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Effect of Organic Seed Enhancement Treatment on Seed Yield and Quality in Ragi Cv. TRY 1

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ABSTRACT

The present investigations were carried out at the Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University to study on the effect of various seed enhancement treatments on seed yield and quality in ragi cv. TRY 1. The seeds of ragi cv. TRY 1 were given with various pre sowing organic seed treatments i.e. Cow urine @ 5%, Vermiwash extract @ 5%, Panchagavya extract @ 5%, Azospirillum extract @ 5%, Goat urine @ 5%, Phosphobacteria extract @ 5% along with control. All the pre sowing treatment seeds were evaluated for the initial quality characteristics. The Vermiwash extract @ 5% pre sowing treatment registered significantly higher values for initial seed qualities and lower electrical conductivity. In field evaluation, Vermiwash extract @ 5% pre sowing treatment seeds recorded higher growth, physiological and yield parameters.

Key words: Ragi, Organic seed enhancement, Seed yield

Finger millet (*Eleusine coracana* L.) is important millet grown extensively in various regions of India and Africa, constitutes as a staple food for a large segment of the population in these countries. Ragi is a rich source of Calcium, Iron, Protein, Fiber and other minerals. The cereal has low-fat content and contains mainly unsaturated fat. It is easy to digest and does not contain gluten; people who are sensitive to gluten can easily consume Finger Millet. Ragi is considered one of the most nutritious cereals. It has different names in local languages. It is known as Ragi in Telugu and Kannada, Kelvaragu/aariyam in Tamil, and Madua/Mangal in Hindi. Seed is the most vital and crucial input for crop production. It is the cheapest input in crop production and key to agriculture progress. The importance of quality seeds has been recognized from the time immemorial. The good seed in good soil yields abundantly. Seed quality has been treated as sacred, being an important factor in the improvement of agriculture and agrarian societies. Seed enhancements is defined as post-harvest treatments that improve germination or seedling growth, or facilitate the delivery of seeds and other materials required at the time of sowing. Seed enhancement is a range of treatments of seeds that improves their performance after harvesting and conditioned, but before they are sown. seed priming is a cost effective technology that can enhance early crop growth leading to earlier and more uniform stand with yield associated benefits in many field crops including oilseeds. Primed seeds actually exhibit increased germination rate, enhanced germination uniformity and enhanced speed of emergence and at times, greater total germination percentage (Shehzad *et al.* 2012). With the above background, the study was undertaken in ragi cv. TRY 1 to study the effect of

various organic seed enhancement treatment on seed yield and seed quality.

METERIALS AND METHODS

The present investigations were carried out at the Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University to study the effect of the pre sowing botanical seed treatment on seed yield and quality in ragi. Freshly harvested bulk seeds of ragi cv. TRY 1 were graded and imposed with the following pre sowing seed treatments.

Treatment details

T_0 – Control
T_1 – *Cow urine* @ 5% hardening
T_2 – *Vermiwash* extract @ 5% hardening
T_3 – *Panchagavya* extract @ 5% hardening
T_4 – *Azospirillum* extract @ 5% hardening
T_5 – *Goat urine* @ 5% hardening
T_6 – *Phosphobacteria* extract @ 5% hardening

The hardened seeds were dried back to original moisture content. The treatments were evaluated for seed quality parameters viz. speed of germination (Maguire 1962), germination (%), root length (cm), shoot length (cm), dry matter production (mg) as per the procedure of ISTA (1999), seedling vigour index I, seedling vigour index I (Abdul-Baki and Anderson 1973) and EC I, electrical conductivity (d sm^{-1}) (Presley 1958), dehydrogenase activity (Kittock and Law 1968) and protein content (%) (Alikhan and Youngs 1973). The above treated seeds were also evaluated for their field performance. Field trial was conducted by adopting randomized block design with three replications. The plot size was 3 × 5 m^2. The crop was raised with the spacing of 25 × 15 cm and recommended package of practices for ragi were followed. And the following growth parameters i.e. field emergence (%), plant height (cm), days to 1st flowering, days to 50% flowering, number of tillers $plant^{-1}$, chlorophyll content, gas exchange parameters, number of productive, length of the earhead (cm), weight of the earhead $plant^{-1}$ (g), weight of earhead $plot^{-1}$ (kg), weight of earhead ha^{-1} (kg), seed yield $plant^{-1}$ (g), seed yield $plot^{-1}$ (kg), seed yield ha^{-1} (kg), harvest index, seed recovery (%) and 1000 seed weight were recorded. All the data were analyzed statistically with appropriate tools and expressed as mean values as per the method of Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Seed treatment with organic products may promote plant growth or provide diseases control through a variety of mechanism, including supply of organic nutrient production of plant hormones, antibiotic or enzyme; induced systemic resistance; direct parasitism of plant pathogen or deleterious micro-organisms; or competition with pathogen for or nutrients (Jayanth kumar *et al*. 2017). Organic priming may be helpful in reducing the risk of poor stand establishment. It improves seed performance might be attributable in part to the decreased lipid peroxidation and increased oxidative activities during seed imbibitions. The effect of priming depends on the adopted method and duration of treatment. It does not require any special technical equipment owing to the use of distilled water or any other organic materials as priming medium (Tiwari *et al.* 2018).

Table 1 Effect of organic seed enhancement treatment on various seedling quality in ragi cv. TRY 1

Treatment	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg $seedling^{-10}$)
T_0	21.50	82 (64.92)	7.40	4.90	2.79
T_1	24.30	90 (71.65)	8.70	6.40	3.79
T_2	25.10	95 (79.01)	9.50	7.00	4.20
T_3	24.70	93 (75.11)	9.10	6.80	4.00
T_4	22.29	86 (68.04)	8.10	5.70	3.29
T_5	21.70	84 (66.45)	7.70	5.40	2.90
T_6	23.20	88 (70.01)	8.30	6.00	3.50
Mean	23.25	88.28 (70.14)	8.40	6.02	3.49
SED	0.7946	3.0064	0.2901	0.2127	0.1246
CD(P=05)	1.7083	6.4637	0.6237	0.4573	0.2678

Figures in parenthesis are arcsin transformation values

In the laboratory analysis the 5% vermiwash hardened seeds recorded higher seed qualities viz. speed of germination, germination percentage, root length, shoot length and dry matter production. The above mentioned treatment was recorded 16.7, 15.8, 28.3, 42.8 and 50.5 percentages higher than control respectively with the above mentioned characters (Table 1). This treatment also recorded higher values for seed qualities viz. vigour index I, vigour index II, total dehydrogenase activity and protein content which recorded 55.4, 58.8, 26.1 and 4.2 percentage higher than control respectively with the above mentioned characters. The seed hardened with vermiwash @ 5% recorded lower EC value 7.03 dSm^{-1} when compared with other treatments (Table 2). Nutrients and growth promoting substances present in the vermiwash showed its potentiality in seed germination and seedling vigour (Chattopadhyay 2015). The enhanced seed quality such as root growth parameters can be attributed to the presence of humic acid in vermicompost and vermiwash. Humic acids have been known to enhance root growth (Tallini *et al.* 1991) and

nutrient uptake by increasing the root cell membrane permeability (Valdrighi *et al.* 1996). The better growth with vermicompost may be attributed to presence of unique mesophylic bacteria, fungi and worm secretions in vermicompost. This signifies that vermicompost is not all about nutritional enrichment but involvement of richer microbial, enzymatic activity of soil and plant growth regulators (Zaller 2006). Increase in shoot length with vermiwash treated plants may be due to increased availability of more exchange of nutrients in the soil by application of vermiwash (Rajan and Murugesan 2012). Increase in dehydrogenase activity and protein content supports the fact that the application of vermiwash influences growth by increasing the mitotic index. This observation can be correlated with the earlier studies of (Gajalakshmi and Abbasi 2004) who reported stimulating influence of vermiwash on seed quality in *Solenum melogena*. Similar results were reported by Rajan and Murugesan (2012), Farooq *et al.* (2006) in rice and Senthilmurugan *et al.* (2018) in Bhendi.

Table 2 Effect of organic seed enhancement treatment on other seedling quality in ragi cv. TRY 1

Treatment	Vigour Index I	Vigour Index II	Electrical conductivity (dSm^{-1})	Total Dehydrogenase activity (OD value)	Protein content (%)
T_0	1008.60	238.60	9.08	0.42	9.95 (18.38)
T_1	1359.00	342.00	8.28	0.49	10.23 (18.65)
T_2	1567.50	379.00	7.03	0.53	10.37 (18.78)
T_3	1478.70	352.00	7.18	0.51	10.29 (18.70)
T_4	1186.80	283.80	8.78	0.43	10.11 (18.53)
T_5	1100.40	243.60	9.06	0.43	10.05 (18.48)
T_6	1258.40	308.00	8.35	0.47	10.17 (18.59)
Mean	1279.91	306.71	8.25	0.47	10.16 (18.52)
SED	46.1445	11.1354	0.2588	0.0168	0.042
CD(P=05)	99.2108	23.9411	0.5565	0.0361	0.082

Figures in parenthesis are arcsin transformation values

The seeds hardened with 5% vermiwash were also evaluated under field condition, the growth parameter, gas exchange and yield parameter were observed. It revealed that the 5% vermiwash hardened seeds recorded higher values for the growth parameters viz. field emergence, plant height and number of tillers $plant^{-1}$ which were 23.07, 9.8 and 58.06 percentages higher than the control respectively with the above mentioned characters (Table 3). This treatment also recorded earlier days to first flowering and days to 50% flowering of 45.30 and 60.30 days respectively when compared to other treatments (Table 3). Vermiwash is liquid manure, extracted of vermicomposts riches with more number of earthworms. Its foliar spray dramatically improves the growth and productivity of crop (Manivannan 2004) has indicated that it is coelomic fluid extraction contains several enzyme, plant growth hormones like cytokinins, gaberdine and vitamins along with micro and macro nutrients. It improves plant growth in crop, (Atiyeh *et al.* 2002) have reported that nitrogen in the form of mucus, nitrogenous excretory substance; growth stimulating hormones and enzyme are found in vermiwash (Karuna 1999). Vermiwash is believed to contain plant growth hormones, enzymes and vitamins from earthworm-associated microbes (Suthar, 2010). Vermiwash promotes plant growth by physical amelioration of substrate and influencing nutrient uptake mechanism (Alvarez and Grigera 2005). Edwards, reported in the microbial activity in vermicomposts could result in production of significant quantity of plant growth regulators such as IAA, gibberellins, cytokinins, by microorganisms. Large amount of humic acid were produced during vermicomposting and these had been reported to have positive effects on plant growth. Similar results were reported by Rajan and Murugesan (2012), Farooq *et al.* (2006) in rice.

Table 3 Effect of organic seed enhancement treatment on various growth parameters in ragi cv. TRY 1

Treatment	Field emergence (%)	Plant height (cm)	Days to 1st flowering	Days to 50% flowering	Number of tillers $plant^{-1}$
T_0	78 (62.04)	95.90	51.70	65.70	3.10
T_1	92 (73.70)	100.50	48.10	63.20	4.20
T_2	96 (80.26)	105.30	45.30	60.30	4.90
T_3	94 (76.43)	104.60	46.20	62.40	4.50
T_4	84 (66.43)	97.60	49.30	64.80	3.70
T_5	82 (64.92)	96.30	49.80	65.30	3.30
T_6	86 (68.23)	99.70	48.50	64.30	4.00
Mean	87.42 (69.47)	99.98	48.41	63.71	3.95
SED	1.6759	1.8543	0.8164	1.0917	0.0861
CD(P=05)	3.6534	4.0423	1.7797	2.3798	0.1878

Figures in parenthesis are arcsin transformation values

The physiological parameter such as chlorophyll content, photosynthesis, transpiration, intercellular CO_2 concentration and stomatal conductance also higher in vermiwash pre sowing seed treatment which was 23.8, 55.3, 53.3, 15.8, 59.2 percentages higher than control respectively with the above mentioned characters (Table 4). The reasons for increased seed physiological parameters may be due to the fact that vermiwash is coelomic fluid extraction contains several enzyme, plant growth, hormones like, cytokinins, gibberlines and vitamins along with micro and macro nutrients. Increased transpiration rate in the presence of vermiwash, may be due to the physical, chemical and biological structure of vermiwash. It increases the amount of water entering roots due to its capacity of holding water and the microorganisms including mycorrhizal fungi. Therefore, the transpiration rate rise along with the increase in plant water. Vermiwash is the source of minerals and plant growth hormones such as auxin and other plant growth regulators, including humic acids, and also because of its physicochemical structure, it has a positive effect on the photosynthetic system (Buckerfield *et al*. 1999). Similar results reported by Rajan and Murugesan (2012), Farooq *et al*. (2006) in rice and Senthilmurugan *et al.* (2018) in Bhendi.

Table 4 Effect of organic seed enhancement treatment on various physiological parameters in ragi cv. TRY 1

Treatment	Chlorophyll content (mg g^{-1})	Photosynthetic rate (mg CO_2 $m^{-1}S^{-1}$)	Transpiration rate (mg H_2O CO_2 $m^{-1}S^{-1}$)	Intercellular CO_2 concentration (mol/mol)	Stomatal conductance (mol/mol. S)
T_0	1.95	22.34	5.45	292.3	0.27
T_1	2.28	32.80	7.87	327.5	0.39
T_2	2.39	34.70	8.36	338.6	0.43
T_3	2.31	33.62	8.18	332.7	0.41
T_4	2.16	27.42	6.65	319.2	0.31
T_5	2.11	24.57	6.36	297.8	0.29
T_6	2.24	30.52	7.32	323.2	0.37
Mean	2.20	29.42	7.17	318.77	0.35
SED	0.0754	1.0563	0.2568	10.8270	0.0132
CD(P=05)	0.1622	2.2710	0.5522	23.2781	0.0284

Table 5 Effect of organic seed enhancement treatment on various yield parameters in ragi cv. TRY 1

Treatment	Number of productive tillers $plant^{-1}$	Ear head length (cm)	Ear head weight (g $plant^{-1}$)	Ear head yield (kg $plot^{-1}$)	Ear head yield (kg/ha)
T_0	2.80	4.90	6.50	3.34	2369
T_1	4.10	6.80	9.90	4.15	2643
T_2	4.50	7.50	10.20	4.17	2784
T_3	4.40	7.30	10.00	4.16	2757
T_4	3.50	5.90	8.70	3.86	2584
T_5	2.90	5.40	7.90	3.48	2478
T_6	3.80	6.30	9.40	3.95	2634
Mean	3.71	6.30	8.94	3.87	2607
SED	0.0799	0.1315	0.1823	0.0752	49.2290
CD(P=05)	0.1743	0.2868	0.3974	0.1639	107.3193

The above treatment was also recorded the higher yield attributes character such as number of productive tillers $plant^{-1}$, ear head length, ear head weight, ear head yield $plot^{-1}$ and ear head yield kg ha^{-1}, which was 60.7, 53.06, 56.9, 24.8 and 17.5 percentage higher than control in respective with the above mentioned characters (Table 5). This treatment was also recorded the seed yield parameters such as seed yield $plant^{-1}$, seed yield $plot^{-1}$, seed yield kg ha^{-1}, harvest index, seed recovery % and 1000 seed weight were also 58.9, 16.7, 16.8, 15.3, 21.9 and 22.7 percentage higher than control respectively with the above mentioned characters (Table 6). The vermiwash contain auxin like substance that modifies the effects of the plant auxins and enhanced plant growth and the application of vermiwash to plants. They enter the cells facilitating easy rapid utilization of nutrients. The vermiwash also contains enzymes and secretions of earthworms and would stimulate the growth and yield of crops (Kale 1998). Vermiwash contains several enzymes, plant growth hormones, vitamins along with micro and macronutrients which increases the resistance power of crops against various diseases and enhances the growth and productivity of crops (Zambare *et al.* 2008). The enhanced growth and yield may be due to the presence of growth regulatory substances such as IAA, GA, cytokinin, essential plant nutrients and effective microorganisms (Esakkiammal *et al.* 2015). Higher seed quality content and yield might be attributed to the presence of plant growth promoters like gibberllins, cytokinin, auxins and vitamins like D present in vermiwash (Radhakrishnan and Mahendran 2009). The increase in various yield attribute due to vermipriming may be attributed to the presence of water-soluble macro- and micronutrients, growth promoting hormones, beneficial

micro-organisms, etc. which might have also caused a buildup of germination-promoting metabolites, metabolic repair during imbibitions and osmotic regulations within the seed and increases its yield. It contains various enzymes cocktail of protease, amylase, unease and phosphatase. These are beneficial for growth and development of plant and stimulate the yield and productivity of crops (Hussain *et al.* 2016). Similar results reported by Rajan and Murugesan (2012), Farooq *et al.* (2006) in rice, Senthilmurugan *et al.* (2018) in Bhendi and Prakash *et al.* (2019) in sesame.

Table 6 Effect of organic seed enhancement treatment on various seed yield parameters in ragi cv. TRY 1

Treatment	Seed yield/plant (g)	Seed yield/plot (kg)	Seed yield (kg/ ha)	Harvest index	Seed recovery (%)	1000 seed weight (g)
T_0	3.90	1.49	986	0.13	55.60 (48.21)	2.20
T_1	5.70	1.69	1135	0.15	64.50 (53.43)	2.60
T_2	6.20	1.74	1152	0.15	67.80 (55.45)	2.70
T_3	5.90	1.71	1143	0.15	66.70 (54.77)	2.60
T_4	4.90	1.64	1089	0.14	60.80 (51.23)	2.50
T_5	4.50	1.53	1056	0.13	57.70 (49.43)	2.30
T_6	5.40	1.67	1121	0.14	62.60 (52.31)	2.50
Mean	5.21	1.63	1097.42	0.14	62.24 (51.89)	2.48
SED	0.1088	0.0292	20.5112	0.0044	1.1949	0.0476
CD(P=05)	0.2371	0.0636	44.7144	0.0095	2.6048	0.1038

Figures in parenthesis are arcsin transformation values

Thus, the effect of various organic seed enhancement treatments on yield and quality seed production in ragi cv. TRY 1. revealed that vermiwash @ 5% hardened seeds recorded the higher seed yield and quality when compared to other treatments and control. It is also on par with the treatment in which the seeds hardened @ 5% panchagavya.

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