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Effect of distillery waste and inorganic fertilizers on dry matter production and nutrient uptake of rice

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Abstract
A field study aimed to evolve integrated nutrient management for improving growth and uptake of rice var. MTU-1010 was conducted on sandy loam soil during *kharif* season of 2015 at college farm, College of Agriculture, Rajendranagar, Hyderabad, PJTSAU, India. The results revealed that application of 100% NPK (T_2) through inorganic fertilizers resulted in higher dry matter production and higher N, P and K uptake which was followed by integration of distillery waste i.e. Godavari Kash @ 4 bags + 50% recommended dose of NPK (T_8) which helped in reducing 50% recommended dose of N and P, in particular muriate of potash and also expenditure incurred on chemical fertilizers.

Keywords: Dry matter production, nutrient uptake, distillery waste, recommended dose of NPK

Introduction
Rice (*Oryza sativa* L.) is the most important food crop of India and is a major energy source for about 60 per cent of the world population. The primary purpose of the cultivation of rice is used as food for humans as the nutritional value is high because of the rice grain contain a high percentage of carbohydrates. Rapid degradation of rice ecologies due to imbalanced use of fertilizers has put tremendous pressure on the rice growers to make rice farming economically viable and ecologically sustainable (Basha and Basvarajappa., 2015) [2]. It is the major source of calories for 40 percent of the world population (Virdia and Mehta, 2009) [10]. The use of inorganic fertilizer to sustain cropping was found to increase yield only for some few years but on long-term, it has not be effective and leads to soil degradation (Satyanarayana *et al*., 2002) [6]. On the other hand, continuous application of organic fertilizer alone on rice field resulting low yield and low N and K content at the mid-tillering stage of rice plant (Javier *et al*., 2004) [4]. This implies that the need of integrated nutrient management for rice production. Compost is rich source of nutrients with high organic matter content and use of compost can be beneficial to improve organic matter status. Physical and chemical properties of soil can be improved by using compost, which may ultimately increase crop yields (Sarwar *et al*., 2008) [7]. The end product of the degradable waste (compost) is consumed by agriculture since it contains sufficient amounts of plant nutrients, including most of the micro-elements. If it is properly managed it could be a valuable resource and alternative for the imported and expensive mineral fertilizers. Hence, the present study was taken up to evaluate the response of distillery waste and inorganic fertilizers on dry matter production and nutrient uptake of rice.

Materials and method
A field experiment was conducted during *kharif* season 2015 at College Farm, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar which is geographically situated at 17º19^1 N latitude, 78º 28^1 E longitude at an altitude of 542.3 m above mean sea level. The soil of the experimental field was sandy loam soil. The soil nutrient status was low in organic carbon (0.41%) and nitrogen (196.52 kg ha^{-1}) and medium in P_2O_5 (28 kg ha^{-1}) and K_2O (160.72 kg ha^{-1}). The field experiment was conducted using rice variety MTU-1010 with duration of 120 days. The experimental was laid out in Randomized block design with three replications. All the treatments were allotted at random to plots within each replication. The experiment consisted of eight treatments *i.e* T_1 : Control, T_2 : 100% NPK- Recommended dose of fertilizers, T_3: Godavari Kash @ 2 bags ha^{-1}, T_4: Godavari Kash @ 3 bags ha^{-1}, T_5: Godavari Kash @ 4 bags ha^{-1}, T_6: 50% NPK + Godavari Kash @ 2 bags ha^{-1}, T_7: 50% NPK + Godavari Kash @ 3 bags ha^{-1} and T_8: 50% NPK + Godavari Kash @ 4 bags ha^{-1}. The field was puddled by tractor drawn puddler in presence of standing water followed by levelling. The planting was done with a rice cultivar, MTU-1010 at a spacing of 20 cm × 10 cm. Recommended dose of fertilizers @ 120:60:60 kg ha^{-1} of N & P was applied through

inorganic sources as a uniform and common dose while K in the form of distillery waste i.e. Godavari kash @ 4 bags, 3 bags, 2 bags ha^{-1} applied one week before transplanting and top dressing at tillering and panicle initiation to respective treatments. The distillery waste used in the study was analysed before application and nutrient status is presented in table 1. The experimental data thus collected during the course of investigation were statistically analyzed by applying the technique of analysis of variance for randomized block design and significance was tested by F-test (Snedecor and Cochran, 1967) [9]. Critical difference for examining treatment means for their significance was calculated at 5 per cent level of probability.

Table 1: Chemical components in the distillery waste

Moisture content (%)	**13.70**
Colour	Grey
C/N ratio	7.10
Nitrogen (%)	0.05
Phosphorus (%)	0.18
Potassium (%)	14.60
Calcium (%)	2.40
Magnesium (%)	2.60
Sulphur (mg/kg)	3.20
Copper (mg/kg)	56.50
Zinc(mg/kg)	35.80
Nickel (mg/kg)	19.4
Lead (mg/kg)	<1.00
Mercury (mg.kg)	<1.00
Cadmium (mg.kg)	2.30
Chromium (mg.kg)	36.6

Results and discussion

Dry matter production

The data regarding dry matter production are presented in table 2. It was observed that significantly higher dry matter production was recorded with 100% NPK- Recommended dose of fertilizers followed by 50% NPK + Godavari Kash @ 4 bags ha^{-1} at tillering and harvest stage. Synchronized availability of sufficient quantity of essential nutrients through inorganic fertilizers had markedly improved the dry matter production. In the integrated treatment basal and split application of compost at tillering and panicle initiation had resulted in the addition of nutrients to the available soil pool, thereby facilitating higher nutrient uptake. Thus integration of compost and chemicals offer more balanced nutrients to the plants especially macro and micro nutrient which positively influence the plant biomass system. Similar results were reported by Dada *et al.* (2014) [3] and Kavitha and Subramanian (2007) [6].

Table 2: Dry matter production of paddy at tillering and harvest stage as influenced by distillery waste and inorganic fertilizers

Treatments	**Dry matter production (kg ha^{-1})**	
	Tillering	**Harvest**
T_1: Control	1079	3804
T_2 : 100% NPK	4556	13800
T_3 : GK @ 2 bags ha^{-1}	1591	4943
T_4 : GK @ 3 bags ha^{-1}	1796	5655
T_5 : GK @ 4 bags ha^{-1}	2048	6470
T_6 : 50% NPK + GK @ 2 bags ha^{-1}	2527	7870
T_7 : 50% NPK + GK @ 3 bags ha^{-1}	3033	9476
T_8 : 50% NPK + GK @ 4 bags ha^{-1}	3466	10550
SE m ±	96	241.36
CD (P=0.05)	282	713.36

Nutrient uptake

The N, P and K uptake increased with the growth stages. The N, P and K uptake in rice straw at tillering and harvest is presented in the table 5 and table 6. A significantly highest nitrogen uptake was recorded in the treatment comprised of 100 % NPK followed by 50% NPK + Godavari Kash @ 4 bags ha^{-1} and 50% NPK + Godavari Kash @ 3 bags ha^{-1}.The increase in nutrient uptakes due to inorganic fertilizers might be due to added supply of nutrients and proliferous root system developed under balanced nutrient management resulting in better absorption of nutrients. In the distillery waste + 50% N P K treatments the organic matter after decomposition increased the nutrient release directly through organic and inorganic sources to the crop as well as indirectly reducing the nutrient loss from soil solution which in turn resulted in better growth, higher biological yield and more nutrient uptake. Similar results were reported by Balasubramanian *et al*. (2002) [1] and Hajna *et al.* (1992) [4].

Table 3: N, P and K uptake (kg ha$^{-1)}$ of paddy at tillering stage as influenced by distillery waste and inorganic fertilizers

Treatments	**Nutrient Uptake (kg ha^{-1})**		
	N	P	K
T_1: Control	11.66	0.37	19.12
T2 : 100% NPK	44.75	3.42	54.06
T_3 : Godavari Kash @ 2 bags ha^{-1}	15.45	0.85	25.62
T_4 : Godavari Kash @ 3 bags ha^{-1}	19.63	1.13	32.0
T_5 : Godavari Kash @ 4 bags ha^{-1}	23.09	1.36	36.23
T_6 : 50% NPK + Godavari Kash @ 2 bags ha^{-1}	28.40	1.61	40.48
T_7 : 50% NPK + Godavari Kash @ 3 bags ha^{-1}	32.41	1.82	44.59
T_8 : 50% NPK + Godavari Kash @ 4 bags ha^{-1}	37.17	2.35	49.02
SE m ±	1.16	0.07	1.28
CD (P=0.05)	3.36	0.2	3.57

Table 4: N, P and K uptake (kg ha^{-1}) of paddy at harvest stage as influenced by distillery waste and inorganic fertilizers.

Treatments	Nutrient Uptake (kg ha^{-1})		
	N	P	K
T_1: Control	42.10	1.41	56.66
T2 : 100% NPK	153.12	9.49	187.88
T_3 : Godavari Kash @ 2 bags ha^{-1}	55.55	2.87	79.47
T_4 : Godavari Kash @ 3 bags ha^{-1}	73.34	3.35	96.90
T_5 : Godavari Kash @ 4 bags ha^{-1}	92.17	3.91	111.32
T_6 : 50% NPK + Godavari Kash @ 2 bags ha^{-1}	104.77	4.73	127.08
T_7 : 50% NPK + Godavari Kash @ 3 bags ha^{-1}	121.30	5.66	144.08
T_8 : 50% NPK + Godavari Kash @ bags ha^{-1}	137.10	6.99	159.43
SE m ±	3.99	0.17	4.65
CD (P=0.05)	11.70	0.47	13.5

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