*International Journal of Environment and Climate Change*

***Volume 13, Issue 10, Page 3131-3137, 2023; Article no.IJECC.106328***
***ISSN: 2581-8627***
*(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)*

# Influence of Specific Gravity Grading Using Floatation Technique on seed and Seedling Quality Characteristics in Amaranthus CV. PLR 1

**N. Tharani [a++*], V. Vijaya Geetha [b#], V. Manonmani [a†], M. S. Aneesa Rani [c‡] and E. Parameswari [d#]**

*[a] Department of Seed Science and Technology, AC&RI, TNAU, Coimbatore-641003, Tamil Nadu, India.*
*[b] Vegetable Research Station, Palur, Cuddalore-607 102, Tamil Nadu, India.*
*[c] HC&RI, Jeenur, Krishnagiri-635115, Tamil Nadu, India.*
*[d] Department of Environmental Sciences, Nammazhvar Organic Farming Research Centre, TNAU, Coimbatore-641003, Tamil Nadu, India.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/IJECC/2023/v13i102981

**Open Peer Review History:**
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/106328

***Original Research Article***

***Received: 06/07/2023***
***Accepted: 08/09/2023***
***Published: 13/09/2023***

## ABSTRACT

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

*[++]Research Scholar;*
*[#]Associate Professor;*
*[†]Professor and Head;*
*[‡]Professor (Horticulture) & Nodal Officer;*
**Corresponding author: E-mail: saithara.na@gmail.com;*

replications in each five treatments. We considered four organic solvents viz., Acetone, Methanol, Dichloromethane and Petroleum Ether along with water and observed the seed recovery percentage, germination percentage, root length, shoot length and vigour index of all the treatments. 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 seed recovery percent of dichloromethane (93%) was higher than sinkers recovered by water (63%). Also, the sinkers of dichloromethane recorded higher germination percent(77%) and vigour index(304) than the sinkers of water whose germination percent is 55% and vigour index is 272.This specific gravity grading using dichloromethane can be adopted to segregate well filled and ill filled seeds in a seed lot of Amaranthus. This method of floatation grading is a good substitute for sieve grading which requires skilled labour and availability of specific size sieve to properly segregate seeds. So, this can be used as an alternate method for grading Amaranthus seeds.

*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 [1], high-density brinjal seeds produced higher germination and vigor indices. The difference in weight of seed is due to the storage reserves and its mobilisation occurring during germination and early stages of seed development determine the physiological parameters of seedling [2].

In the context of *Jatropha curcas* seeds, large seeds displayed higher germination rates and biomass production compared to medium and small seeds [3]. Ramandane and Ponnuswamy [4] opined that high and medium density seeds obtained after grading with specific gravity separator had good germination and vigour than low density seeds.

## 2. MATERIALS AND METHODS

### 2.1 Materials

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, TNAU, Palur formed the base material for the study. The organic solvents used in this experiment were procured from Department of Seed Science and Technology

and Department of Environmental Sciences, TNAU, Coimbatore.

## 2.2 Methods

The seeds were subjected to floatation grading using organic solvents and water by dropping 1 gram of seeds in 50 ml of solvents. This method 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 8$^{th}$ day, seed and seedling quality characters viz., germination (%) [5], root and shoot length [6], drymatter production (mg 10 seedlings$^{-1}$), vigour index [7] were recorded. Vigour Index was computed using the following formula;

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

Specific gravity of the considered organic solvent was estimated using the below mentioned formula [8].

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

The experiment was conducted with Completely Randomized Design (CRD). The recorded observations were statistically analysed by adopting the procedure described by Gomez and Gomez [9] for evaluating the treatment significance (P = 0.05). Percentage values were transformed to arc-sine values prior to statistical analysis.

## 3. RESULTS AND DISCUSSION

The seed weight evaluated for both fractions after dropping 1 gram of seed in 50 ml of solvent (Fig. 1) have shown that sinker seed were heavier in weight than floater seeds in both water and dichloromethane (Data was depicted in Table 1). This is in accordance with Nascimento [10] where pea 1000 seed weight and purity decreased with decreasing density.

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., [11] where *Casuarina equistifolia* seed lots were upgraded using petroleum ether exhibited efficient separation of Casuarina seeds as witnessed by higher germination in sinker fraction (90%) than in floater fraction (4%). This implies that the germination of seeds increased with increase in weight of the seeds recovered in each fraction (Table 1).

In rest of the other solvents seeds just got settled down. This aids us to look into the solvents' specific gravity using specific gravity bottle (Fig. 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 (Table 2).

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 [12,13].

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 as depicted in Table 3.

Similar results were found in upgrading petunia seeds by Natarajan and Srimathi [14] where sinkers found in acetone performed better than water. Results are in conformity with Selvaraju and Selvaraj [15] where marigold seed lot was said to 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.

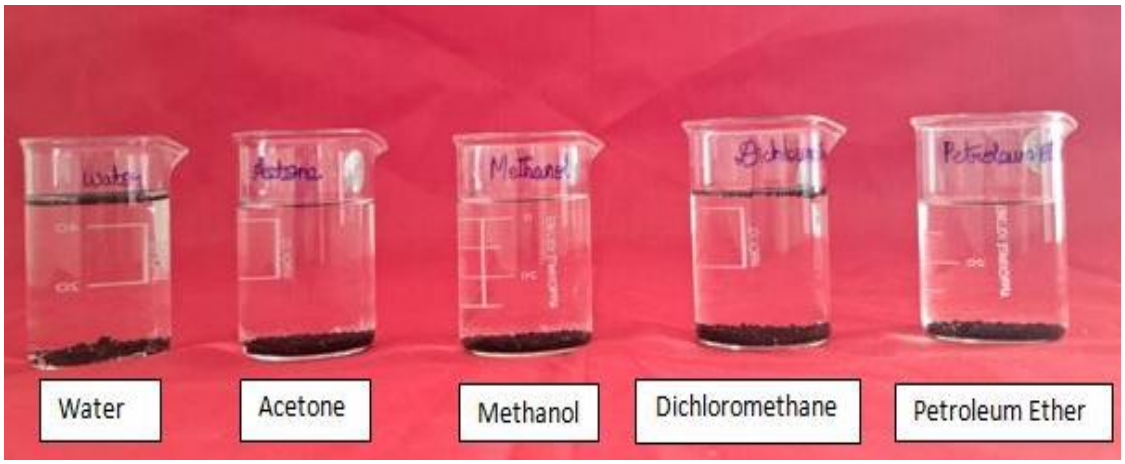


**Fig. 1. Floatation grading in Amaranthus Cv. PLR 1 seeds using organic solvents**
*Source-picture taken during my research work, 2023 in TNAU*

**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 parentheses 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 |

**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 parentheses indicate arc-sine values*


**Fig. 2. Specific gravity bottle**
*Source- picture taken during my research work, 2023 in TNAU*

## 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.

## ACKNOWLEDGEMENT

The authors of this work would like to express their gratitude to Vegetable Research Station, Palur and Department of Seed Science and Technology and Department of Environmental Sciences at Tamil Nadu Agricultural University in Coimbatore, for their support and perceptions during the entire research process.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Jacqueline AS, Ramaswamy KR. Effect of density grading on seed quality attributes in brinjal. Seed Res. 1988;16: 117-20.
2. Umarani R, Vanangamudi K. The effect of specific gravity separation on germination and biochemical potential of *Casuarina equisetifolia* seeds. Journal of Tropical Forest Science. 2002;207-212.
3. Sundaramoothy L, Srimathi P, Mariappan N. Influence of graded seeds on seed and seedling quality characters during storage of *Jatropha curcas* l. Life Sciences Leaflets; 2014.
4. Ramanadane T, Ponnuswamy AS. Standardization of seed upgradation Techniques in Hybrid rice (*Oryza sativa* L.); 2019.
5. ISTA, International Rules for Seed Testing. Seed Sci. & Technol., Supplement Rules. 1999;27:25-30.
6. ISTA. International Seed Testing Association. Seed Vigour Testing. International Rules for Seed Testing, Zurich, Switzerland; 2014.
7. Abdul-Baki AA, Anderson JD. Vigour determination in soybean seed by multiple criteria. Crop Science. 1973;13:630-32
8. Agnihotri SK, Tewari DN. TDS (Total Dissolved Salts) and specific gravity in ground waters. Journal-American Water Works Association. 1968;60(6):733-737.
9. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. AnInternational Rice Research Institute Book, Wiley-Interscience Publication, Philippines. 1984;207–14.
10. Nascimento WM. Effect of processing on pea seed quality. Pesquisa Agropecuaria Brasileira (Brazil); 1994.
11. Sivakumar V, Anandalakshmi R, Warrier RR, Singh BG, Tigabu M, Oden PC.

Petroleum flotation technique upgrades the germinability of *Casuarina equisetifolia* seed lots. New Forests. 2007;34:281-291.

12. Mao P, Guo L, Gao Y, Qi L, Cao B. Effects of seed size and sand burial on germination and early growth of seedlings for coastal Pinusthunbergii Parl. in the Northern Shandong Peninsula, China. Forests. 2019;10(3):281.
13. Chandraprakash R, Masilamani P, Rajkumar P, Geetha R, Albert VA, Eevera T. Optimization of Grading Efficiency of a Specific Gravity Separator to Upgrade the Quality of (*Moringa oleifera* Lam.) Seeds. Madras Agricultural Journal. 2020; 107(december (10-12)):1.
14. Natarajan K, Srimathi P. Influence of Floatation Techniques on seed and seedling quality characteristics of Petunia Cv. Mix. International Journal of Logistics & Supply Chain Management Perspective. 2018;7(02):3334-3344.
15. Selvaraju P, Selvaraj JA. Density grading by organic solvents to improve seed qualities in marigold (*Tagetes erecta* L.). South Indian Horticulture. 1996;44:110-111.



*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*https://www.sdiarticle5.com/review-history/106328*