International Journal of Research in Engineering, Science and Management
Volume-1, Issue-9, September-2018
www.ijresm.com | ISSN (Online): 2581-5782

Evaluation of Seed Invigoration Method in Finger Millet (*Eleusine Corcana*) Through Hydration-Dehydration Treatment

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***Abstract*—The experiment was conducted in Post Graduate Laboratory, Department of Genetics and Plant Breeding, SHUATS, Allahbad, U.P. The objective of this study was to evaluate seed hardening technique in millet. Two varieties of finger millet were taken to harden and the seeds were soaked in water/salts/bio-active solution for 6hr and 12hr at same concentrations viz., T_0= Control, T_1= Distill Water 6hr, T_2= Kcl 6hr, T_3= Nacl 6hr, T_4= Moringa 6hr, T_5= Wooden Apple 6hr, T_6= Distill Water 12hrs, T_7= Kcl 12hrs, T_8= Nacl 12 Hrs, T_9= Moringa 12hrs and T_{10}= Wooden Apple 12 hrs and were dried to initial moisture content. It was found that all hydration-dehydration methods showed significant difference with the control and the highest germination%, seedling length (mm), seedling fresh weight (mg), seedling dry weight (mg) and vigour index were observed in T_4= Moringa 6hr .This study helps to improve the quality of seed with the help of hardening treatments which are cost effective, economic, non-toxic and eco-friendly.**

***Index Terms*—finger millet, hydration-dehydration, seed enhancement, invigoration**

I. Introduction

Millets are some of the oldest cultivated crops. In the sixties, the Green Revolution led to the widespread use of high yielding crop varities and since then the production of rice has doubled and wheat has tripled in India. “Crops that survived on rain rather than, irrigation and were far more sustainable were forgotten” explained Dinesh Kumar, who runs non-profit organisation Earth360. Finger Millet or ragi, Eleusine coracana (L.) is the fourth most important millet crop in the world. The grains of finger millet are rich in protein, having high amount of tryptophan, cysteine and methionine, fibre, phytochemicals, calcium and other chemicals (Upadhya et al., 2010; Chandrashekhar et al., 2012). Finger millet is comparatively resistant to storage insect pest, which make the crop an important source of food during famine, as the grain can be stored as long as 50 years without much loss due to deterioration (Ayyangar, 1932). Finger millet is suitable for cultivation across a range of environmental conditions. Seeds can retain their high vigour for some time and thereafter begin to deteriorate losing their germination capacity, vigour and viability (Ellis and Filho, 1992; McDonald, 1999). During aging of seeds, several biochemical and physiological changes occur that result in a progressive decline in seeds quality and performance (McDonald, 1999). These low vigor seeds germinate and emerge poorly and result in smaller plants as compared to high vigor seeds (Ellis and Roberts, 1981). Various techniques are available, which enhance the vigor of seeds and these technologies are termed as seed invigoration/seed enhancement techniques (Basra et al., 2005; Farooq et al., 2008; Moghadam and Mohammadi, 2013; Kyrychenko, 2014). The hydration-dehydration treatments, for the maintenance of vigour and viability of seeds have been put forward by Basu (1976) and De et.al. (2003). Beneficial effects of seed hardening includes accelerated rapid germination and growth rate of seedling, hardened plants recover much more quickly from wilting than those from untreated plants, induces resistance of salinity and to drought condition, seeds with stand higher temperature for prolonged period, flowering is slightly accelerated, compete more efficiently with weeds due to early emergence and results in more yield. In the view of this, the present investigation was taken up to find out the effect of hydration and dehydration on seed vigour in two varieties of finger millet.

II. Materials and Methods

Seeds of finger millet were obtained from local seed market of Ranchi, Jharkhand, India. Two varieties desi variety-Tapera Marwa and hybrid-BM-2 were taken. The aqueous extract of each plant material were prepared by grinding 20 gm of fresh leaf in 50ml of sterile distil water at room temperature then filtered through double layered muslin cloth. The seeds were divide into eleven sub-samples each, one from each was kept as control. Then seeds were soaked in freshly prepared salt solutions, i.e. Potassium chloride and sodium chloride @ 1% leaf extracts viz, Moringa (moringa oleifera) and Wooden apple (Aegle marmelos) @ 2% and distil water for 6hr and 12hr. The soaked seeds were dried back to its original moisture content at room temp 25-30ºC. Eleven replicates each of both varieties of

25 seeds from each treatment (100 seeds) were placed in petri dish containing 3 layer of moistened blotters and incubated at 25±2°C and following parameters were evaluated. Germination percentage was calculated based on the number of normal seedlings on 8th day after planting (according to ISTA 1999) and it was expressed in percentage. Seedling characters of treated and untreated seeds were determined. Root length was taken by randomly selecting ten seedlings from each treatment on 8th day from germination test. The root length will be measured from the tip of the primary root to base of hypocotyl with the help of a scale and mean root length will be expressed in centimetres. Shoot length was also taken by randomly selecting ten seedlings after 8th day the length between hypocotyl and tip of shoot was measured and mean was expressed.Vigour index length was calculated by adopting the formula suggested by Abdul-baki, et al. (1973) and expressed in whole number.

The data obtained from laboratory were analysed statistically following the method of analysis of variance (Fisher, 1948).

III. Results and Discussion

Germination test carried out 15 days after treatment, the result of ANOVA did show significant difference on vigour and viability between treated and untreated seeds. It indicated that root, shoot and seedling length at 8 DAP varied for different treatment (Table I & II)

Akther et al (1992) suggested that decreasing in germination percentage was related to chromosomal aberrations that occur under long storage conditions. Decrease of germination percentage in aged seeds may be due to α-amylase activity and carbohydrate content (Bailly, 2004). Seedling emergence was positively influence by the treatment, in desi variety maximum germination percentage was recorded in T_3(98) with NaCl 6hr followed by T_4(97) with moringa 6hr and in BM-2 variety maximum germination percentage was recorded in T_8(98) NaCl 12hr followed by T_3(97) with NaCl 6hr. The treatment of seed with NaCl showed high germination this may be due to the uptake of Na+ and Cl− ions by the seed, maintaining a water potential gradient allowing water uptake during seed germination.

In desi seed, maximum root length was recorded in T_4(48.25) with Moringa 6hr followed by T_5(44.15) with Wooden apple 6hr. In BM-2 seed maximum root length was recorded in T_1(41.38) Distill water 6hr . Hydration with water enhances the emergence due to leaching of inhibitors (Sharrir, 1978) and enhancement of nucleic acid and protine synthesis, thus increase in root length followed by T_4(41) with Moringa 6hr.In desi seed, maximum shoot length was recorded as T_4(48.25) with Moringa 6hr followed by T_5(44.15) with Wooden apple 6hr. In BM-2 seed maximum shoot length was recorded in T_7(21.75) KCl 12hr followed by T_4(21.53) with Moringa 6hr.In desi seeds, maximum seedling length was recorded in T_4(70.23) with Moringa 6hr followed by T_5(70.13) with Wooden apple 6hr. In BM-2 seed maximum seedling length was recorded in T_4(62.53) Moringa 6hr followed by T_6(61.83) with Distill water 12 hr.

In desi seeds, maximum fresh weight of seedling was recorded in T_4(31.75) with Moringa 6hr followed by T_{10}(30.75) with Wooden apple 12hr. In BM-2 seed maximum fresh weight of seedling was recorded in T_9(31.75) Moringa 12hr followed by T_6(28.50) with Wooden apple 12 hr. The increase in dry weight was claimed to be due to enhanced lipid utiliza¬tion and enzyme activity due to the presence of bioactive substances in the leaf extracts (Rathinavel and Dharmalingam, 1999). In desi seeds, maximum dry weight of seedling was recorded in T_4(10.75) with Moringa 6hr followed by T_9(9.50) with Moringa 12hr. In BM-2 seed maximum seedling length was recorded in T_4(11) Moringa 6hr followed by T_2(8.50) with KCl 6hr. The treatment with Moringa extract had shown superiority in all the aspect of the experiment like germination, shoot length , root length, seedling length, fresh and dry weight of seedling even in seed vigour and mass. The positive impact of moringa is due to the presence of zeatin in Moringa which is a natural plant hormone and belongs to the cytokinin group, involved in enhancing germination percentage (Makkar and Becker, 1996)

Dehydration of seeds following priming is of vital importance. In fact, sustainability of the beneficial effects of priming depends on subsequent dehydration conditions.

TABLE I
Effect of Treatment on Both Varieties Seed Germination and Vigour

Treatment	Germination%		Seedling Length (Mm)		Vigour Index		Vigour Index Mass	
	DESI	BM-2	DESI	BM-2	DESI	BM-2	DESI	BM2
T_0= CONTROL	80	55	41.25	30.73	3300.00	1693.86	140.00	96.25
T_1= DISTILL WATER 6HR	93	92	62.35	61.43	6077.55	5651.10	441.75	345.00
T_2= KCL 6HT	95	86	58.78	50.43	5569.38	4336.55	308.75	731.00
T_3= NACL 6HR	98	97	62.53	61.30	6127.45	5946.10	343.00	679.00
T_4= MORINGA 6HR	97	96	70.23	62.53	6811.83	6002.40	1042.75	1056.00
T_5= WOODEN APPLE 6HR	96	96	70.13	61.10	6732.00	5865.60	768.00	816.00
T_6= DISTILL WATER 12	92	92	51.98	61.83	4781.70	5687.90	621.00	322.00
T_7= KCL 12HR	97	94	62.73	57.20	6084.33	5376.80	776.00	258.50
T_8= NACL 12 HR	91	98	62.25	61.43	5664.75	6019.65	500.50	465.50
T_9= MORINGA 12HR	93	86	50.88	57	4731.38	4902.00	883.50	322.50
T_{10}= WOODEN APPLE 12 HR	92	84	48.73	50.83	4482.70	4269.30	414.00	420.00
S.EM	1.497	1.856	0.341	0.577	79.529	52.685	113.226	76.964
C.D AT 5%	4.309	5.340	0.982	1.659	228.824	151.587	325.779	221.445

TABLE II
EFFECT OF TREATMENT ON MORPHOLOGICAL VARIETIES OF BOTH VARIETIES

Treatment	Root Length (Mm)		Shoot Length (Mm)		Fresh Weight (Mg)		Dry Weight (Mg)	
	DESI	BM-2	DESI	BM-2	DESI	BM-2	DESI	BM2
T_0= CONTROL	19.30	16.53	21.95	14.20	11.50	10.00	1.75	1.75
T_1= DISTILL WATER 6hr	40.10	41.38	22.75	20.05	25.25	22.50	4.75	3.75
T_2= KCl 6ht	37.08	30.93	21.70	19.50	26.25	20.50	3.25	8.50
T_3= NaCl 6hr	40.53	40.40	22.00	20.95	26.50	21.75	3.50	7.00
T_4= MORINGA 6hr	48.25	41.00	21.98	21.53	31.75	27.50	10.75	11.00
T_5= WOODEN APPLE 6hr	44.15	39.98	25.98	21.13	30.50	22.00	8.00	8.50
T_6= DISTILL WATER 12	40.45	41.08	18.38	20.50	23.75	20.50	6.75	3.50
T_7= KCl 12hr	41.00	35.45	22.28	21.75	22.25	21.00	8.00	2.75
T_8= NaCl 12 hr	30.23	40.48	21.08	20.83	35.00	28.50	5.50	4.75
T_9= MORINGA 12hr	23.60	38.95	20.90	18.05	23.75	31.75	9.50	3.75
T_{10}= WOODEN APPLE 12 hr	19.30	30.93	17.35	19.90	30.75	28.50	4.50	5.00
S.Em	2.497	0.336	0.341	0.358	1.031	0.911	1.205	0.847
C.D at 5%	7.211	0.966	0.982	1.031	2.966	2.621	3.468	2.438

These are temperature, speed (which depends on ambient air, forced air or vacuum drying) and degree of dehydration (Pill, 1995; McDonald, 2000; Copeland and McDonald, 2001). Moreover, the effects of the above dehydration conditions on viability and vigour of primed seeds vary depend on species (Pill, 1995; McDonald, 2000). In desi seeds, maximum seed vigour length was recorded in T_4(6811.83) with Moringa 6hr followed by T_5(6732) with Wooden apple 6hr. And in BM-2 seed maximum seed vigour length was recorded in T_8(6019.65) NaCl 12hr followed by T_4(6002.40) with Moringa 6hr. In desi seeds, maximum vigour index mass was recorded in T_4(1042.75) with Moringa 6hr followed by T_9(883.50) with Moringa 12hr. . In BM-2 seed maximum vigour index mass was recorded in T_4 (1056) Moringa 6hr followed by T_5(816) with Wooden apple 6hr.

IV. CONCLUSION

The results indicated that the addition of hydration-dehydration techniques to the current procedures of the regulations of finger millet or ragi production could be a useful strategy from different points of view. Application of these techniques to finger millet seeds could provide faster and more uniform germination.

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