86.68
T ₁₁	50.20	51.23	50.72	82.77	82.97	82.87
T ₁₂	53.67	54.20	53.93	84.50	85.83	85.17
T ₁₃	55.87	57.53	56.70	86.45	88.70	87.58
SEm±	1.87	1.81	1.48	1.53	1.73	1.06
CD (5%)	5.49	5.32	4.35	4.50	5.06	3.12

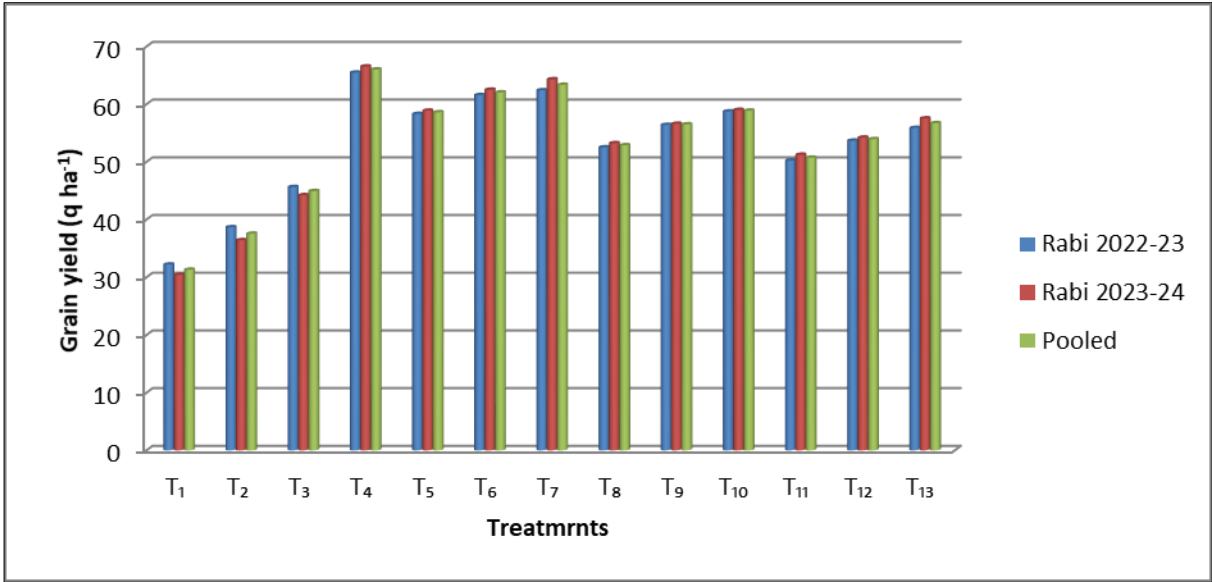


Fig.1: Effect of cow urine on grain yield (q ha⁻¹) of Maize

Effect of Cow Urine on growth attributes of Maize

The effect of different nutrient management practices on growth parameters like plant height (cm), days to 50% tasselling, days to 50% silking and dry matter per plant (g) of maize after rabi 2022-23, 2023-24 mentioned in pooled data was significant and presented in Table 2 and graphically in fig 2. The tallest plants were observed in T₄ (100% RDN + P + K) with a mean height of 252.33 cm, which was statistically at par with T₇ (50% RDN + 10-day foliar spraying 60% cow urine + P + K) (248.00 cm). Treatments involving higher concentrations of cow urine at shorter foliar spray intervals (T₆, T₇, T₁₀, and T₁₃) generally produced taller plants compared to their lower concentration or longer interval counterparts. These results suggest that integrating reduced nitrogen doses with phosphorus, potash,

and strategic foliar application of cow urine—particularly at 60% concentration and shorter spray intervals—can enhance maize plant height to levels comparable with or exceeding 100% RDN application. Application of 100% RDN + phosphorus + potash (T₄) has a significant impact on growth parameters including plant height (cm), days to 50% tasseling, days to 50% silking and dry weight of plants(g) across both seasons which was significantly superior to all other treatments. Among the integrated treatments involving 50% RDN + 60% cow urine foliar spray at 10 days interval has a significant impact on growth of maize. The application of 50% RDN + 60% and 40% Cow urine foliar spray at 10 days interval recorded the considerably higher growth parameters compared to control and only 50% RDN. Similar result reported by Singh (2018)

Table 2: Effect of cow urine on growth and yield attributes of Maize

Treatments	Growth parameters				Yield attributes			
	Plant height (cm)	Days to 50% taselling	Days to 50% silking	Dry Matter per plant (g)	No. of cobs per plant	Test weight (g)	Number of grains per cob	Harvest index (%)
T ₁	152.17	66.15	68.50	141.57	1.15	204.30	374.67	34.42
T ₂	162.83	63.63	67.50	148.97	1.25	208.44	393.67	35.23
T ₃	186.83	60.45	62.30	169.50	1.39	211.60	475.50	35.41
T ₄	252.33	51.83	52.00	199.25	2.02	219.30	563.17	40.33
T ₅	220.67	55.28	57.83	179.86	1.73	215.50	506.50	40.57
T ₆	229.67	53.90	54.45	184.28	1.82	217.00	527.00	40.87
T ₇	248.00	51.80	52.83	186.60	1.95	217.70	529.67	41.40
T ₈	209.17	56.84	61.53	179.12	1.54	214.56	501.83	38.47
T ₉	218.00	55.92	57.43	181.23	1.57	215.77	508.83	39.67
T ₁₀	226.50	54.93	55.68	186.68	1.74	216.65	517.00	40.44
T ₁₁	204.33	58.48	61.33	178.05	1.55	212.70	496.00	37.95
T ₁₂	211.42	58.30	59.87	179.80	1.60	213.90	501.00	38.76
T ₁₃	221.75	56.17	57.55	180.87	1.67	214.84	512.50	39.30
SEm±	1.65	0.38	0.58	1.05	0.17	1.01	5.20	0.72
CD (5%)	4.82	1.11	1.69	3.07	NS	NS	15.26	2.12

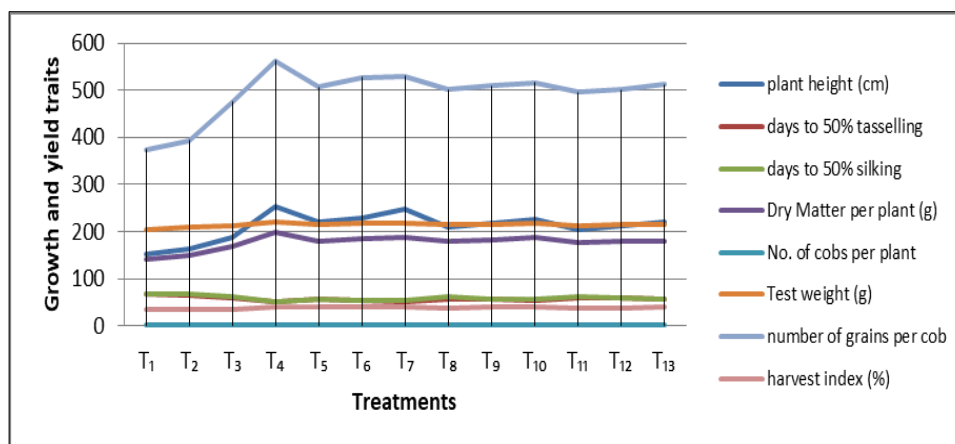


Fig 2: Effect of cow urine on growth and yield attributes of Maize

Effect of Cow Urine on yield attributes of Maize

The yield attributes like No. of cob per plant, no of grain per cob, test weight (%) and harvest index (%) in maize was significantly influenced by the nutrient management treatments during both Rabi 2022–23 and Rabi 2023–24 which presented as pooled mean data (Table 2 and fig. 2). In the pooled analysis, the maximum cob was recorded with T₄: 100% RDN + Phosphorus + Potash, which was statistically superior to all other treatments. This was followed by T₇: 50% RDN + foliar spraying of 60% cow urine at 10-day intervals, T₆: 50% RDN + foliar spraying of 40% cow urine at 10-day intervals, and T₁₀: 50% RDN + foliar spraying of 60% cow urine at 15-day intervals, which were at par with each other but significantly higher than the absolute control. These findings are in close conformity with Prasanna *et al.*, (2020) [10]. The lowest number of grains per cob was obtained in the absolute control (T₁), which was statistically at par with T₂: RDN 0% (water spray) + phosphorus + potash. The results clearly indicate that combining recommended nitrogen levels with balanced phosphorus and potassium, along with foliar applications of cow urine at optimal concentrations and intervals, substantially enhanced grain set in maize. Foliar spraying of cow urine at varying concentrations and intervals in combination with 50% RDN + phosphorus + potash also enhanced test weight compared to the control. Among these, T₇ (50% RDN + 10-day interval foliar spraying of 60% cow urine) recorded a pooled mean of 245.05 g, closely followed by T₁₀ (50% RDN + 15-day interval foliar spraying of 60% cow urine) with 240.28 g. Similar result obtained by Jadhav *et al.* (2020) [10]. T₇ recorded the highest mean HI (41.40%), significantly outperforming all treatments except T₆ (40.87%), T₅ (40.57%), and T₄ (40.33%). The absolute control remained lowest with a pooled mean of 34.42%. Overall, the results indicate that foliar spraying of cow urine at 60% concentration at 10-day intervals in combination with 50% RDN and basal phosphorus and potassium substantially enhanced the harvest index compared to the control and other nutrient management practices.

Effect of Cow Urine on Major Nutrients Uptake (kg ha⁻¹) by Maize

Table 3 presents the effect of cow urine (CU) applied as foliar spray (FS) at different concentrations and days of application, in combination with varying levels of recommended dose of nitrogen (RDN), on uptake major nutrients (kg ha⁻¹) by maize grain and stover.

The highest nitrogen uptake was consistently recorded with T₄ (100% RDN + P + K) with a pooled mean of 64.51 kg ha⁻¹. This was significantly superior to all other treatments, indicating the direct role of adequate nitrogen supply in enhancing nitrogen accumulation in maize grain.

Among the cow urine-based treatments, application of 50% RDN combined with 60% CU-FS at 10 days interval (T₇) resulted in comparatively higher nitrogen uptake with a pooled value of 55.72 kg ha⁻¹. This treatment was statistically at par with T₁₀ (50% RDN + 60% CU-FS at 15 DI) and T₆ (50% RDN + 40% CU-FS at 10 DI), indicating the beneficial effect of higher concentration of cow urine and earlier foliar application on nitrogen uptake. Similar trend also follows for phosphorus and potassium uptake.

The increased major nutrients uptake under cow urine treatments may be attributed to the presence of readily available nitrogen, growth-promoting substances, and micronutrients in cow urine, which enhance leaf absorption, photosynthetic activity, and nutrient translocation to grains. Similar findings have been reported by Subbaiah *et al.*, (2018) [16] and Patil *et al.*, (2020) [18], who observed improved nutrient uptake in cereal crops with foliar application of cow urine along with reduced chemical nitrogen.

Overall, the results suggest that partial substitution of chemical nitrogen with cow urine foliar spray, particularly at higher concentrations and earlier stages, can enhance nitrogen uptake in maize grain, though it could not surpass the full recommended nitrogen dose.

Table 3: Effect of Cow Urine on Major Nutrients Uptake (kg ha⁻¹) by Maize

Treat	Nitrogen uptake (kg ha ⁻¹)			Phosphorus uptake (kg ha ⁻¹)			Potash uptake (kg ha ⁻¹)		
	By grain	By Straw	Total	By grain	By Straw	Total	By grain	By Straw	Total
T ₁	35.47	28.19	63.66	13.80	2.30	16.10	13.77	68.38	82.15
T ₂	39.71	32.14	71.85	16.27	2.67	18.95	17.44	83.37	100.81
T ₃	46.57	39.75	86.31	21.97	3.39	25.37	21.34	102.59	123.92
T ₄	64.51	41.49	106.0	29.84	4.94	34.78	31.08	129.30	160.39
T ₅	52.56	35.78	88.33	25.73	3.62	29.35	22.81	108.66	131.47
T ₆	54.26	36.00	90.26	21.17	4.39	25.56	24.84	114.26	139.10
T ₇	55.72	36.40	92.13	28.02	4.23	32.24	27.65	124.89	152.54
T ₈	48.29	41.26	89.55	20.57	3.06	23.63	19.08	101.87	120.95
T ₉	51.32	38.57	89.88	24.57	2.98	27.55	23.52	105.04	128.56
T ₁₀	54.99	36.60	91.59	24.38	4.15	28.53	25.54	107.14	132.68
T ₁₁	45.62	42.65	88.27	18.88	2.71	21.59	20.56	101.43	121.99
T ₁₂	46.18	44.10	90.28	19.90	3.07	22.97	22.23	106.89	129.12
T ₁₃	52.27	38.62	90.90	22.85	3.70	26.54	24.61	110.96	135.57
SEM±	1.99	1.46	2.44	1.15	0.34	1.05	0.98	2.25	2.16
CD (5%)	5.81	4.26	7.12	3.35	0.99	3.06	2.87	6.57	7.63

Conclusion

RDN must be applied to maize (120 kg ha⁻¹) at 100% and cannot be reduced. Foliar applications of 60% or 40% cow urine at 10 days interval with 50% RDN improved growth, yield attributes, yield and nutrients uptake of maize. The treatment T₃ (50% RDN + P + K) was significantly lower than most cow urine treatments, suggesting that foliar application of cow urine enhanced potassium uptake beyond soil-applied fertilizers alone. The lowest potassium uptake was observed under absolute control (T₁).

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