Original Research Article

INFLUENCE OF SPECIFIC GRAVITY GRADING USING FLOATATION TECHNIQUE ON SEED AND SEEDLING QUALITY CHARACTERISTICS IN AMARANTHUS Cv. PLR 1

ABSTRACT

A Research Study was undergone to evaluate the efficacy of floatation grading on the seeds of Amaranthus Cv. PLR 1 using organic solvents in Department of Seed Science and Technology, TNAU, Coimbatore during March 2023.The experiment was laid out in Completely Randomized Design with four replications in each five treatments.We considered four organic solvents viz., Acetone, Methanol, Dichloromethane and Petroleum Ether along with water. The results showed that sinker fraction regardless of organic solvent and water performed better than floater fraction. The grading ability of Dichloromethane was greater among the assessed organic solvents. The sinkers of Dichloromethane recorded higher germination % and vigour index than the sinkers of water. This specific gravity grading using dichloromethane can be adopted to segregate well filled and ill filled seeds in a seed lot of amaranthus.

Keywords: *Amaranthus, Dichloromethane,Germination ,Grading, Sinkers, Specific gravity*

1. INTRODUCTION

Amaranthus which belongs to the family Amaranthaceae is a genus of 50 species of herbaceous annuals found in tropical and subtropical regions worldwide.Generally, members of this genus are weeds possess rapid vegetative growth and produce plentiful

small seeds with good-quality protein. Amaranthus is an underutilized inexpensive leafy vegetable which are rich sources of vitamins, proteins, dietary minerals and bioactive compounds with potential health benefits.Dietary fiber is abundant in leafy foods. According to the Indian Council of Medical Research, an adult man needs 300 grams of vegetables each day which includes 100 grams of roots and tubers, 125 grams of leafy vegetables, and 75 grams of other vegetables.Vegetables are necessary to human health as it is the repository of nutrition. Improved seed production is the first step to boost availability of organic vegetables. As a labor-intensive crop, it requires considerable skill and attention.Improved varieties and better management practices help reduce production costs and increase yield through seed production technology. A crucial ingredient in the cultivation of vegetables is good seed.Homogenization of seed lot is the ultimate goal of seed processing.Physical characteristics are the main focus of homogenization since they are the most readily adaptable. Amaranthus is propagated through seeds which are tiny. Due to its indeterminate growth habit, seeds are continuously produced on branches, which generate immature, smaller seeds from late formed inflorescence. Such immature or empty seeds must be eliminated from good ones in seed processing.The seeds of the amaranthus pass through the smallest sieve size of BSS 22 x 22 (British Standard Sieve), so size grading could be a tedious one.Hence, attempts were made in Amaranthus Cv. PLR 1 to grade the seeds by density using organic solvents and were evaluated for the seed and seedling quality characters

Density grading is a technique where seeds are separated based on their weight using solvents or equipments like specific gravity separator. According to Jacqueline and Ramaswamy (1988), high-density brinjal seeds produced higher germination and vigor indices. The difference in weight of seed isdue to the storage reserves and its mobilisation occurring during germination and early stages of seed development determine the physiologicalparameters of seedling(Umarani, 2002)

In the context of *Jatropha curcas* seeds, large seeds displayed higher germination rates and biomass production compared to medium and small seeds (Sundaramoothy*et al.*,2014). Ramandane and Ponnuswamy (2019) opined that high and medium density seeds obtained after grading with specific gravity separator had good germination and vigourthan low density seeds.

2. MATERIALS AND METHODS

The experiment was conducted at Department of Seed Science and Technology, Agricultural College and Research Institute, Coimbatore. Fresh seeds of *Amaranthus polygonoides* Cv. PLR 1 were obtained from Vegetables Research Station, Palur formed the base material for the study. The seeds were subjected to floatation grading using organic solvents and water by dropping 1 gram of seeds in 50 ml of solvents. It works based on the principle of specific gravity of liquids to separate seeds based on its density. The organic solvents used were acetone, methanol, dichloromethane and petroleum ether. Seeds were stirred well and allowed to stand for one to two min. The well filled seeds get separated as sinkers (sink in the column of solution/water) and the ill filled tend to separate as floaters (seeds that float in the column of solution/water). Both the grades were then collected separately and dried to its original moisture content. The respective grades were evaluated for recovery percentage by using the following formula

$$\text{Sinkers}(\%) = \frac{\text{Weight of sinkers}}{\text{Total weight of seeds}} \times 100$$

$$\text{Floaters}(\%) = \frac{\text{Number of floaters}}{\text{Total weight of seeds}} \times 100$$

Then, each of the fractions were sown in quadruplicate in a paper medium using inclined plate method and allowed to germinate in a germination room maintained at 25± 2 °C and 85 per cent relative humidity and illuminated with fluorescent light. At 8th day, seed and seedling quality characters viz., germination (%) (ISTA, 1999), root and shoot length, drymatter production (mg 10 seedlings^{-1}), vigour index (Abdul Baki and Anderson, 1973) were recorded.

VigourIndex = Germination (%) x Dry matter production (mg/10 seedlings)

Specific gravity of the considered organic solvent was estimated using the following formula(Agnihotri and Tewari, 1968)

$$\text{Specific Gravity} = \frac{\text{weight of sample in bottle} - \text{weight of empty bottle}}{\text{weight of water in bottle-weight of empty bottle}}$$

The experiment was conducted with Completely Randomized Design (CRD). The recorded observations were statistically analysed by adopting the procedure described by Gomez and Gomez (1984) for evaluating the treatmental significance (P = 0.05). Percentage values were transformed to arc-sine values prior to statistical analysis.

3. RESULTS AND DISCUSSION

Table(1) Data shows that the seed weight evaluated for both fractions after dropping 1 gram of seeds have shown that sinker seed were heavier in weight than floater seeds in both water and dichloromethane. This is in accordance with Nascimento (1995) where pea 1000 seed weight and purity decreased with decreasing density.

Table(1) The recovery of seeds was higher in dichloromethane followed by water. Dichloromethane was able to recover 93% of seeds as sinkers with 77 % germination. This could be obtained by rejecting 7% of seeds which floated on the surface with 24% germination, whereas water able to recover 63% of seeds as sinkers with 55% germination by rejecting 37% of seeds which floated on the surface with 53% germination. This correlates with the findings of Sivakumar *et al.*,(2007).

In rest of the other solvents seeds just got settled down. This aids us to look into the solvents' specific gravity. Table (2) The specific gravity of universal solvent i.e; water is 1 and dichloromethane is 1.27. The considered remaining organic solvents viz., acetone, methanol and petroleum ether's specific gravity are 0.73, 0.77 and 0.64 respectively. From this we can conclude that amaranthus seeds got separated as sinkers and floaters in solvents whose specific gravity is greater than or equal to 1. In dichloromethane, ill filled seeds got separated as floaters precisely when compared with water where both well filled and ill filled found to float on the surface for first few minutes due to their lighter weight but thereafter the seed sink to the bottom based on the adsorption principle because of which the recovery of seeds were lower in water than dichloromethane. Several authors have recorded their experience on relationship between specific gravity of seed and seedling vigour(Mao *et al.*,2019; Chandraprakash *et al.*,2020)

Table (3) Though the seeds retained as sinkers by water recorded higher root length (cm), shoot length (cm) and DMP (mg 10 seedlings^{-1}) as 5.47, 3.81 and 4.95 respectively than dichloromethane sinkers. The vigour index of dichloromethane sinkers were higher than sinkers of water which endrose the mixture of ill filled and well filled seeds in sinker fraction of water which lead to lower germination percentage.Highly significant differences were observed between sinkers and floaters of water and dichloromethane for the evaluated parameters viz., seed recovery, sinkers and floaters seed weight, germination and vigour index. Similar results were found in upgrading petunia seeds by Natarajan and srimathi(2018)where sinkers found in acetone performed better than water. Selvaraju and Selvaraj(1996) reported similar result that marigold seed lot can be improved by adopting density grading by organic solvent.

The result of the present study indicated that among the four organic solvents used for grading the amaranthus seeds, dichloromethane stood efficient in segregating the ill filled seeds and well filled seeds as sinkers and floaters. Apart from dichloromethane solvent, sinkers and floaters fraction were found in water also. The seeds got settled down in remaining organic solvents completely which indicate that the solvents' specific gravity is not sufficient to separate as fractions.

Fig 1. Floatation Grading Amaranthus Cv.PLR 1 seeds using Organic Solvents

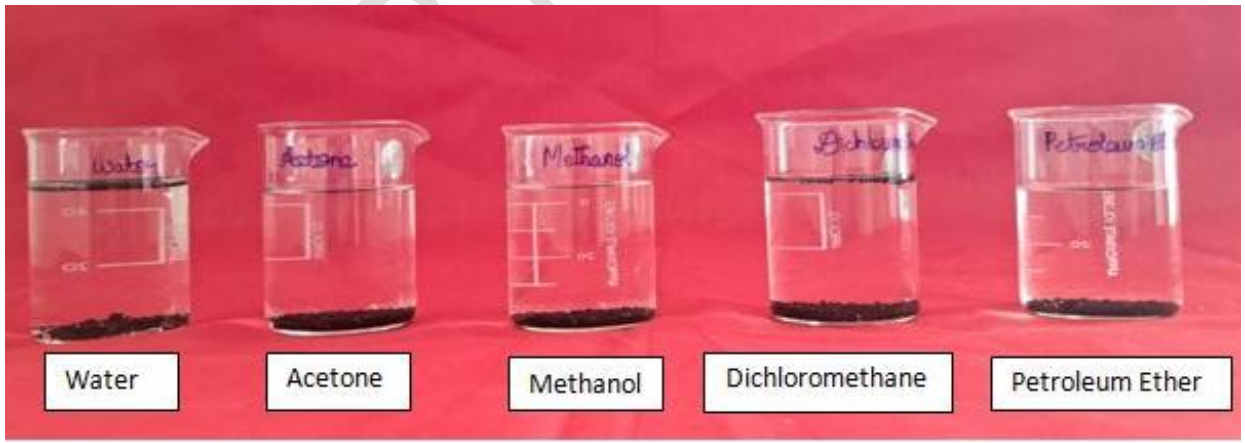

Table 1. Effect of seed grading on seed weight, seed recovery percentage of amaranthus Cv. PLR 1

Treatment	Seed weight (g)		Seed recovery (%)	
	Sinkers	Floaters	Sinkers	Floaters
T_1	0.63	0.37	63 (52.54)	37 (37.47)
T_2	1	0	100 (89.71)	0 (2.866)
T_3	1	0	100 (89.71)	0 (2.866)
T_4	0.93	0.07	93 (74.66)	7 (15.34)
T_5	1	0	100 (89.71)	0 (2.866)
Mean	**0.91**	**0.09**	**91.2**	**8.8**
SEd	0.019	0.003	1.352	0.180
CD(P=0.05)	0.041	0.007	2.881	0.383

T_1-Water, T_2-Acetone, T_3- methanol, T_4-dichloromethane, T_5- Petroleum Ether

Numbers in parenthesis indicate Arc-sine values

Table 2. Specific Gravity of solvents used

Solvents	Specific gravity
Water	1.00
Acetone	0.73
Methanol	0.77
Dichloromethane	1.27
Petroleum Ether	0.64

Fig 2. Specific Gravity bottle

Table 3. Effect of sinker and floater seeds on physiological parameters of amaranthus Cv. PLR 1

Treatment	Germination%		Root length (cm)		Shoot length (cm)		Dry matter production (mg 10 seedlings^{-1})		Vigour index	
	Sinkers	**Floaters**	**Sinkers**	**Floaters**	**Sinkers**	**Floaters**	**Sinkers**	**Floaters**	**Sinkers**	**Floaters**
T_1	55 (47.87)	53 (46.72)	5.47	3.78	3.81	2.25	4.95	4.37	272	231
T_2	70 (56.79)	0 (2.866)	4.00	0	2.44	0	2.52	0	176	0
T_3	62 (51.94)	0 (2.866)	4.15	0	3.22	0	3.08	0	191	0
T_4	77 (61.34)	24 (29.33)	4.82	3.29	2.86	1.98	3.95	0.57	304	14
T_5	68 (55.55)	0 (2.866)	3.31	0	3.07	0	2.9	0	197	0
Mean	**66.4**	**15.4**	**4.35**	**1.42**	**3.08**	**0.846**	**3.48**	**0.988**	**228**	**49**
SEd	0.992	0.403	0.097	0.050	0.071	0.031	0.082	0.040	5.446	2.135
CD(P=0.05)	2.114	0.858	0.207	0.106	0.151	0.067	0.176	0.085	11.601	4.551

T_1-Water, T_2-Acetone, T_3- methanol, T_4-dichloromethane, T_5- Petroleum Ether

Numbers in parenthesis indicate arc-sine values

4. CONCLUSION:

Hence considering both the recovery and quality of seed, grading using dichloromethane could be adopted. The principle behind the separation might be the relationship between the seed density and the buoyancy it exhibit. Thus the study expressed that grading of amaranthus seed with dichloromethane established proper stratification of well filled and ill filled seeds.

REFERENCES

ABDUL-BAKI, A. A. & ANDERSON, J. D. 1973. Vigour determination in soybean seed by multiple criteria. Crop Science 13: 630-632.

Agnihotri, S. K., & Tewari, D. N. (1968). TDS and specific gravity in ground waters. *Journal-American Water Works Association*, *60*(6), 733-737.

Chandraprakash, R., Masilamani, P., Rajkumar, P., Geetha, R., Albert, V. A., &Eevera, T. (2020). Optimization of Grading Efficiency of a Specific Gravity Separator to Upgrade the Quality of (Moringa oleifera Lam.) Seeds. *Madras Agricultural Journal*, *107*(december (10-12)), 1.

Gomez, K.A.and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research. AnInternational Rice Research Institute Book, Wiley-Interscience Publication, Philippines, pp 207–214

Jacqueline A.S. and Ramaswamy K.R., 1988. Effect of density grading on seed quality attributes in brinjal. Seed Res., 16, 117-120

L., Sundaramoothy., P., Srimathi., N., Mariappan. (2014). Influence of graded seeds on seed and seedling quality characters during storage of jatropha curcasl.. LIFE SCIENCES LEAFLETS

Mao, P., Guo, L., Gao, Y., Qi, L., & Cao, B. (2019). Effects of seed size and sand burial on germination and early growth of seedlings for coastal Pinus thunbergii Parl. in the Northern Shandong Peninsula, China. *Forests*, *10*(3), 281.

Nascimento, W. M. (1994). Effect of processing on pea seed quality. *Pesquisa Agropecuaria Brasileira (Brazil)*.

Natarajan, K., & Srimathi, P. (2018). INFLUENCE OF FLOATATION TECHNIQUES ON SEED AND SEEDLING QUALITY CHARACTERISTICS OF PETUNIA CV. MIX. *International Journal of Logistics & Supply Chain Management Perspectives*, *7*(02), 3334-3344.

Ramanadane, T., &Ponnuswamy, A. S. (2019). Standardization of seed upgradation Techniques in Hybrid rice (Oryza sativa L.).

Selvaraju, P., & Selvaraj, J. A. (1996). Density grading by organic solvents to improve seed qualities in marigold (Tagetes erecta L.). *SOUTH INDIAN HORTICULTURE*, *44*, 110-111.

Sivakumar, V., Anandalakshmi, R., Warrier, R. R., Singh, B. G., Tigabu, M., & Oden, P. C. (2007). Petroleum flotation technique upgrades the germinability of Casuarina equisetifolia seed lots. *New Forests*, *34*, 281-291.

Umarani, R., & Vanangamudi, K. (2002). The effect of specific gravity separation on germination and biochemical potential of Casuarina equisetifolia seeds. *Journal of Tropical Forest Science*, 207-212.