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Influence of different doses of fertilizers and foliar spray of nutrients on yield and yield attributes of rice

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ABSTRACT

A field investigation was carried out at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University during January - April (2019) to study the effect of different doses of inorganic fertilizer and organic foliar nutrition on productivity enhancement of rice. The results of the experiment showed that application of 100 % RDF in main plot registered significantly improved yield and yield attributes of rice. Among the foliar nutrition in the sub plots, foliar application of 2% humic acid at panicle initiation and flowering significantly increased the yield and yield attributes of rice.Regarding the interactions, M_3S_2 - application of 100% RDF along with foliar spray of 2% Humic acid at panicle initiation and flowering excelled all other treatments by recording higher yield and yield attributes during the cropping period. The least growth and yield parameters were recorded in application of50% RDF along with control (M_1S_5).

Key Words : RDF, 2% humic acid foliar spray, yield attributes and yield

INTRODUCTION :

Agriculture plays a crucial role in our Indian economy. It is the backbone of our economic system and considered as the primary occupation in the globe. Rice (*Oryza sativa L.*) is a principal source of food for more than half of the world population and more than 90 % of rice grown in the world is consumed in Asia (Amutha *et al.,* 2009). Among all crops, rice being the major staple food extensively cultivated in India. Rice is the most predominant ancient crop, which is cultivated in 117 countries and about 90 per cent of total rice is grown and consumed in Asian countries (Seema *et al.,* 2014). As per Global Market Analysis 2018-19, Rice is cultivated worldwide in an area of 162.41 million ha^{-1} with the production of 496.46 million tonnes, having the productivity of 4.56 tonnes ha^{-1}. In India, rice grown about 44.16 million hectares having the annual production of 116.48 million tonnes with the productivity of 3.96 tonnes ha^{-1} (USDA, 2019). Use of chemical fertilizers alone does not sustain the productivity under continuous intensive cropping, but inclusion of organic materials improves the soil physical properties, builds up soil fertility and increase the crop yields. Applying combination of organic and inorganic fertilizers is preferred to articulate for the crop production. Several research studies showed beyond doubt that the complementary use of inorganic sources and organic sources of plant nutrients can improve the soil health and sustain the crop yield. Moreover recent years there has been severe concern about long term contrary effect of uninterrupted and undifferentiating use of inorganic fertilizers on detoriation of soil health, soil structure and environmental pollution (Zaller, 2007). The low yield is attributed to several reasons *viz*., poor nutrition management practices and low yield potential of varieties. In addition to that the lack of nutrients during the critical stages of crop growth leads to nutrient stress, which leads to poor yield and productivity of the crop. A suitable combination of organic and inorganic sources of nutrient is necessary for sustainable crop yield. Judicious use of fertilizer and liquid organic manures as one of the important strategies for increasing the production of rice per unit area. Liquid organic manures can help

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to maintain optimum crop yield by maintaining the soil fertility status of the soil. With this background, the present investigation was undertaken to find out different doses of fertilizers and foliar nutrition on improvement of yield in rice

MATERIALS AND METHODS:

Field experiment was conducted at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University during Navarai (January to April 2019) to find out the effect of graded dose of fertilizer and organic foliar nutrition on rice. Experiment was laid out in split plot design with three replications using variety CO - 47 as the test crop. The Experimental Farm is geographically situated at 11° 24' North Latitude and 79° 44' East Longitude and with an altitude of + 5.79 m above mean sea level. The Experimental Farm is characterized by tropical climate with a mean annual rainfall of 1500 mm. The soils of the experimental field was clay loam. The soil was low in available nitrogen, medium in available phosphorous and high in available potassium.The treatment includes, different methods of sowing *viz*., M_1 -50% RDF, M_2 -75% RDF, M_3 – 100% RDF and five sub plot treatments *viz.*,S_1 - Foliar application of 0.35 % Auxin Gold Sea weed extract at panicle initiation and flowering stage, S_2 - Foliar application of 2% Humic acid at panicle initiation and flowering stage, S_3 - Foliar application of 3% Panchagavya at panicle initiation and flowering stage, S_4 - Foliar application of 2% Vermiwash at panicle initiation and flowering stage and S_5 - Control. Twenty one day rice seedlings were transplanted in 5x4m plots with a spacing of 15 x 10cm. The variety was raised under optimum conditions of nutrient supply (120:40:45 kg NPK ha^{-1}) and plant protection measures in the field. The soil was clay in texture having pH 6.7, EC 0.34 ds/m, low in available N (246.50 $kgha^{-1}$) medium in available P (18.5 $kgha^{-1}$) and high in available K (280.75 $kgha^{-1}$). Observations on growth and yield attributes were taken on five randomly selected peg marked plants in periodical intervals. The mean values were used for statistical analysis as suggested by Panse and Sukatame (1978).

RESULTS AND DISCUSSION:

Yield attributes:

All the yield attributes were significantly influenced by different doses of fertilizers and foliar spraying of nutrients. The yield components *viz*., Number of productive tillers $hill^{-1}$, Total number of filled grains $panicle^{-1}$, Panicle length, Thousand grain weightwere enhanced due to different graded doses of fertilizers along with foliar spraying of nutrients **(Table -1 and Table -2).** The highest yield attributes was recorded in 100 % RDF + foliar spray of 2% humic acid at panicle initiation and flowering stages (M_3S_2). Among the different graded doses of fertilizer in the main plot, 100% RDF (M_3) significantly recorded the maximum yield attributes like Number of productive tillers $hill^{-1}$ of 374 , Total number of filled grains $panicle^{-1}$ of 105.49, Panicle lengthof 23.71 and thousand grain weight of 19.49 g at harvest stage of the crop. This might be due to favourable growth conditions and better translocation of assimilates to the sink from the source. These results are in line with the reports of Ali *et al*., (2007), Singh and Singh (2010) and Kumari and Sudheer (2015). Improved growth parameters and translocation of more assimilates to the sink. Similar results was obtained by Lavanya and Malla Reddy (2019)

Among the different foliar nutrition practices in the sub plot, the foliar spray of 2% humic acid at panicle initiation and flowering stages (S_2) was significantly superior over the other treatments and

recorded the highest Number of productive tillers hill^{-1} of 363 , Total number of filled grains panicle^{-1} of 96.24, Panicle lengthof 23.09 and thousand grain weight of 19.449 g at harvest stage of the crop. Humic acid improved physical chemical and biological condition of the soil while directly increased the hormonal growth response increased penetration in plant membrane. This was earlier revealed by Vanitha and Mohandas (2014). Humic acid involved in the synthesis of chlorophyll content and enhanced the growth and photosynthetic activity of plant by supplying macro and micro nutrients resulted in higher yield attributes of rice. The result is in agreement with the findings of Singh *et al.,* (2006). The highest number of productive tillers m^{-2} and panicle length at application of humic acid 2% at flowering and panicle initiation (fig. 4) may be due to the presence of plant growth regulators, vitamins, micronutrients and trace elements which might have increased the panicle numbers and proper grain filling resulted in more number of productive tillers m^{-2} and panicle length. Similar results were earlier revealed by Leindah Devi and Mani (2015). This result was agreement with Biswajith Pramanick *et al.* (2014), who reported that combined application of 100% RDF along with humic acid granules application at 12.5 Kg ha^{-1} significantly influenced the yield attributes of rice.

The treatment combinations of 100 % RDF + foliar spray of 2% humic acid at panicle initiation and flowering stages (M_3S_2) significantly recorded the highest Number of productive tillers hill^{-1} of 394 , Total number of filled grains panicle^{-1} of 112.68, Panicle lengthof 24.05 and thousand grain weight of 19.56 g at harvest stage of the crop. Inorganic fertilizers and humic acid substances significantly influenced the plant growth and yield both direct and indirect ways. These nutrients increased the chlorophyll content, accelerated plant respiration and hormonal growth response increased penetration in plant membrane resulted in more number of filled grains due to effective translocation of photosynthates from source to sink. This results is in line with Rahul Sadhukhan *et al.,* (2019). Similar findings were reported by Vanitha and Mohandas (2014) and Victor Debbarma *et al.,* (2015).

Yield:

The yield of the crop was significantly influenced by different graded doses of fertilizer and foliar spraying of nutrients **(Table 3)**. The grain yield and straw yield were enhanced due to different levels of fertilizer along with foliar spraying of nutrients. Among the different sowing methods in the main plot, 100 % RDF (M_3) significantly recorded the maximum grain yield of 5775 kg ha^{-1} and straw yield of 8594 kg ha^{-1}. The highest grain yield and straw yield was obtained by the effective utilization of resources that increased the performance of crop. This result was conformity with the reports of Chaturvedi *et al*. (2015).

Among the different foliar nutrition practices in the sub plot, the treatment (S_2) recorded the highest grain yield of 5314 kg ha^{-1} , strawyield 8043 kg ha^{-1}. This might be due better translocation of assimilates to the sink which reflected in maximum values in yield components and other traces in humic acids could have resulted in higher post- flowering photosynthesis and assimilate apoplast and symplast movement of nutrients. This result was in conformity with the reports of Kalaichelvi *et al*. (2006).There was significant interaction between treatment combinations of 100% RDF + foliar spray of 2% humic acid at panicle initiation and flowering stages (M_3S_2) significantlyrecorded the highest grain yield of 6135 kg ha^{-1} and highest straw yield of 9119 kg ha^{-1}. Yield increase was due to quick adsorption and assimilation of more nitrogen, phosphorus, potassium and micro nutrients present in inorganic fertilizers and organic substances. This leads to physiological and morphological character

improvement and finally reflected in higher yield. This results is in conformity with those of Priyanka *et al.* (2019). The increased in straw yield was due to increased growth parameters such as plant height, high number of tillers, leaf area index and dry matter production. Combined application of inorganic fertilizer and organic substances releases the nutrients slowly throughout the crop growth, it helps to produce more photosynthates and translocation from source to sink and also the immediate release of N and increased the soil physical properties due to application of humic acid granules. This is in conformity with the findings of Warren *et al.*, (2006). This result was in conformity with the findings of Mishra *et al.* (2012) and EL – Habbasha *et al.* (2012).

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TABLE-1

Effect of different doses of fertilizers and foliar spray of nutrients on yield attributes of rice

r of productive tillers hill^{-1}					Total number of filled grains panicle^{-1}				
plot nt	Main plot treatment				Sub plot treatment	Main plot treatment			
	M_1	M_2	M_3	Mean		M_1	M_2	M_3	Mea
	319	345	370	**344**	S_1	69.14	85.06	102.32	**85.5**
	337	359	394	**363**	S_2	80.03	96.01	112.68	**96.2**
	329	351	383	**354**	S_3	75.30	91.34	108.31	**91.6**
	328	351	381	**353**	S_4	74.24	90.10	106.99	**90.4**
	310	338	342	**330**	S_5	64.93	81.00	97.11	**81.0**
	324	**348**	**374**		**Mean**	**72.73**	**88.71**	**105.49**	
	Main	**Sub**	**M × S**	**S × M**		**Main**	**Sub**	**M × S**	**S × M**
	2.785	3.613	6.239	**7.984**	SE_d	0.753	0.971	1.676	**2.01**
	5.815	**7.502**	**12.994**	**16.632**	**CD (p=0.05)**	**1.564**	**2.014**	**3.481**	**4.19**

M_1 -50% RDF, M_2 -75% RDF, M_3 – 100% RDF S_1 - Foliar application of 0.35 % Auxin Gold Sea weed extract at panicle initiation and flowering stage, S_2 - Foliar application of 2% Humic acid at panicle initiation and flowering stage, S_3 - Foliar application of 3% Panchagavya at panicle initiation and flowering stage, S_4 - Foliar application of 2% Vermiwash at panicle initiation and flowering stage and S_5 – Control

TABLE-2

Effect of different doses of fertilizers and foliar spray of nutrients on yield attributes of rice

length (cm)					Test weight (g)				
plot nt	Main plot treatment				Sub plot treatment	Main plot treatment			
	M_1	M_2	M_3	Mean		M_1	M_2	M_3	Mea
	21.40	22.43	23.58	**22.47**	S_1	19.24	19.38	19.39	**19.3**
	22.05	23.18	24.05	**23.09**	S_2	19.33	19.43	19.56	**19.4**
	21.79	22.87	23.80	**22.82**	S_3	19.30	19.47	19.52	**19.4**

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	21.64	22.71	23.76	**22.71**	**S_4**	19.28	19.37	19.52	**19.39**
	21.24	22.26	23.37	**22.29**	**S_5**	19.23	19.35	19.44	**19.34**
	21.62	**22.69**	**23.71**		**Mean**	**19.28**	**19.40**	**19.49**	
	Main	**Sub**	**M × S**	**S × M**		**Main**	**Sub**	**M × S**	**S × M**
	0.048	0.252	0.436	**0.393**	**SE_d**	0.099	0.207	0.359	**0.330**
	0.137	**0.523**	**NS**	**NS**	**CD (p=0.05)**	**NS**	**NS**	**NS**	**NS**

M_1 -50% RDF, M_2 -75% RDF, M_3 – 100% RDF S_1 - Foliar application of 0.35 % Auxin Gold Sea weed extract at panicle initiation and flowering stage, S_2 - Foliar application of 2% Humic acid at panicle initiation and flowering stage, S_3 - Foliar application of 3% Panchagavya at panicle initiation and flowering stage, S_4 - Foliar application of 2% Vermiwash at panicle initiation and flowering stage and S_5 - Control

TABLE-3

Effect of different doses of fertilizers and foliar spray of nutrients on yield of rice

ield (kg ha^{-1})					**Straw yield (kg ha^{-1})**				
plot nt	**Main plot treatment**				**Sub plot treatment**	**Main plot treatment**			
	M_1	**M_2**	**M_3**	**Mean**		**M_1**	**M_2**	**M_3**	**Mea**
	3939	4793	5604	**4778**	**S_1**	6127	7289	8412	**7276**
	4486	5322	6135	**5314**	**S_2**	6991	8035	9119	**8043**
	4230	5111	5898	**5079**	**S_3**	6546	7700	8747	**7664**
	4169	5062	5810	**5014**	**S_4**	6484	7643	8705	**7610**
	3636	4536	5427	**4533**	**S_5**	5751	6932	7987	**6890**
	4092	**4965**	**5775**		**Mean**	**6380**	**7520**	**8594**	
	Main	**Sub**	**M × S**	**S × M**		**Main**	**Sub**	**M × S**	**S × M**
	77.931	52.842	91.306	**106.787**	**SE_d**	108.535	56.088	131.552	**153.1**
	162.409	**109.697**	**190.008**	**220.943**	**CD (p=0.05)**	**225.103**	**157.609**	**272.972**	**317.2**

M_1 -50% RDF, M_2 -75% RDF, M_3 – 100% RDF S_1 - Foliar application of 0.35 % Auxin Gold Sea weed extract at panicle initiation and flowering stage, S_2 - Foliar application of 2% Humic acid at panicle initiation and flowering stage, S_3 - Foliar application of 3% Panchagavya at panicle

initiation and flowering stage, S_4 - Foliar application of 2% Vermiwash at panicle initiation and flowering stage and S_5 - Control