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Impact of Jeevamritham on growth, yield and nutrient uptake of ADT-43 rice variety

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Abstract
A field experiment was carried out during the *Kuruvai* season of 2021 at Experimental Farm, Department of Agronomy, Annamalai University, and Annamalai Nagar in Tamil Nadu to examine the impact of Jeevamritham on growth, yield and nutrient uptake of ADT – 43 rice variety. The experiment was laid out in a randomized block design (RBD) with three replications with nine treatment comparing recommended dose of fertilizers along with foliar application of Amirthakaraisal @ 3%, Panchagavya, @ 3%, Vermiwash @ 6%, Fish amino acid @ 1%, Sea weed extract @ 0.5%, Humic acid @ 0.1%, Gibberellin acid @ 0.05%, and Jeevamritham @ 3%. Among the treatment tried out, T_8- RDF + Jeevamritham at 3% recorded the highest plant height (114.70 cm), number of tillers m^{-2} (454.52), SPAD value, dry matter production, grain yield (5752 kg ha^{-1}), nutrient uptake (133.04 N,27.37 P,127.81 K kg ha^{-1}) and net income (Rs 51385 ha^{-1}). The least value was recorded in recommended dose of fertilizer application alone with plant height (80.62 cm), number of tillers m^{-2} (368.16), SPAD value, dry matter production, grain yield (3715 kg ha^{-1}), nutrient uptake (98.21 N,19.21 P,105.20 K kg ha^{-1}) of NPK respectively and net income (Rs 21321 ha^{-1}).

Keywords: Jeevamritham, nutrient, uptake, ADT-43, variety

Introduction
Among the crops, rice is the staple food of the planet that is cultivated largely on the total available agricultural land in the world. Rice is the most important ancient crop cultivated in 117 countries and about 90% of total rice is grown and consumed in Asia (Debbarma *et al.*, 2015) [4]. The release of high yielding varieties and the use of higher doses of fertilizer is attributed to an increasing trend for production of rice during recent time. But the usage of a higher quantity of fertilizer (containing only nitrogen (N), phosphorus (P), potash (K) and insufficient use of organics has created deficiencies of secondary and micronutrients. Apart from this, the farmers have to use more and additional fertilizer to obtain the same yield level as in previous years. Excess and imbalanced use of chemical fertilizer has reduced the soil fertility status and rice yield by 38% (Priyanka *et al.*, 2019) [14].
The incessant and steady application of inorganic fertilizers leads plant tissues to frequently absorb and accumulate heavy metals, which subsequently declines the nutritional and grain quality of crops (Maqbool *et al.*, 2020) [11]. Consequently, extreme usage of inorganic fertilizers has affected the environment and extinct of biodiversity causes water, air, and soil pollutions which leads to the destruction of physical soil characteristics, leaching of nutrients and accumulation of contaminated substances in water bodies (Agbede, 2010) [1]. Hence, agrochemicals are dominant and considerable as hazardous factors in livestock and human health. (Sharma *et al.*, 2017) [15]. Organic nutrients sustain the quality, improves soil chemical and physical properties, proliferation of organic matter in soil through the disintegration of its substances (Mader *et al.*, 2002) [9].
Organic matter enriches, plant growth regulators, soil nutrients and biodiversity (Kakar *et al.*, 2019) [8]. Therefore, an integrated nutrient management system is requisite to conserve soil quality and also to attain ideal grain quality with higher yield. Thus, there is a crucial requirement to apply abundant sources of organic nutrients as a substitute to decrease the consumption rate of inorganic fertilizers.
Foliar application is one of the methods of nutrient application in which fertilizers are applied in the form of a solution on the foliage of the plant. But foliar application alone may not be sufficient to obtain optimum yield. Foliar applied nutrients move in the crop plant through stomata. In this method, minor quantity of nutrient is applied at critical stages of crop growth and are absorbed quickly and effectively (Meyyappan *et al.*, 2021) [12].

During the *Kuruvai* season of 2021, a field experiment was executed in Experimental Farm, Department of Agronomy, Annamalai University, and Tamil Nadu. The experiment field is located at 11º24'N latitude and 79º44'E longitude and an altitude of + 5.79 m above mean sea level. The soil of the experimental farm was clay loam in nature with low in available N, pH of 7.5 and electrical conductivity of 0.50. The experimental soil was having 228, 18.53 and 317.50 kg ha^{-1} of accessible N, P and K, respectively with organic carbon of 0.62. The maximum temperature ranges from 30.9 ºC to 38.6 ºC with a mean of 34.6 ºC while the minimum temperature ranges from 23.0 ºC to 25.4 ºC with a mean of 24.1 ºC and the mean relatively humidity ranges from 81 to 92%.

The experiment was set up in a Randomized Block Design with nine different treatments and was replicated thrice. The treatment consists of RDF + Amirthakaraisal @ 3%, RDF + Panchagavya, @ 3%, RDF + Vermiwash @ 6%, RDF + Fish amino acid @ 1%, RDF + Sea weed extract @ 0.5%, RDF + Humic acid @ 0.1%, RDF + Gibberellin acid @ 0.05%, RDF + Jeevamritham @ 3% and recommended dose of fertilizer alone. The paddy seeds of ADT - 43 were sown adopting a seed rate of 60 kg ha^{-1}. The seeds were treated with Azospirillum @ 2 g kg^{-1}. The seedlings were transplanted in manual method by adopting 12.5x10 cm. The rice crop was fertilized with recommended dose of NPK with 120:40:40 kg of N, P_2O_5 and K_2O ha^{-1} in the form of Urea (46%), DAP (18% N and 46% P_2O_5) and Muriate of Potash (60% K_2O). The entire quantity of P and 50% of N and K_2O were applied as basal and the remaining quantity of N and K_2O were given as top dressing in two equal splits. One at active tillering and another at panicle primordial initiation stage. The foliar application of amirthakaraisal 3%, panchagavya 3%, vermiwash 6%, fish amino acid 1%, sea weed extract @ 0.5%, humic acid 0.1%, gibberellin acid @ 0.05% and Jeevamritham 3% were sprayed as per the treatment schedule at active tillering stage and panicle primordial initiation stage. The observations were recorded at different stages of crop growth. The samples were air-dried first, then oven-dried at 70 °C until they attained a uniform dry weight, which was then recorded. The mean dry weight was calculated in kg per hectare. Biometric data, analytical data from soil and plant samples, and calculated data were all statistically scrutinized using Gomez and Gomez (1984) technique. Where the treatment difference was found to be significant, the crucial difference was calculated at a 5% probability level using F test.

Results and Discussion

Among the treatment tried out, T_8- RDF + Jeevamritham at 3% recorded the highest plant height (114.70 cm), number of tillers/m^2 (454.52), SPAD value (42.70), dry matter production (13240 kg/ha). It was followed by RDF + Panchagavya @ 3% recorded plant height (110.30 cm), number of tillers m-^{2} (444.18), SPAD value (40.64), dry matter production (12733 kg ha^{-1}). The least value was recorded in recommended dose of fertilizer application alone with plant height (80.62 cm), number of tillers m^{-2} (368.16), SPAD value (24.89), dry matter production (8990 kg ha^{-1}).

All treatment was significantly influenced the plant height parameters. The highest value was recorded while spraying the Jeevamritham at 3% at active tillering stage and panicle primordial initiation stage along with recommended dose of fertilizers. Comparing with Jeevamritham with Panchagavya, the plant height was increased around 4.3 cm. The application of organic solution at the active tillering and panicle primordial stage increased the plant height up to 34.08 cm compared with recommended dose of fertilizer alone. The appearance of greater quantity of major nutrients in Jeevamritham leads to the increase of plant height. These finding were resulted by Goveanthan *et al*., 2020 [7].

All treatment was significantly influenced the number tillers m^{-2} parameter. The highest value was recorded while spraying the Jeevamritham at 3% at active tillering stage and panicle primordial initiation stage along with recommended dose of fertilizers. The use of Jeevamritham increased the number tillers m^{-2} up to 10.34 compared to Panchagavya application. The foliar application of organic solution at the active tillering and panicle primordial stage increased the number tillers/m^2 up to 86.36 compared with recommended dose of fertilizer alone. The increase in number of tillers per square meter might be due to the additional availability of nitrogen, which plays a pivotal role in cell division. (Mahanta *et al*., 2021) [10].

The dry matter production of the treatment recorded the significant different between treatments. T_8- RDF + Jeevamritham at 3% recorded the highest dry matter accumulation compared to other treatments. This was followed by Panchagavya application at 3% on par with treatment T_3- RDF + Vermiwash @ 6%. The least was recorded in recommended dose of fertilizer alone treatment. Compared to recommend dose of fertilizer with RDF + Jeevamritham at 3% and RDF + Panchagavya at 3% increased the dry matter production up to 47.27% and 41.63%. This could be attributed to greater potential of growth promoting substances in Jeevamritham which helps to enhance carbohydrate synthesis and effective translocation of photosynthates which would contribute to improvement in growth attributes these findings are in accordance with Dhapke *et al*. (2013) [5].

Among the treatment, T_8- RDF + Jeevamritham @ 3 per cent spray with 42.70 at flowering stage recorded the highest SPAD value. RDF + Panchakavya @ 3 per cent spray with 40.64 at flowering stage was next in order which was on par with treatment T_3 – RDF + Vermiwash @ 6 per cent spray with 39.88 at flowering stage. The lowest value of chlorophyll content index with 24.89 at flowering stage was registered under the RDF. All the growth parameters were presented in Table 1. The important effect of Jeevamritham is stimulation and growth of fine hair roots. Plants drenched with Jeevamritham consistently produce finer leaves and denser canopy. This was supported by findings of Bama and Somasundaram (2017) [3].

The data regarding grain yield was recorded at harvest stage of the crop. The grain yield at harvest was significantly enhanced by different treatment of foliar application spray at active tillering stage and panicle primordial initiation stage. The grain yield significantly differed from all the treatments. As regards the foliar application of various concentrations of nutrients, a maximum grain yield of 5752 kg ha^{-1} was recorded in the treatment RDF + Jeevamritham @ 3 per cent spray and followed by RDF + Panchagavya @ 3 per cent spray ranked next which was on par with RDF + Vermiwash @ 6 per cent spray. The minimum grain yield of 3715 kg ha^{-1} was exerted under the RDF (Table 2). The treatment with higher yield could be traced due to the beneficial effect of Jeevamritham cause more vigorous and extensive root system of crop leading to increased vegetative growth means for

more efficient sink formation and greater sink size, greater carbohydrate translocation from vegetative plant parts to the grains and higher dry matter accumulation during grain filling period. It also increase biological efficiency of crop plants and enhanced the level of enzyme activities in soil and promoted the reutilizing of soil nutrients in the ecosystem, improve the absorptive power of cations and anions present on soil particle and that may be released slowly during the crop growth and improvement in soil structure to existence of favourable nutritional environment under the influence of organic liquid manures which had a positive effect on vegetative and reproductive growth which ultimately led to realization of higher values for growth attributes leading to higher yield of crop. These results were in accordance with the findings of Patel *et al*. (2021) [13].

All the treatment showed a significant influence on nitrogen uptake by rice over control. Among the treatments, application of RDF + foliar application of Jeevamritham @ 3 per cent spray recorded the higher nitrogen, phosphorus and potassium uptake of 133.04, 27.37, 127.81 kg ha^{-1}. It was followed by RDF + Panchagavya @ 3 per cent spray and which was on par with RDF + Vermiwash @ 6 per cent spray. The least nitrogen, phosphorus and potassium uptake was recorded in RDF with 98.21, 19.21, 105.20 kg ha^{-1} (Table 2). The organic foliar application of Jeevamritham @ 3% increased the nutrient uptake of nitrogen, phosphorus and potassium up to 34.83, 8.16 and 22.61 kg ha^{-1}. Jeevamritham was found to be good in the content of soil fertilizing bacteria like N-fixers and P-solubilises and also the Lactobacillus. This may be attributed to addition of garden soil for the preparation of Jeevamritham. These findings were reported by Balakumar *et al*. (2021) [2].

The maximum gross returns of Rs. 96434 ha^{-1}, net returns of Rs. 51385 ha^{-1} was obtained with the treatment, application of RDF + Jeevamritham @ 3 per cent spray. This was followed by application of RDF + Panchagavya @ 3 per cent. The treatment (T_9) RDF (Control) registered the minimum gross returns of Rs. 64620 ha^{-1}, net returns of Rs. 21321 ha^{-1} (Table 2). Foliar spray is the cheapest methods of cultural practices for achieving better grain yield with minimum cost. BCR ratio gets increased with the less input cost and high economic yield. The usage of Jeevamritham as a soil enriching nutrients is both farmer and farm friendly under organic farming practices significantly enhances the growth and yield attributes along with straw yield and quality of harvested produce, which will result in better economics of crops grown. This is with the agreement with the finding of Somdutt *et al*. (2021) [16].

Table 1: Impact of Jeevamritham on growth, yield and nutrient uptake of ADT – 43 rice variety

Treatment	Plant height (cm)	Number of tillers m^{-2}	Dry matter production (kg ha^{-1})	SPAD value at flowering stage
T_1- RDF+ Amirthakaraisal @ 3 per cent spray	99.53	418.38	11224	35.48
T_2- RDF+ Panchagavya @ 3 per cent spray	110.30	444.18	12733	40.64
T_3- RDF+ Vermiwash @ 6 per cent spray	108.12	438.86	12263	39.88
T_4- RDF + Fish amino acid @ 1.0 per cent spray	103.89	428.59	11751	37.71
T_5- RDF+ Sea weed extract @ 0.5 per cent spray	94.99	407.15	10684	33.21
T_6- RDF+ Humic acid @ 0.1 per cent spray	85.57	381.47	9581	27.48
T_7- RDF+ Gibberellic acid @ 0.05 per cent spray	90.30	394.83	10137	30.87
T_8- RDF + Jeevamritham @ 3 per cent spray	114.70	454.52	13240	42.70
T_9- RDF (Control)	80.62	368.16	8990	24.89
S.Em±	1.00	3.11	163	0.60
CD (P= 0.05)	3.04	9.41	494	1.80

Table 2: Impact of Jeevamritham on growth, yield and nutrient uptake of ADT – 43 rice variety

Treatment	Grain yield (kg/ha)	N Uptake (kg/ha)	P Uptake (kg/ha)	K Uptake (kg/ha)	Gross Income (Rs./ha)	Net Income (Rs./ha)
T_1- RDF + Amirthakaraisal @ 3 per cent spray	4859	117.37	23.43	117.59	82490	37191
T_2- RDF+ Panchagavya @ 3 per cent spray	5480	128.88	26.35	125.11	92184	47035
T_3- RDF+ Vermiwash @ 6 per cent spray	5407	126.16	25.48	123.28	91056	43957
T_4- RDF + Fish amino acid @ 1.0 per cent spray	5136	121.89	24.46	120.50	86816	41117
T_5- RDF+ Sea weed extract @ 0.5 per cent spray	4578	112.70	22.39	114.62	78104	34080
T_6- RDF+ Humic acid @ 0.1 per cent spray	4013	103.15	20.28	108.49	69274	25250
T_7- RDF+ Gibberellic acid @ 0.05 per cent spray	4308	107.98	21.34	111.59	73866	26215
T_8- RDF + Jeevamritham @ 3 per cent spray	5752	133.04	27.37	127.81	96434	51385
T_9- RDF (Control)	3715	98.21	19.21	105.20	64620	21321
S.Em±	65.26	1.25	0.30	0.71		
CD (P= 0.05)	197.34	3.79	0.93	2.16		

Conclusion

The results of field experiment can be concluded that the treatment T8 – RDF + Jeevamritham @ 3 per cent spray is superior compared to the other treatment.

Hence, application of recommended dose of NPK with foliar application of Jeevamritham @ 3 per cent spray at active tillering and panicle primordial initiation stage is beneficial with minimal cost and eco-friendly for augment the growth and yield of rice.

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