

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.910.075>

Seed Quality Improvement in *Amaranthus polygonoides* var. PLR 1 through Specific Gravity Separator

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ABSTRACT

An experiment was conducted to get vigorous seedlings through processing in *Amaranthus polygonoides* var. PLR 1 seeds. The seeds of *Amaranthus polygonoides* var. PLR 1 were subjected to specific gravity separation at different combinations of machine settings like vertical height (0.5, 1, 1.5), horizontal height (0.5, 1, 1.5 cm), air flow rate (3, 3.5 m³/hr) and deck oscillation speed (400, 450, 465 rpm). The seeds were separated into five grades from heaviest, heavy, medium, light, lightest weighed seeds as grade A, B, C, D, E respectively. The E grade represents the low weighed seeds and A grade represents the heavy weighed seeds. After grading the seeds are tested for its seed quality parameters like seed germination, shoot length, root length, dry matter, vigour index, 1000 seed weight, seed recovery percentage. The results revealed that the machine setting with 0.5 cm of vertical height, 1.5 cm of horizontal height, 3.5 m³/hr of air flow rate, and 465 rpm of deck oscillation speed recorded recovery percentage of 92% (grade A + grade B) with the highest 1000 seed weight and 83 % of germination and vigour index of 701.

Keywords

Amaranthus polygonoides,
Specific gravity,
Vigour

Article Info

Accepted:
07 September 2020
Available Online:
10 October 2020

Introduction

Amaranthus is the leafy vegetable belongs to the family *Amaranthaceae*. *Amaranthus* is also known as Poor man's Spinach because of its high nutrition at cheaper cost. It is the rich source of protein. Among the twenty five species of *Amaranthus*, *Amaranthus polygonoides* var. PLR 1 have nutrients like iron (38.5 mg/ 100 g of leaves), calcium, vitamin A and vitamin C. with a crop duration of 65- 70 days. It is highly nutritive, adapts to

various climatic conditions and propagated through seeds. Seeds produced are heterogeneous due to floral biology necessitates seed upgrading. Specific gravity separator is the grading technique based on the seed weight and density. Yogeeshia *et al.*, (2013) reported that specific gravity separator was efficient in grading and improves the quality of okra seeds thereby improved the field emergence percentage. Chandraprakash *et al.*, (2019) reported that the oil and protein content decreases when the weight of the seed

decreases in caster. Late formed spikes of *Amaranthus polygonoides* var. PLR 1 produces many ill filled and immature seeds, poses the problem of seed processing with seed grader. Hence an attempt was done with specific gravity separator with different machine settings to upgrade the seeds of *Amaranthus polygonoides* var. PLR 1.

Materials and Methods

The experiment was conducted at Department of seed Science and Technology, Agricultural college and Research Institute, Madurai. Fresh seeds of *Amaranthus polygonoides* var. PLR 1 were graded in specific gravity separator based on their density. It works on the principle of specific gravity. The seeds were graded with different machine settings like vertical slope (0.5, 1, 1.5 cm), horizontal slope (0.5, 1, 1.5 cm), air blow rate (3, 3.5 m³/hr) and deck oscillation rate (450, 465, 500 rpm). The details of treatments imposed were as follows in Table 1.

The seeds were separated into five grades from heaviest, heavy, medium, light, lightest weighed seeds as grade A,B,C,D,E respectively. Seed recovery percentage is calculated for each grade separately. The seeds with recovery percent of more than 80 (Grade A & Grade B) were evaluated for its seed quality parameters which comes to seven combinations among the 17 combinations tested. Ungraded seeds served as control. The seed quality parameters germination (%), shoot length (cm), root length(cm), dry matter(mg/10 seedlings), vigour index I, vigour index II, and 1000 seed weight (mg) were observed. The germination test was conducted as per the ISTA (1999) rules at the room temperature of 25±1° C, RH of 97 ± 2 ° C in the presence of white light and evaluated at the end of 14 days. Vigour index values were calculated as per Abdul-baki and Anderson (1973)

Vigour index I = Germination (%) x Total Seedling length (cm)

Vigour index II = Germination (%) x Dry matter production (g/10 seedlings)

The experiment was conducted with Completely Randomized Design (CRD). The results were subjected to analysis of variance and tested (t- tested) as suggested by Panse and Sukhatme (1999) for its significant difference (p=0.05). Percentage values were transformed to sine values prior to statistical analysis.

Results and Discussion

In this experiment the seeds of *Amaranthus polygonoides* var PLR 1 were graded in specific gravity separator with different combinations of machine settings. Here the seeds after the discharge from the hopper move based upon the combination of shaking (deck oscillation speed) and air flow and collected as different grades like A,B,C,D and E. The heavy weight seeds were collected as grade A whereas light weight seeds as E. From the graded seeds, seed recovery percent and 1000 seed weight for each combination were calculated (Table 2). The maximum seed recovery percent (98.5 %) was obtained from the combination of deck slope with vertical axis as 1.0 & horizontal axis as 1.5 along with the oscillation speed of 450 and air blow rate of 3 (T13) followed T4 (94.9 %) and minimum seed recovery was obtained from T2 (10.64 %).

The maximum 1000 seed weight of 77 mg and 76 mg with the A & B grade seed was obtained from T₁₆ (V- 1.5, H- 1.5, A- 3, D- 450) followed by T₁₅ (V- 1.5, H- 1, A- 3, D- 450) and ungraded bulk had registered a 1000 seed weight of 65 mg. 1000 seed weight of seeds revealed that there was a positive correlation between seed weight and its

separation. The highest seed weight in T16 was due to the larger seed size and food reserves in the seed. Patil and Sarode (1988) observed that the seed weight was higher and heavy seeds compared to the light and lighter seeds for the heaviest graded seeds in Agricultural crops. Manikandan and Srimathi (2014) recorded that the 1000 seed weight was higher in heaviest fraction of seed collected.

Evaluation of seed quality parameters was done for the seeds obtained from seven machine settings (T1, T4, T5, T6, T7, T9 & T13) which have recorded the seed recovery percentage of more than 80 percent when seeds were combined from A & B grades. The maximum germination (83 %) was obtained from the combination T₄ (V- 0.5, H – 1.5, A – 3, D – 450 rpm) and followed by T₆ (V- 0.5, H- 1.5, A- 3, D- 500) of 80 %. The minimum

germination (72 %) was obtained from the combination T₇ (V – 0.5, H- 1, A- 3.5, D- 465) and T₉ (V- 0.5, H- 1, A- 3.5, D - 465) and the ungraded seeds recorded 72 % germination. Whereas the bulk recorded the germination of 72 %. The seeds with larger seed weight recorded the highest germination is because of large seeds have more and faster breaks in embryonic axis with the increased activity of redox enzyme that breaks the larger complex reserve food materials into simpler soluble sugars and also in other seed parts than the small seeds which results the lowest germination (Nagi *et al.*, 1998.). The germination was higher in heavier seeds was due to well developed embryo and good seed filling and the large weight seeds have more food reserves that produces the large energy which are expressed in seedling length and seed vigour (MC Daniel., 1969).

Table.1

TREATMENTS	VERTICAL AXIS (V)	HORIZONTAL AXIS (H)	AIR BLOW RATE(A)	DECK OSCILLATION SPEED (D)
T ₁	0.5	0.5	3	400
T ₂	0.5	1	3.5	400
T ₃	0.5	1	3.5	450
T ₄	0.5	1	3.5	465
T ₅	0.5	1.5	3	450
T ₆	0.5	1.5	3	500
T ₇	0.5	1.5	3.5	500
T ₈	1	0.5	3	450
T ₉	1	0.5	3	465
T ₁₀	1	0.5	3	500
T ₁₁	1	1	3	400
T ₁₂	1	1	3	465
T ₁₃	1	1.5	3	450
T ₁₄	1.5	0.5	3	500
T ₁₅	1.5	1	3	450
T ₁₆	1.5	1.5	3	450
T ₁₇	1.5	1.5	3	465

Table.2 Seed recovery percent and 1000 seed weight of the graded Amaranthus seed

TREATMENT/ GRADE	SEED RECOVERY (%)					1000 SEED WEIGHT(mg)				
	A	B	C	D	E	A	B	C	D	E
T ₁	43.98	37.46	17.56	0.86	0.05	67.25	63.00	59.62	53.50	48.6
T ₂	1.84	8.80	16.30	33.00	40.50	73.00	68.00	67.00	67.00	55.00
T ₃	13.40	17.40	20.70	22.90	25.90	74.00	71.00	69.00	68.00	60.00
T ₄	72.50	22.40	3.32	1.18	0.47	66.00	63.00	54.00	46.00	42.00
T ₅	54.00	31.92	12.93	1.05	0.46	73.50	60.75	57.65	56.37	50.50
T ₆	79.46	14.91	4.64	0.61	0.36	67.62	59.00	56.50	55.12	54.33
T ₇	71.42	21.90	5.60	0.73	0.12	67.25	65.37	58.25	54.50	48.00
T ₈	89.90	9.21	0.54	0.27	-	68.00	54.00	46.00	35.00	-
T ₉	49.00	35.00	15.00	0.90	0.10	73.12	67.75	66.62	54.25	52.17
T ₁₀	98.90	1.06	-	-	-	51.00	44.00	-	-	-
T ₁₁	2.00	9.46	22.90	23.20	43.30	76.00	69.00	68.00	61.00	56.00
T ₁₂	38.40	20.60	19.34	13.50	8.04	72.00	67.00	64.00	62.00	57.00
T ₁₃	76.60	21.90	1.04	0.39	0.01	73.00	63.00	56.00	46.00	44.00
T ₁₄	35.12	33.05	28.82	2.58	0.41	72.75	67.62	61.00	55.00	52.62
T ₁₅	40.90	17.97	15.67	12.60	11.30	75.00	72.00	66.00	60.00	49.00
T ₁₆	30.70	26.30	20.67	13.92	8.92	77.00	76.00	66.00	58.00	56.00
T ₁₇	35.14	26.02	17.50	13.08	8.23	70.00	69.00	67.00	63.00	61.00
BULK						65.08				

Table.3 Seed quality parameters after grading of Amaranthus seeds in specific gravity separators

	Germination (%)	Shoot length (cm)	Root length (cm)	Dry matter (mg/10 seedling)	Vigour Index I	Vigour Index II
Bulk	72 (56.790)	2.32	4.19	4.33	469	3.11
T ₁	75 (60.001)	2.42	4.51	5.66	518	4.23
T ₄	83 (65.651)	3.14	5.27	6.33	701	5.28
T ₅	72 (58.053)	2.84	4.46	6.0	525	4.30
T ₆	80 (63.436)	3.01	4.48	6.66	598	5.33
T ₇	73 (58.053)	2.45	5.04	4.5	549	3.30
T ₉	72 (58.053)	2.90	5.17	5.33	582	3.84
T ₁₃	77 (61.343)	2.79	5.02	5.33	597	4.08
S.ED	1.9437	0.1880	0.4795	0.6922	41.4528	0.8456
CD	4.1204	0.3985	1.0165	1.4675	87.8771	1.7926

The maximum shoot length (3.14 cm) obtained from T₄ (V-0.5, H-1, A- 3.5, D- 465) followed by T₆ (V- 0.5, H- 1.5, A- 3, D- 500) of 3.01 cm. The minimum shoot length (2.32 cm) obtained from the control followed by T₁(V-0.5,H-1.5, A- 3.5, D-500) of 2.42 cm. The similar results were obtained from the results of Menaka and Balamurugan (2008) in *Amaranthus* and Manikandan and Srimathi (2014) in *Amaranthus*. The maximum root length (5.27 cm) was obtained from treatment T₄ (V- 0.5, H – 1.5, A – 3, D – 450 rpm) and followed by 5.17 cm from T₉ (V– 1, H –0.5 , A –3, D- 465 rpm). The minimum root length was obtained from control (4.19 cm) followed by the treatment T₅ (4.46 cm). The results obtained from the results of Manikandan and Srimathi (2014) were similar. The larger shoot length and root length was due to the larger size of the seeds. The larger seeds usually larger sized seedlings both shoot and root length.

The maximum dry matter was obtained from the treatment T₆ (6.6 mg/10 seedlings) and followed by T₄ (6.3 mg/ 10 seedlings) and the minimum dry matter was obtained from the control (4.33 mg/ 10 seedlings) followed by treatment T₇ (4.5 mg/10 seedlings). The highest dry matter in T₆ and T₄ because of the fact that the seeds with large seeds have more food reserve material and more number of cells per cotyledon may increase the dry matter accumulation and thus increase the dry weight of the seedlings (Guldan and Brun, 1985). Vishwanath *et al.*, (2019) in soybean concluded that the seeds with larger size will have larger dry matter accumulation than the seeds with smaller size. Chandraprakash *et al.*, (2019) in castor agree with the similar results.

The maximum vigour index I obtained from the treatment T₄ (701) followed by T₆ (598) and the minimum treatment was obtained from the bulk (469) followed by treatment T₁

(518). The maximum vigour index II was obtained from the treatment T₆ (5.33) followed by the treatment T₄ (5.28) and the minimum was obtained from the bulk (3.11) which is followed by treatment T₇ (3.30) (Table 3). The size of the seeds might directly influence the vigour of the seedlings. This was described as large sized seeds have the mature embryo with containing more food reserves and nutrients which provides physiological stamina for the seeds (Pollock and Roos, 1972). Yogeesh (2013) in okra and Menaka and Balamurugan (2008) in *Amaranthus* reported the similar results of heavier the seed weight with highest vigour index.

From the above data results it is clear that the germination and other seed quality parameters were good in grade A whereas the grade with only large sized seeds with high weight due to absence of ill filled seeds and presence of fully developed embryo and of food reserves that completely utilized during germination that its utilization of nutrients and stamina was expressed on vigour of the seedling. The positive correlation between weight of the seeds and its germination was similar to Anon (1996) in sunflower and soybean, Patil and Sarode (1998) in wheat and Saraswathi (1995) in cotton. Similar records were observed in Dharmalingam (1989) and Anon (1998) in *Eucalyptus* of having highest germination and other quality characters which are influenced by its weight and its storage food reserves.

It is concluded, thus the seeds of *Amaranthus polygonoides* var. PLR 1 could be graded with the machine setting of 0.5 cm of vertical height, 1.5 cm of horizontal height, 3.5 m³/hr of air flow rate and 465 rpm of deck oscillation speed for obtaining heavier seeds with maximum seed recovery of 92% (grade A + grade B) and highest germination (83 %) and vigour (701).

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How to cite this article:

Kavinila, R., R. Geetha, R. Chandraprakash and Sujatha, K. 2020. Seed Quality Improvement in *Amaranthus polygonoides* var. PLR 1 through Specific Gravity Separator. *Int.J.Curr.Microbiol.App.Sci.* 9(10): 635-641. doi: <https://doi.org/10.20546/ijcmas.2020.910.075>