



# INTEGRATION OF NPK WITH DIFFERENT GRANULAR ORGANIC MANURES ON YIELD ATTRIBUTES AND YIELD OF LOWLAND RICE

G. Baradhan, S.M. Suresh Kumar\*, S. Elankavi, S. Ramesh and N. Ramesh

Faculty of Agriculture, Annamalai University, Annamalai Nagar-608002, Tamilnadu, India

## Abstract

Field investigation was conducted at Annamalai University Experimental Farm to study the impact of integration of graded dose of NPK and different granular organic manures on growth and yield of low land rice (*Oryza sativa* L.) The experiment was laid out in a Randomized Block Design (RBD) with nine treatments. All the treatments significantly influenced the yield components of lowland rice. Results of the experiment revealed that 75 percent NPK + Azophos @ 2 kg ha<sup>-1</sup> + pressmud based organic manure granules @ 125 kg ha<sup>-1</sup> + distillery ash granules @ 125 kg ha<sup>-1</sup> recorded enhanced values of yield components viz., number of tillers hill<sup>-1</sup>, number of filled grains panicle<sup>-1</sup> and seed yield as compared to other treatments. The application of 50 percent NPK + Azophos 2 kg ha<sup>-1</sup> resulted in the lowest values of these yield components and yield of lowland rice.

**Key words :** Granular organic manures, Yield attributes and yield, lowland rice

## Introduction

Rice is cultivated in about 160 million hectares globally with a produce of 685 million tonnes (DRR, 2011). India is one of the leading rice producing countries of the world along with China, Thailand, Vietnam, USA and Pakistan. It has the world's largest area under rice with 43.95 million hectare with an annual production of 106.54 million tonnes and an average yield of 2424 kg ha<sup>-1</sup> (GOI, 2014). Around 90% of the total rice in the world is produced and consumed in Asia. More than 50% of the world's population that resides here depends mainly on rice as staple food. Although India is the second most rice producing country in World, the yield level is very low compared to the major rice producing countries. Rice crop alone contributes to about 40 to 43 per cent of the total food grain production and that is why the crop plays a vital role in national food and livelihood security mission. India is the second largest producer and consumer of rice in the world and is also the hub of food security of the global population. Rice export contributes nearly 25 per cent of total agriculture export from the country. Rice is a staple food of majority of Indians and its demand in future is bound to increase with growing population, which is projected to be 1.301 and 1.378 billion by 2020 and

2030 respectively (DRR, 2011). Till today, the increasing productivity of rice is related to the increased application of chemical fertilizer at geometric rate. Chemical fertilizers cannot be avoided completely since they are the potential sources of high amount of nutrients in easily available forms. Continuous use of chemical fertilizers in intensive cropping system is leading to imbalance of nutrients in soil, which has an adverse effect on soil health and also on crop yields (Baradhan and Suresh Kumar, 2018). But considering the global environmental changes and crises, massive application of chemical fertilizers, especially, nitrogenous one is certainly a key limiting factor. Therefore, it is essential to develop and adopt an integrated nutrient management to supplement and make proper application of nitrogen as fertilizers with the addition of suitable environment friendly alternative resources. Efficient utilization of chemical fertilizers and practical application of organic manures can lead to the sustainable crop yield (Krol, 1999, Singh *et al.*, 2002). Owing to high growth and yield attributes, wetland rice removes a substantial amount of major and minor nutrients from the soil, and deficiency of either nutrient reduces its growth and yield. But with the present day high yielding cultivars, which have higher nutrient requirements, the use of inorganic fertilizers has increased considerably leading to decline in the use of organic materials. As rice is grown

\*Author for correspondence :

under submerged anaerobic conditions, integrated management of nutrients offers a wide scope for harnessing the efficiency of different nutrients and their combinations.

Integrated use of chemical fertilizers along with organic manure and bio-fertilizers has therefore, become need of the hour for improvement and maintenance of soil fertility leading to sustainable crop production. Addition of granular organic manures provides better availability of nutrient to the crop plants maintaining soil fertility and grain quality. After granulation compared with powdered organic manures, granules are compact and dry. Thus, they are easily handled and applied to crop and it results in slow release of nutrients resulting in increased nutrient efficient (Suresh Kumar and Baradhan, 2018). Biofertilizers are products containing living cells of different types of microorganisms, which have an ability to convert nutritionally important elements from unavailable to available form through biological processes. The capacity of fixing atmospheric nitrogen (N) has made many microorganisms as a centre of modern agronomic interest. *Azospirillum* species fix atmospheric nitrogen in rice fields through non-symbiotic process, and thereby, supplement nutrient requirement of the crop (Haider Iqbal Khan, 2018).

*Azospirillum*, blue green algae and *Azolla* can reproduce very fast, reduce the application of inorganic N fertilizers up to 25 percent with their atmospheric N fixation, and perform a dynamic part in increasing the rice yield. INM can thus be considered an effective means of ensuring food security and improving environmental quality by minimizing nutrient losses, improving plant uptake and nutrient use efficiency which enhance the growth and yield attributes (Ghosh 2015).

### Materials and Method

The Field Experiment was conducted in Experimental Farm, Annamalai University, Annamalainagar. The Experimental Farm is geographically situated at 11°24' North latitude and 79°44' East longitude and at an altitude of +5.79 m above mean sea level, during the *Navarai* season of 2017 to study the graded dose of NPK with different granular organic manures at yield attributes and yield of lowland rice. The experiment was laid out in Randomized Block Design with three replications. The treatments comprised of T<sub>1</sub>- Recommended Dose of Fertilizer (RDF) 120:40:40 kg NPK ha<sup>-1</sup>, T<sub>2</sub>-75 percent NPK + Azophos @ 2 kg ha<sup>-1</sup>, T<sub>3</sub>-75 percent NPK + Azophos @ 2 kg ha<sup>-1</sup> + pressmud based organic manure granules @ 125 kg ha<sup>-1</sup>, T<sub>4</sub>-75 percent NPK + Azophos @ 2 kg ha<sup>-1</sup> + distillery ash granules @ 125 kg ha<sup>-1</sup>, T<sub>5</sub>-75

per cent NPK + Azophos @ 2 kg ha<sup>-1</sup> + pressmud based organic manure granules @ 125 kg ha<sup>-1</sup> + distillery ash granules @ 125 kg ha<sup>-1</sup>, T<sub>6</sub>-50 percent NPK + Azophos 2 kg ha<sup>-1</sup>, T<sub>7</sub>-50 percent NPK + Azophos 2 kg ha<sup>-1</sup> + pressmud based organic manure granules @ 125 kg ha<sup>-1</sup>, T<sub>8</sub>-50 percent NPK + Azophos 2 kg ha<sup>-1</sup> + distillery ash granules @ 125 kg ha<sup>-1</sup>, T<sub>9</sub>-50 percent NPK + Azophos 2 kg ha<sup>-1</sup> + pressmud based organic manure granules @ 125 kg ha<sup>-1</sup> + distillery ash granules @ 125 kg ha<sup>-1</sup>. Rice seedlings were raised in dry nursery beds. The fertilizers were applied to the experimental field as per the recommended schedule of 120:40:40 kg N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O ha<sup>-1</sup>. 75 percent and 50 percent NPK was done as per the treatment schedule. Azophos @ 2 kg ha<sup>-1</sup> and pressmud based organic manure granules @ 125 kg ha<sup>-1</sup> and distillery ash granules @ 125 kg ha<sup>-1</sup> was applied basally to the respective treatment plots as per the treatment schedule.

### Results and Discussion

Nutrient management showed significant effect on increasing plant height, LAI and DMP of rice. The results of the present investigation involving nitrogen applied through inorganic fertilizer and Azophos and organic manure granules (pressmud and distillery ash granules) showed marked impact on growth characters of rice. From the perusal of experimental results, it is evident that the values of rice yield attributes at varied stages of crop growth were significantly higher with application of 75 percent NPK + Azophos 2 kg ha<sup>-1</sup> + press mud based organic manure granules @ 125 kg ha<sup>-1</sup> + distillery ash granules @ 125 kg ha<sup>-1</sup> (T<sub>5</sub>). Among the treatments 75% NPK along with Azophos 2 kg ha<sup>-1</sup> and pressmud based organic manure granules @ 125 kg ha<sup>-1</sup> + distillery ash granules @ 125 kg ha<sup>-1</sup> (T<sub>5</sub>) significantly registered the highest number of tillers m<sup>-2</sup> (19.5), number of panicles m<sup>-2</sup> (420), number of filled grains panicle<sup>-1</sup> of (92.72) and significantly highest grain yield of 5.02 t ha<sup>-1</sup>. Application of 50% NPK along with Azophos @ 2 kg ha<sup>-1</sup> (T<sub>6</sub>) recorded the least number of tillers m<sup>-2</sup> (10.41), number of panicles m<sup>-2</sup> (273), number of filled grains panicle<sup>-1</sup> of (79.2) and least grain yield of 2.46 t ha<sup>-1</sup>.

All the yield attributes showed an impressive improvement with combined application of 75% NPK along with Azophos 2 kg ha<sup>-1</sup>, press mud based organic manure granules @ 125 kg ha<sup>-1</sup> and distillery ash granules @ 125 kg ha<sup>-1</sup> (T<sub>5</sub>) in rice. Yield is the manifestation of yield attributing characters. Higher grain yield was influenced mainly by yield attributing components like number of tillers hill<sup>-1</sup>, number of filled grains panicle<sup>-1</sup> and filled and unfilled ratio. Tillering is largely related with genetic behavior of a variety. It is the outcome of

the expansion of auxillary buds which is closely associated with the nutritional condition of the mother culm and a tiller receives carbohydrates and nutrients from the mother culm during its early growth period which gets improved by the application of N and organic manures (Debiprasad Dash *et al.*, 2010). The treatment combinations of 75% NPK through inorganics plus Azophos 2 kg ha<sup>-1</sup>, press mud based organic manure granules @ 125 kg ha<sup>-1</sup> and distillery ash granules @ 125 kg ha<sup>-1</sup> significantly resulted in higher values of various yield parameters *viz.*, number of tillers hill<sup>-1</sup> and number of filled grains panicle<sup>-1</sup>. This might be due to ready supply of nutrients through inorganics in the initial stages of crop growth and slow release of nitrogen and steady supply of other nutrients over an extended period of crop growth by organics.

The combined application of 75% NPK along with organic manure and bio fertilizers shows better tillering under higher fertility could be attributed to increased availability of nutrients for the production of new meristematic tissues which resulting in maximum no of productive tillers, higher number of spikelets and number of filled grains (Ghulam *et al.*, 2009). The increase in the number of tillers might be due to the fact that organic sources of nutrients acted as slow release fertilizer and it synchronized with the nutrient demand of the crop (Gill and Brar, 2005).

75% NPK in conjunction with azophos, press mud based organic manure granules and distillery ash granules made it possible for high C:N ratio and increased the

tiller production relating to more primary, secondary and tertiary tillers. Similar findings were reported by Mari *et al.*, (2004). Further, this might have improved the nutrient availability resulting in higher uptake of nutrients which ultimately led to better translocation of photosynthesis from source to sink resulting in maximum number of productive tillers, higher number of spikelets and number of filled grains panicle<sup>-1</sup>. These finding are in conformity with the earlier reports of Patel and Patel (2010).

Increase in grains per panicle through different organics might be attributed to different rates of mineralization that had the ultimate effect on nutrient uptake and translocation of synthesized food to grains. The increase in the yield attribute in the treatment receiving azophos, press mud based organic manure granules and distillery ash granules may also be attributed due to the combined effect of nutrient supply, synergism and improved soil physical and biological properties.

Ram *et al.*, (2000) reported significant increase in grains per panicle in rice due to integrated use of press mud along with fertilizer N. Organics have a priming effect on the release of nitrogen from inorganic fertilizer. Moreover thoroughly decomposed organics were used in this treatment which might have mobilized native nutrients from soils. In the present study, integrated application of 75% NPK along with Azophos 2 kg ha<sup>-1</sup>, press mud based organic manure granules @ 125 kg ha<sup>-1</sup> and distillery ash granules @ 125 kg ha<sup>-1</sup> (T<sub>5</sub>) recorded the highest grain yield of 5.02 t ha<sup>-1</sup>. The organic manures

**Table 1:** Integration of NPK with different granular organic manures on yield attributes and yield of lowland rice.

Treatments	Number of tillers m <sup>-2</sup>	Number of panicles m <sup>-2</sup>	Number of filled grains panicle <sup>-1</sup>	Grain yield (t ha <sup>-1</sup> )
T <sub>1</sub> - RDF (120:38:38 NPK kg ha <sup>-1</sup> )	12.42	319	82.24	3.09
T <sub>2</sub> - 75% RDF + Azophos @ 2 kg ha <sup>-1</sup>	11.21	302	80.24	4.84
T <sub>3</sub> - 75% RDF + Azophos @ 2 kg ha <sup>-1</sup> + Pressmud based organic manure granules @ 125 kg ha <sup>-1</sup>	17.15	384	89.52	4.22
T <sub>4</sub> - 75% RDF + Azophos @ 2 kg ha <sup>-1</sup> + Distillery ash granules @ 125 kg ha <sup>-1</sup>	16.33	372	87.54	4.01
T <sub>5</sub> - 75% RDF + Azophos @ 2 kg ha <sup>-1</sup> + Pressmud based organic manure granules @ 125 kg ha <sup>-1</sup> + Distillery ash granules @ 125 kg ha <sup>-1</sup>	19.5	420	92.72	5.02
T <sub>6</sub> - 50% RDF + Azophos @ 2 kg ha <sup>-1</sup>	10.41	273	78.2	2.46
T <sub>7</sub> - 50% RDF + Azophos @ 2 kg ha <sup>-1</sup> + Pressmud based organic manure granules @ 125 kg ha <sup>-1</sup>	15.37	351	85.42	3.82
T <sub>8</sub> - 50% RDF + Azophos @ 2 kg ha <sup>-1</sup> + Distillery ash granules @ 125 kg ha <sup>-1</sup>	14.79	338	84.02	3.51
T <sub>9</sub> - 50% RDF + Azophos @ 2 kg ha <sup>-1</sup> + Pressmud based organic manure granules @ 125 kg ha <sup>-1</sup> + Distillery ash granules @ 125 kg ha <sup>-1</sup>	18.25	403	91.3	4.38
<b>S.Ed</b>	<b>0.30</b>	6.24	0.61	0.07
<b>CD (P = 0.05)</b>	<b>0.7</b>	13.24	1.30	0.15

has the essential plant nutrients and other growth promoting substances like enzymes and hormones, while no synthetic fertilizer can supply all together. Similar results were reported by Kandeshwari *et al.*, (2012). Better performance of combined use of organic manures with chemical fertilizers might be due to synergistic effect of inorganic fertilizers and organic manures, as well as slow release of nutrients throughout the crop growth, thus helping to form more photosynthates and translocating the same from source to sink and also the immediate release of N and improved soil physical properties due to application of organic manures and inorganic fertilizers enhanced the crop growth and in turn yield of rice. This was also evidenced by studies of Singh and Singh (2008), Kumar *et al.*, (2010) and Sridevi (2011).

Application of 50% NPK + Azophos 2 kg ha<sup>-1</sup> (T<sub>6</sub>) resulted in the least values in all these yield parameters which is due to the absence of beneficial effect of pressmud based organic manure, distillery ash and 25 percent lesser dose of NPK. Integrated use of organic manures and inorganic fertilizers sources are effective in arresting the deterioration in productivity.

### Conclusion

On the basis of the result of the field experiment, it may be inferred that application of 75 percent NPK + Azophos 2 kg ha<sup>-1</sup> + pressmud based organic manure granules @ 125 kg ha<sup>-1</sup> + distillery ash granules @ 125 kg ha<sup>-1</sup> holds promise as an eco-friendly and economically suitable nutrient management system with emphasis to achieve the sustained production together with maintenance of soil fertility over a long period of low land rice production in Cauvery delta region.

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