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Effect of Foliar Spraying of Cow Urine Based Derivatives in Combination with RDF on Growth and Yield of Rice

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Abstract **– Rice (*Oryzae sativa*) is a staple food crop in India. Rice play a vital role in food security. Cow urine is rich source of nutrients (especially nitrogen and potassium) enhance the growth of crops. Accordingly, a field experiment was conducted during 2018-2019 at Rajagoplapuram village in farmer's holding, Mayiladuthurai district, Tamilnadu, to study the growth, yield attributes and yield of rice as influenced by foliar spraying of cow urine based derivatives in combination with RDF in sandy loam soil. The experiment was laid out in randomized block design. The experiment consisted seven treatments. T_1 - NPK (RDF + water spray), T_2 - NPK + foliar spray of CUD @5% (SS), T_3- NPK + foliar spray of CUD @10% (SS), T_4 - NPK + foliar spray of CUD @ 15% (SS), T_5- NPK + foliar spray of CUD @5% (DS), T_6 - NPK + foliar spray of CUD @10% (DS), T_7 - NPK + foliar spray of CUD @15% (DS). The 100 per cent recommended dose of inorganic NPK fertilizers were applied uniformly to all plots. The results revealed that foliar application of cow urine based derivatives as single or double spray significantly increased the growth attributes, yield attributes and yield of rice. Regarding growth attributes viz., plant height, number of tillers, leaf length, leaf breadth and yield attributes viz., number of panicles m^{-2}, number of grains $panicle^{-1}$, panicle length and number of filled grains $panicle^{-1}$ and the maximum values were recorded with foliar application of 10% cow urine based derivatives at tillering stage but this was found to be on par with 15% single and double spray of CUD. The maximum grain yield 3917 kg ha^{-1} was recorded with foliar application of 10% (Single spray) of CUD and significantly superior to rest of the treatments. The control (RDF + water spray) registered lowest grain yield of 1883 kg ha^{-1}.**

Keywords **– Cow Urine Based Derivatives, Inorganic NPK Fertilizers, Growth, Grain Yield, Rice.**

I. INTRODUCTION

Rice (*Oryza sativa* L.), is a staple food crop in India. Rice play vital role in food security and it is means of livelihood of millions of people making a slogan "Rice is life" most appropriate. Globally, the highest area under rice in India (43.86 million hectare) and stood second position in production (104.80 million tons) after china (144.85 million tons) with an average productivity of 3.77 t ha^{-1} [1]. Within the country, rice occupies one quarter of the total cropped area, which contributes about 40-43 per cent of total food grain produced; is a source of livelihood for millions of Indians and also earn foreign exchange worth 12,000 crores [15]. The fourth largest rice producing state in the country is Tamil Nadu which produced about 7.98 million tons of rice during 2015-2016. The area on which rice was cultivated in the state amounted to 2.04 million hectares. The national food security heavily depends on rice.

India is primarily agrarian, and this sector provides livelihood to a major part of the population. To feed the 1.3 billion population of the country, increasing tremendously approximately at 1.2% every year, the food grain production need to be increased correspondingly, towards attaining this goal, there is requirement of higher doses of fertilizers, which require non-renewable energy. In the same time, declining factor productivity owing to imbalanced and indiscriminate use of fertilizers in most productive zone of the country i.e. Indo Gangetic

Plains, food grain production in India reached to the plateau. In recent days farmers facing many problems like - insufficient fertilizer for cost variation of petroleum products (Naphtha), insufficient level of good quality of seed in this fast growing agriculture many companies were produce many types of seed but quality of seed was questioned, insufficient labour, lack of technology and deficit equipment. The major crises of nitrogen fertilizers demanding and pay higher amount of money farmer community fully. These fertilizers were produce soil infertility, salinity and agricultural plantation totally suffered. They were creating major crises affected to day to day life of farmer. Thus, the importance of organic sources of nutrients was recognized in current scenario in order to get higher yield without disturbing soil health [2].

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 [12]. Cattle urine is a good source of nitrogen, phosphate, potassium, calcium, magnesium, chlorite and sulphate. It contains 95% water, 2.5% urea, 2.5% others (mineral salts, hormones and enzymes). 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 [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 [5]. Application of cow urine has been reported to have a favorable impact, for enhancing productivity of different crops viz., mustard, maize and rice etc.

II. MATERIALS AND METHODS

A field experiment was carried out at Rajagoplapuram village in farmers' holding, Mayiladuthurai district, Tamilnadu to find out the effect of foliar spraying of cow urine based derivatives in combination with RDF on growth and yield of rice variety white ponni, as the test crop under irrigated condition during the year 2019. The experimental soil was sandy loam in texture with pH 7.25, EC 0.15 dSm^{-1}, organic carbon 3.4 g kg^{-1}. The available N, P_2O_5 and K_2O contents were 282.8, 23.4 and 267.6 respectively. The experiment was laid out in randomized block design with seven treatments. The 100 per cent recommended dose of inorganic NPK fertilizers were applied uniformly to all plots. Different levels of cow urine based derivatives was applied based

on the treatment schedule. The treatment details include, T1- NPK (RDF + water spray), T2- NPK + foliar spray of CUD @5% (SS), T3- NPK + foliar spray of CUD @10% (SS), T4- NPK + foliar spray of CUD @ 15% (SS), T5- NPK + foliar spray of CUD @5% (DS), T6- NPK + foliar spray of CUD @10% (DS), T7- NPK + foliar spray of CUD @15% (DS). The growth attributes were recorded at different growth stages of rice. The yield attributes and yield were recorded at harvest period.

III. RESULTS AND DISCUSSION

Foliar spray of different concentrations of cow urine derivatives as single or double spray gradually increased the growth attributes, yield attributes and yield of rice var White ponni.

Table 1. Effect of cow urine derivatives on plant height, LAI, tiller count and chlorophyll.

Treatments	Plant Height			Number of Tiller Hill^{-1}			LAI		Chlorophyll Content (SPAD)	
	Tillering Stage	Panicle Initiation	Harvest Stage	Tillering Stage	Panicle Initiation	Harvest Stage	Tillering Stage	Panicle Initiation	Tillering Stage	Panicle Initiation
T_1 – RDF + Control (Water spray.)	61.8	80.4	108.1	13.9	15.5	12.40	2.5	3.6	31.0	33.0
T_2 – RDF + foliar spray of CUD (5%) @SS	63.1	85.5	111.5	15.3	17.1	13.80	2.8	4.0	31.8	34.9
T_3 – RDF + foliar spray of CUD (10%) @SS	66.2	89.4	114.7	16.6	18.7	14.70	3.8	4.7	34.0	36.8
T_4 – RDF + foliar spray of CUD (15%) @SS	65.4	86.1	112.3	15.7	17.4	13.30	3.4	4.5	33.2	35.9
T_5 - RDF + foliar spray of CUD (5%) @DS	63.3	86.9	112.9	16.4	18.2	14.30	3.0	4.2	32.8	35.1
T_6 - RDF + foliar spray of CUD (10%) @DS	69.2	90.7	115.0	15.9	17.9	13.60	3.2	4.4	33.0	35.8
T_7 - RDF + foliar spray of CUD (15%) @DS	65.5	88.5	113.5	16.9	19.1	14.90	2.9	3.9	32.3	34.9
SE_d	1.19	1.58	2.02	0.29	0.26	0.28	0.06	0.08	0.58	0.69
CD @ 5%	2.59	3.45	4.42	0.64	0.57	0.62	0.14	0.17	1.28	1.52

SS-Single spray at TS, DS-Double spray at TS and PI.

Growth Attributes (Table 1)

The foliar application of cow urine based derivatives along with inorganic NPK fertilizers were influenced the all growth stages of rice. The plant height was significantly increased from 69.2, 90.7 and 115.0 (cm) at tillering stage, panicle initiations and at harvest respectively with the application of cow urine derivatives at double spray of 10%. This is on par with application of CUD at single spray of 10%. The lowest was observed in control. The application of cow urine derivatives significantly influenced the number of tillers/hill of paddy. The maximum number of tillers/hill 16.9, 19.1 and 14.9 were recorded at tillering stage, panicle initiations and at harvest stage, respectively in the treatment T_7 (CUD @ 15% DS). It is on par with application of CUD @ 10% single spray

and the lowest values of 13.9, 15.5 and 12.40 were recorded at tillering stage, panicle initiations and at harvest stage, respectively were observed in control. With regard to leaf area index, they was significantly influenced by the foliar application of CUD.

The highest leaf area index 3.8 and 4.7 were recorded at tillering stage and panicle initiations respectively in the foliar application of CUD @ single spray of 10% and this is on par with foliar application of CUD @ single spray of 15% (3.4 and 4.5 were recorded at tillering stage and panicle initiations, respectively).

The highest chlorophyll content 34.0 and 36.8 (SPAD) were recorded at tillering stage and panicle initiations, respectively in the foliar application of CUD @ single spray of 10% and this is on par with foliar application of CUD @ single spray of 15%. The values are 33.2 and 35.9 were recorded at tillering stage and panicle initiations, respectively. The lowest chlorophyll content was observed in control in all stages of white ponni. The lowest chlorophyll content 31.0 and 33.0 were recorded at tillering stage and panicle initiations, respectively were recorded. This suggest that foliar application of 10% single pray is enough to increase the growth attributes and thereafter there was significant increase.

The increased growth components with cow urine derivatives foliar application might be attributed to increased carbohydrate accumulation, cell enlargement, translocation of solute, chlorophyll synthesis and enhanced photosynthesis activity due to supply nitrogen and other major, secondary and micro nutrients from cow urine derivatives. The present findings on the significant impact of cow urine derivatives on growth parameters studied in banana and rice was confirmed by previous researchers [3, 13, 9, 11].

Table 2. Effect of cow urine derivatives on yield attributes of rice var. White ponni.

Treatment	Number of Panicles m^{-2}	Number of Grains $Panicle^{-1}$	Panicle Length (cm)	1000 Grain Weight (g)	Number of Filled Grains $Panicle^{-1}$
T_1 – RDF + Control (Water spray.)	256	72	16.0	16.93	66
T_2 – RDF + foliar spray of CUD (5%)@SS	285	88	16.5	17.00	70
T_3 – RDF + foliar spray of CUD (10%)@SS	315	117	17.8	17.82	108
T_4 – RDF + foliar spray of CUD (15%)@SS	300	100	17.1	17.62	93
T_5 - RDF + foliar spray of CUD (5%)@DS	305	103	16.9	17.34	85
T_6 - RDF + foliar spray of CUD (10%)@DS	293	110	16. 6	17.08	100
T_7 - RDF + foliar spray of CUD (15%)@DS	287	92	16.4	17.40	90
SE_d	4.58	1.55	0.19	0.39	2.00
CD @ 5%	9.98	3.39	0.42	NS	4.36

SS- Single spray at TS, DS- Double spray at TS and PI.

Yield Attributes (Table 2)

Foliar spray of different concentrations of cow urine derivatives as single or double spray caused a significant increase in yield attributes of white ponni over control at harvest stage. All the parameters increased linearly and the maximum value was recorded with rice plants which received single spray of 10% CUD compared to other treatment combinations. The best treatment caused 21% (number of panicles m^{-2}), 62.5% (number of grains

panicle^{-1}), 63.6% (number of filled grains panicle^{-1}) and 11.25% (panicle length) over control. Foliar feeding of major nutrients like N, P, K to the plants through cow urine. When nutrients required by plants are applied through foliage, there is enhancement in uptake, translocation and synthesis of photosynthetic assimilates which results into increase in various plant growth characters such as plant height, number of tillers hill^{-1}, leaf area and total dry matter which ultimately leads to extend in yield attributes like number of panicles m$^{-2,}$ number of grains panicle^{-1} and panicle length in rice. The results are in close conformity with the findings of [4, 14, 13, 10, 11].

Table 3. Effect of cow urine based derivatives on rice yield var. white ponni.

Treatment	Grain Yield (kgha^{-1})	Per cent Increase Over control	Straw Yield (kgha^{-1})	Per Cent Increase Over Control
T_1 – RDF + Control (Water spray.)	1883	-	2252	-
T_2 – RDF + foliar spray of CUD (5%)@SS	2135	13.4	3167	40.6
T_3 – RDF + foliar spray of CUD (10%)@SS	3917	108.1	4250	88.7
T_4 – RDF + foliar spray of CUD (15%)@SS	2600	38.1	3667	62.8
T_5 - RDF + foliar spray of CUD (5%)@DS	2917	54.9	4083	81.3
T_6 - RDF + foliar spray of CUD (10%)@DS	2250	19.5	3917	73.9
T_7 - RDF + foliar spray of CUD (15%)@DS	2533	34.5	5067	125
SE_d	177		173.	
CD @ 5%	386		378	

SS- Single spray at TS, DS- Double spray at TS and PI.

Rice Yield (Table 3)

Foliar spray of different concentrations of cow urine derivatives as single or double spray caused a significant increase in grain and straw yield of white ponni over control. There was significant variation in improving the grain yield between concentrations and time of spray. Grain yield increased with concentrations and the maximum grain yield was noticed at 10 % spray at tillering stage (3917 kg ha^{-1}) and decreased at 15% spray. Foliar spray of cow urine derivatives twice at tillering and panicle initiation did not go well in improving the grain yield except at 5% spray. The per cent increase in grain yield due to different treatments ranged from 13.4 to 108.1. The maximum straw yield was noticed with foliar spray of cow urine derivatives at 15% sprayed at tillering and panicle initiation stages (5067 kg ha^{-1}) and significantly superior rest of the treatments. The percent increase in straw yield due to different treatments ranged from 40.6 to 125 over control. Unlike grain yield, straw yield increased with time of spray. Double spray at tillering and panicle initiation stages with 5 and 15% increased the straw yield from 40.6 to 81.3 % and 62.8 to 125% respectively compare to single spray. However double spray at 10% decreased the straw yield from 88.7 to 73.9% compared to single spray.

Grain yield depends on the synthesis and accumulation of photosynthates and their distribution among various plant parts. The synthesis, accumulation and translocation of photosynthates depends upon the efficient photosynthetic structure as well as the extent of translocation into sink (grains). The production and translocation of synthesized photosynthates depends upon mineral nutrition supplied by foliar application of cow urine derivatives.

As nitrogen and potassium both are involved in protein synthesis and K helps within the translocation of photosynthates to sink, under adequate urine supply, there would have been greater translocation of photosynthates from source to sink leading thereby to production of higher number of panicle with more number of filled grains. Higher straw yield shows that at higher levels of urine application, the translocation of photosynthates to the sink (grain) was not efficient that favored more to the straw production than grain. The results are in agreement with the findings of [8, 12, 6, 13, 10, 11].

IV. CONCLUSION

The study has clearly underlined the significance of using foliar application of cow urine based derivatives along with recommended dose of inorganic NPK fertilizers in realization of maximum rice yield and use efficiency. The study has demonstrated that foliar spray of cow urine derivatives at 10% at tillering stage with RDF recorded the maximum growth and yield of rice.

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