



Effect of organic and inorganic substances on the growth and yield of rice

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Abstract

In order to enhance the yield of rice by foliar application of organic and inorganic substances, a field experiment was conducted in a Randomized Block Design with three replications at Annamalai University Experimental farm, Annamalai Nagar during Late *Kuruvai* season (July - September) with CO - 47 rice cultivar. Among the different treatments tried, application of 100% NPK + humic acid granules @ 12.5 kg/ha along with foliar application of Panchagavya @ 3% + Fish meal extract @ 3% + Auxin Gold sea weed extract @ 0.35% on 20, 35 and 50 DAT performed better compared to other treatments and ranked first in terms of plant height, number of productive tillers/m² (353), number of spikelets /panicle (119), sterility per centage (11.4), grain yield (5.6 t/ha) and straw yield (8.5 t/ha).

Keywords: Fish meal extract, Panchagavya, Seaweed extract, Potassium nitrate, Productive tillers and Yield

Introduction

In the world, rice is the second most widely consumed cereal next to wheat and it has occupied an area of 163.47 million hectares with production and productivity of 501.56 million tonnes and 4.58 t/ha, respectively (USDA, 2019). In Asia, rice and its derived products provide 60 to 70 per cent of energy requirement to more than 2 billion people. In Tamil Nadu state of India, rice is grown in an area of 17.80 lakh hectares with production and productivity of 60 lakh metric tonnes and 3.37 t/ha, respectively. In Cuddalore district rice is grown in an area of 134677 hectares with production of 641958 metric tonnes and productivity of 4.1 t/ha. Continuous use of chemical fertilizers causes long term imbalance in pH and fertility of the soil. Moreover, applied nitrogen (N), phosphorus (P) and potassium (K) fertilizer undergoes various transformation processes in soil. Application of organic nutrient is more appropriate because it contributes to the improvement and sustainability of natural resources and environment. Application of humic acid improves the plant growth and yield by increasing the soil organic matter. Panchagavya is used in different means in agriculture such as foliar spray, soil application along with irrigation water, seed or seedling treatments etc. Panchagavya contains several vitamins, macro nutrients, micro nutrients, amino acid, growth regulators like auxin,

gibberellins and useful microorganisms which is required for the growth and development of crops (Ajay Alias Mangtu Ram, 2017). Fish amino acid, a potential source of auxin and promoting the vegetative growth through active cell division, cell enlargement and cell elongation. Sea weed extract application on plants resulted in wide benefits like early seed germination, establishment, improved crop performance and yield, improved resistance to biotic and abiotic stress, enhanced postharvest shelf life of perishable products. This study was conducted mainly to get higher yields, sustain soil health and to reduce the cost of fertilizers through the integration of foliar application of different organic sources with recommended NPK.

Materials and Methods

A field experiment was conducted at the Experimental Farm, Department of Agronomy, Annamalai University, Annamalai Nagar which is situated at 11°24' N latitude and 79°44' E longitude and at an altitude of +5.79 m above mean sea level during Late *Kuruvai* (July to September 2018) season with rice variety Co-47 to study the effect of organic and inorganic substances on rice along with 100 and 75% recommended dose of NPK individually and as combined spray. The experimental field soil was clayey

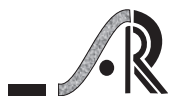
loam in texture, low in available nitrogen (210 Kg/ha), medium in available phosphorus (19.6 Kg/ha) and high in available potassium (319.5 Kg/ha). The experiment was laid out in a Randomized Block Design with 12 treatments and replicated thrice. The twelve treatments were T_1 - 100% NPK + Humic acid granules @ 12.5 kg/ha, T_2 - T_1 + Panchagavya spray @ 3% at 20, 35 and 50 DAT, T_3 - T_1 + Fish meal extract spray @ 3% at 20, 35 and 50 DAT, T_4 - T_1 + Auxin Gold sea weed extract spray @ 0.35% at 20, 35 and 50 DAT, T_5 - T_1 + Potassium nitrate spray @ 0.5% at 20, 35 and 50 DAT, T_6 - T_1 + Panchagavya + Fish meal extract + Auxin Gold sea weed extract spray at 20, 35 and 50 DAT, T_7 - 75% NPK + Humic acid granules @ 12.5 kg/ha, T_8 - T_7 + Panchagavya spray @ 3% at 20, 35 and 50 DAT, T_9 - T_7 + Fish meal extract spray @ 3% at 20, 35 and 50 DAT, T_{10} - T_7 + Auxin Gold sea weed extract spray @ 0.35% at 20, 35 and 50 DAT, T_{11} - T_7 + Potassium nitrate spray @ 0.5% at 20, 35 and 50 DAT, T_{12} - T_7 + Panchagavya + Fish meal extract + Auxin Gold sea weed extract spray at 20, 35 and 50 DAT. 21 days old seedlings were transplanted @ 2/ hill with a spacing of 15x10 cm. The recommended dose of 120:40:40 kg/ha was adopted for 100 per cent and from that 75 per cent NPK was calculated and were applied to plots as per treatment schedule. Half dose of N, K and full dose of P were applied as basal and the remaining N and K were top dressed in two equal split at active tillering and panicle initiation stages. The various organic and inorganic substances were sprayed at respective concentrations at 20, 35 and 50 DAT as per treatment schedule.

Results and Discussion

Among the treatments tested, T_6 -100% NPK + Humic acid granules @ 12.5 Kg/ha + Panchagavya + Fish meal extract + sea weed extract spray on 20,35 and 50 DAT excelled rest of the treatments and resulted in the tallest plant (Table 1) on 60 DAT and at harvest (89.10 and 99.73 cm, respectively). This might be due to the optimum level of nutrients available in the rhizo - ecosystem of soil applied with basal application of fertilizer resulting in better growth and development. Application of nutrients at critical stages would have resulted in better vegetative growth as observed by taller plants. In this treatment panchagavya spray would have provided growth promoting substances, encouraging quick growth and increased the plant height. This result of increased shoot length is in line with the report of Mallavarapu Geethav *et al.* (2015). Among the

foliar spraying of organic substances individually with 75 or 100% NPK, spraying of fish meal extract was found to be better. Application of 75% NPK along with humic acid granules application @ 12.5 kg/ha resulted in reduced plant height to the tune of 8.3 and 9.2 cm compared to 100% NPK + humic acid granules application 12.5 kg/ha at 20, 35 and 50 DAT respectively. Within the treatments tested, T_6 - 100% NPK + Humic acid granules @ 12.5 Kg/ha + Panchagavya @ 3%+ Fish meal extract @ 3%+ sea weed extract spray @ 0.35% on 20, 35 and 50 DAT along with application of humic acid granules @ 12.5 kg/ha ranked first with a value of 353 productive tillers/m². This may be due to the presence of certain plant growth regulators, trace elements, vitamins and micronutrients in organic substances which might have enhanced the growth and yield contributing characters. Combined application of each 3% of Panchagavya + Fish meal extract + sea weed extract spray along with 100% NPK + humic acid granules application @ 12.5 kg/ha increased the number of productive tillers/m² to the tune of 7.29 per cent over T_1 - 100% NPK + Humic acid granules application @ 12.5 kg/ha. Application of 75% NPK along with humic acid granules application @ 12.5 kg/ha resulted in reduced total number of productive tillers/m² to the tune of 6.8 per cent compared to 100% NPK + humic acid granules application @ 12.5 kg/ha.

Among the treatments tested, T_6 - 100% NPK + Humic acid granules @ 12.5 Kg/ha+ Panchagavya + Fish meal extract + sea weed extract spray on 20, 35 and 50 DAT surpassed all other treatments and produced the highest number of spikelets/panicle (119) and with least (11.41) sterility per centage. The greater availability of nutrients in soil, improvement of soil environment resulting in higher root proliferation leading to better absorption of moisture and nutrients which ultimately resulted in higher yield parameters and yield. In rice, increased grains/panicle, grain yield due to spraying of *Kappaphycus alvarezii* @ 10% + recommended NPK result is in agreement with the report of Singh *et al.* (2018). The second in order was T_3 - 100% NPK + Humic acid granules @ 12.5 Kg/ha + Fish meal extract spray @ 3% on 20, 35 and 50 DAT and it was comparable with T_2 - T_1 + Panchagavya spray @ 3%, T_4 - T_1 + Auxin Gold Sea weed extract spray @ 0.35% and T_5 - T_1 + Potassium nitrate spray @ 0.5% on 20, 35 and 50 DAT. Application of 75% NPK along with humic acid granules application @ 12.5 kg/ha resulted in reduced number of



spikelets/panicle to the tune of 7.6 per cent compared to 100% NPK + humic acid granules @ 12.5 kg/ha. Foliar application of organic substances or inorganic substances individually with 75% NPK + humic acid @ 12.5 kg/ha resulted in similar effect.

Among the treatments tried out, T₆ - 100% NPK + Humic acid granules @ 12.5 Kg/ha + Panchagavya + Fish meal extract + sea weed extract spray on 20,35 and 50 DAT surpassed rest of the treatments with a grain yield of 5660 kg/ha which is 12.52 per cent higher than T₁- 100% NPK + Humic acid granules @ 12.5 kg/ha. That may be due to the highest number of productive tillers/m², number of spikelets/panicle and number of filled grains/panicle. Yield increase was due to quick absorption and assimilation of more nitrogen, phosphorus, potassium and micro nutrients present in inorganic fertilizers and organic substances. This lead to physiological and morphological character improvement and finally reflected in higher yield. Similar result of increased growth attributes and yield due to the combined application was earlier reported by Carol

Lyngdoh *et al.*, (2017). The second best was T₃ - T₁ + Fish meal extract spray @ 3% on 20, 35 and 50 DAT and it was on par with T₂ - T₁ + Panchagavya spray @ 3% on 20, 35 and 50 DAT and T₄ - T₁ + Auxin Gold Sea weed extract spray @ 0.35% on 20, 35 and 50 DAT. Foliar application of panchagavya @ 3% or fish meal extract 3% or sea weed extract 0.35% increased the grain yield to the tune of 372, 439 and 327 kg/ha respectively over T₁- 100% NPK + Humic acid granules @ 12.5 kg/ha. Application of 25% less NPK compared to 100% recommended NPK + humic acid granules @ 12.5 kg/ha reduced the grain yield to the extent of 790 kg/ha. This might be due to the unavailability of required quantity of nutrients present in soil during the crop period which resulted in reduced yield components. Similar results of reduced grain yield to the tune of 1.58 t/ha were obtained by Ali *et al.*, (2009). The combined application of Panchagavya + Fish meal extract + sea weed extract along with 75% NPK + humic acid granules @ 12.5 kg/ha gave 16.29 per cent additional yield over T₇ - 75% NPK + Humic acid granules @ 12.5 kg/ha. Application of

Table 1: Effect of various organic and inorganic substances on growth and yield of rice

Treatments	Plant height at 60 DAT (cm)	Plant height at harvest (cm)	No. of productive tillers/ m ²	No. of spikelets/ panicle	Sterility (%)	Grain yield (Kg/ha)	Straw yield (Kg/ha)
T ₁ - 100% NPK + Humic acid granules @ 12.5 kg/ha	77.7	89.73	329	108.45	18.03	5030	7599
T ₂ - T ₁ + Panchagavya spray @ 3% on 20, 35 and 50 DAT	82.49	93.66	341	111.18	16.03	5402	8242
T ₃ - T ₁ + Fish meal extract spray @ 3% on 20, 35 and 50 DAT	83.62	95.23	342	111.86	13.96	5469	8281
T ₄ - T ₁ + Auxin Gold Sea weed extract spray @ 0.35% on 20, 35, 50 DAT	82.13	92.87	339	110.3	16.54	5357	8157
T ₅ - T ₁ + Potassium nitrate spray @ 0.5% on 20, 35 and 50 DAT	81.1	91.82	334	108.44	17.5	5296	7803
T ₆ - T ₁ + Panchagavya, Fish meal extract and sea weed extract spray on 20, 35 and 50 DAT (T ₂ +T ₃ +T ₄)	89.1	99.73	353	119	11.41	5660	8569
T ₇ - 75% NPK + Humic acid granules @ 12.5 kg/ha	69.4	80.53	308	100.8	25.94	4240	6431
T ₈ - T ₇ + Panchagavya spray @ 3% on 20, 35 and 50 DAT	76.28	86.29	322	102.47	21.36	4627	7166
T ₉ - T ₇ + Fish meal extract spray @ 3% on 20, 35 and 50 DAT	77.37	88.45	322	103.72	20.61	4627	7008
T ₁₀ - T ₇ + Auxin Gold Sea weed extract spray @ 0.35% on 20, 35 and 50 DAT	75.84	84.36	316	101.65	21.81	4638	6820
T ₁₁ - T ₇ + Potassium nitrate spray @ 0.5% on 20, 35 and 50 DAT	72.61	81.94	310	101.94	25.34	4326	6920
T ₁₂ - T ₇ + Panchagavya, Fish meal extract and sea weed extract spray on 20, 35 and 50 DAT (T ₈ +T ₉ + T ₁₀)	79.83	90.25	329	106.29	19.44	4931	7445
S. Ed	1.42	1.62	6	1.95	0.41	90	137
CD (p = 0.05)	2.95	3.37	12	4.06	0.86	186	285

potassium nitrate either with 75% NPK or 100% NPK with humic acid granules @ 12.5 Kg/ha improved the grain yield to the tune of 86 and 266 Kg/ha, respectively.

Among the treatments tested, T₆ - 100% NPK + Humic acid granules @ 12.5 Kg/ha + Panchagavya + Fish meal extract + sea weed extract spray on 20, 35 and 50 DAT surpassed all other treatments and resulted in the highest straw yield (8569 kg/ha). This might be due to increased growth parameters like plant height, more number of tillers, leaf area index and dry matter production. Better performance of combined use of organic substances with chemical fertilizer might be due to synergistic effect of inorganic fertilizers and organic substances as well as the slow release of nutrients throughout the crop growth, thus helping to produce more photosynthates and also the immediate release of N and improved soil physical properties due to application of humic acid granules. The Application of 25% less NPK resulted in 18.16% less straw yield compared to 100% NPK application. Foliar application of panchagavya or fish meal extract or sea weed extract increased the straw yield to the tune of 735, 577 and 389 kg/ha over 75% NPK + humic acid granules @ 12.5 kg/ha, respectively.

Conclusion

Application of 100% NPK + Humic acid granules @ 12.5 Kg/ha + Panchagavya @ 3% + Fish meal extract @ 3% + sea weed extract spray @ 0.35% on 20, 35 and 50 DAT is recommended for low land rice to get higher yields.

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