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Research Article

EFFECT OF COW URINE (*GOMUTRA*) AS A SOURCE OF NITROGEN ON GROWTH, YIELD AND NITROGEN UPTAKE IN RICE (*Oryza sativa* L.)

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Abstract- Rice (*Oryza Sativa* L.) is an important food crop. The demand for rice continues to increase owing to continued growth of population. It is predicted that a 50% to 60% increase in rice production will be required to meet demand by 2025 in India. Cow urine (*Gomutra*) is used for several centuries in different ways in many parts of the world. Cow urine contains nitrogen constituents in different amounts and may be used as source of nitrogen for plant nutrition. Hence, the present study was taken up to evaluate the effect of cow urine on growth yield and nutrient uptake of rice. Accordingly, a field experiment was conducted during kharif 2017at crop cafeteria of BHU- Krishi Vigyan Kendra, Institute of Agricultural Sciences, Rajiv Gandhi South campus, Barkachha, Mirzapur (Banaras Hindu University) in randomized block design taking rice variety Shusk Samrat as a test crop. The soil of the study region was red soil having pH 7.8, EC 0.67 dS m^{-1}, organic carbon 0.42%, available N 185.3, P 9.6, K 189 and S 9.4 kg $ha^{-1}$and available micronutrient Fe 32.6, Mn 18.6, Zn 2.26, Cu 2.1 and Boron 0.98 mg kg^{-1}. The experiment consisted of five treatments comprising T_1 (control- no input), T_2 (N at 120 kg ha^{-1}), T_3 (N at 150 kg ha^{-1}), T_4 (N at 120 kg ha^{-1} + cow urine) and T_5 (N at 100 kg ha^{-1}) taking four replications in randomized block design. Cow urine procured from same cow was applied weekly up to six weeks from the date of transplanting. The results of the study revealed that paddy crop favourably responded to different levels of nitrogen through fertilizer alone and in combination of cow urine. Plant growth (plant height, number of tiller) and yield (grain and straw) significantly increased as compared to control by the application of nitrogen. Application of N at 120 kg ha^{-1} + cow urine registered maximum dry matter production. Without cow urine, application of nitrogen at 150 kg ha^{-1} recorded higher yield than control and 120 kg ha^{-1} level. Nitrogen content in plant (grain and straw) and uptake were also found maximum when nitrogen was applied at 120 kg ha^{-1} + cow urine.

Key words- Rice, Cow urine

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Introduction

Rice (*Oryza sativa* L.) is a food crop in most of the part of the world; it is staple food for nearly half of the world's seven billion people and one of the widely cultivated consumer oriented crop in India. The demand for rice continues to increase owing to continued growth of population. It is predicted that a 50% to 60% increase in rice production will be required to meet demand from population by 2025 and speculated demand for five billion rice consumers by the year 2030 is to be met from available land and water resources [1].Chemical and organic sources and their management have shown promising results not only in sustaining the productivity but have also proved to be effective in maintaining soil health and enhancing nutrient use efficiency. Heavy use of chemicals in agriculture has deteriorated the ecological base on to degrading the soil, water resource and quality of the food. Therefore, it is very much essential to develop a strong workable and compatible package of nutrient management through organic sources for various crops based on scientific facts, local conditions and viability.

Nitrogen is a key input limiting rice production because, to produce one tone of rice grain, it takes up an average of 20 kg N ha^{-1} from the soil over the period of 3-5 months. For rice productivity to sustain at present levels, the nitrogen in harvested produce or lost from the system must be replaced by nitrogen fertilizers [2]. The nitrogen fertility status of a rice soil depends on total nitrogen content in the soil, nitrogen transformations and that influence on nitrogen absorption by rice roots. Since the amount of N that could be added through different organic sources alone is not sufficient to meet all the N requirement of rice, fertilizer N applied in conjunction with organic measures may be a better alternative than the sole inorganic or organic source. Cow urine (*Gomutra*) is used for several centuries in different ways in many parts of the world. The "Cow" occupies the highest place of honour in Indian civilization; it's five products used are urine, dung, ghee, milk and curd in different organic systems. Many farmers are reviewing age old practices of applying cow dung, cow urine, and their products in the form of manures and pesticides [3]. Cow urine contains nitrogen constituents in different amounts and may be used as source of nitrogen for plant nutrition. The cow urine contains 95% water, 2.5 % urea and other nutrientie. nitrogen, sulphur, phosphate, sodium, manganese, carbolic acid, iron, silicon, chlorine, salt, vitamins, enzyme, hormone, etc. It increases the microbial enzymal activities in soil, hence, it can be considered as bio-fertilizer for increasing soil fertility. In general, the total N content in cow urine is 6.8-21.1 g N $litre^{-1}$ of which about 69% is present as urea, 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 [4]. Hence, the present investigation was carried out to evaluate the effect of cow urine (*Gomutra*) as a source of nitrogen on growth, yield and nutrient uptake of rice (*Oryza sativa* L.).

Materials and Methods

Field experiment was conducted during kharif 2017 at crop cafeteria of BHU-

Krishi Vigyan Kendra, Institute of Agricultural Sciences, Rajiv Gandhi South campus, Barkachha, Mirzapur (Banaras Hindu University) in randomized block design taking rice variety Shusk Samrat as a test crop. The soils of the study area were red sandy clay having pH 7.8, EC 0.67 dS m^{-1}, organic carbon 0.42%, available N 185.3, P 9.6, K 189 and S 9.4 kg $ha^{-1}$and available micronutrient Fe 32.6, Mn 18.6 Zn 2.26, Cu 2.1 and Boron 0.98 mg kg^{-1}respectively. The experiment consisted of Five treatments comprising T_1 (control- no input), T_2 (N at 120 kg ha^{-1}), T_3 (N at 150 kg ha^{-1}), T_4 (N at 120 kg ha^{-1} + cow urine) and T_5 (N at 100 kg ha^{-1}) in four replications. Full doses of phosphorus (60 kg ha^{-1}) and potassium (60 kg ha^{-1}) and half dose of nitrogen were applied at the time of transplanting, after puddling through diammonium phosphate, muriate of potash and urea respectively. The remaining half dose of nitrogen was applied in two equal splits first at tillering stage and second at panicle initiation stage. Cow urine procured from same cow was applied weekly upto six weeks from the date of transplanting @ 500 ml $plot^{-1}$ (10 m^2) as per treatment.

Plant height and number of tillers from marked rows were recorded in each plot at different growth stages (30, 60, 90 days after transplanting and at harvesting stage). Five hills from the marked area were selected randomly and tagged in each replicate plot to record the height and tiller number. Soil samples were collected from surface soil (0 to 20 cm depth) with wooden tools to avoid any contamination at 45 days after transplanting and after harvesting of rice. Composite soil samples were air-dried, ground and passed through 2 mm sieve for chemical analysis. Soil pH and electrical conductivity (EC) were determined by glass electrode and direct reading conductivity meter using 1:2.5 soil water suspensions [5]. Available nitrogen content was determined using alkaline potassium permanganate method [6]. Nitrogen content in straw and grain was determined as per method prescribed by [7]. Available phosphorus in soil was determined by [8], available potassium in neutral ammonium acetate extractable method by flame photometer [9] and organic carbon [10].The important physical properties of experimental soil sand, silt, clay, bulk density and particle density was analyzed as per standard methods. The physical properties of experimental soil were sand (48%), Silt (50%) clay (47%) bulk density (1.366 Mgm^{-3}), particle density (2.217 Mgm^{-3}) respectively [Table-1].

Table-1 *Physico-chemical properties of the experimental soil.*

S. No.	Property		S. No.	Property	
1.	Sand %	53	10.	Organic Carbon (%)	0.42
2.	Silt %	6	11.	Available Nitrogen (kg^{-1})	185.3
3.	Clay %	41	12.	Available Phosphorus (kg^{-1})	9.6
4.	Bulk density (Mg m^{-3})	1.36	13.	Available potassium (kg^{-1})	189
5.	Particle density(Mg m^{-3})	2.21	14.	Available Fe (mg kg^{-1})	32.6
6.	Soil colour	Red	15.	Available Mn (mg kg^{-1})	18.6
7.	Soil Texture	Sandy clay	16.	Available Zn (mg kg^{-1})	2.26
8.	pH (1:2.5 Soil: water suspension)	7.1	17.	Available Cu (mg kg^{-1})	2.1
9.	Electrical Conductivity (dSm^{-1})	0.67	18.	Available Boron (mg kg^{-1})	0.98

Results

Growth and Yield Attributing Characters

All parameters of the growth and yield of rice plant like plant height, number of tillers, grain and straw yield were significantly increased as compared to control. The data presented in [Table-2] revealed that the application of N and cow urine under different combination showed significant improvement in plant height and number of tillers as compared to control (T_1).

The treatment $T_4$was found to be superior over other treatments. Maximum grain (37.55 q ha^{-1}) and straw yield (60.20 q ha^{-1}) of rice were recorded in the treatment T_4followed by T_3, T_2, T_1 and T_5. Minimum yield was observed in case of T_1 (control, no input).

Table-2 *Effect of cow urine and nitrogen doses on plant height, number of tillers, grain and straw yield of rice*

Treatment	Plant height (cm)				Number of tillers $plant^{-1}$				Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
	30 DAT*	60 DAT	90 DAT	At Harvest	30 DAT	60 DAT	90 DAT	At Harvest		
T_1	51.58	69.59	94.52	101.36	9.35	69.59	94.52	9.52	9.475	18.67
T_2	60.11	79.28	98.30	104.37	15.35	79.28	98.30	16.22	21.55	42.52
T_3	62.51	84.41	100.32	105.11	16.50	84.41	100.32	18.37	27.68	48.32
T_4	63.38	86.32	105.38	110.37	20.35	86.32	105.38	20.65	37.55	60.20
T_5	62.53	84.71	102.41	107.33	17.52	84.71	102.41	18.55	31.38	52.62
SEm±	0.598	0.150	0.072	0.192	0.110	0.150	0.072	0.113	0.090	0.123
CD(P=0.05)	1.845	0.462	0.224	0.592	0.341	0.462	0.224	0.349	0.280	0.379
*DAT= Days after transplanting SEm = Standard Error Mean CD= Critical Difference										

Nutrient Content Grain and Straw

Application of nitrogen through chemical fertilizer and conjunctive use of cow urine respectively increased the nitrogen content in grain and straw over control. Maximum nitrogen content in straw was found with the treatment T_4 (0.61 %) followed by T_3, T_2, and T_5 and minimum was in the treatment T_1 (control). Similar trend was also recorded in case of nitrogen content in grain. The overall treatments effect was found to be significant at 5% level of significance (p=0.05). Maximum N content in grain was obtained with treatment T_4 (1.22 %) and minimum in control (0.94%). Treatment T_4 was found to be significantly superior over other treatments. The available nitrogen content of soil [Table-3] was significantly affected by different treatments at both the stages of soil sampling. The treatment T_4 registered maximum available nitrogen content followed by T_5, T_3andT_2. The minimum available nitrogen content in soil was recorded with the treatment T_1 (control). The overall treatment effect was found to be significant (p=0.05) at both stages of soil sampling. The available nitrogen content of soil was ranged from 163.35 to 215.52 and 150.45 to 212.45 kg ha^{-1}at 45 days after transplanting (DAT) and after harvesting, respectively. Available nitrogen status of soil was increased by the application of nitrogen in different combination as compared to initial status (185.3 kg ha^{-1}). Highest nitrogen content increase was recorded by T_4.

Nutrient Uptake of nitrogen

Application of nitrogen through chemical fertilizer and conjunctive use of cow urine respectively increased the nutrient uptake of nitrogen grain and straw over control. Maximum nutrient uptake of nitrogen grain was found with the treatment T_4 (48.73kg ha^{-1}) followed by T_5, T_3, and T_2 and minimum was in the treatment T_1 (control). Similar trend was also recorded in case of nutrient uptake in rice straw.Collectiveuse of nitrogen and cow urine in rice crop significantly increased nitrogen uptake which directly affects the yields [Table-2 and 3]. The highest uptake (kg ha^{-1}) of nitrogen was recorded in the treatment T_4 (87.58) followed by T_5 (69.70), T_3 (61.52), T_2 (52.17) and T_1 (15.53) where, minimum was in the treatment T_1 (control) respectively. Results shows that total nutrient uptake of

Nitrogen [Table-3] had increasing trend with physiological maturity of rice.

Table-3 *Effect of cow urine and nitrogen doses on soil N, plant N and uptake of N*

Treatment	Soil N (kg ha^{-1})		Plant N (%)		Uptake (kg ha^{-1})		Total uptake (kg ha^{-1})
	45 DAT*	At harvest	Grain	Straw	Grain	Straw	
T_1	163.35	150.45	0.94	0.30	9.17	5.63	15.53
T_2	207.57	203.80	1.13	0.51	26.22	24.28	52.17
T_3	213.55	202.45	1.16	0.54	32.44	27.49	61.52
T_4	215.52	212.55	1.22	0.61	48.73	37.41	87.58
T_5	210.42	201.40	1.15	0.55	37.59	30.41	69.70
SEm±	0.089	0.149	0.008	0.006	0.103	0.109	0.082
CD(P=0.05)	0.275	0.460	0.027	0.021	0.317	0.338	0.254
***DAT= Days* after transplanting SEm = Standard Error Mean CD= Critical Difference**							

Discussion

Increasing population and reducing the cultivated area has created stress on soil vis- a vis rice cultivation. In this experiment, there is enormous variation in grain yield and nutrient uptake in various treatments. The use of cow urine can increase the enzymatic activity and alleviate micronutrient deficiency in the soil. Cow urine was further effective in increasing the growth and yield with nitrogen levels supplied through urea. The increased growth and dry matter is produced due to efficient availability of nitrogen and its ultimate uptake and translocation to the different parts of plants where the nitrogen is highly needed. Many research workers have also reported that the cow urine is the effective source of nitrogen. Phyto-chemical investigation of cow urine sample and medicinal plant extracts positively prove the presence of active phyto constituents like alkaloids, anthraquinones, flavonoids, tannins and saponins; which are the main constituents promoting antimicrobial activity [11]. Significant positive response due to application of nitrogen in respect of growth and yield of paddy were also reported [12]. The application of nitrogen and cow urine on paddy crop, increased plant height, plant tiller, nutrient content and nutrient uptake as compared to control [13]. The combinations of cow urine and plant parts and neem-based commercial products have shown significant synergistic effect to enhance product toxicity resulting in pest mortality [14]. So, for as effect of cow urine is concerned it has been reported that the application of cow urine accelerates the different aspects of growth in several crops like maize, rice, mustard, lettuce [15].

The cow urine caused a large increase in rye grass yield, entirely due to its N component. Highest N content in grain and straw as well as uptake was also recorded with T_3 (NPK 120:60:60 kg ha^{-1} + cow urine) [16]. This is probably due to higher availability of N through T_3, so, plant might be able to take the more nitrogen. The uptake is the product of dry matter yield and content and this increased due to higher dry matter yield. Increase in total nitrogen, available phosphorus, Ca, Mg, organic carbon, pH, exchangeable K and Na were obtained under human and cattle urine treatments as compared to control in maize cultivation [17]. The availability of nitrogen in soil depends upon the amount and nature of nitrogenous source, soil characteristics and interaction with the other nutrient present in the soil. The effect of different levels of nitrogen through chemical source alone and in combination of cow urine significantly increased the availability of nitrogen at all stages of crop growth. It is clear that the availability of nitrogen increases with advancing stage of crop growth. Highest availability was recorded with T_4 (N at 120 kg ha^{-1} + cow urine). This is probably due to high level of applied nitrogen supplemented by N from cow urine. Effect of cow urine application has shown favourable effect for enhancing the productivity of different agricultural crops *viz*. maize, mustard and rice etc [3].

Conclusion

In the present study soil application of cow urine (1:10 Cow urine: water ratio) increased the growth and yield of crops. The treatment supplied with 120 kg N along with cow urine showed higher grain and straw yield compared to that obtained through 150 kg N. Also, the treatment in which cow urine was applied showed higher N uptake in grain and straw. Hence, cow urine can be an effective input to improve the nutritional quality of the food grain and fodder also.

Application of research: India is a country of villages and cattle are being domesticated traditionally with the largest cattle population in world. But, because of mis-management and poor handling practices the cow urine is not utilized and losses of N through volatilization occur in the cattle shed. There is an immense scope in increasing the utilization of cow urine in field.

Research Category: Cow urine (*Gomutra*)

Abbreviations: EC: electrical conductivity

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