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EFFECT OF PRE SOWING BIOFERTILIZER SEED TREATMENT ON MORPHOLOGICAL AND PHYSIOLOGICAL SEED QUALITY IN RICE (*ORYZA SATIVA* L.)

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Abstract

Rice is the most important staple food in Asia. More than 90% of the world's rice is grown and consumed in Asia, where 60% of the world's population lives. Expanding the area under rice cultivation is not an option for increasing rice production in many areas due to the pressures of urbanization, industrialization, crop diversification and other economic factors. In the present study, seeds treated with various biofertilizers. The results of this study showed that seed treated with *Azospirillum* + *Phosphobacteria* + *VAM* @ 600g ha^{-1} recorded significantly higher values for germination percentage, speed of germination, root length, shoot length, seedling length, dry matter production, vigour index I and vigour index II under the laboratory condition over the control. Hence, it is concluded that triple inoculation of biofertilizers (*Azospirillum* + *Phosphobacteria* + VAM @ 600g ha^{-1}) recommended for improved seed quality over single and dual inoculation.

Key words : Rice (*Oryza sativa* L.), biofertilizer, seed quality, seed treatment.

Introduction

Rice is the most important staple food in Asia. More than 90% of the world's rice is grown and consumed in Asia, where 60% of the world's population lives. It is estimated that 40% of the world's population use rice as a major source of energy. White rice is a good source of magnesium, phosphorous, manganese, selenium, iron, folic acid, thiamine and niacin. It is low in fiber and its fat content is primarily omega-6 fatty acids, which are considered pro-inflammatory.

Globally, rice ranks second only to wheat in terms of area harvested, but in terms of importance as a food crop, rice provides more energy per hectare than any other cereal crops. For almost three decades since the green revolution, the rice yield growth rate was approximately 2.5% per year. During the 1990's however, this has decreased to only 1.1% (Riveros and Figures, 2000). Expanding the area under rice cultivation is not an option for increasing rice production in many areas due to the pressures of urbanization, industrialization, crop diversification and other economic factors (Tyagi and Mohanty, 2000).

The total world area, production and productivity under rice was 159.17 million hectares, 472.16 MMT and 4.42 metric tons per hectare in 2015-2016 (Anonymous, 2017). Major rice producing countries are China, India, Indonesia, Bangladesh, Vietnam, Thailand, Burma, Philippines, Brazil and Japan.

In India, Rice cultivated in an area of 43.5 million hectares with a production of 104.41 MMT and productivity of 3.60 metric tons per hectare in 2015-2016 (Anonymous, 2017). India ranks first in area and second in production. In India, major rice producing states are West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab and Tamilnadu. In Tamilnadu area under rice cultivation is 21 lakh hectares with a production of 93 L.MT and productivity of 4.43 metric tons per hectare (Urban Development and Agriculture, 2015).

Inoculation is the process of adding effective bacteria to the host plant seed before planting. The purpose of inoculation is to make sure that there is enough of the correct type of bacteria present in the soil so that a successful cereal-bacterial symbiosis is established. So

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that we can improve the quality of the seed.

Materials and Methods

Genetically and physically pure seeds of rice cv. ASD 16 were obtained from the Tamil Nadu Rice Research Institute (TRRI), Aduthurai, which formed the basic material for the study. The laboratory experiments were carried out in the Seed Testing Laboratory, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamilnadu, India. Required quantity of inoculant for seed treatment is mixed with rice kanji to make a slurry. Then required seeds are mixed in the slurry so as to have a uniform coating of the inoculants over the seeds. After the treatment the seeds were shade dried for 30 minutes and then sun dried to bring back into original moisture content and used for sowing. The laboratory experiment was carried out with the following presowing seed treatments such as $\mathbf{T_0}$ - Control; $\mathbf{T_1}$ - Azospirillum @ 600g ha^{-1}; $\mathbf{T_2}$ - *Phosphobacteria* @ 600g ha^{-1}; $\mathbf{T_3}$ - VAM @ 600g ha^{-1}; $\mathbf{T_4}$ - *Azospirillum* + *Phophobacteria* @ 600g ha^{-1}; $\mathbf{T_5}$ - *Azospirillum* + VAM @ 600g ha^{-1}; $\mathbf{T_6}$ - *Phosphobacteria* + VAM @ 600g ha^{-1}; $\mathbf{T_7}$- *Azospirillum* + *Phosphobacteria* + VAM @ 600g ha^{-1}.

Germination test was conducted in a completely randomized design with three replications. From each treatment randomly selected 50 seeds per replication were put for germination in a sterilized sand media. Daily count on the number of germinated seeds was recorded separately for each treatment and replications till the final count (14th day). The trays were incubated at normal light at room temperature. Observations on germination percentage, speed of germination, root length, shoot length, seedling length, dry matter production, vigour index I and vigour index II were worked out. The data were statistically analysed using ANOVA.

Results and Discussion

Bio-inoculation is one of the presowing seed enhancement techniques which had a significantly positive effect on different aspects of seed quality characters under laboratory and field condition. In this present laboratory study, seeds were evaluated for their physiological quality and morphological qualities. The germination per cent was ranged from 80% to 91%, which were significantly different over the various seed inoculation treatment. The highest germination was observed in $\mathbf{T_7}$ (91%) followed by $\mathbf{T_6}$ (89%) whereas the lowest per cent was recorded by $\mathbf{T_0}$ (80%). Increase in germination percentage may be the possible mechanism of PGPR on the germination process *i.e.* these useful microorganisms can excrete phytohormones such as auxins and gibberellins, etc., thereby improving seed germination and early development. Besides, during metabolism the bacteria excrete organic acids (citric, malic acid, etc.,) as well, thus helping nutrient uptake at a later stage of growth (Nezarat and Gholami, 2009 and Gholami *et al*., 2009).

The reason for increase in speed of germination (35.76) may be due to the role of *Azospirillum*,

Table 1 : Effect of pre sowing biofertilizer seed treatment on germination percentage, speed of germination, root length (cm) and shoot length (cm)

Treatment	Germination percentage	Speed of germi-nation	Root length (cm)	Shoot length (cm)
T_0	80(63.44)	29.73	21.16	11.04
T_1	84(66.42)	30.96	24.14	12.14
T_2	83(65.65)	30.30	22.90	11.70
T_3	82(64.90)	30.17	22.84	11.48
T_4	86(68.03)	33.06	25.04	13.04
T_5	85(67.21)	32.31	25.00	12.76
T_6	89(70.63)	34.46	2s7.02	13.46
T_7	91(72.54)	35.76	27.60	13.60
Mean	85(67.35)	32.09	24.46	12.40
SEd	0.1888 (0.1599)	0.2076	0.0092	0.0520
CD (P=0.05)	0.4002 (0.3390)	0.4400	0.0196	0.1103

Table 2 : Effect of pre sowing biofertilizer seed treatment on seedling length (cm), dry matter production (g seedlings^{-10}), vigour index I and vigour index II.

Treatment	Seedling length (cm)	Dry matter production (g seedlings^{-10})	Vigour index I	Vigour index II
T_0	32.20	0.20	2576.00	16.00
T_1	36.28	0.22	3047.52	18.48
T_2	34.60	0.22	2871.80	18.26
T_3	34.32	0.21	2814.24	17.22
T_4	38.08	0.23	3274.88	19.78
T_5	37.76	0.22	3209.60	18.70
T_6	40.48	0.24	3602.72	21.36
T_7	41.20	0.26	3749.20	23.66
Mean	36.87	0.23	3143.25	19.19
SEd	0.1085	0.0024	8.2564	0.0660
CD (P=0.05)	0.2300	0.0050	17.5036	0.1399

Phosphobacteria and *VAM* enhancing the metabolic activity in germinating seeds thus, resulted in early and higher seed germination (Krishna *et al*., 2008).

The root length, shoot length and seedling length were significantly different over the other treatments. The maximum root length (27.60 cm), maximum shoot length (13.60 cm) and maximum seedling length (41.20 cm) was recorded in treatment $\mathbf{T_7}$ followed by $\mathbf{T_6}$ (27.02 cm, 13.46 cm and 40.48 cm, respectively) (table 1). Increased root length, shoot length and seedling length after inoculation was due to bacterial phytohormones. Triple inoculation resulted in more root length, shoot length and seedling length than single strain. This may be attributed to synergistic effects (Kapulnik *et al*., 1985; Iruthayathas *et al*., 1983 and Kloepper and Beauchamp, 1992). Biofertilizer treatment influenced root and shoot growth and seedling length positively which has an important role in nutrient uptake (Bashan *et al*., 2004 and Ashraf and Foolad, 2005).

The increase in the dry matter production in $\mathbf{T_7}$ (0.26 g) directly correlates with the increased plant vigour, plant growth promotion and improvement in the micronutrient status of the plants. Also, an increase in the shoot dry matter directly correlates to the plant's productivity (Rana *et al*., 2012; Sharma *et al*., 2014).

The highest vigour index I and vigour index II recorded in $\mathbf{T_7}$ followed by $\mathbf{T_6}$ whereas low value was recorded in T_0. Seed vigour index strongly correlated with early and higher germination due to *Azospirulum*, *PSB* and *VAM* fixer through inoculation (Sanders *et al*., 1975) which enhance the metabolic activity in germinating seeds and also make available more nutrients through mobilization and increasing root surface area by the presence of hyphae of *VAM* (table 2). Thus from the present study, it could be concluded that rice seeds should be inoculated with *Azospirulum*, *PSB* and *VAM* to enhance the seed quality characteristics.

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