Seed Research, Vol. 45(2): 99-104, 2017

Upgradation of Onion Seed Planting Value using Floatation Technique

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ABSTRACT: An investigation made with onion to upgrade the quality of seeds based on specific gravity using floatation technique with water and salt solutions (0.5, 1.0 and 2.0 %) and studies on anatomical structures for the separated fraction of sinkers and floaters of floatation graded seeds were carried out with the use of SEM (Scanning Electron Microscope). Results revealed that the suitability of water and 2.0 % salt solution for separating the seeds as floaters and sinkers. Higher seed recovery was obtained by water (96.8%) whereas 2.0 % salt solution resulted better with respect to other seed quality characters. The sinkers of 2.0 % salt solution recorded maximum 100 seed weight (0.36 g), speed of germination (8.3), germination (94 %), shoot length (8.1 cm), root length (5.9 cm), dry matter production (22.3 mg 10 seedlings-1) and vigour index (1316). In anatomical study, presence of curved embryo in the sinkers was clearly observed, whereas in the floaters the embryo was not observed at all, instead a well distinct empty cavity was noticed. However, the presence of endosperm was recorded in the floaters of onion seeds. Thus, the floatation technique could be used to improve the plating value in Onion.

Keywords: Floatation technique, Planting value, Salt solution, Scanning Electron Microscope

Onion (*Allium cepa* L.) is one of the important commercial vegetable crops and ranks second after potato among the total vegetable crop production area in the world. Onion occupies premier position among the vegetables due to its high remunerative price and regular demand in the market. In past 20 years, production of onion in India has increased more than four times. However, productivity has not increased at the same rate. The onion productivity has increased only by about one time from nearly 10 to 15 tonnes ha^{-1}. Thus there is an urgent need to improve the productivity of onion in India. In this view availability of quality seed plays an important role in the enhancement of crop production [1].

Quality of onion seeds depends on many factors, such as; environmental conditions during growth of mother plant and seed development, location of seeds on the plant, time and method of harvesting and most importantly the storage conditions. The main reasons of low quality of onion seeds as, long flowering period resulted in different stages of seed maturity in the umbel, very fast reduction of seed viability if stored in suboptimal conditions and seed infestation with fungi has been reported [2].

In most of the vegetable crops due to longer period of flowering and ripening, early formed seeds differed from later formed ones in quality due to exposure to different environmental conditions like; RH in air, temperature and moisture stress and also differential supply of the essential nutrients [3] and thus variation in seed size occurred within the same plant [4], necessitating the grading of seeds for quality enhancement. Seeds are graded based on seed color, shape, size and density. Since onion seeds of uniform in size are having variation in seed density, a suitable grading technique based on seed density is very much essential for separation of

Received : January 2017 Revised : June 2017 Accepted : July 2017

uniform sized good quality seeds from the ill filled and immature seeds. Therefore, the present study was undertaken to evaluate the quality of onion seeds graded by floatation.

MATERIALS AND METHODS

The laboratory analysis was carried out at Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during 2015-2016. Seeds of onion CO (On) 5 received from Horticultural College and Research Institute, Periyakulam, Tamil Nadu, with 9 % moisture content and 87 % germination were utilized for standardizing the floatation technique and anatomical studies. Bulk onion seeds were subjected to floatation technique by dropping four replications of 100 g seeds in 600 ml of water and common salt solution. Then stirred well and were allowed to settle for three to five minutes. The seeds were divided into two parts; sinkers and floaters. Floater seeds were that floated in the upper side and sinkers were that settled at bottom. Both these parts were collected separately and dried under shade for 2 days. After shade drying the seed recovery was observed for both sinkers and floaters on weight basis, the seed and seedling quality characters were observed. The separated seeds along with ungraded seeds were evaluated for the physical and physiological characteristics. The experiment consisted of five treatments; T1 - Control (ungraded), T2 - Separation of seeds with water, T3 - Separation of seeds with 0.5 % NaCl, T4 - Separation of seeds with 1 % NaCl and T5 - Separation of seeds with 2 % NaCl. The observations on 100 seed weight (g), Speed of germination, germination (%), root length (cm), shoot length (cm), dry matter production (mg per 10 seedlings) and vigour index were recorded as per standard protocols.

SEM FEI QUANTA 250 was used to study the anatomical structure of sinkers and floaters of onion seeds by floatation technique. The separated sinker and floater seeds were soaking in water for 12 h and the soaked seeds were sectioned, subjected to sequential dehydration using ethanol with specified time intervals (25, 50, 75, 95 % for 20 minutes and 100 % for 30 minutes). The dehydrated seeds were observed under Scanning Electron Microscope (SEM).

RESULTS AND DISCUSSION

Highly significant results were obtained due to floatation technique for the evaluated seed and seedling quality characters of sinkers and floaters (Table 1). Floatation on liquid media is a widely used technique for density grading of seeds. This technique works on the separation of ill-filled or empty seeds in liquid media based on differences in specific density of seed and solution. Floatation technique which is cheap and best method to separate filled viable seeds from empty, dead, mechanically and insect damaged seeds.

Various liquid media such as water [5-7], n-pentane [8] ether [9], ethanol [10, 11], acetone [12, 13], sodium chloride solution [14, 15] and ethanol and petroleum ether [16, 17] could be used in separating filled and empty seeds by the flotation method. It is quite important not to damage the seed embryo and consequently seed germination ability during or after the flotation treatment by these liquids that have different densities. In this study some of the organic solvents like ethanol, methanol, acetone, kerosene, dichloromethane and petroleum ether were tried as a floatation media but the organic solvents were not suitable since they had less specific gravity compared to water and different concentrations of salt solutions.

Seed recovery (%)

In this study, the seeds were separated as sinkers and floaters using water and different concentrations of salt solutions *viz.*, 0.5, 1.0 and 2.0 %. The recovery of seeds in each of the above floatation fractions vary with respective to concentration of liquid media (Fig. 1). Among the upgrading techniques, floatation is the widely used technique to separate filled seeds from ill filled seeds based on their difference in specific gravity [6]. In this respect, through a simple method, the proportion of filled seeds or in other words seed quality in a seed lot could be improved at considerable amounts by using the flotation method. Thus, more uniform seedling emergence and higher germination percentages could be achieved in seedling production activities.

The superiority of sinkers over floaters has been well established. Moreover, sinkers recovered from different concentrations of common salt solution

Table 1. Influence of floatation technique on seed recovery (%), 100 seed weight (g), speed of germination and germination (%) in onion cv. CO (On) 5

Treatments	Seed recovery (%)		100 seed weight (g)		Speed of germination		Germination (%)		Shoot length (cm)		Root length(cm)		DMP (mg 10 seedling-1)		Vigour index	
	F[+]	S[++]	F	S	F	S	F	S	F	S	F	S	F	S	F	S
T1 - Control	-	-	0.27	0.27	6.9	6.9	87.0 (68.87)	87.0 (68.87)	7.0	7.0	4.0	4.0	17.2	17.2	957	957
T2 - Water	3.2 (10.30)*	96.8 (79.69)	0.23	0.32	3.1	8.0	18.0 (25.10)	88.0 (69.73)	5.0	7.0	1.2	4.8	5.1	18.0	112	1038
T3 - NaCl 0.5%	3.9 (11.39)	96.1 (78.61)	0.24	0.32	3.2	8.1	24.0 (29.33)	88.0 (69.73)	5.3	7.2	1.4	5.2	7.8	19.7	161	1091
T4 - NaCl 1%	5.7 (13.81)	94.3 (76.18)	0.28	0.34	3.4	8.3	30.0 (33.21)	92.0 (73.57)	5.4	8.0	1.5	5.6	9.1	21.4	207	1251
T5 - NaCl 2%	7.8 (16.25)	92.2 (73.81)	0.28	0.36	3.6	8.3	34.0 (35.67)	94.0 (75.82)	5.4	8.1	1.7	5.9	10.2	22.3	241	1316
Mean	5.1 (12.94)	94.9 (77.07)	0.26	0.32	4.0	7.9	39.0 (38.44)	90.0 (71.55)	5.6	7.5	2.0	5.1	9.9	19.7	336	1131
SEd	0.104	0.598	0.005	0.006	0.046	0.113	0.587	0.946	0.106	0.132	0.147	0.164	0.210	0.236	6.77	8.20
CD (p=0.05)	0.238	1.380	0.001	0.013	0.097	0.240	1.253	2.017	0.226	0.283	0.313	0.349	0.447	0.503	14.43	17.47

*Figures in parentheses are arc sine transformed values

[+]F - Floaters [++]S - Sinkers

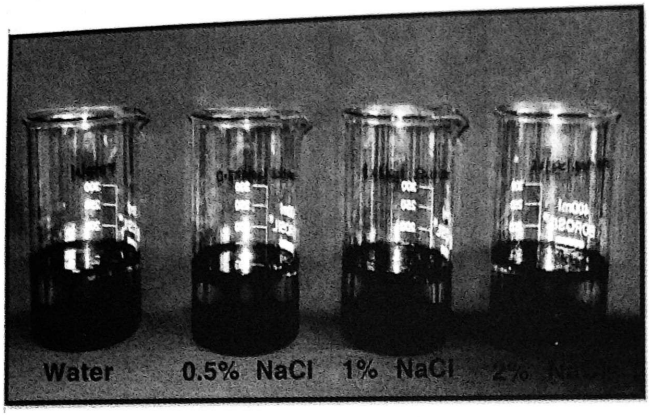

Fig. 1. Influence of floatation techniuque on seed recovery (%) in onion cv. CO (On) 5

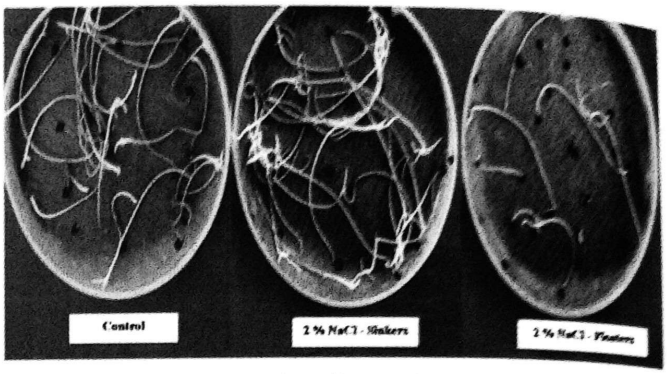

Fig. 2. Influence of floatation technique on germination (%) in onion cv. CO (On) 5

consistently over those obtained by water. However, the recovery of sinkers was more in water (96.8 %) when compared to salt solutions and which was on par with 0.5 % salt solution (96.1 %). The weight of 100 seeds (sinkers) increased significantly with raise in the density of the solution by increased salt concentrations. The weight increased from low to the high concentration of solution (0.5 to 2.0 %), from 0.27 g to 0.36 g.

Speed of germination

In this study, the maximum speed of germination was reported by the sinkers of NaCl 1.0 % and 2.0 % (8.3) and ungraded bulk seeds recorded the minimum (6.9). Germination was reported to be a function of both seed density and weight of which seed density exercised a profound influence on the ultimate seed quality [18]. In this study also, a close association between seed density and seed quality attributes *viz.*; seed recovery, 100 seed weight, speed of germination, root, shoot length, dry matter production and vigour index was clearly evident. Similar results were also reported in marigold [19, 20], in zinnia and gaillardia [12], in petunia [13], in China aster [16], in cockscomb and gingelly [7, 15].

Physiological parameters

Germination percentage of upgraded seeds was higher in 2 % salt solution (94 %) than ungraded seeds (87 %) (Fig. 2). Upgrading with 0.5 % salt solution increased the germination percentage over the ungraded seeds reported in cockscomb [15]. In the investigation, seed germination and vigour of sinkers was higher than floaters and ungraded seeds. The superiority of floatation technique over size grading was endorsed by many scientists in different crops. They reported that, flotation is more appropriate and efficient to upgrade the germinability of *Casuarina equisetifolia* seed lots than grading using sieves, blowers and specific gravity separator [21, 22].

An investigation on floatation technique with water and salt solution clearly indicated that seed recovery, 100 seed weight, speed of germination, germination, shoot length, root length, dry matter production and vigour index were increased with increase in concentration of salt solution. Hence, the seeds can be upgraded with common salt solution of 2 % (Specific gravity of solution - 1.02) to get higher seed quality characteristics. Compare to size grading with BSS sieves and other methods of seed grading, floatation technique could be easily adoptable by farmers, the recovery and seed quality enhancement in terms of germination and vigour were maximum by floatation technique.

Histological study of sinker and floater seeds

In this study, investigation on anatomical structures for the separated fraction of sinkers and floaters of floatation grading was carried out with use of SEM (Scanning Electron Microscope). Results revealed that the presences of curved embryo in the sinkers were clearly observed, whereas in the floaters the embryo was not observed at all, instead a well distinct empty cavity was noticed. However, the presence of endosperm was recorded (Fig. 3a& 3b) in the floaters of onion seeds.

CONCLUSION

The study on floatation technique to upgrade the seed quality established superiority of sinkers over floaters. The seed recovery of sinkers was more in water (96.8 %) when compared to salt solutions of different concentrations. The weight of 100 seeds of sinkers increased significantly with raised in the density of the salt solution. The weight increased from low to the high concentration of solution (0.5 % to 2.0 %) suggesting that seed density reflected on embryo filled ratio of seeds. The results of floatation technique revealed a close association between seed density and seed quality characteristics *viz.*, seed recovery, 100 seed weight, speed of germination, shoot, root length, dry matter production and vigour index. It was clearly evident that all the above parameters were increasing with increase in density of salt solution. Thus this result indicated that the seeds upgraded with 0.2 % salt solution obtained higher seed quality characters.

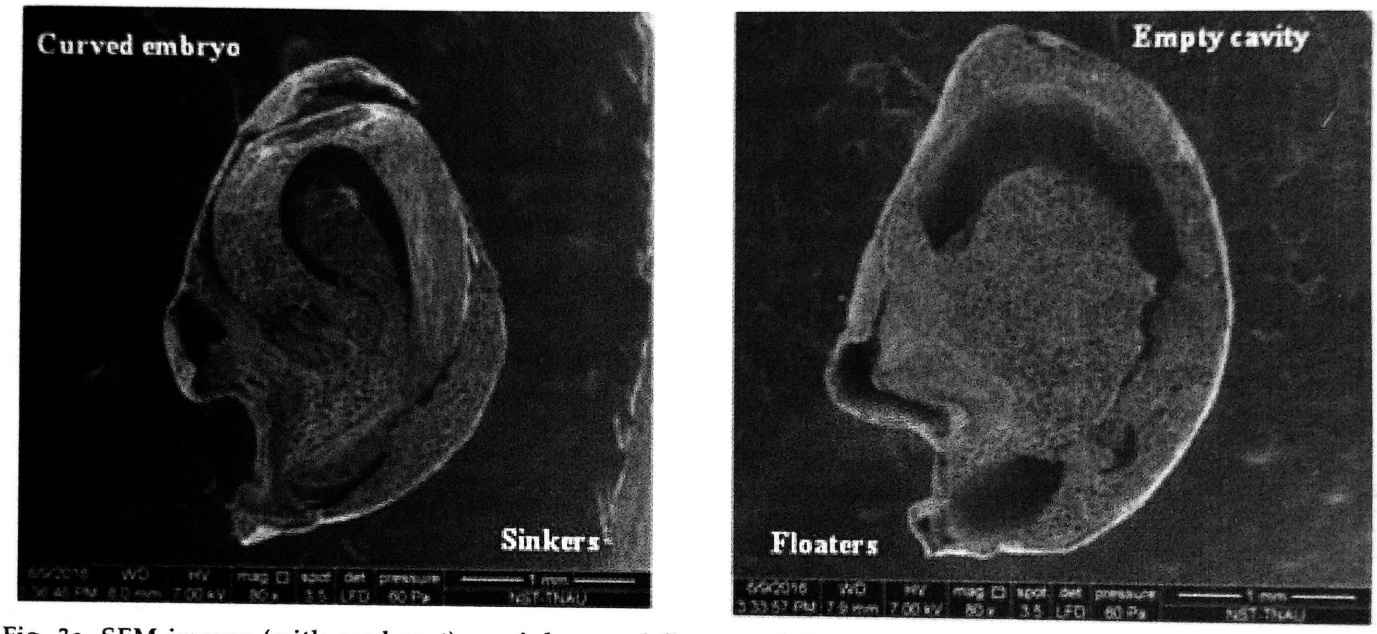

Fig. 3a. SEM images (with seed coat) on sinkers and floaters of floatation technique

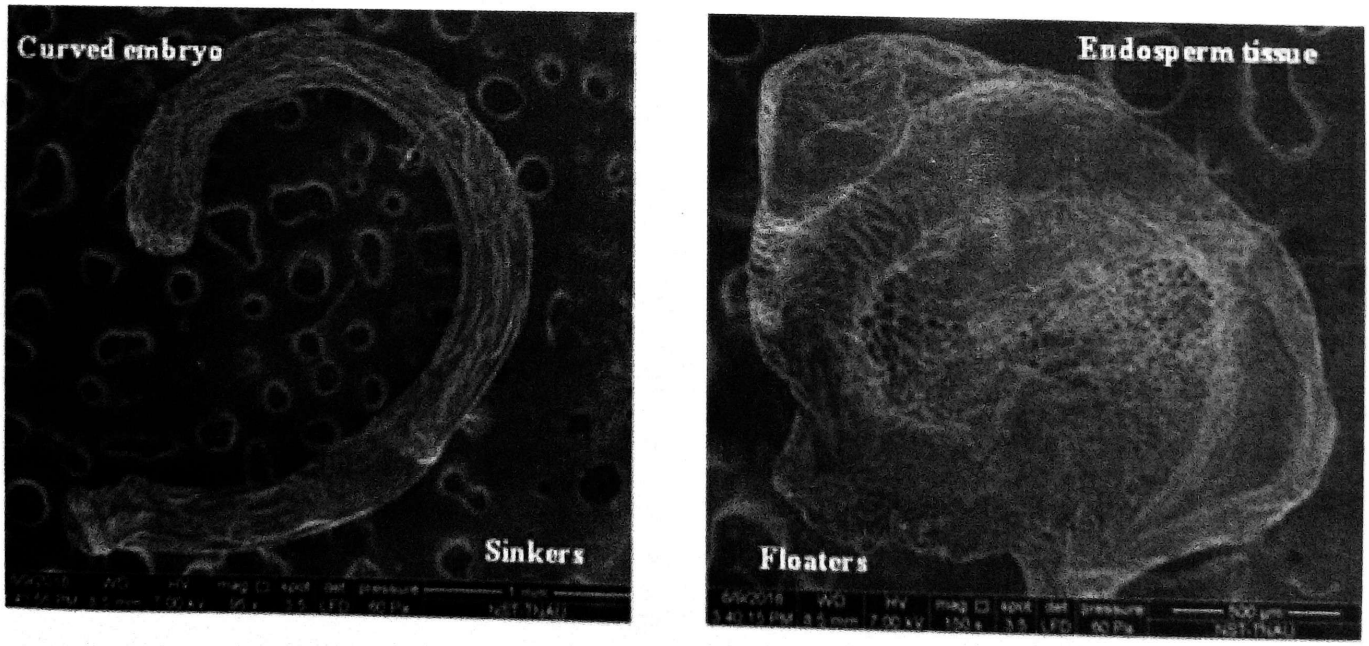

Fig. 3b. SEM images (without seed coat) on sinkers and floaters of floatation technique

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