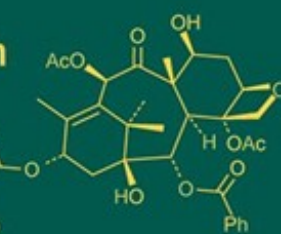
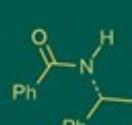


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Concentrated cow urine (CCU) as potential liquid manure for organic crop production

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ABSTRACT

Organic farming is a holistic food production and management systems which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity (FAO). Nowadays, lot of emphasis is being given by the Government and a large number of non-governmental organisations to promote organic farming in the country at larger scale. Nutrient (particularly of nitrogen) and pest management are key to the success of organic farming. Bulky organic manures (FYM, compost, vermicompost etc.) and concentrated organic manures (oil cakes etc.) are the main nutrient sources for nitrogen management under organic farming. However, one of the easily available livestock by-product i.e. urine has very less explored area for nitrogen management in the crops. According to livestock census (2019) India possesses 193.50 million cattle and 109.85 million of buffalo population and in Uttar Pradesh possesses 19 million cattle and 33 million buffalo population. According to a rough estimate, the present cattle and buffalo population in the country have potential of producing approximately 1500 million Litre of urine which could supply 7.5 million kg of nitrogen to our crops. This is approximately 45% of total nitrogen (16.4 million kg) supplied through urea during 2022-23 in India. It means the cattle and buffalo urine if, 100% utilized, have potential, to reduce the urea consumption by 45%. The present study was conducted under pot conditions during 2023 at ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut to utilize the cow urine in concentrated form for organic production of wheat. The results of the study revealed that, on-farm prepared concentrated cow urine (CCU) has emerged as a potential liquid source of nitrogen for organic production of wheat. There was significant and positive response of CCU on most of the growth and yield parameters of wheat i.e. germination, biomass accumulation, effective tillers, ear head length, no. of grains earhead⁻¹ and 100-grain weight etc. Hence, in future, CCU may prove effective liquid organic manure for organic crop production.

Keywords: Organic farming, Concentrated cow urine (CCU), Nutrient management through liquid organic manure, Wheat production

1. Introduction

Wheat (*Triticum aestivum* L.) is the most important cereal crop and essential commodity for human population. In the world, it is grown annually on an area of around 220 million hectares (m ha). It provides about 21% of the food calories and 20% of the protein for more than 4.5 billion human populations in about 94 countries in the world. In India, it is the second most important cereal crop also including production and plays a key role in food and nutritional security (Anonymous 2026a) [1]. Wheat is a significant source of protein, minerals, and vitamins, it compares favourably to other important cereals in terms of nutritional content. It contains a comparatively high amount of thiamine and niacin and provides more calories to the world diet than any other food crop. Wheat production in 2025, harvested last June, is officially estimated at a record level of 117.94 million tonnes, (Anonymous 2026b) [2]. However, world as well as India sustaining its productivity from continuously shrinking land poses a formidable challenge like micronutrient deficiencies in soil and other soil health related problems are becoming common in most of the wheat growing areas in the country. Use of synthetic fertilizers and pesticide had sustained the productivity level for quite some time.

Modern agriculture techniques employing chemical fertilisers and pesticides to maximise crop yields have adversely affected the India's traditional agricultural practices. However, the quality of the food we eat and the environment are being negatively impacted by conventional farming. Organic farming is a holistic food production and management systems which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity (FAO). organic farming in India is enormous since, in addition to being healthier for the environment and human health, it also allows farmers to save money on inputs like fertiliser and pesticides. In India, organic farming has become more popular, in the states like Madhya Pradesh, Rajasthan, Andhra Pradesh, Maharashtra, Sikkim, Tamil Nadu, and Karnataka etc. Asia

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has the largest percentage of growers (36%), followed by Africa (29%) and Europe (17%) under organic farming. Nowadays lot of emphasis is being given by the Government and a large number of non-governmental organisations to promote organic farming in the country at larger scale (**Raj et al., 2006**). International organisations such as the Food and Agriculture Organisation (FAO), European Commission (EC), United States Department of Agriculture (USDA), and International Federation of Organic Agriculture Movements (IFOAM) oversee the regulation of organic farming on a global scale. This is achieved through the implementation of Codex Alimentarius, EC guidelines, USDA organic regulations, and IFOAM standards (**Singh et al., 2024**) [3].

Cow urine is a kind of dairy product having several uses including liquid manure, disinfectant, and antibacterial agent. It constitutes water (95%), urea (about 2.5%), and the remaining 2.5 percent mineral salts, 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**) [4]. According to livestock census (2019) India possesses 193.50 million cattle and 109.85 million of buffalo (**Anonymous 2025**) [5]. This cattle and buffalo population have potential of produce approximately 1500 million Litre of urine having potential to supply 7.5 million kg of nitrogen (@0.5% average nitrogen content) to our crops. This is approximately 45% of total nitrogen (16.4 million kg) supplied through urea during 2022-23 in the country. It means the cattle and buffalo urine if 100% utilized, have potential, to reduce the urea consumption by 45%. In organic farming, cow urine is utilised in the production of several organic concoctions for nutrient and pest management. Cow urine, often discarded as livestock waste, can be converted into bio-urine, a liquid organic fertilizer. This utilisation helps reduce environmental pollution while improving air and water quality. Organic fertilizer is produced through the microbial decomposition of plant materials and organic wastes. Using livestock urine as a raw material enhances the efficiency and sustainability of liquid organic fertilizer production (**Vebriyanti et al., 2022**) [6]. In a study by **Pradhan et al. (2018)** [7] cow urine was found a potential liquid manure to improve the yield of various crops, including wheat, rice, mustard, and maize. As an organic manure and biopesticide, cow urine has been thought to be quite useful in agriculture (**Dharma et al., 2005**) [8].

Organic fertilizers prepared from cow urine are natural and free from harmful chemicals or synthetic compounds, making them an environmentally friendly alternative to chemical fertilizers (**Saini et al., 2019; Shaji et al., 2021**) [9, 10]. Cow urine is a liquid livestock waste composed of water, urea, minerals, enzymes and other organic compounds, making it a valuable raw material for organic fertilizer production (**Dhama et al., 2005**) [11]. Traditionally, it has been used in Indian agriculture as a natural fertilizer and pesticide due to its rich nitrogen, potassium and nutrient content, which improves soil fertility and promotes plant growth (**Pradhan et al., 2018**) [7]. In addition, cow urine contains beneficial microorganisms that enhance soil health and help suppress plant diseases, supporting sustainable crop production (**Boraiah et al., 2017**) [12].

Cow urine are natural by-products of cows and other ruminants that support sustainable agriculture (**Gupta et al., 2016**) [13]. They are rich in nutrients and organic matter, improving soil health, promoting plant growth, and reducing dependence on synthetic fertilizers (**Rawat et al., 2019**). Cow urine is a valuable source of essential plant nutrients such as nitrogen, phosphorus and potassium, mainly present as urea, ammonia and other organic compounds that are readily absorbed by plants for growth (**Saunders, 1982; Prabhu et al., 2014**) [14, 15]. It's also contains beneficial microorganisms, including bacteria and fungi, which improve soil health by enhancing soil structure, increasing nutrient availability and suppressing harmful pathogens and pests (**Prabhu et al., 2014**) [14].

2. Materials and Methods

2.1 Experimental site

The field experiment was conducted at ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut- 250110, Uttar Pradesh, during *Rabi* season of 2023-24. Agro-climatically Meerut falls under the western plain zone of Uttar Pradesh which temperature vary from 1.5°C to 43.2°C (max. temperature at 34.5 °C was recorded in the month of Oct. 15 whereas, the lowest min. temperature of 13.8 °C remained in the month of Nov. 2) and Humidity varies between 32% to 85.0%, average rainfall is 795 mm.

The Physico-chemical characteristics of experimental soil was (4.9) in organic carbon (wet digestion method) with slightly alkaline in reaction (pH 7.8). The available N is 243.9 (alkaline permanganate oxidisable), P is 26.6 (0.5 M NaHCO₃ extractable), K is 234.5 (1 M ammonium acetate exchangeable K) and sand (56%), silt (28%) and clay (16%) respectively.

2.2 Experimental design and treatment details

The experiment was laid out in a Completely Randomized Design (CRD) keeping these recommended FYM at pre-sowing time and Urea as soil drenching 1st -25 DAS and 2nd-50 DAS, FYM + CCU (ready for use in 3-4 days) and FCU applied at 1st Pre-sowing, 2nd 25 DAS, 3rd 40 DAS, 4th 55 DAS, 5th 70 DAS, 6th 85 DAS [T₁ - Control, T₂ - FYM (67gm) Pot⁻¹, T₃ - Urea (0.81gm) Pot⁻¹, T₄ - CCU (34gm FYM +10% CCU 6th time) Pot⁻¹, T₅ -FCU (34gm FYM +10% FCU 6th time) Pot⁻¹] in pots with five replications. Sowing of wheat (DBW-222) was done (15th November, 2023) with a pot size of 20 cm, using seed rate ten seed Pot⁻¹. Cow urine was collected from the indigenous Sahiwal cow and kept for one week for fermentation, which contained 0.47% N (Kjeldahl method), 0.038% P (Vanado-molybdophosphoric acid yellow colour method) and 0.53% 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). Wheat (*Triticum aestivum* L.) variety 'DBW-222' was the test crop in the experiment. Similar practices such as weed control and irrigation have been maintained in all the pots during the crop season. The crop was harvested at physiological maturity the produce was dried and processed for yield determination.

2.3 Leaf

Chlorophyll content (SPAD value)

For leaf Chlorophyll content (SPAD value) from three leaf (each plant) randomly selected, chlorophyll was recorded from the upper newest fully developed leaf. In the middle of the leaf blade, halfway between the base and tip, readings were taken on one side of the midrib. the extractable chlorophyll in leaves was quickly and non-destructively estimated using the SPAD 502, a hand-held chlorophyll metre (Minolta Corporation, Ramsey, NJ) (Earl and Tolleraar, 1997).

2.4 Growth attribute

a. Plant height

For measuring the plant height, five plants were selected at random from each pot, and height was recorded at 25, 50 DAS and at harvest. The height was measured from the pot upper surface to the base of the fully opened leaf before heading and to the tip of ear head of the main shoot after heading. The average of these five plants was taken as mean plant height in centimetre.

b. Fresh weight of wheat

Fresh plant samples was collected from treatment pots at 25, 50 DAS and then fresh weight accumulation per plant was recorded through weighing machine.

c. Dry matter accumulation

Fresh plant samples was collected from treatment pots at 25, 50 DAS and after harvest. The dry matter was recorded after drying the plants in oven to constant weight at 60 °C. Then dry matter accumulation per treatment was calculate.

d. Number of tillers

The Number of tillers were counted pots⁻¹ on at 25, 50 DAS.

2.5 Yield attributes

a. Number of effective tillers

The number of effective tillers was counted plant⁻¹ at the time of harvest, which was to obtain number of effective tillers plant⁻¹.

b. Length of spike

The average length of the spike from five (each pot) randomly selected spikes was recorded from the base of lowest spikelet to the tip of the top most spikelet.

c. Number of grains spike⁻¹

From each of the five randomly selected pot⁻¹ spikes was threshed separately and number of grains was counted and a mean was calculated and recorded.

d. 100-grain weight

Grain samples from the produce of pots were collected and counted hundred grains. The grain samples were thoroughly dried and their weight was recorded in gram pots⁻¹.

e. Grain yield

The produce from each pot was harvested, and threshed after sun drying. The grains were cleaned and weighed after threshing. The weight of grains recorded in gram pot⁻¹.

2.6 Studies on cow urine analysis

Cow Urine sampling

The fresh cow urine was collected during the early morning hour at IIFSR Dairy farm from a single female cow of a given variety (Gaury) by using a sterile container (polyethylene bucket) and then poured and packed to a sterile container of minimal size for carrying and came into the laboratory.

Cow Urine analysis in laboratory

The Urine sample was collected and immediately filtered using Whatman No. 1 filter paper to remove precipitated contaminants, debris, and pollutants before usage. The nitrogen (N) analysis in the lab was conducted using the Macro-Kjeldahl method (Bremner, 1996), and 'P' Vanadomolybdate phosphoric acid yellow colour method Jackson (1973), and 'K' Flame photometer method Jackson (1973), along with pH measurements (Msaky, 2018) on the sample.

3. Result and Discussions

3.1 Growth response

3.1.1 Germination of wheat

Data regarding germination percent per pot have been presented in Table 1. There was significant effect of different treatment on the germination of wheat at 7 days after sowing (DAS) maximum germination was observed with (54%) concentrate cow urine followed by (46%) fresh cow urine, minimum germination (17%) was regarded with control. At 15 days after sowing (DAS) again maximum germination was recorded with (78.60%) concentrate cow urine (CCU) and this was at par with (78%) fresh cow urine (FCU). It shows that application of CCU has positive effect on seed germination of wheat crop. Mahal and Khatun (2021) also found increase seed germination of wheat after application of cow urine. Tamrakar (2016) [16] also found early emergence of culms due to application of cow urine on *gladiolus* var. *Candyman*.

3.1.2 Chlorophyll content (SPAD reading)

Different nitrogen sources affect the chlorophyll content of the wheat crop depending upon availability of nitrogen in the manure/fertilizer. Soil Plant Analysis Development (SPAD) is an important observation indicating the chlorophyll content in crops. Under the present study maximum SPAD reading (41.82) was recorded with Urea followed by CCU and FCU. Minimum SPAD (33.80) was recorded with control. This shows that due to readily available source Urea resulted in higher SPAD reading as compare to all other treatment. However, CCU was also found as better source of nitrogen with good chloro-

phyll content in wheat leaf. These data are presented in Table 1. Sadhukhan et al. (2019) [17] also reported about increase green leaves in wheat crop by using cow urine. Janjal et al. (2021) also showed improved chlorophyll content in fodder maize with the application of cow urine.

3.1.3 Plant height of wheat

Data pertaining to the effect of different treatments on plant height have been presented in Table 1. Plant height of wheat crop was taken from different treatment at 25 and 50 DAS and at harvest. At 25 DAS, maximum plant height was recorded with CCU (29.40 cm) and this was at par with FCU and farm yard manure (FYM). At 50 DAS, maximum plant height (54.40 cm) was observed with CCU and this was at par with other treatments except for control (43.40 cm). At harvest the same trend was observed and maximum plant height (86.56 cm) was recorded with CCU and minimum (70.78 cm) with control. Increase plant height in various crops after the application of cow urine. Where also reported by Sivasubramanian et al. (2004) [18], Tamrakar (2016) [16], and Lestari et al. (2017) [19].

3.1.4 Number of tillers

At 25 days after sowing there was no any significant different between the treatment with respect to number of tillers plant⁻¹. This is because of starting of tillering in wheat at around 21 to 25 DAS. However, at 50 DAS there was significant different among the treatment with respect to tiller number. Maximum tiller number pot⁻¹ (32) were observed with CCU and it was at par with Urea and FCU. Minimum tiller pot⁻¹ (23.40) was recorded in the control. The results shows that, CCU has the same potential to promote tillering in wheat crop as compared to urea (the commercially use nitrogenous fertilizer). The data regarding Average number of tillers per pot have been presented in Table 1. Positive effect of cow urine on plant growth and yield was reported earlier by Devasena et al. (2022) [20].

3.2 Fresh weight and dry matter accumulation

Data pertaining to fresh weight and dry matter accumulation plant⁻¹ of wheat crops at different growth stages have been presented in Table 2 (Fresh weight) and Table 3 (Dry weight). The perusal of data in Tables showed that the treatments had a significant effect on the fresh weight and dry matter accumulation. Sadhukhan et al. (2020), reported that, growth and yield parameters of wheat crops were improved by the foliar application of 100% concentration of cow urine as an organic source of nutrients. Due to different fertility levels and the application of cow urine, there were substantial variations in the number of tillers, green leaves, dry matter accumulation (DMA) m⁻².

3.2.1 Fresh weight of shoot

Fresh weight of shoot per plant of wheat crop was taken from different treatment at 25 DAS and 50 DAS. At 25 DAS, maximum fresh weight of shoot (0.490 gm) observed in CCU and this was at par with FYM and Urea. And least weight of Control (0.412 gm) was observed after FCU (0.464). At 50 DAS maximum fresh weight of shoot was observed with CCU (0.756 gm) and minimum in Control (0.584 gm).

3.2.2 Fresh weight of root

The fresh weight of root per plant of wheat was taken from different treatment at 25 DAS and 50 DAS. At 25 DAS maximum fresh weight of root (0.317 gm) observed with CCU. And minimum fresh weight of root with Control (0.244 gm). At 50 DAS same trend was observed and maximum fresh weight (0.444 gm) was found with CCU and minimum in control (0.127 gm).

3.2.3 Total fresh weight of wheat

Total fresh weight per plant of wheat was taken from different treatments at 25 and 50 DAS. At 25 DAS, maximum total fresh weight was recorded in CCU (0.807 gm) followed by Urea, FCU, FYM. At 50 DAS, maximum total fresh weight (1.194 gm) was observed with CCU and this was at par with FCU. Minimum total fresh weight (0.894 gm) was recorded with control.

3.2.4 Dry weight

Patil *et al.* (2011) [21] and Pradhan *et al.* (2016) [22] reported that the dry matter and grain yield were increased by different potash levels and foliar spray of cow urine

3.2.5 Dry weight of shoot

The maximum dry weight (0.102 gm) of shoot per plant observed with FYM followed by CCU, Urea and FYM at 25 DAS. At 50 DAS, the different trend was observed and maximum shoot dry weight (0.155 gm) was found with CCU and minimum (0.127 gm) with Control.

3.2.6 Dry weight of root

Root dry weight of wheat crop plant⁻¹ was taken from different treatment at 25 and 50 DAS. At 25 DAS, the maximum root dry weight plant⁻¹ was observed with CCU (0.073 gm) followed by Urea. At 50 DAS, maximum root dry weight (0.108 gm) was recorded with CCU followed by Urea which was at par with FCU. Minimum (0.076 gm) with Control.

3.2.7 Total dry weight

The maximum total dry weight of wheat crop plant⁻¹ was observed with CCU (0.174 gm) followed by FCU at 25 DAS. However at 50 DAS, there was significant difference among the treatments with respect to total dry weight plant⁻¹. Maximum total dry weight was observed with CCU (0.264 gm) followed by FCU and least dry weight with control.

3.2.8 Plant dry weight at harvest

The plant total dry weight was taken from different treatments at harvest. Maximum total plant dry weight was observed with CCU (2.322 gm) and this was as par with other treatments except for control (2.068 gm).

3.3 Yield attributes

Data pertaining to various yield attributes viz, spike length, number of spikelet's spike⁻¹, number of grains spike⁻¹, number of effective tillers at harvest and test weight have been presented here.

3.3.1 Length of earhead

A cursory glance of data in Table 4 revealed that the treatments have significant effect on the spike length. Length of earhead, number of grains earhead⁻¹ are most important parameter effecting the final yield of wheat crop. Observation was taken average length of earhead in all the treatment at harvest. Maximum length of earhead was recorded with (12.34 cm) Urea. Which was at par with CCU, FCU and FYM as well. The least (9.12 cm) of earhead length was recorded in control. It shows that CCU as equal potential like urea in determining the length of ear in wheat crop. Positive effect of cow urine on ear length and other reproductive part of crop plant was earlier reported by Tamrakar (2016) [16], Lestari *et al.* (2017) [19] and Devasena *et al.* (2022) [20].

3.3.2 Stem (culm) length

Maximum stem length was observed in case of (74.50 cm) Urea and this was at par with CCU and FCU. Minimum stem length (61.66 cm) was recorded in control. Here again CCU showed same potential like urea for affecting the stem length of wheat. These data are presented in Table 4. Increase plant height in various crops after the application

of cow urine. Where also reported by Sivasubramanian *et al.* (2004) [18], Tamrakar (2016) [16], and Lestari *et al.* (2017) [19].

3.3.3 Number of effective tillers

A perusal of data on effect of different treatments on number of effective tillers have been given in Table 4. There was significant effect of different treatments on the effective tiller plant⁻¹. At harvest, maximum effective tiller was observed with Urea (1.716) followed by CCU (1.680). Minimum effective tiller plant⁻¹ was recorded with Control. It shows that, application of CCU has good potential for nitrogen management of crops under organic farming. Positive effect of cow urine on plant growth and yield was reported earlier by Devasena *et al.* (2022) [20].

3.3.4 Number of grains earhead-1 (Spike)

Data pertaining to the effect of different treatments on number of grains spike⁻¹ have been presented in Table 4. All the treatment shows significant effect on number of grains earhead⁻¹ as compare to control. Maximum grain earhead⁻¹ (59.40) was recorded with Urea. And this was at par with CCU, FCU and FYM. Minimum number of grains earhead⁻¹ has recorded in control (40.80). It shows that, CCU has similar potential like urea in effecting the number of grains earhead⁻¹ in wheat crop. Shadhukhan *et al.* (2021) also reported increase spike length in wheat after application of cow urine.

3.3.5 100 grain weight

Hundred grain weight is important parameter which decides final yield of wheat crop. Under the present study maximum 100 grain weight was recorded with CCU and Urea and these where at par with FCU and FYM. however least (3.86 gm) 100-grain weight recorded with control. This result shows that CCU has similar potential like Urea in determining the 100- grain weight in wheat crop. These data are presented in Table 4. Positive effect of cow urine on yield parameters of crops was also reported earlier by Sivasubramanian *et al.* (2004) [18], Tamrakar (2016) [16], Lestari *et al.* (2017) [19] and Shadhukhan *et al.* (2020).

3.4 Yield

The data on grain yield of wheat as influenced by different treatments have been presented in Table 4.

3.4.1 Grain yield of wheat

Maximum grain yield of wheat pot⁻¹ was record with CCU (8.89 gm) and this was as par with FCU and Urea. FYM showed significant lower grain yield (17.20 gm). However, least grain yield (13.88 gm) pot⁻¹ was observed in case of control. Positive effect of cow urine on grain yield of wheat earlier was reported by Shadhukhan *et al.*, (2018) [23]; Devakumar *et al.*, (2014) [24].

3.5 Nutritional status of cow urine

Concentrate Cow Urine (CCU) has significantly higher concentrations of nitrogen, phosphorus, and potassium compared to Fresh Cow Urine (FCU). The nitrogen content in CCU is approximately 5.3 times higher than in FCU, phosphorus content in CCU is about 6.2 times higher than in FCU, and potassium content in CCU is around 5.5 times higher than in FCU.

These differences indicate that CCU is a more concentrated source of essential nutrients compared to FCU, making it potentially more effective for use in agricultural applications where higher nutrient levels are desirable.

Organic concoction	N %	P %	K %	pH
1. Concentrate Cow Urine (CCU)	2.49	0.234	2.89	7.9
2. Fresh Cow Urine (FCU)	0.47	0.038	0.53	7.6

Saunders (1982) [15] and Suresh *et al.* (2019), Chaudhary *et al.* (2022) [25] reported about chemical composition of cow urine and ad-

vocated i.e. a good source of Nitrogen, phosphorous and other minerals elements of crops.

4. Conclusion

Under the present study, on-farm prepared concentrate cow urine (CCU), has emerged as a potential liquid source nitrogen for organic production of wheat. There was positive response of CCU on most of the growth and yield parameters of wheat i.e. germination, biomass

accumulation, effective tillers, ear head length, no. of grains earhead⁻¹ and 100- grain weight etc. Hence, if future after detailed investigation and rigorous field testing, CCU may become a potential liquid organic manure for organic crop production.

Tables :-

Table 1.

Treatment	Germination (%) at		Chloro- phyll (SPAD value)	Plant height (cm) at			Number of Tiller pot ⁻¹ at	
	7 DAS	15 DAS		25 DAS	50 DAS	139 DAS	25 DAS	50 DAS
1.Farm Yard Manure (FYM)	32.00	76.00	35.00	29.00	53.20	84.68	7.40	28.40
2.Urea	30.00	76.40	41.82	28.60	54.00	86.00	7.80	31.20
3.Concentrated Cow Urine (CCU)	54.00	78.60	38.92	29.40	54.40	86.56	8.00	32.00
4.Fresh Cow Urine (FCU)	46.00	78.00	38.88	29.20	53.80	85.92	7.80	30.80
5.Control	17.80	70.00	33.80	27.60	43.40	70.78	7.20	23.40
CD(P = 0.05) =	1.898	0.897	1.746	0.636	3.281	3.528	NS	2.377
CV (%) =	3.972	2.645	3.487	4.942	4.772	3.208	9.968	6.135

Table 2.

Treatment	Fresh shoot weight (gm) plant ⁻¹ at		Fresh root weight (gm) plant ⁻¹ at		Total fresh weight (gm) plant ⁻¹ at	
	25 DAS	50 DAS	25 DAS	50 DAS	25 DAS	50 DAS
1.Farm Yard Manure (FYM)	0.486	0.690	0.312	0.342	0.756	1.022
2.Urea	0.484	0.719	0.308	0.416	0.792	1.135
3.Concentrated Cow Urine (CCU)	0.490	0.756	0.317	0.444	0.807	1.194
4.Fresh Cow Urine (FCU)	0.464	0.728	0.313	0.417	0.776	1.192
5.Control	0.412	0.584	0.244	0.310	0.652	0.894
CD(P = 0.05) =	0.013	0.001	0.003	0.001	0.002	0.002
CV (%) =	2.503	0.118	0.001	0.167	0.190	1.022

Table 3.

Treatment	Shoot dry weight (gm) plant ⁻¹ at		Root dry weight (gm) plant ⁻¹ at		Total dry weight (gm) plant ⁻¹ at	
	25 DAS	50 DAS	25 DAS	50 DAS	25 DAS	50 DAS
1.Farm Yard Manure (FYM)	0.102	0.151	0.064	0.091	0.165	0.224
2.Urea	0.097	0.145	0.067	0.098	0.163	0.242
3.Concentrated Cow Urine (CCU)	0.100	0.155	0.073	0.108	0.174	0.264
4.Fresh Cow Urine (FCU)	0.090	0.145	0.063	0.098	0.152	0.248
5.Control	0.087	0.127	0.054	0.076	0.141	0.201
CD(P = 0.05) =	0.001	0.001	0.001	0.001	0.002	0.001
CV (%) =	0.787	0.448	1.034	0.689	0.933	0.401

Table 4.

Treatment	Spike length (cm)	Length of culm plant ⁻¹ (cm)	Effective tillers plant ⁻¹	Grain earhead ⁻¹ (spike)	100- grain weight (gm)	grain yield (gm) pot ⁻¹	Dry weight (gm) at Harvest
1.Farm Yard Manure (FYM)	12.04	72.84	1.678	58.80	5.000	17.200	2.257
2.Urea	12.32	74.50	1.716	59.40	5.400	18.822	2.254
3.Concentrated Cow Urine (CCU)	12.24	74.42	1.680	59.20	5.400	18.896	2.322
4.Fresh Cow Urine (FCU)	12.12	74.20	1.670	58.80	5.340	18.684	2.295
5.Control	9.12	61.66	1.476	40.80	3.860	13.876	2.068
CD(P = 0.05) =	0.36	1.556	0.018	1.841	0.179	1.107	0.234
CV (%) =	2.34	1.637	0.807	2.501	2.698	4.762	7.738

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