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EFFECT OF ORGANIC SEED MANAGEMENT TECHNIQUES ON SEEDLING PRODUCTION IN RICE cv. ADT 45

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Abstract

Sustainable organic nursery practices can increase plant marketability and reduce a nursery's impact on the environment in organic seed production. The present investigation was carried out to evaluate the efficiency and efficacy of various organic seed management techniques for seedling production, which is the integral part of the organic seed production in paddy. The fresh seeds of paddy cv. ADT 45 were raised in the nursery with the following treatments *i.e.*, Recommended practice (FYM 625 g + DAP 50 g), Green leaf manure (*Glyricidia sepium*) + *Azospirillum* soil application, Green leaf manure + *Azospirillum* + starter solution (10%) @ 1 lit m_2^{-1}, FYM (625 g) + GLM (green leaf manure) (225 g), FYM (625 g) + GLM (green leaf manure) (225 g) + panchakavya (3%), Vermicompost (330 g), Vermicompost (330 g) + panchakavya (3%) alongwith a control. Seeds from each treatment along with control were evaluated for various growth parameters *i.e.*, root length, shoot length, dry matter production, root volume, number of leaves per plant and chlorophyll content. Among the treatments, it was found that the T_7, *i.e.*, treatment with vermicompost + panchakavya recorded maximum root length, shoot length, dry matter production, root volume, number of leaves seedling^{-1} and total chlorophyll content when compared to other treatments and control.

Key words : Rice, seedling production, organic techniques, green leaf manure, shoot length, root volume.

Introduction

Rice is the staple food for nearly 65 per cent of the population in India. India, the second largest country in rice cultivated area (41 million hectares), holds the same position in production (105 million tonnes) as China contributes 7.53 per cent of the world's total rice production (USDA, 2013). Demand for rice is expected to grow faster than production in most countries (Swaminathan, 1998). The projected global rice demand for 2025 was 700 million tonnes, but current production was only 545 million tonnes.

Modern intensive agriculture is heavily dependent upon the chemical fertilizers for meeting the nutrient demand. The usage of chemical fertilizers has lead to accelerated growth of plants with the weakening of its tissue necessitating greater usage of pesticides for crop protection. The chemical residues of fertilizers and pesticides accumulated in the soil year after year have rendered our soil lifeless with its structure hardening. This has led to further increased usage of chemical inputs of exorbitant cost with miserably poor crop yields and crop failure. Deterioration of soil health, stagnation in productivity, insecurity of quality seed and environmental hazards have come before the scientific and farming community as big challenges along with new research avenues.

Hence, awareness has sprung on the adoption of organic farming as a remedy to cure the ills of modern chemical agriculture. Organic agriculture is environmental friendly ecological production system that promotes and enhances biodiversity, biological cycle and biological activities. It is based on minimal use of off-farm inputs and management practices that restore, maintain and enhance ecological harmony. The principal guidelines for organic production are to use materials and practices that enhance the ecological balance of natural systems and integrate the parts of the farming systems into an ecological holistic system.

Panchagavya, starter solution and vermicompost are the pieces of traditional wisdom meant to safe guard plants and soil micro organisms (Natarajan, 2002). Hence, seed production using organic means is getting momentum now a days. As per the stipulations of International Federation of Organic Agriculture Movements (IFOAM), sowing

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organic seed has become mandatory for organic agriculture since 2003. With this insight in view, the present work on organic method of seedling production in rice was taken up.

Materials and Methods

Genetically pure seeds of paddy *cv.* ADT 45 obtained from the Tamil Nadu Rice Research Station, Aduturai constituted the study material for the present investigation. Nursery trials were laid out during June 2013 with the following treatments. The trial was laid in RBD with three replications. Nursery bed of 1 × 1 m dimension was prepared. Equal amount of N in the form of FYM, vermicompost, green leaf manure, *Azospirillum*, starter solution alone and in combination with foliar spraying of 3 per cent panchakavya were applied to individual plots. One bed without nutrient application was kept as control. Then, pre-germinated seeds at the rate of 50 g m^{-2} were sown to all the plots irrespective of treatments. The initial seed qualities and other growth parameters were recorded on 25th day after sowing.

Treatments

T_0 - Control.

T_1 - Recommended practice (FYM 625 g + DAP 50 g).

T_2 - Green leaf manure (*Glyricidia sepium*) + azospirillum soil application.

T_3 - Green leaf manure + azospirillum + starter solution (10%) @ 1 lit m^2.

T_4 - FYM (625 g) + Green leaf manure) (225 g).

T_5 - FYM (625 g) + Green leaf manure (225 g) + panchakavya (3%).

T_6 - Vermicompost (330 g).

T_7 - Vermicompost (330 g) + panchakavya (3%).

Preparation of organic solutions

Panchakavya

Panchakavya is a combination of five products obtained from the cow. These are cow dung, cow's urine, cow's milk, curd and ghee. Five kg fresh cow dung and one litre of cow's ghee were mixed well and kept for 3 days. On fourth day, cow's milk (2 lit.), cow's curd (2 lit.) and cow's urine (3 lit.) were added to the cow dung mixture. This mixture was stored for fermentation in a wide mouthed earthern pot in open for 15 days. The contents were stirred well twice a day, both in the morning and evening. Then 5 days after fermentation, panchakavya was diluted to different concentrations and used for seed treatments (Somasundaram, 2003).

Starter solution

Starter solution is a mixture of cow dung, cow's urine and palm sugar with a ratio of 1:1:0.25. The mixture was kept for 24 hrs. for fermentation and then used.

Observations recorded

Ten seedlings were randomly removed from each plot carefully with utmost care to remove the plant intact with entire root system undisturbed. The length of root in each plant was recorded and the mean was arrived at and reported in cm. Shoot length of the same seedlings was recorded from the base of the seedling to the tip of the top most leaf stretched, mean shoot length was arrived at and reported in cm. The seedlings selected for root and shoot length were placed in a paper cover, shade dried for 24 hrs. and again in hot air oven at 85 ± 1°C. Then, they were cooled in a desiccator, weighed and expressed in g per $seedlings^{-10}$.

The roots of randomly selected five seedlings from each plot were scooped along with soil and whole seedling was washed in running water carefully. Then the roots were detached from the nodal base of seedlings. Any excess moisture on the surface of the roots was removed by wiping with blotting paper. Thereafter, the roots were placed in a measuring cylinder containing known volume of water. By measuring the increase in the water column, root volume was assessed. Mean value was expressed in cc $seedling^{-1}$.

Ten seedlings from each plot were randomly selected and the number of leaves were counted and finally expressed as number of leaves $seedling^{-1}$. Leaf chlorophyll content was estimated as per the procedure of Yoshida *et al*. (1972). The data pertaining to the above observations were statistically analysed by adopting the procedure described by Panse and Sukhatme (1999). Wherever necessary, suitable transformation was made before analysis.

Results and Discussion

Proper nutrient management in nursery will reflect on the behavior of crop in the main field. Earlier findings revealed that healthy and vigorous seedling with desirable root and shoot development could be obtained by nursery manuring (Rajendran, 1991). Proper fertilization of nursery beds produces early and deep rooted seedlings, which will therefore have a great resistance to setbacks. In an attempt on organic seed production in rice, it becomes essential to raise an organic nursery. In the present study, the fresh seeds of paddy cv. ADT 45 were raised in the nursery using the following treatments *i.e.*, Recommended practice (FYM 625 g + DAP 50 g), Green leaf manure (*Glyricidia sepium*) + azospirillum soil application, Green leaf manure + azospirillum + starter solution (10%) @ 1 lit m_2^{-1}, FYM (625 g) + GLM (green leaf manure) (225 g), FYM (625 g) + GLM (green leaf manure) (225 g) + panchakavya (3%), Vermicompost (330 g) and Vermicompost (330 g) + panchakavya (3%). Seeds from each treatment along with untreated seeds were evaluated for various growth parameters *i.e.*, root length (cm), shoot length (cm), dry matter production, root volume, number of leaves per plant and chlorophyll content.

The organic techniques followed in this experiment significantly influenced root and shoot length, dry matter production, root volume, number of leaves and chlorophyll content. The maximum root length was observed in the treatment $\mathbf{T_7}$ (19.41 cm) followed by $\mathbf{T_5}$ (18.64cm) .The minimum root length was noted in control, $\mathbf{T_0}$ (15.91 cm) when compared to other treatments. Similarly for shoot length and root volume, maximum values were observed in treatment $\mathbf{T_7}$ (27.58 cm and 1.49 cc seedling^{-1}) followed by $\mathbf{T_5}$ (26.34cm and 1.34 cc seedling^{-1}) respectively. The minimum root volume was noted in control, $\mathbf{T_0}$ (1.09 cc seedling^{-1}), when compared to the other treatments (table 1). The maximum dry mater production was observed in the treatment $\mathbf{T_7}$ (0.584 g/ 10 seedlings) followed by $\mathbf{T_5}$ (0.458 g/10 seedlings) and minimum dry mater production was noted in control, $\mathbf{T_0}$ (0.214 g/10 seedlings). The maximum number of leaves was observed in the treatment $\mathbf{T_7}$ (7.7) followed by $\mathbf{T_5}$ (6.7). The minimum number of leaves was noted in control, $\mathbf{T_0}$ (4.9) when compared to the other treatments (table 1).

The $\mathbf{T_7}$ treatment, *i.e.*, vermicompost (330 g) + panchakavya (3%) treatment recorded higher values for the biometrical traits *viz.*, root length (cm), shoot length (cm), dry matter production, root volume, number of leaves per plant, chlorophyll a, chlorophyll b and total chlorophyll contents which were 21.9, 22.5, 27.5, 36.6, 32.7, 25.0, 60.7 and 38.1 percentages higher than the control, respectively with the above mentioned characters. Similar results were reported by Ganesh *et al.* (2011) in rice, Srimathi *et al.* (2013) in biofuel crop, Rajesh and Kaliyamoorthy (2013) in bhendi and Rao and Wahab (2014) in rice fallow green gram.

Vermicompost + panchakavya treatment was found superior in enhancing root length, shoot length and dry matter production as measured at two growth stages. Root volume also was found improved by vermicompost + panchakavya treatment. According to Rayle and Cieland (1977), enhanced cell division and elongation would have contributed towards root volume increase. Increased root and shoot length might be due to increase in total ATPase activity, which might have increased

Table 1 : Influence of organic nursery management techniques on seedling quality in rice *cv.* ADT 45.

Treatments	Root length (cm)	Shoot length (cm)	Dry matter production (g 10 seedlings^{-1})	Root volume (cc seedling $^{-1}$)
T_0	15.91	22.51	0.214	1.09
T_1	18.28	26.23	0.446	1.32
T_2	16.66	23.87	0.296	1.25
T_3	17.71	24.96	0.324	1.31
T_4	17.09	23.77	0.350	1.24
T_5	18.64	26.34	0.458	1.34
T_6	17.41	24.11	0.297	1.22
T_7	19.41	27.58	0.584	1.49
Mean	17.73	24.92	0.355	1.282
S.Ed	0.297	0.709	0.852	0.013
CD(0.05)	0.593	1.416	1.704	0.027

Table 2 : Influence of organic nursery management techniques on growth parameters in rice *cv.* ADT 45.

Treat-ments	Number of leaves	Chlorop-hyll a (mg g^{-1})	Chlorop-hyll a (mg g^{-1})	Chlorophyll total (mg g^{-1})
T_0	4.9	1.949	0.833	2.383
T_1	6.6	2.179	1.087	3.197
T_2	5.2	2.048	0.883	2.627
T_3	5.8	2.102	0.957	2.773
T_4	5.7	2.162	0.976	2.791
T_5	6.7	2.310	1.123	3.208
T_6	5.5	2.166	0.943	2.912
T_7	7.7	2.437	1.339	3.293
Mean	6.012	2.169	1.017	2.898
S.Ed.	0.124	0.001	0.091	0.072
CD(0.05)	0.246	0.002	0.182	0.144

active cell division and cell elongation resulting in increased length (Maeshima, 1990). Shoot length increase might also be due to increase in chlorophyll content (Srivastava *et al.*, 1994). Seedling dry matter production is an important contributing character for crop performance. In the present study, vermicompost + panchakavya recorded maximum dry matter.

Generally, organic manures improve the nutrient status of soil pool in view of slow release effect. Positive effect of vermicompost treatment might be due to enhanced activity of beneficial microbes like N_2 fixers and colonization by mycorhiza fungi. They played significant role in N_2 fixation and phosphate mobilization leading to better uptake by the plants. Thus, the increased availability of nutrient and uptake by plants would have resulted in better growth in plots treated with vermin compost (Kale *et al*., 1992). Vermicompost also possesses a variety of constituents like enzymes, hormones and vitamins (Jose, 2002). Similar result about vermi-compost has been reported by Ambika *et al*. (2014), Govindan *et al.* (1995), Puspha (1996), Singh *et al.* (1998), Ganesh *et al.* (2011) in rice and Srimathi *et al.* (2013) in biofuel crops.

The number of leaves was maximum in the plants raised from vermicompost + panchakavya treatment plots. Similar results were obtained by Govindan *et al*. (1995) in bhendi. Eventhough vermicompost application alone has caused increased seedling growth characters, it is the combination effect of panchakavya spray, which increased the seedling growth characters to the maximum level. Panchakavya spray on foliage would have enabled better nutrient absorption encouraging quick growth and increased plant height as noticed in the treatments receiving panchakavya spray. This was in line with the results of Ambika *et al*. (2014) in rice, Subhashini Sridhar *et al*. (2001) in chillies, Somasundram (2003) in maize, sunflower and green gram, Boomiraj (2003) in bhendi and Yadav (2005) in rice.

Chlorophyll is the most important cell organelle as they are involved in photosynthesis. The maximum chlorophyll a was observed in $\mathbf{T_7}$ (2.437) followed by $\mathbf{T_5}$ (2.310). The minimum chlorophyll a was noted in control, $\mathbf{T_0}$ (1.949) when compared to the other treatments. A similar trend was also followed in chlorophyll b and total chlorophyll. Vermicompost + panchakavya recorded the highest chlorophyll content. Vermicompost and panchakavya, by virtue of presence of variety of constituents like enzymes, hormones, vitamins, nutrient content and growth promoters (IAA, GA) could have contributed towards increased chlorophyll content (Jose, 2002). Higher chlorophyll content of leaves due to panchakavya spray was also reported in *Moringa* (Beaulah, 2001), *Withania sominifera* (Cynthia starlyn Emily, 2003) and *Coleus forskholi* (Kanimozhi, 2003).

Hence, it can be concluded that in organic seedling production in rice, vermicompost + panchakavya treatment was found very effective in enhancing seedling growth and chlorophyll content, when compared to other treatments and control.

Annexure I : Biochemical properties of Panchakavya (Somasundaram, 2003).

Contents	Quantity
Total N (ppm)	382
Total P (ppm)	238
Total K (ppm)	356
Total sugars (ppm)	205
Reducing sugars (ppm)	92
Glucose (mg/dl)	6.0
Total N (ppm)	92
Total organic carbon (%)	0.80
IAA (ppm)	9.15
GA (ppm)	4.0
Bacteria (CFU/ml)	24×10^6
Fungi (CFU/ml)	1×10^3
Actinomycetes (CFU/ml)	3×10^3
Pseudomonas (CFU/ml)	45×10^3
Yeast (CFU/ml)	35×10^4
Lactic acid bacteria (CFU/ml)	18×10^5
Methylotrophs (CFU/ml)	5×10^3
Azospirillum (CFU/ml)	2×10^2
Acetobacter (CFU/ml)	43×10^3
Ammonium oxidizes (CFU/ml)	24×10^5
Nitrite oxidizes (CFU/ml)	2×10^2
Ph	5.12
EC (dSm^{-1})	9.9
Zn (ppm)	0.26
Fe (ppm)	0.83
Mn (ppm)	0.23
Cu (ppm)	0.20

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