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Influence of Vermiwash on Growth, Yield Attributes and Nutrient Uptake of Rice

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Field experiments were conducted at Annamalai University, Annamalai Nagar to study the influence of vermiwash on the growth, yield attributes and nutrient uptake of rice during *Navarai* 2013 (January to April) and *Kuruvai* 2013 (June to September). The experiment was laid out in randomized block design with three replications. These were eleven treatments involving panchakavya, fish amino acid and vermiwash sprayed at different concentrations and time. The results of the study revealed that foliar application of vermiwash @ 5% at tillering and flowering stages had resulted in significantly better plant growth in terms of plant height, number of tillers and dry matter production, higher number of yield attributes, grain and straw yield. This was followed by fish amino acid @ 3% at tillering and flowering. Foliar application of vermiwash @ 5% at tillering and flowering resulted in significantly increased nutrient uptake in rice.

Key words: Panchakavya, Vermiwash, Fish amino acid, Rice yield, Nutrient uptake.

Rice is the staple food of over half the world's population. Currently, rice is cultivated in an area of about 146 million ha with the total production of 535 million tonnes around the globe. In India, rice is cultivated in an area of about 42.3 million ha with an annual production of 103 million tonnes (2011-2012) and it is needs to be increased upto120 million tonnes by 2020. In Tamil Nadu, the area under rice is 2.20 million ha with a total production of 7.53 million tonnes and an average productivity of 3.76 tonnes per ha (TNAU, 2013). To meet the demand and to maintain self-sufficiency, the production has to be increased with an annual growth rate of at least 3 per cent in the productivity without compromising total area (ICAR, 2006). The additional production will have to come from less land area, less water and less human labour (Gujja and Thiyagarajan, 2009).

Continuous use of fertilizers, improved varieties and plant protection chemicals cause several hazards to soil health, which ultimately may result in the reduction of crop yield. Organic sources of plant nutrients offer twin benefit of increasing the organic matter content and improving the physical, chemical and microbiological properties of soil (Chettri and Bandhopathaya, 2005). Vermiwash, a foliar spray, is a liquid fertilizer collected after the passage of water through a column of earth worm activation. It is the collection of excretory and secretory products of earthworms, along with major micronutrients of the soil and soil organic molecules (Ismail, 1997). Thangavel *et al.* (2003) observed that both growth and yield of paddy increased with the application of vermiwash and vermicast extract. The nutrients present in vermiwash are in water soluble form and the immediate requirements of a number of components can be met from a single source (Rani Jasmine *et al.,* 2003). Vermiwash contains earthworm enzymes and molecules that enhance plant growth and yield. It also contains dissolved nutrients, organic acids and earthworm mucus (Siva Subramanian and Ganesh Kumar, 2004). Vermiwash has significant influence on plant growth and yield attributes (Meenatchi *et al.,* 2010). With these information in view, the present investigation was carried out to find out the influence of vermiwash on the growth, yield attributes and nutrient uptake in rice.

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Materials and Methods

Field experiments were conducted at Annamalai University, Annamalai Nagar. The experimental farm is situated at 11^0 24 N latitude, 79^0 44 E longitude at an altitude of ± 5.79 m above mean sea level. The soil of the experimental site was clay loam in texture, having pH 7.8, organic carbon 0.9 % , low in available nitrogen (227 kg ha^{-1}), medium in available phosphorus (18 kg ha^{-1}) and high in potassium (320 kg ha^{-1}). The experiments comprised eleven treatments of foliar application *viz.,* T_1 - control (no fertilizer and foliar application), T_2 - panchakavya 3% at tillering, T_3 - panchakavya 3% at tillering and flowering, T_4 - fish amino acid 3% at tillering, T_5 - fish amino acid 3% at tillering and flowering, T_6 - fish amino acid 5% at tillering, T_7 - fish amino acid 5% at tillering and flowering, T_8 - vermiwash 3% at tillering, T_9 - vermiwash 3% at tillering and flowering,

T_{10} - vermiwash 5% at tillering and T_{11} - vermiwash 5% at tillering and flowering. The experiment was laid out in randomized block design with three replications. Rice variety ADT 43 was used as test variety. All the treatments received recommended dose of fertilizer *viz.,* 120: 38: 38 kg N, P_2O_5 and K_2O ha^{-1}. Foliar fertilization of 3 % panchakavya (30 ml L^{-1} of water), fish amino acid 3 and 5 % (30 and 50 ml L^{-1}) and vermiwash 3 and 5 % (30 and 50 ml L^{-1}) were given tillering and flowering stages of rice as per the treatments. The quantity of spray fluid used was 750 L ha^{-1}. Growth and yield attributes, yield and nutrient uptake were recorded at harvest stage. The method of preparation of liquid organic manure is given below.

Preparation of liquid organic manures

Panchakavya

Panchakavya was prepared by using cow's dung (5kg) along with its urine, milk, curd and ghee @ 3,2,2 and 1 L, respectively were used along with 3 L each of sugarcane juice, tender coconut water and one kg of riped banana.

Cow dung was mixed with all other ingredients at once in a plastic container (25 L capacity). Riped bananas were also added to facilitate quick fermentation. All the materials were put into a wide mouthed plastic container and kept open under shade. The contents were stirred thoroughly for about 20 min, both in the morning and evening to facilitate aerobic microbial growth in order to increase the storability. After 30 d, panchakavya stock solution was ready for use. From the stock solution 3 and 5 % concentrations were prepared according to the requirement.

Vermiwash

The system to extract vermiwash consisted of a 10 L plastic container. At the bottom side, a hole measuring 1'' diameter was made to insert the vertical pipe to a T-joint in such a way that about half to one inch of the tube projects into a bucket. A tube was attached with the tap at the delivery end of the container.

In the container, the first layer was filled with broken bricks and pebbles up to 25 cm. This was followed by a 20 cm layer of coarse sand. Over this, good loamy soil was spread to a thickness of 30 cm and kept moistened constantly. In different layers of the bed, 25 worms of *Perionyx excavatus* (native species) and 25 worms of *Eudrilus euginae* (African species) were introduced. The top of the bed was covered with cattle dung and paddy straw. This system was moistened every day up to 15 d. The tap at the bottom was opened 20-25 min every day at the time of moistening. During the first 15 d, the earthworms population increased. They produced the compost and large number of drilospheres and vertical burrows made by earthworms, which would modify the accumulation and circulation of water and gases in soils, further influencing the decomposition of soil organic matter. On 16th d, the tap at the bottom of the container was closed and a 5 L vessel perforated at the base like a sprinkler was mounted as second unit, which gradually allowed the vermiwash percolated through the compost and drilosphere. This washing carried along with nutrients from freshly formed castings, as well as from the drilospheres through the filter unit. This vermiwash was used in the trial as per treatments; the washings were once again collected after 15 d of composting and used for further foliar spray. The vermiwash was found to be clear transparent and pale yellow.

Fish amino acid (FAA)

Fish amino acid is a liquid made from fish trash. It contains abundant amounts of nutrients and various types of amino acids. It is absorbed directly by the crops and is also known to stimulate microbial activities. The whole fish (bones, gills, guts, scales, tails *etc.*,) was mixed with brown sugar at the ratio of 10:1 and placed in a plastic container. Preparation of FAA was done at night to prevent flies from breeding. The contents were kept under shade after covering the container mouth. In about 2 - 3 d, due to osmotic pressure, the fish meat was liquefied. Further fermentation was completed in about 10 d. After 15 d, extractants were drained from the container and the liquid stored in clean plastic bottles.

Results and Discussion

Growth components

Foliar application of liquid organic manures exerted significant influence on plant height, number of tillers $hill^{-1}$ and dry matter production. Among the different liquid organic manures tested, foliar application of vermiwash @ 5% at tillering and flowering stages (T_{11}) recorded the maximum plant height of 100 and 102 cm; number of tillers $hill^{-1}$ of 13.50 and 13.56 and dry matter production of 11,715 and 11,986 kg ha^{-1} during *Kuruvai* and *Navarai* seasons, respectively. This treatment significantly differed from all other treatments (Table 1). The possible reason for this acceleration of plant growth might be due to the activation of cell division and cell elongation in the axillary buds, which would have increased plant height, dry matter production and number of tillers per hill. The application of organic sources of nutrients as foliar spray would have induced the endogenous synthesis of native auxins also, resulting in increased growth. Moreover, the interaction with the synthesis of native cytokinins in the root cells and their transport to auxiliary buds at later stages might have stimulated more branches. Increased dry matter production might be due to well established root system in addition to increased plant height and number of tillesr $hill^{-1}$. This finding

Table 1. Effect of vermiwash application on growth attributes of rice

Treatments	*Navarai* 2013			*Kuruvai* 2013		
	Plant height (cm)	Number of tillers hill $^{-1}$	Dry matter Production (kg ha^{-1})	Plant height (cm)	Number of tillers hill $^{-1}$	Dry matter Production (kg ha^{-1})
T_1 - Control (No fertilizer and foliar application)	62	8	6000	69	7	6175
T_2 - Panchakavya 3 % at tillering	75	9	8450	75	8	8650
T_3 - Panchakavya 3% at tillering and flowering	89	11	10300	94	12	10400
T_4 - Fish amino acid (FAA) 3 % at tillering	79	9	9000	78	9	9250
T_5 - Fish amino acid 3 % at tillering and flowering	96	13	11100	99	13	11400
T_6 - Fish amino acid 5 % at tillering	87	11	9990	90	11	10108
T_7 - Fish amino acid 5 % at tillering and flowering	88	11	10100	92	11	10225
T_8 - Vermiwash 3 % at tillering	82	9	9300	80	9	9450
T_9 - Vermiwash 3 % at tillering and flowering	93	12	10900	97	12	11000
T_{10}- Vermiwash 5 % at tillering	85	10	9872	88	11	9989
T_{11}- Vermiwash 5 % at tillering and flowering	100	14	11715	102	14	11986
SE_d	1	0.3	239	1	0.3	243
CD (p=0.05)	3	0.6	481	2	0.6	490

is in agreement with the findings of Nath and Singh (2011) who conducted summer experiments from in soybean.

Yield attributes

Foliar application of vermiwash @ 5% at tillering and flowering stages recorded higher number of

Table 2. Effect of vermiwash application on yield and yield attributes of rice

Treatments	*Navarai* 2013				*Kuruvai* 2013			
	No.of panicles m^{-2}	No. of filled grains panicle	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	No.of panicles m^{-2}	No. of filled grains panicle	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1 - Control (No fertilizer and foliar application)	251	50	2500	3432	275	55	2575	3472
T_2 - Panchakavya 3 % at tillering	300	61	3440	4900	350	66	3600	4950
T_3 - Panchakavya 3% at tillering and flowering	410	81	4725	6008	420	85	4750	5900
T_4 - Fish amino acid (FAA) 3 % at tillering	355	68	3700	5212	375	74	3900	5250
T_5 - Fish amino acid 3 % at tillering and flowering	440	90	5049	6450	452	91	5100	6470
T_6 - Fish amino acid 5 % at tillering	395	76	4400	5804	406	81	4600	5814
T_7 - Fish amino acid 5 % at tillering and flowering	403	79	4600	5903	412	83	4752	5895
T_8 - Vermiwash 3 % at tillering	369	70	3940	5405	380	75	4100	5475
T_9 - Vermiwash 3 % at tillering and flowering	430	86	5001	6316	440	89	5050	6205
T_{10}- Vermiwash 5 % at tillering	391	74	4200	5755	400	79	4400	5800
T_{11}- Vermiwash 5 % at tillering and flowering	461	95	5305	6767	475	94	5406	6788
SE_d	**9**	**2**	**125**	**148**	**8**	**1**	**126**	**147**
CD (p=0.05)	**18**	**4**	**251**	**299**	**17**	**3**	**254**	**297**

panicles m^{-2} (461 and 475) and number of filled grains panicle^{-1} (95 and 94) during *Navarai* and *Kuruvai* seasons (Table 2). This treatment was followed by foliar application of fish amino acid @ 3% at tillering and flowering stages. The experimental results further showed that all the yield parameters were similar irrespective of the seasons. The positive response to foliar application of vermiwash might be attributed to the better nutrient availability, resulting in increased yield attributes and yield in paddy, as reported earlier by Thangavel *et al*., (2003).

Grain and straw yield

The maximum yield of grain and straw were observed with the foliar application of vermiwash @ 5% at tillering and flowering stages (T_{11}), which had recorded significantly higher grain yield of 5,305 and 5,406 kg ha $^{-1}$; straw yield of 6,767 and 6,788 kg ha^{-1} during *Kuruvai* and *Navarai* seasons, respectively (Table 2). This was followed by foliar application of fish amino acid @ 3% at tillering and flowering stages. The pronounced increase in yield might be due to the sustained availability of essential plant nutrients throughout the growing phase and it also might be due to enhanced carbohydrate synthesis, and effective translocation of photosynthates to the developing sink. The proportion and activity of beneficial microbes would have been at the higher rate in vermiwash, which would have resulted help in the synthesis of growth promoting substances, in turn increasing grain and straw yield. Sivasubramanian and Ganesh Kumar (2004) also made similar observation enumeration of beneficial microbes and their identification in case of effective treatments need further exploration.

Table 3. Effect of vermiwash application on nutrient uptake in rice

Treatments	*Navarai* 2013			*Kuruvai* 2013		
	N(kg ha^{-1})	P(kg ha^{-1})	K(kg ha^{-1})	N(kg ha^{-1})	P(kg ha^{-1})	K(kg ha^{-1})
T_1 - Control (No fertilizer and foliar application)	94	15	160	90	15	160
T_2 - Panchakavya 3 % at tillering	104	16	211	106	17	190
T_3 - Panchakavya 3% at tillering and flowering	119	20	257	119	21	265
T_4 - Fish amino acid (FAA) 3 % at tillering	108	18	225	110	18	208
T_5 - Fish amino acid 3 % at tillering and flowering	123	22	271	124	23	285
T_6 - Fish amino acid 5 % at tillering	116	19	248	118	20	247
T_7 - Fish amino acid 5 % at tillering and flowering	118	20	250	119	21	259
T_8 - Vermiwash 3 % at tillering	110	18	230	113	19	215
T_9 - Vermiwash 3 % at tillering and flowering	122	22	269	123	23	280
T_{10}- Vermiwash 5 % at tillering	114	19	243	117	20	241
T_{11}- Vermiwash 5 % at tillering and flowering	126	24	284	128	25	298
SE_d	1.5	0.4	5.5	1.6	0.4	6.1
CD (p=0.05)	**3.0**	**0.8**	**11.2**	**3.3**	**0.8**	**12.4**

Nutrient uptake

Foliar application of vermiwash @ 5% at tillering and flowering stages (T_{11}) recorded the maximum nitrogen uptake of 126.6 and 127.5 kg ha^{-1}, phosphorus uptake of 23.9 and 24.5 kg ha^{-1} and potassium uptake of 284.2 and 298.4 kg ha^{-1} during *Navarai* and *Kuruvai* seasons, respectively (Table 3). This was followed by foliar application of fish amino acid @ 3% at tillering and flowering stages (T_5). The attributed reason might be due to the surplus availability and effective absorption of foliar nutrients in the plant system accelerating root growth, which would have contributed to better absorption of nutrients from soil. The present findings are in agreement with the result of Surya (2012) who reported similarly in Sweet corn.

Conclusion

Based on the results, it could be concluded that foliar application of vermiwash @ 5% at tillering and flowering (T_{11}) stages of rice could significantly enhance the crop growth parameters, yield attributes, yield and nutrient uptake. The foliar nutrient should be given at the right stages along with the recommended dose of fertilizers.

References

ICAR. 2006. Hand Book of Agriculture, ICAR, New Delhi.

TNAU. 2013. 33 Years of Rice in Tamil Nadu. In: www.tnau.ac.in. Department of Rice, Centre for Plant Breeding and Genetics, TNAU, Coimbatore.

Chettri, M. and P. Bandhopathaya. 2005. Effect of integrated nutrient management on fertilizer use efficiency and changes in soil fertility status under rice based cropping system. *Int. J. Agril. Sci.*, **75(9)**: 596-99.

Gujja, B. and T.M. Thiyagarajan. 2009. Indian food security. The System of Rice Intensification. Gate keeper series**. 143**: 4-5.

Ismail, S.A. 1997. Vermicology: The biology of earthworms. Orient Longman press, Hyderabad, p: 92.

Meenatchi, R., R.S. Giraddi, D.P. Biradar and A.S. Vastrad. 2010. Studies on effect of vermin technologies on insect pest activity and yield of soybean. *Kar. Jou. Agric. Sci.,* **32(2)**: 249-252.

Nath, G. and K.Singh. 2011. Effect of foliar spray of bio pesticide and vermiwash of animal agro and kitchen wastes on soybean (*Glycine max L.*). *Crop. Bot. Res. Intl.*, **4(3)**: 52-57.

Rani Jasmine, K., Ushakumari and M.S. Sailaja Kumara. 2003. Soil application of vermiwash on growth, yield and quality of tomato. *J. Agric. Resour. Mgt***. 2(3&4)**: 80-82.

Sivasubramanian, K. and M. Ganesh Kumar. 2004. Influence of vermiwash on the biological productivity of marigold. *Mad. Agric. J.,* **91**: 221-225.

Surya, K. 2012. Effect of intercropping and foliar nutrition through organic sources on growth and yield of sweet corn. M.Sc. (Ag.) Thesis*,* Annamalai University, Annamalai Nagar, Tamil Nadu.

Thangavel, P., R. Balagurunathan, J. Divakaran and J. Prabhakaran. 2003. Effect of vermiwash and vermicast extraction on soil nutrient status, growth and yield of paddy. *Adv. Plant Sci*., **16**: 187-190.

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