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Research Paper

Influence of Various Halo Primming Seed Treatment on Quality Seed Production in Kodo Millet Cv. CO3

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A B S T R A C T

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 Kodo millet cv. CO 3. The fresh seed of kodo millet cv. CO 3 were given with various chemical seed hardening treatments i.e., hardened with $ZnSO_4$ @ 1%, MgCl @ 1%, $MgSo_4$ @ 1%, $FeSo_4$ @ 1%, KOH @ 1%, Kcl @ 1%, $NaHCO_3$ @ 1%, $CaCl_2$ @ 1%, CH_4N_2S @ 1% and KH_2PO_4 @ 1%. Then the treated seeds were evaluated for their seed qualities and productivity using untreated seeds as control. The KH_2PO_4 @ 1% hardened seeds registered significantly higher values for initial seed qualities and lower electrical conductivity. In field evaluation, the KH_2PO_4 @ 1% hardened treated seeds recorded higher growth, physiological and yield parameters.

Key words: Kodo millet, Seed hardening, Seed quality, Seed yield

Kodo millet, is an annual grain that is grown in primarily in India, but also in the Philippines, Indonesia, Vietnam, Thailand, and in West Africa where it originates. Kodo millet is a nutritious grain and a good substitute to rice or wheat. The grain is composed of 8.3g of protein, it is an excellent source of fibre at 10 grams (37-38%), as opposed to rice, which provides 0.2/100 g, and wheat, which provides 1.2/100 g. An adequate fibre source helps combat the feeling of hunger. Kodo millet contains 66.6 g of carbohydrates and 353 kcal per 100 g of grain, comparable to other millets. It also contains 1.4g fat. It provides minimal amounts of iron, at 0.5/100 mg, and minimal amount calcium, 27/100 mg and phosphorous 188mg. Seed enhancement may be defined as post-harvest treatments that improve germination and seedling growth or facilitate the delivery of seeds and other inputs/materials required at the time of sowing smoothly [1]. Seed enhancement has been reported to induce drought resistance in the plants, such seeds as indicated by its capacity to withstand dehydration and overheating. The other beneficial effects of hardening are including better root growth, higher rate of photosynthesis and larger dry matter accumulation [2]. Seed fortification with chemical solutions either individual or in combinations, help the seeds to tide over soils moisture stress, removal of inhibitors, get rid of pathogens during germination and initial stages of seedling establishment and quenching of free radical [3]. Application of nutrients through seed fortification becomes important for their efficient utilization and better performance of the crop [4]. Pre-sowing hardening or imbibition and drying back of seed is one of the methods which results in modifying physiological and biochemical nature of seed so as to get the characters that are favorable for drought resistance. With this background, the study was undertaken in kodo millet was CO 3 to study influence of various seed management practices on quality seed production

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MATERIALS 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 chemical seed treatment on seed yield and quality in in Kodo millet. Freshly harvested bulk seeds of in Kodo millet cv. CO 3 were graded and imposed with the following pre sowing seed treatments. The treatment details are: T_0– Control, T_1– $ZnSO_4$ @1% hardening, T_2– $MgCl_2$ @1% hardening, T_3– $MgSO_4$ @1% hardening, T_4– $FeSO_4$ @1% hardening, T_5– KOH @1% hardening, T_6– KCl @1% hardening, T_7– $NaHCO_3$ @1% hardening, T_8– $CaCl_2$ @1% hardening, T_9– CH_4N_2S @1% hardening, T_{10}– KH_2PO_4 @1% hardening.

Preparation of solution

The solutions were prepared by mixing of the exactly weigh 1 g chemicals by dissolving in 100 ml of water. The seeds were soaked in equal volume of (1:1) chemical solution viz., $ZnSO_4$@ 1%, $MgCl_2$@ 1%, $MgSO_4$@ 1%, $FeSO_4$@ 1%, KOH @ 1%, KCl @ 1%, $NaHCO_3$@ 1%, $CaCl_2$@ 1%, CH_4N_2S @ 1%, KH_2PO_4@ 1%, for 4 hours along with water. The soaked seeds were dried back to original moisture content.

The treatments were evaluated for seed quality parameters viz., speed of germination [5], germination (%), root length (cm), shoot length (cm), dry matter production (mg) as per the procedure of [6], seedling vigour index I, seedling vigour index I [7] and seed metabolic efficiency [8]. The above treated seeds were also evaluated for their field performance. Field trial was conducted by adopting Randomized Block Design (RBD) with three replications. The crop was raised with the spacing of 20×10 cm and recommended package of practices for kodo millet were followed. Ten plants were randomly selected in each of the treatment replication wise and the following observation was recorded i.e. Plant height (cm), Days to first flowering, Days to 50 percent flowering, Number of leaves per plant, Dry matter production (g), Number of tillers plant^{-1}, Leaf area index (LAI), Length of panicle (cm), No. of panicles per plant, Weight of grains per panicle (g), 1000 grain weight (g), Harvest index, Seed yield per plant (g) and Seed yield per plot (g) were recorded. All the data were analyzed statistically with appropriate tools and expressed as mean values as per the method of [9].

RESULTS AND DISCUSSION

Macro and micronutrients and plant growth regulators are vital for plant growth and development. Though micronutrients are required in relatively smaller quantities for plant growth, they are essential elements in physiological process like respiration, photosynthesis [10]. Seed germination and seedling growth are known to be regulated by exogenous hormones [11]. Seed fortification is a pre sowing seed management technique: where, essential and bioactive substances can be added to improving the initial stamina of the seed for higher germination ability, seedling vigour and field stand. Seed fortification with plant growth regulators and inorganic nutrients have already been reported [12] in solanaceous vegetables.

In laboratory analysis the KH_2PO_4 @ 1% hardened seeds recorded higher seed qualities viz., speed of germination, germination percentage, shoot length and root length. The above mentioned the treatments was recorded 13.59, 30.76, 24.17 and 59.18 percentage higher than control respectively with the above-mentioned characters and also for other seed qualities viz., dry matter production, vigour index I, vigour index II and seed metabolic efficiency. The above treatment also recorded 40.47, 60.1, 60 and 60.1 percentage higher than control respectively with the above-mentioned characters (Table 1).

The above hardened seeds were also evaluated under field condition, the growth parameters and yield parameters were observed it revealed that that the KH_2PO_4 @ 1% hardening higher values for the growth parameters such as viz., plant height, number of tillers per plant, no of leaves per plant, dry matter production, leaf area index and panicle length which were 19.95, 23.78, 50.43, 47.45, 57.57and 35.59 percentage higher than the control respectively with above mentioned characters (Table 2). It recorded early days to first flowering and days to 50% flowering parameters which was 49.56 and 53.73 respectively when compared control and other treatments. The promotory effect observed in the KH_2PO_4 primed seed for Speed of germination and germination parameters has been referred to the invigorating effect of presoaking. The KH_2PO_4 seed priming treatment had improved the velocity of germination and seedling emergence [13].

Table 1 Effect of chemical seed enhancement treatment initial seed qualities in kodo millet cv. CO 3

Treatment	Speed of germination	Germination percentage (%)	Shoot length (cm)	Root length (cm)	Dry matter production (mg seedlings^{-10})	Vigour index I	Vigour index II	Seed metabolic efficiency
T_0	9.86	65 (53.73)	4.90	9.10	0.042	951	2.90	0.690
T_1	9.89	65 (52.82)	6.10	9.40	0.043	1,007	2.75	0.872
T_2	10.24	78 (62.04)	6.40	10.90	0.051	1,349	3.97	0.998
T_3	10.10	73 (58.70)	5.90	10.40	0.050	1,189	3.65	0.964
T_4	10.12	76 (60.67)	6.20	10.95	0.049	1,269	3.24	0.991
T_5	9.90	74 (59.53)	5.40	11.10	0.048	1221	3.55	1.073
T_6	9.91	72 (58.06)	5.10	9.30	0.047	1,036	3.38	0.731
T_7	10.90	80 (63.47)	6.80	10.80	0.053	1,416	4.24	0.843
T_8	11.09	83 (65.66)	6.98	10.90	0.055	1518	4.56	1.080
T_9	9.88	70 (56.79)	5.30	9.50	0.045	1,036	3.15	0.862
T_{10}	11.20	85 (67.23)	7.00	11.00	0.059	1530	4.64	1.110
Mean	10.28	74.64	6.15	10.35	0.049	1234.38	3.64	0.906
SE(d)	0.226	1.631	0.290	0.225	0.001	26.859	0.255	0.020
C.D (P=0.05)	0.471	3.403	0.290	0.469	0.002	56.061	0.531	0.041

Figures in parenthesis are arcsine transformation values

Enhancement in α-amylase activity in primed seeds may be attributed to proper hydration during imbibition that increased the starch hydrolysis and suggested that starch was converted into reducing sugars [14]. The effect of the increased starch hydrolysis due to hydration treatments was not lost during the redrying process, as seen in the faster germination and increased uniformity of germination, higher seedling dry weight. They have also observed that partial soaking and subsequent drying back had shown the invigorating effect upon the seeds of a number of species. Studies have indicated that relatively short pre-hydration treatments, either brief imbibition in water or exposure to high relative humidity can improve the vigour of the seeds [15]. Many studies have related the KH_2PO_4 priming induced germination enhancement to the improvement in membrane integrity as well as the increases in protein and nucleic acid syntheses [16]. It was also plausible to presume that the enhanced germination due to potassium dihydrogen phosphate might be due to ions absorption during priming [17].

Moreover, the potassium salts had been reported to raise the ambient oxygen level by making less oxygen available for the citric acid cycle [18]. In the present study, increase in shoot length, root length and dry matter production due to priming might be due to earlier start of emergence. This paved way to conclude that the potassium ions were absorbed during seed priming with KH_2PO_4 solution and it was utilized rapidly during the course of germination. This might be one of the reason for germination enhancement and production of longer root, shoot and heaviest seedlings by seeds primed with KH_2PO_4 1% for 6 h. Similar results were reported in banyard millet [19], in maize [20], in certain minor millet [21].

Table 2 Effect of chemical seed enhancement treatment on initial growth parameters in kodo millet cv. CO 3

Treatment	Plant height (cm)	Days to first flowering	Days to 50 percent flowering	No of tillers per plant	No. of leaves per plant	Dry matter production (g seedlings^{-10})	Leaf area index	Panicle length (cm)
T_0	56.78	58	66	40	13.84	2.95	1.65	8.85
T_1	63.71	57	56	41	16.21	3.01	1.76	8.94
T_2	60.12	56	59	44	14.56	3.33	1.66	9.65
T_3	58.73	53	64	43	13.96	3.10	1.68	9.35
T_4	51.79	49	56	45	17.38	3.45	1.74	10.1
T_5	64.76	55	64	43	15.40	3.25	1.85	8.87
T_6	61.31	51	63	44	16.33	2.98	1.71	11.10
T_7	60.74	50	60	44	17.86	3.55	1.90	10.90
T_8	67.32	50	51	49	18.46	4.01	2.55	11.36
T_9	59.74	50	61	41	15.84	3.24	2.36	10.50
T_{10}	68.11	49	53	50	20.82	4.35	2.60	12.00
Mean	61.19	53	59	44	16.42	3.38	1.95	10.14
SE(d)	2.15	1.89	2.27	0.815	0.29	0.06	0.07	0.37
C.D (P=0.05)	1.07	0.94	1.13	1.64	0.58	0.12	0.03	0.18

The seed hardened KH_2PO_4 @ 1% with was also recorded the yield parameters such as number of panicles per plant, weight of grain, 1000 seed weight, seed yield per plant, and harvest index. It recorded 56.41, 58, 439.63, 59.52 and 22.55 percentage higher than control respectively with this above mentioned characters (Table 3). The KH_2PO_4 priming which was attributed to micronutrients to the seeds that often act as co -factors in enzyme systems and participate in redox reactions, in addition to having several other vital seed functions. Most importantly, they are involved in the key physiological processes [22-23]. It was reported earlier that KH_2PO_4 participated in regulation of many growth and developmental processes in plants [24] (Guan *et al.*, 2014) and was particularly important in regulating stem elongation [25].

Table 3 Effect of chemical seed enhancement treatment on yield parameters in kodo millet cv. CO 3

Treatment	No of panicles per plant	Weight of grainper panicle	1000 seed weight (g)	Harvest index	Seed yield per plant (g)	Seed yield per plot (g)	Seed yield per hectare (kg)
T_0	3.90	0.50	3.28	30.42	1.95	177.77	0.177
T_1	4.85	0.56	3.32	33.56	2.71	193.93	0.193
T_2	5.10	0.74	3.46	32.10	3.77	238.12	0.238
T_3	4.33	0.66	3.30	35.63	2.85	220.29	0.220
T_4	3.64	0.52	3.58	34.25	1.89	190.41	0.190
T_5	3.65	0.63	3.67	33.10	2.29	220.21	0.220
T_6	4.01	0.53	3.43	34.38	2.12	190.08	0.190
T_7	4.83	0.56	3.33	35.21	2.70	216.28	0.216
T_8	5.10	0.75	3.56	36.10	3.82	260.30	0.260
T_9	5.01	0.58	3.90	34.10	2.90	251.18	0.251
Mean	6.10	0.79	4.58	37.28	14.81	271.69	0.271
SE(d)	4.55	0.62	3.58	34.19	0.063	4.182	0.004
C.D (P=0.05)	0.09	0.02	0.06	0.61	0.132	8.784	0.009

The KH_2PO_4 priming induces a range of biochemical changes in the seed that required initiating the germination process i.e., breaking of dormancy, hydrolysis or metabolism of inhibitors, imbibition's and enzymes activation [26]. Some previous researcher indicated that some or all process that precede the germination are triggered by The KH_2PO_4 priming and persist following the re-desiccation of the seed [27]. Thus, upon sowing, primed seed can rapidly imbibe and revive the seed metabolism, resulting in higher germination percentage and a reduction in the inherent physiological heterogeneity in germination [28]. Moreover, the potassium salts had been reported to raise the ambient oxygen level by making less oxygen available for the citric acid cycle [29] and influencing plant development by modulating pre-germination metabolic activity prior to emergence of the radicle and generally enhances germination rate and plant performance.

Increase in fresh weight was observed in roots primed with KH_2PO_4, leads to supply of high P which was in line with root weight increase due to priming. High P influences the rate of regeneration of ribulose1, 5-bisphosphate, as well as the activity and the content of ribulose 1,5-bisphosphate carboxylase in maize leaves which eventually affects photosynthesis in leaves [30]. Phosphorus priming in our study led to enzymatic changes in the seed and hence resulted in increased shoot and root biomass [31]. The "P" ions liberated from KH_2PO_4 was assayed at different growth stages of kodo millet and at final harvest showed that enzyme activity increased up to tillering stage. It coincides with the active growth stage of the crop, enhanced root activity and release of extra cellular enzymes during active growth phase [32].

The KH_2PO_4 priming - improved seed performance might be attributable in part to metabolic repair processes, a buildup of germination metabolites or osmotic adjustment during treatment [33]. KH_2PO_4 in raising the P content of seeds and as effective at increasing the biomass and shoot P content of seedlings which leads to increasing biomass and grain yield [34]. Phosphorus (P) is an important plant macronutrient, making up about 0.2% of a plant's dry weight. After nitrogen, P is the second most important nutrient. The increase grain yield may be due to the fact that priming advances the metabolism of the seed and the seed protein is synthesized which has a direct affect in increasing seed performance and hence yield [35].

Moreover, 'P' is the major key element which received from KH_2PO_4 necessary for the synthesis of amino acids, proteins and nucleic acids. The high supply of which due to inoculations, resulted in more seed filling, good seed development, leading to production of more number of filled seeds. The increase in number of filled seeds and seed filling per cent due to Potassium dihydrogen phosphate (KH_2PO_4) priming [36].

CONCLUSIONS

Thus, the influence of various seed management practices on quality seed production in kodo millet cv. Co 3 revealed that KH_2PO_4 @ 1% hardened seeds recorded the higher seed yield and quality when compared to other treatments and control.

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