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Enhancing Ragi Yield: The Effect of Organic Seed Priming

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The field study was conducted to evaluate the organic seed priming of ragi on growth, yield attributes and yield. A field experiment was conducted during 2021 at Experimental Farm, faculty of Agriculture, Annamalai University. It consists of seven treatments. The treatments were arranged in a randomized block design (RBD) with three replications. Results showed that organic seed priming of custard leaf extract has a significant impact on the growth attributes of plant height, LAI, Dry matter production and yield parameters like number of productive tillers per hill, weight of the single ear head per hill, number of fingers per ear head, length of the earhead, number of grains per ear head, grain yield and straw yield. The control treatment recorded the lowest values in all parameters. Maximum grain yield of 1777 kg ha^{-1} was recorded with organic seed priming of ragi with Custard leaf extract @ 3% (T_4) and the lowest grain yield 1003 kg ha^{-1} was observed with control treatment.

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Keywords: Organic seed priming; ragi; growth; yield.

1. INTRODUCTION

"Finger millet (*Elusine coracana* L. *Garten.*) is commonly called as Ragi in India. The generic name *Eleusine* is derived from the Greek goddess of cereals, "*Eleusine*" while the common name finger millet indicates "finger-like" branching of the panicle. It has dual importance as a source of food grain as well as straw. Straw is excellent as animal fodder with up to a total of 60 per cent digestible nutrients and is grown in an area of 1.27 million hectare with an annual production of 1.93 million tones and with a productivity of 1600 kg per ha" [1]. Finger millet ensures the round the year food supply or even during a crop failure, which has earned it the popular name of "famine crop" [2]. "Ragi is known to be an ideal food for diabetic individuals due to its higher glycemic index, which is it has low sugar content and slow release of glucose/sugar in the body. Its nutritional significance in providing minerals, calories and protein makes it an ideal model for nutrition.Inspite of its economic value and its nutritional importance it grow in a very lesser area and also its productivity less. By increasing productivity we can increase the area of cultivation. For that seed priming is an effective method to enhance its productivity" [3].

"Seed priming is a controlled hydration process followed by re-drying that allows seeds to imbibe water and begin internal biological processes necessary for germination, but which does not allow the seed to actually germinate. The priming process gives the seed a "head-start" at germination and emergence when planted in the soil. That results in an increase in seed vigour and seedling establishment in several species" [3]. Deepak et al., [3] reported that "sorghum seeds primed with 8 % panchakarma showed the highest germination, seedling vigour index and quality parameters as compared to control". Prakash et al., *(*2017) reported that "seed pelleted with pungam leaf powder@150 g kg^{-1} recorded higher growth and yield parameters. While the custard apple has countless health benefits like being rich in antioxidants and minerals like calcium, magnesium and potassium, its leaves are equally nutritious. They are prized for their health benefits especially in Ayurveda. The leaves are often used for medicinal purposes due to their quick healing capability". Panchagavya is known to provide immunity and promote plant growth. Cow dung and cow urine are the key ingredients of the preparation. It is usually mixed with water and is used to irrigate the fields.By considering the above facts, the field experiment is conducted to enhance the growth and yield of ragi.

2. MATERIALS AND METHODS

The field experiment was conducted at Annamalai University experimental farm,Annamalai Nagar,Tamil Nadu, during January 2021 to find out the effect of seed priming in the growth and yield of ragi.The experiment were conducted at an Agronomic research area at $11^{0}24^{'}$N latitude and $79^{0}41^{'}$E longitude at an altitude of +5.79 meters above mean sea level. The soil of the experimental field was clay loam with low in nitrogen, medium in phosphorus and high in potassium content. The experiment comprised of seven treatments with three replications and it was laid out in the randomized block design.the details of the treatments are. T_1- Control,T_2- Parthenium leaf extract @ 3%, T_3- Neem leaf extract @ 3%,T_4- Custard leaf extract @ 3%,T_5 - Calotropis leaf extract @ 3%,T_6 - Panchagavya @ 3% ,T_7 - Cows urine @ 3%. The test variety was CO-14 and its spacing was 30×10 cm in each plots. The seeds were treated with Custard leaf extract at the concentration of 3% and Panchgavya at the concentration of 3% along with distilled water and dry seed as control.

Matured neem leaves (250g) were homogenized in a pre-chilled pestle and mortar using 250 ml chilled, sterilized distilled water (Dilution of 1:1). The extract was filtered through four layers of moistened muslin cloth. The supernatant thus obtained was designated as concentrated leaf extract and seeds were soaked by making dilution of required concentration. Further, 3 ml filtrate was added to 100 ml to get 3 per cent solution. This solution is used for soaking the seeds as per the required weight by volume ratio of seed to solution. Seed to solution ratio of 1:0.5 were made and soaked for 8 hrs. Then the seeds were air dried overnight. The same procedure was followed for custard apple, parthenium and calotropis leaf extracts. Then seeds were dried overnight further it was used for the sowing. Five plants were chosen randomly and they were marked with wooden pegs having wax-coated tag. These plants were noted for the periodic

biometric observations and the mean value obtained were analysed statistically.

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

The seeds that are primed with Custard leaf extract @ 3% (T_4) recorded the highest plant height of 47.20,65.80 and 110.05 cm at 20,40,60 DAP , LAI of 2.25,3.59,4.65 at 20,40,60 DAP and DMP of 1535,7545,9857 kg at 20,40,60 DAP. It is closely followed by the treatments that are primed with the panchagavya @3%.Highest growth attributes might be due to better mobilization of compounds (e.g.amino acids,soluble sugars,etc.) from the storage organs to the growing embryo prior to sowing.The presence of bio-active chemicals of gibberlic acid helps in the translocation.

As a result of priming, the root system is deeper and flowering is faster in the seeds .It is due to the enhancement of enzymatic activity as a result of priming.Priming results in higher leaf area and increase in root system with more absorbing surfaces as indicated by the Jerlin and sumathi [4]. “Priming increases the viscosity and elasticity of protoplasmic colloids, increase the phosphorylation activity of mitochondria, reduces solute leakage and regains cell integrity” [5].

“Generally the biochemical changes that occur in the primed seeds include reduced time for replication of DNA, prolongation of mRNA life under moisture stress conditions and higher proline content” [6]. Custard apple leaf extract consists of various poly phenolics compounds that helps in the various biochemical and physiological process namely, enzymatic activity, cell proliferation, signal transduction pathways and cellular redox potential [7] that favours the growth and yield of the crop.

3.2 Yield Attributes and Yield

Custard apple leaf extract @3% primed seeds have better influence the yield attributes and yield of the crop. Higher yield parmeters like number of productive tillers per hill (4.1), the weight of the single ear head per hill (7.81 g), number of fingers per ear head (6.8), length of the earhead (8.12 cm),number of grains per ear head (1987),grain yield (1777 kg) and straw yield (6180 kg) were recorded in that treatment.Test weight was found to be nonsignificant. The length of the finger and number of finger per earhead was also unaffected by the seed treatments. In all the yield attributes and yield, panchakavya @3% closely followed by it.

Priming leads to different biochemical and physiological changes in seeds. It synchronizes germination after breaking dormancy [8] diminishes the lag time required for imbibition, hydrolyses or metabolises inhibitors, activates enzymes, mobilises reserved food and enhances embryonic tissue outgrowth [9].

Highest yield attributes might be due to enhancement in nutrient use efficiency as result of priming-induced overexpression of genes encoding for specific transporters.As calotropis leaf extract posses almost all the major and micronutrients namely P, K, Fe, Ca, Mg, Na, Cu, Se, Zn also the growth hormones which enhance the metabolic activity of plants [10] “Priming increase the nitrate reductase enzyme activity which will improve N nutrition in plants” [11].This organic nutritions enhances nutrient absorption as reported by Prakash et al., [12].

“Early and synchronized field emergence observed in seed priming treatments resulted in more leaf area and early canopy development. Evaporation loss will be reduced due to better ground cover. Also, early emergence resulted in vigorous plants with deeper and more extensive root systems which are capable of extracting water from the deeper layers even under lower irrigation regimes. Hence water use efficiency increases due to priming which in turn increases the yield of crops” [13].

The aqueous seed extract of custard apple has the insecticidal activity.The leaf extracts are also possessing them in a considerable amount. The insecticidal activity is due to the presence of chemical known as acetogenins. This also favours to increase the yield attributes of the crops. Treatment of custard apple leaf extract produced the most favourable result in respect of pest control and yield [14,15].

Table 1. Effect of organic foliar nutrition seed priming on the growth attributes of Ragi

Treatments	Plant height (cm)			LAI			Dry matter production (kg ha^{-1})		
	20 DAP	40 DAP	60 DAP	20 DAP	40 DAP	60 DAP	Vegetative stage	Flowering stage	Harvest stage
T_1- Control	36.25	54.20	90.05	0.72	2.02	3.05	706	4536	6101
T_2- Parthenium leaf extract @ 3%	38.56	55.50	93.62	0.90	2.12	3.17	1025	5555	6787
T_3- Neem leaf extract @ 3%	42.65	61.90	103.85	1.76	2.87	3.38	1249	6196	8725
T_4- Custard leaf extract @ 3%	47.20	65.80	110.05	2.25	3.59	4.65	1535	7545	9857
T_5 - Calotropis leaf extract @ 3%	42.03	60.06	101.25	1.65	2.62	3.25	1191	6011	7491
T_6 -Panchagavya @ 3%	45.30	63.50	106.23	1.82	3.18	4.05	1422	6498	9150
T_7 - Cows urine @ 3%	40.80	57.23	98.75	0.72	2.02	3.05	1153	5685	6966
S.Ed	**2.05**	**2.16**	**3.63**	**0.3**	**0.38**	**0.65**	**79.8**	**495.2**	**456.5**
C.D (p-0.05)	**4.1**	**4.32**	**7.26**	**0.6**	**0.76**	**1.3**	**159.6**	**990.5**	**914**

Table 2. Effect of organic foliar nutrition seed priming on the yield attributes of Ragi

Treatments	Number of productive tillers hill^{-1}	Weight of single ear head (g)	Number of fingers ear head^{-1}	Length of the ear head (cm)	Number of grains ear head^{-1}	Test weight (g)
T_1- Control	3.0	5.78	5.9	7.38	1412	3.01
T_2-Parthenium leaf extract @ 3%	3.3	6.14	6.2	7.69	1595	3.15
T_3- Neem leaf extract @ 3%	3.8	7.03	6.7	7.96	1786	3.25
T_4- Custard leaf extract @ 3%	4.1	7.81	6.8	8.12	1987	3.29
T_5 - Calotropis leaf extract @ 3%	3.7	6.94	6.5	7.89	1688	3.24
T_6 - Panchagavya @ 3%	3.9	7.08	6.7	8.05	1853	3.28
T_7 - Cows urine @ 3%	3.4	6.75	6.4	7.81	1589	3.20
S.Ed	**0.11**	**0.25**	**0.33**	**0.43**	**112**	**0.09**
C.D (p-0.05)	**0.22**	**0.54**	**NS**	**NS**	**1987**	**NS**

Table 3. Effect of organic foliar nutrition seed priming on the yield of Ragi

Treatments	Grain yield (Kg ha^{-1})	Straw yield (Kg ha^{-1})	Harvest index
T_1- Control	1003	4934	16.89
T_2- Parthenium leaf extract @ 3%	1056	5155	17.00
T_3- Neem leaf extract @ 3%	1354	5708	19.17
T_4- Custard leaf extract @ 3%	1777	6180	22.33
T_5 - Calotropis leaf extract @ 3%	1234	5469	18.40
T_6 - Panchagavya @ 3%	1558	5950	20.75
T_7 - Cows urine @ 3%	1143	5204	18.01
S.Ed	**198**	**234**	**0.05**
C.D (p-0.05)	**1777**	**6180**	**0.12**

4. CONCLUSION

From the above results,it can be concluded that,organic seed priming of ragi with Custard leaf extract @ 3% (T_4) recorded the highest growth attributes of plant height,LAI,Dry matter production and yield parmeters like number of productive tillers per hill , weight of the single ear head per hill , number of fingers per ear head,length of the earhead , number of grains per ear head , grain yield and straw yield. The control treatment recorded lowest values in all parameters.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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