Indian J. Pl. Genet. Resources 11(1): 87-91, 1998

IMPROVING SEED GERMINATION OF GRAIN AMARANTH GENOTYPES BY SOME PHYSICAL AND CHEMICAL TREATMENTS

B.K. Ghosh, N.K. Birua and P.K. Mishra*

Department of Plant Physiology Orissa University of Agriculture and Technology, Bhubaneswar 751 003 (Orissa)

Nine-month old seeds of ten grain amarnath (*Amaranthus* sp.) were subjected to various physical and chemical treatments to evaluate the effects on seed germinability. Physical treatments like hot water dipping (70°C for one minute), dry heat (50°C in incubator for 24 hrs) and cold temperature (presoaked seeds at 4°C for 7 days) and chemical treatments like soaking the seeds in GA, ascorbic acid and ethylene solution (200 ppm each) for 24 hrs could enhance the germinability considerably. Use of hot water and ethylene were found superior among physical and chemical treatments respectively.

Key words : Grain amarnath, seed germination

Grain amaranth (*Amaranthus* sp.) has attracted the people in the recent years owing to versatile use of its seed in human food, medicines, cattle feed and food dye etc. and use of its green leaves as vegetable and fodder. Poor germination of amaranth seeds in field is a common problem of the farmers. Very limited information is available on the effects of germination stimulating physical and chemical treatments on grain amaranth seeds. An attempt has, therefore, been made to study the effects of some physical and chemical treatments on grain amaranth germination.

MATERIALS AND METHODS

Nine-month old seeds of ten grain amaranth genotypes were collected from the Breeders' stock when the seeds were ready for sowing. The seeds were subjected to various physical treatments like hot water (70°C for one minute), dry heat (50°C in incubator for 24 hrs) and cold temperature (pre-soaked seeds at 4°C for 7 days) and chemical treatments like soaking in gibberellic

*U.U. & U.E.P. Scheme (ICAR), OUAT, Bhubaneswar

acid (200 ppm), ethylene (200 ppm) and ascorbic acid (200 ppm) solution for 24 hours. Thereafter, the seeds were washed thoroughly with distilled water and transferred to 5 replicated petridishes (50 seeds per dish) for each treatment, and kept in a seed germinator for germination test at 27°C temperature in light following ISTA rules (Anonymous, 1985). Untreated controls were also grown in similar manner.

RESULTS AND DISCUSSION

Data on percent germination recorded on 7th day of test revealed that both physical and chemical treatments could stimulate the germination in all the grain amaranth genotypes considerably (Table 1).

The mean germination varied from 83.5-86.5% in different untreated genotypes. But both the physically and chemically treated seeds showed considerably higher germinability ranging from 94.7 to 97.2%. Hot water and dry heat treatments showed mean germination percentage of 96.9 and 96.6 respectively. Low temperature treatment showed slightly lesser germinability (94.7%) as compared to other two physical treatments. Though lowest germinability (76-81%) was noticed in the untreated seeds of genotype IC 6646, hot water and dry heat treatments could raise the germination percentage further to 99-99.6%. The germinability of IC 35711 was enhanced to 97-99.3 % due to hot water of dry heat treatment.

Untreated seeds of AG 114 showed 81.6% germinability whereas the same genotypes when subjected to low temperature treatment, the germinability was raised to 95%. Though the actual mechanism involved in stimulating germination by hot water or dry heat is not fully understood. Mayer and Poljajkoff-Mayber (1982) have cited examples of *Amaranthus fibriatus* and some other species of seeds as high temperature requiring species for germination. Raju and Sivaprakasham (1994) have noticed increased germination in cabbage seeds by hot water treatment. Low temperature (stratification) has been known to stimulate germination by breaking dormancy in many seeds (Bratcher *et al.*, 1993). It is quite possible that the nine-months old seed lots taken in this investigation might contain dormant seeds which could germinate due to low temperature treatment.

The chemical treatments like GA, ethylene and ascorbic acid also enhanced the germinability considerably considerably. The mean germination percentage of GA, ethylene and ascorbic acid treated seeds were as high as 96.7, 96 and 97.20 respectively whereas in the untreated seeds the germination percentages were 85.0, 84.6 and 84.9 respectively. Among the genotypes, IC 21930, Rasna-2, GA-1, IC 42006 and IC 35453 showed high germinability of 99.3, 99.3, 98.3, 98.0 and 97.0 per cent respectively due to GA treatment. On the other hand,

Table 1. Effect of different physical and chemical treatments on seed germination of grain Amaranth genotypes

Genotypes	Physical						Chemical					
	Hot water		Dry heat		Low Temp.		Gibberllic acid		Ethylene		Ascorbic Acid	
	a	b	a	b	a	b	a	b	a	b	a	b
IC 21930	81.0	96.0	82.0	97.3	85.6	98.0	83.0	99.3	84.3	95.6	83.3	96.3
AG 21	84.6	97.6	85.0	96.0	92.0	99.3	86.0	94.0	82.0	94.0	86.3	94.3
IC 42006	84.0	94.0	86.0	96.0	82.3	88.6	85.3	98.0	86.3	92.3	86.0	99.6
GA I	80.0	92.3	88.0	96.0	86.0	90.3	88.0	98.3	80.6	96.6	88.0	95.6
AG 114	80.3	98.6	83.0	94.0	81.6	95.0	84.0	92.0	82.0	95.6	82.0	97.6
IC 6646	76.0	99.0	81.0	99.6	84.4	95.0	80.0	96.0	78.3	94.0	80.0	98.3
Rasna-2	85.0	97.0	86.0	98.0	94.3	97.0	86.0	99.3	86.0	98.6	85.0	96.3
IC 35453	86.6	99.0	88.6	97.6	84.0	96.6	87.6	97.0	88.0	98.0	88.3	88.3
IC 35711	89.6	97.0	88.6	99.3	85.3	92.0	88.6	95.0	90.6	97.6	88.3	98.6
R-104	88.0	99.0	82.0	92.3	90.3	96.0	81.6	98.3	88.6	98.3	82.0	97.6
Mean	83.5	96.9	84.9	96.6	86.5	94.7	85.0	96.7	84.6	96.0	84.9	97.2
C.D. (P = 0.05)	3.73		2.87		1.86		3.94		2.68		3.58	

a - Untreated b - Treated

in the untreated seeds of above genotypes, the germination percentage recorded were 83.0, 86.0, 88.0, 85.09 and 87.6 respectively. Even the lowest 92% germinability was noticed in AG 114 due to GA treatment whereas in untreated control of the same genotype germination was only 84%. Ethylene also enhanced germination in all the genotypes maximum being in IC 42006 (99.6 %) followed by IC 35711 (98.6 %), IC 6646 (98.3%), IC 35453 (98.3%) and AG 114 (97.6%). Similarly Ascorbic acid treatment enhanced the germination in all the genotypes, the highest being in Rasna-2 (98.6%) followed by R 104 (98.3%), IC 35453 (98.0%) and IC 35711 (97.6%). Rest of the genotypes also showed high germinability.

Thus, from these observations it was clear that all the three chemicals were capable of enhancing the germination in grain amaranth genotypes but most encouraging response was by ethylene treatment. The mean germination percentage for ethylene treatment was the highest (97.2 %) among the three treatments.

The ability of GA to stimulate germination of seeds is well documented (Ashri and Palevitch, 1979). GA overcomes the inhibitory effect of ABA (Taylorson and Hendricks, 1977). Kepizynsky and Karsen (1985) observed stimulation in germination due to ethylene treatment in *Amaranthus caudatus*. Tomar *et al.* (1987) have reported stimulation of germination in paddy seeds due to AA treatment. Since AA is considered as enzyme mobilizing hormone (Saxena *et al.* 1969) it is possible that AA may mobilize or activate the enzymes responsible for germination in grain amaranth.

Therefore, it may be concluded that both physical and chemical treatments enhanced germinability in Amaranthus sp. Among the physical treatments, hot water dipping or dry heat are better than cold treatment. Among the chemical treatments, ethylene was most promising. Genotypes vary in their response to both physical and chemical treatments. Physical treatments like hot water or dry heat which are more economic can be adopted by the farmers for enhancing germination of grain amaranth seeds.

REFERENCES

Anonymous. 1985. ISTA rules for Seed Testing. *Seed Science* and *Technology*, **13**(2): 455.

Ashri, A. and Palvitch, D. 1979. Seed dormancy in sesame (*S. indicum*) and the effect of gibberellic acid. *Experimental Agric.* **15**: 81-83.

Bratcher, C. B., Dole, J. M. and Cole, J. C. 1993. Stratification improves seed germination of five native wild flower species. *Hort. Sci* **28**(9): 899-901.

Kepezynaski, J. and Karsen, C. M. 1985. Requirement for the action of endogenous ethylene during germination of non-dormant seeds of *Amaranthus caudatus*. *Physiol. Plant* **63**(2): 49-52.

Mayer, A. M. and Poljakoff - Mayber, A. 1989. The germination of seeds, pergamon press, UK.

Raju, V. J. and Shivaprakasham, K. 1994. Seed treatment of cabbage seed by chemical and non-chemical methods on the viability. *Madras Agric. J.* **81**(5): 237-238.

Saxena, O. P., Ghesari, P. I., Shukla, S. P. and Chinoy, J. J. 1969. Role of ascorbic acid as an enzyme mobilizing hormone. *Indian J. Plant Physio.* **12**(1-2): 1-6.

Tomar, R. P. S., Ram, C. and Promila. 1987. Breaking seed dormancy in paddy varieties. *Seeds and Farms*, **13**(6): 23-26.

Taylorson, R. B. and Hendricks, S. B. 1977. Dormancy in seeds. *Ann. Rev. Plant Physiol.* **28**: 331-354.