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Short Communication

Seed fortification with sprouted pulses extract for enhancing seed quality in rice

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In India, rice is the important staple food for over two thirds of the population and it plays a vital role in our national food security [1]. Intensive cultivation is more fertilizer responsive, which often lead to aggravation of pest problem, as the plants become succulent enough to be fed upon by a variety of crop pests. This in turn necessitates use of increasingly huge amount of pesticides to combat the pest problems. The uninterrupted and disproportionate use of chemical pesticides and fertilizers over a longer period of time has resulted in deterioration of soil and environmental health that can endanger the existence of all forms of life on this planet. Therefore, apparent contradiction exists between the need for nutritional security on one hand and environmental sustainability on the other. This makes it inevitable to resort to the organic or eco-farming system as it appears to be a feasible option to meet both the objectives. Since rice is the staple food for over half of the world population, major emphasis has to be laid on ways to fortify seeds organically in order to improve germination, vigour and productivity.

Seed fortification is a method of seed invigoration which helps to improve the initial seed quality with enhanced germinability, seedling vigour and field stand. Sprouting triggers the enzymatic activities in seeds, which lead to conversion of complex carbohydrates, proteins and fats into simple sugars and amino acids [2]. Sprouted pulses are good source of ascorbic acid [3], riboflavin [4], thiamine [5], choline, tocopherols, pantothenic acid [6] and minerals [7].

Hence, it was hypothesized that application of sprouted pulses extract as a nutrient and growth regulator in the form of seed fortification will be beneficial to increase the seed vigour and performance.

The breeder seed samples of rice variety ADT 47 with 8% moisture content were obtained and experiments were conducted in the Department of Seed Science and Technology, TNAU, Coimbatore. Horse gram and cowpea seeds were separately soaked overnight and incubated in a wet cloth for 12 h to enable sprouting. Then 100g of sprouts of both seeds were ground separately in a mixer-grinder by using ice cubes of 100 ml of water. The ground paste was squeezed through cloth bag to obtain the sprout extract with 100 percent concentration. Concentrated extract was diluted with water to 5 different concentrations *viz.*, 1, 2, 3, 4 and 5%. The pulse sprout extracts obtained from both horse gram and cowpea were estimated for total antioxidant activity by ferric reducing ability of plasma assay [8], soluble protein content by lowry's method [9], total soluble sugars by phenol sulphuric acid method [10], ascorbic acid by oxalic acid method (volumetric method). Analysis of minerals *viz.*, nitrogen, phosphorus, potassium, calcium, iron and zinc, were conducted using Atomic Absorption Spectrophotometer [11].

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Rice seeds were fortified with 1, 2, 3, 4 and 5% of sprouted horse gram extract and cowpea extract for 8h and dried back to the original moisture content under shade. Water soaked seeds and untreated dry seeds were used as control. The fortified and control seeds were subjected to germination test as per ISTA rules [12] with four replicates of 100 seeds each in rolled towel medium and evaluated for seed quality parameters such as germination, shoot length, root length and dry matter production. Total number of normal seedlings were counted at 14th day after sowing and expressed in percentage (%). Shoot length was measured from collar region to the shoot apex and expressed in centimeter (cm). Root length was measured from collar region to root tip and expressed in centimeter (cm). Dry matter production was estimated by drying the normal seedlings at 80°C and the values were expressed as mg per 10 seedlings.

The experiment was conducted by adopting Factorial Completely Randomized Block Design. The data recorded were analyzed statistically as per Panse and Sukhatme [13].

The results revealed that seed germination and seedling vigour of rice seedlings were positively influenced by fortification treatments with pulse sprout extracts. Among the different fortification treatments, seeds fortified with 3% sprouted cowpea extract recorded higher germination (92%), shoot length (10.05 cm), root length (21.68 cm) and dry matter production (1.00 mg / 10 seedlings); it was at par with 3% sprouted horse gram extract (92%, 10.04 cm , 21.14 cm , 0.99 mg respectively). The untreated control recorded significantly lower germination (80%), shoot length (7.16 cm), root length (15.70 cm) and dry matter of seedlings (0.92 mg/ 10 seedlings) (Fig.1). Biochemical analysis of sprouted horse gram and cowpea extract revealed that it contains higher amount

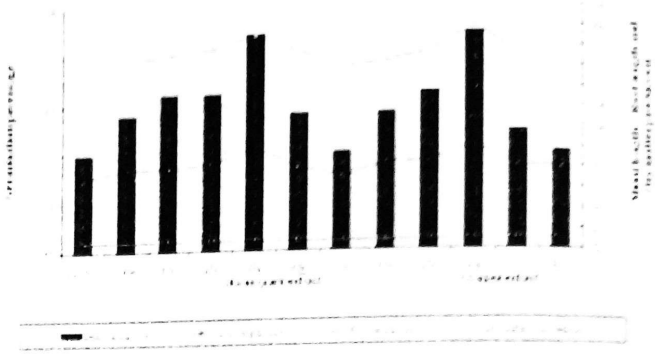

Fig. 1. Effect of seed fortification with pulse sprout extract on seed quality in rice cv. ADT 47.

of minerals such as nitrogen (89.36 and 93.61 mg/ 100 ml, respectively), phosphorus (410, 520), potassium (291, 339), calcium (20, 14) iron (8.25, 10) and zinc (91, 89), in addition to total soluble sugars (0.90 and 1.05%) and soluble proteins (1.59 and 3.00%) (Table 1). These observations clearly indicate that the beneficial effect of sprouted cowpea and horse gram extracts could be attributed to the presence of minerals, soluble sugars and soluble proteins. These findings were in conformity with the findings of Dhaliwal and Agarwal [6] who reported that sprouting increases the bioavailability of minerals and vitamins. Chang and Harrold [14] concluded that sprouting is an inexpensive and effective technology for improving the quality of legumes, by enhancing their digestibility, increasing the content of amino acids and reducing the levels of anti-nutrients. Marimuthu [15] and Grzywnowicz-Gazda [16] also reported similar pronounced effect due to fortification with micronutrients. The improvement in seed germination percentage and seedling vigour of rice seedlings is attributable to the higher nutrient potential of pulse sprout extracts used for seed fortification. Hence, seed fortification of rice seeds either in 3 % sprouted cowpea extract or in 3 % sprouted horse gram extract can be adopted to increase the seed germination, seedling vigour and successful field establishment of rice seedlings.

Table 1. Nutrients in sprouted horse gram and cowpea extracts

Name of the sample	Horse gram sprout extract	Cowpea sprout extract
Nitrogen (mg / 100 ml)	89.36	93.61
Phosphorus (mg / 100 ml)	410	520
Potassium (mg / 100 ml)	291	339
Calcium (mg / 100 ml)	20.00	14.00
Iron (mg / 100 ml)	8.25	10.00
Zinc (mg / 100 ml)	91.00	89.00
Total soluble sugars (%)	0.90	1.05
Soluble Protein (%)	1.59	3.00

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