Plant Archives Vol. 18 No. 2, 2018 pp. 2466-2468 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

STUDIES ON INTEGRATED PLANT NUTRIENT SUPPLY SYSTEM ON MAXIMIZATION OF *RICE* FOR CAUVERY DELTA REGION

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Abstract

Field investigation was carried out during September 2016 to January 2017 at the Experimental Farm, Annamalai University, Tamil Nadu, India to evaluate the integrated plant nutrient supply system on *rice* in the tail end area of Cauvery delta region of Tamil Nadu. The experiment comprised of twelve treatments with various cheaply available organic nutrient sources in substitution with recommended dose of nitrogen at 25 and 50 per cent. Water hyacinth, vermicompost, enriched pressmud compost, poultry manure, Green manure and biofertilizers were the organic sources used along with the recommended dose of P and K. The treatment T_2 consisted of recommended dose of fertilizer and T_1 was the control with no application of organic and inorganic sources of N, P and K. The experiment was laid out in randomized block design with three replications and statistically analyzed to find out the best performing treatments. Among the IPNSS imposed treatments, the treatment T_{11} (75 % recommended dose of N + recommended dose of P and K + 25 % N on equivalent basis of vermicompost + biofertilizers) exerted significant influence on growth attributes, yield attributes and yield.

Introduction

Rice is one of the most predominant and staple food crop that are being extensively cultivated and consumed all over the world by more than two billion people in Asia. India has the largest acreage under *rice* of 44 million hectares with a production of about 141 million tonnes. However, the national productivity of *rice* is 3.21t ha^{-1}. The burgeoning population of our country may stabilize around 1.4 and 1.6 billion by 2025 and 2050, requiring annually 380 and 450 million tonnes of food grains, respectively (Siddiq, 2000). To meet the future food requirements, India has to increase its *rice* productivity by three per cent per annum. Nitrogen is the kingpin for any fertilizer management programme in *rice* cultivation and is the universal key element for realizing the yield potential of high yielding *rice* varieties in Indian soils. Though use of inorganic fertilizers are beneficial in increasing the crop yields, exclusive use of them causes imbalance of micronutrients and also has the deleterious effect on soil micro flora. Besides, the high cost of fertilizers deters the farmers from using them in recommended doses. Therefore, there is a felt necessity to evaluate suitable agronomic strategies with emphasis on eco friendliness to accomplish the twin objectives of achieving the sustained production and to maintain the soil fertility over a longer period. Therefore, it is envisaged that for sustainable agricultural production in the country, integrated plant nutrient supply system (IPNSS) appears to be more promising. Such system would also reduce the cost of farming in addition to maintaining the soil productivity, improving the eco-system and ultimately resulting in improved soil-plant-health in a sustainable agricultural eco-system.

Materials and method

A comprehensive field study was conducted on *rice* (ADT 49) in the tail end area of Cauvery deltaic zone of Tamil Nadu during September 2016 to January 2017. The experimental site is situated at 11°24' N latitude and 74°44' E longitude at an altitude of + 5.79 m above mean sea level in the southern part of India. The soil is deep clay, low in available N, medium in available P_2O_5 and high in available K_2O. This experiment comprised of twelve treatments *viz.*, Absolute control (T_1), 100% of Recommended dose of nitrogen (RDN) + recommended dose of P & K (T_2), 75% RDN + 25% water hyacinth compost + recommended dose of P and K + azolla + azophos (T_3), 50% RDN + 50% water hyacinth compost

+ recommended dose of P and K + azolla + azophos (T_4), 75% RDN + 25% enriched pressmud compost + recommended dose of P and K + azolla + azophos (T_5), 50% RDN + 50% enriched pressmud compost + recommended dose of P and K + azolla + azophos (T_6), 75% RDN + 25% poultry Manure + recommended dose of P and K + azolla + azophos (T_7), 50% RDN + 50% poultry Manure + recommended dose of P and K + azolla + azophos (T_8), 75% RDN + 25% green manure + recommended dose of P and K + azolla + azophos (T_9), 50% RDN + 50% green manure + recommended dose of P and K + azolla + azophos (T_{10}), 75% RDN + 25% vermicompost + recommended dose of P and K + azolla + azophos (T_{11}), 50% RDN + 50% vermicompost + recommended dose of P and K + azolla + azophos (T_{12}). The experiment was laid out in randomized block design with three replications and statistically analyzed to find out the best performing treatments.

Results and discussion

Growth attributes

Among the treatments tested, treatment T_{11} (75% N as RDN + 25% N as vermicompost + biofertilizer) recorded the maximum values for plant height, number of tillers at maximum tillering stage, LAI @ 60 DAT and DMP @ harvest stage (table 1). The beneficial effect of N applied through inorganic fertilizer and vermicompost to supply N in the proportion of (75:25) on the growth attributes *viz.*, plant height, number of tillers hill^{-1}, LAI and DMP of *rice* was observed to be significant when compared to other treatments. Similar results were found in the research findings of Kuldeep Singh *et al.* (2015) in cereal crop of sweet sorghum with the observations of maximum growth and development parameters. The increase in the growth parameters was also due to the Azospirillum which produces phytohormones to enhance plant growth, that also formed for the uptake of nutrients through higher availability, which in turn reflected on the growth attributes. Application of phosphobacteria also favoured by producing organic acids which favoured for the mobilization of phosphorus in the soil, and all these cumilately led to increase in the growth parameters of *rice* (Saravanan, 2015).

Yield attributes

The yield potential of *rice* is determined by the yield attributes and the values of the yield attributes were in accordance with that of growth parameters. Among the treatments, combined application of 75 % recommended dose of N + recommended dose of P and K + 25 % N on equivalent basis of vermicompost + azolla + azophos (T_{11}) resulted in significantly superior effect on all the yield attributes *viz.*, number of panicles hill^{-1} and number of filled grains, except the test weight (Table 2), since the weight of individual grain is mainly influenced by the genetic makeup of the plant as compared to other environmental factor. These results are in accordance with the findings of Kuldeep Singh *et al.*, (2015). The better performance of integrated application might also be due to the counteraction of the effect of inorganic fertilizer by the vermicompost and the steady and liberal supply of adequate nutrients during the later stages of crop growth, thus helping in fixing more photosynthates and translocation of them from source to sink and thereby

Table 1: Effect on growth attributes of *rice* as influenced by IPNSS

Treatments	Plant ht @ flowering (cm)	LAI @ flowering	Tillers /hill @ maxi. tillering stage	DMP @ harvest (t/ha)
T_1	72.76	4.71	5.63	7.9
T_2	79.71	5.41	9.49	11.17
T_3	81.98	5.61	10.76	11.52
T_4	75.05	4.92	6.9	10.4
T_5	82.01	5.67	10.78	11.54
T_6	75.14	4.99	6.99	10.49
T_7	84.25	5.84	12.01	11.89
T_8	77.42	5.21	8.21	10.81
T_9	81.97	5.59	10.75	11.51
T_{10}	75.1	4.96	6.95	10.44
T_{11}	**86.5**	**6.04**	**13.25**	**12.25**
T_{12}	77.44	5.22	8.24	10.84
S.Ed	1.13	0.09	0.62	0.16
C.D (p=0.05)	2.23	0.16	1.21	0.31

Table 2: Effect on yield attributes of *rice* as influenced by IPNSS

Treatments	Panicles hill^{-1}	Filled grain panicle^{-1}	1000 grain weight (g)
T_1	3.75	48.54	19.89
T_2	5.32	66.02	20.05
T_3	5.81	68.48	20.08
T_4	4.26	60.98	19.93
T_5	5.84	68.5	20.08
T_6	4.35	61.07	19.96
T_7	6.33	70.92	20.1
T_8	4.85	63.54	20.01
T_9	5.79	68.47	20.07
T_{10}	4.31	61.02	19.94
T_{11}	**6.81**	**73.35**	**20.12**
T_{12}	4.86	63.57	20.02
S.Ed	0.25	1.23	0.57
C.D (p=0.05)	0.45	2.41	NS*

NS* - non significant

enhanced the number of filled grains panicle^{-1}. This is in line with the findings of Stalin and Vaiyapuri (2009); Suseendran (2011).

Yield

Among the various treatments imposed in the study, substantial increase in yield attributes *viz*., number of productive tillers m^{-2} and filled grains panicle^{-1} was evidenced in the treatment (T_{11}) that received the recommended dose of N through inorganic and vermicompost (75: 25) which in turn reflected on enhanced grain and straw yield. This treatment registered higher values of 4.87t ha^{-1} and 6.65 t ha^{-1} of grain and straw yield than all other treatments (Table 3). The constant release of N supplemented by vermicompost in conjunction with inorganic N might have satisfied the demand of *rice* crop at every phenophase as opined by Babu Mathew (2001). The application of biofertilizers *viz*., Azospirillum produce phytohormones that induce root growth, improved nutrient and water absorption by plants, that augmented increase in production of shoot dry biomass that ultimately favoured for higher growth parameters, yield attributes and yield of *rice*. The above findings are in collaborative with the earlier report of Sunil and Shankara Lingappa (2014).

Table 3: Grain and Straw yield (t ha^{-1}) of ADT 49 as influenced by IPNSS

Treatments	Grain yield	Straw yield
T_1	1.62	2.17
T_2	4.3	5.75
T_3	4.51	6.1
T_4	3.79	4.85
T_5	4.54	6.13
T_6	3.96	5.01
T_7	4.7	6.42
T_8	4.11	5.3
T_9	4.49	6.05
T_{10}	3.84	4.97
T_{11}	**4.87**	**6.65**
T_{12}	4.12	5.37
S.Ed	0.09	0.13
C.D (p=0.05)	0.15	0.22

Nutrient uptake and post-harvest soil available nutrients

Among the treatments tested, the highest NPK uptake of 114.35 kg ha^{-1}, 28.96 kg ha^{-1} and 95.45 kg ha^{-1} respectively was observed in the treatment T_{11}. This effect might be due to organic matter present in vermicompost and its influence in increasing the native microbial population and consequent mobility and availability of NPK nutrients. The present result is in agreement with the findings of Babu Mathew (2001).

The maximum soil available NPK status of post harvest soil was 221.50 kg ha^{-1}, 19.65 kg ha^{-1} and 285.45 kg ha^{-1} respectively was recorded in the vermicompost and biofertilizer applied plots (T_{11}) when compared to other organic manures. This is because, apart from nutrient supply and availability, vermicompost also improved the fertilizer use efficiency by increasing the nutrient uptake of plants.

Conclusion

The conjoint application of inorganic N and vermicompost in the ratio of 75: 25 of recommended dose of nitrogen along with biofertilizers for *rice* was found to be a suitable and sustainable integrated plant nutrient supply system for *rice*. It also registered maximum values for most of the parameters like growth, yield and yield components of *rice*, as a whole without affecting the soil fertility and thereby maintaining the soil health and sustainability of *rice* production for the tail end of Cauvery deltaic region.

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