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Maintaining Onion Seed Quality during Storage Through Seed Priming

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ABSTRACT

Background: Seed is an important component and the quality seed plays a crucial role in agricultural production as well as in the national economy. Availability of viable and vigorous seeds at the planting time is important. Onion seeds have a short life span among the vegetable crops and lose viability rapidly after harvest. The main reason for the low quality of onion seeds includes a long flowering period resulting in different stages of seed maturity in the umbel, very fast reduction of viability if stored in suboptimal conditions and seed infestation with fungi. Seed priming is a widely used technique to enhance seed performance during storage.

Methods: The seed was primed with Neem leaf powder (100 g/kg) after hydration and dehydration, hydration with KH_2PO_4 (2.0%), KNO_3 (1.0%), K_2SO_4 (1.0%) and Captan (N-trichloromethylthio-4-cyclohexane-1,2-dicarboximide) at 2.5 g/kg and stored in polyethylene (100µ) bags under ambient conditions. After each treatment, seeds were dried back to their original moisture content under shade.

Result: The results revealed that different priming treatments had a significant effect on germination percentage, seedling length and vigour index-I except for moisture percentage in both the years. The maximum germination (74.1 and 71.2%) was observed in seeds treated with Captan (2.5 g/kg) followed by Neem leaf powder 100 g/kg seed (71.1 and 69.72%) during 2014-15 and 2015-16, respectively. The onion seeds primed with KH_2PO_4 (2.0%), KNO_3 (1.0%) and K_2SO_4 (1.0%) had an adverse effect on seed germination. The germination decreased significantly with the increase in the storage period. The maximum seedling emergence (60.0%) was observed from the seed primed with Captan (2.5 g/kg) followed by Neem leaf powder 100 g/kg seed (56.1%).

Key words: Neem leaf powder, Onion seed, Priming, Storage, Seed quality.

INTRODUCTION

Onion (*Allium cepa* L.) is an important food crop worldwide. The availability of viable and vigorous seed at the planting time is important for achieving the targets of agricultural production because good quality seed acts as a catalyst for realizing the potential of other inputs. According to Indian Minimum Seed Certification Standards (IMSCS), the required minimum germination in onion should be 70% for marketing (Anonymous, 2013). Onion seeds have the shortest life span among the vegetable crops and lose their viability rapidly after harvest. Hence, it possesses a serious problem for the carry-over seed stocks, unless special precautions are taken in their storage (Singh *et al.,* 2018). The seed of a particular harvest cannot be used immediately for sowing the following crop, so it must be stored until the next sowing season. Therefore, the fresh seeds must be stored for 5-6 months after harvest and under uncontrolled storage conditions. Thus, the production of seeds with high vigour is essential to improve seed storability and productivity under various field conditions.

Seed invigoration implies an improvement in seed vigour by any post harvest treatment resulting in improved germinability, greater storability and better field performance than the corresponding untreated (control) seed. Seed priming is one of the pre-sowing seed management techniques where the seeds are partially soaked and subsequently dried back for an invigorative effect that expresses field emergence and extends up to yield (Thejeshwini *et al.,* 2019).

Seed priming is a widely used technique to enhance seed performance, notably concerning the rate and uniformity of germination, thereby enabling better crop establishment (Bradford, 1986; Brocklehurst, 1985; Parera *et al.,* 1994; Taylor *et al.,* 1998). Moreover, due to heavy chemical use in intensive cropping systems, concerns to environmental health have raised the world over. Hence, bio-friendly compounds like Neem leaf powder, *Trichoderma*, *etc*., have gained attention in recent times. Onion seeds show poor germination with the slow growth of seedlings and they have a short storage life. Hence, considering the above facts, the present research work was undertaken to maintain the seed quality by various priming treatments.

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MATERIALS AND METHODS

Experimental site

The experiment was conducted on the freshly harvested seeds of the onion variety Hisar-2 in the research area of the Department of Vegetable Science and the laboratories of the Department of Seed Science *and* Technology CCS, Haryana Agricultural University, Hisar during the period 2014 to 2015 and 2015-2016.

Treatment details

The seeds were invigorated for 8 hours at room temperature with the following priming treatments: T_1 -Control, T_2- Neem leaf powder (100 g/kg seed) after hydration and dehydration, T_3 - Hydration with KH_2PO_4 (2.0%), T_4 - Hydration with KNO_3 (1.0%), T_5 - Hydration with K_2SO_4 (1.0%) and T_6 - Captan (2.5 g/kg seed) after hydration and dehydration. The primed seed was dried back toroom temperature to bring its original moisture content before assessing the various quality parameters. After drying to a safer moisture level *i.e.* 8%, the seeds were stored in the plastic bags (100 µ) under ambient conditions and the observations were recorded on various seed quality parameters.

Observations

The observations were recorded initially and at four months intervals up to one year on moisture content (%), standard germination (%), seedling length (cm), vigour index-I and field emergence (%). Field emergence per cent was recorded six months after storage of onion seed. To determine the germination percentage, one hundred seeds in three replicates were placed between sufficient moistened rolled towel papers (BP) and kept at 20°C in a seed germinator. After 12 days, the seedlings were evaluated and normal seedlings were considered for per cent germination according to the rules of the International Seed Testing Association (ISTA, 2004). Ten normal seedlings were selected randomly at the time of final count of standard germination and seedling length (root + shoot) was measured in centimeters. The average length of ten seedlings was recorded in each treatment replicated three times. Seedling Vigour index-I was calculated according to the method suggested by Abdul-Baki and Anderson (1973):

Vigour index-1=

Standard germination % × Seedling length (cm)

Statistical analysis

The factorial experiment in a completely randomized design (CRD) as well as in a randomized complete block design (RBD) were conducted in three replicates for laboratory and field parameters, respectively and the data were subjected to the statistical analysis as described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Since there were no significant differences between the results of the years 2014-15 and 2015-16 with respect to different parameters, therefore, pooled analysis was done and discussed the pooled data.

Effect of priming

The moisture content of seeds recorded initially before storage and after every 4 months duration was not significantly affected by different priming treatments. However, the different priming treatments had a significant effect on the germination percentage, seedling length and vigour index-I except for moisture content (Table 1). Among the different priming treatments, the maximum germination (72.65%) was observed in seeds coated with Captan @ 2.5 g/kg followed by Neem leaf powder (71.41%) after hydration and dehydration. This may be due to the beneficial effect of Captan and Neem leaf powder after hydration and dehydration that maintained the seed fungal-free during storage.

Table 1: Effect of priming treatments and storage period on seed quality parameters of onion (Pooled data).

Treatment	Moisture content (%)	Germination (%)	Seedling length (cm)	Vigour index-I	Seedling emergence (%)
Priming treatments					
Control	8.12	68.5	11.5	787.8	53.4
Neem leaf powder	8.05	71.5	12.7	908.2	56.1
KH_2PO_4 (2.0%)	8.20	66.7	11.2	747.2	51.5
KNO_3 (1.0%)	8.15	65.9	10.5	692.0	52.4
K_2SO_4 (1.0%)	8.13	67.2	11.2	752.6	50.7
Captan (2.5 g/kg)	8.03	72.7	13.3	966.2	60.0
CD at 5%	NS	1.3	0.8	63.3	4.2
Storage period (months)					
Initial	8.10	74.7	13.0	971.1	-
4	8.15	71.9	12.5	898.3	-
8	8.12	67.9	11.7	794.3	-
12	8.08	60.5	11.0	657.5	-
CD at 5%	NS	1.1	0.7	51.7	-
Interaction priming × Storage	NS	S	NS	NS	-

NS: None significant, S: Significant.

A similar trend was observed for other seed quality parameters also and maximum seedling length (13.3 and 12.7 cm) and vigour index-I (966.2 and 908.2) were observed in the seeds coated with Captan and Neem leaf powder, respectively. Similar finding was also reported by Brar *et al.,* (2020) in onion suggesting that seeds hydrated with KH_2PO_4 and KNO_3 reduced the seed quality. The onion seeds hydrated with KH_2PO_4 (2.0%), KNO_3 (1.0%) and K_2SO_4 (1.0%) resulted in reducing the germination percentage compared with control because of the toxic effect of potassium salt on seed germination.

Priming of seeds facilitates de novosynthesis of alpha-amylase, which increases the metabolic activities in seeds, resulting in higher seedling vigour. Thus, the higher vigour of the primed seeds is related to metabolic activities in seeds due to increased amylase activity (Lal *et al.,* 2013). Singh *et al.,* (2018) reported that germination in onion seeds can be enhanced by hydrating the seeds with 100 ppm GA_3 or coating the seeds with 3% Aloe vera gel.

The six months stored seeds were also evaluated under field conditions and it was observed that the maximum field emergence (60.0%) was recorded from the seed coated with Captan (2.5 g/kg) followed by Neem leaf powder (56.1%), while the seeds hydrated with KH_2PO_4 (2.0%), KNO_3 (1.0%) and K_2SO_4 (1.0%) resulted in reducing the field emergence percentage compared with control. Seeds coated with Captan and Neem leaf powder showed better field emergence, may be due to its beneficial effect in quick and uniform germination due to intensified hydrolytic process, better uptake of nutrients and moisture and imparting stimulation for better establishment of the seedling. Bosland and Votara (2000) were of the view that priming leads to enhanced and uniform germination.

Effect of storage period

The different storage periods had no effect on the moisture content of the onion seeds. The standard germination percentage, seedling length and vigour index-I decreased significantly with an increase in the storage period of onion seeds *and* maximum values (74.7%, 13 cm and 971.1) of the above mentioned traits were noticed in primed seeds just before storage. The minimum germination (60.5%), seedling length (11.0 cm) and vigour index-I (657.5) were recorded from the aged seed of one year. These results are in confirmation with the findings of Kumar, 2004 in onion. A gradual decline in standard germination, seedling length (cm) and vigour indices was observed in all priming treatments with the progression of the storage period (Brar *et al.* (2020).

Interaction effects

The standard germination percentage of onion seeds decreased as the storage period increased (Table 2). The significantly maximum standard germination (76.1%) was recorded with the seed primed with Captan @2.5 g/kg followed by Neem leaf powder and without primed seed (75.6%) before storage and after 4 months of storage seed primed with Captan (75.5%). age. No doubt performance of fresh seed was found to be better over all but, the seeds coated with Captan 2 g/kg seed and Neem leaf powder (100 g/kg seed) after hydration and dehydration maintained a germination percentage above the Indian Minimum Seed Certification (IMSCS) Standards *i.e.* above >70% germination up to 8 months of storage period.

Table 2: Interaction of priming treatments and storage period for germination percentage of onion seeds (Pooled data).

Priming treatments	Storage period (months)				
	Initial	4	8	12	Mean
Control	75.6	71.7	68.0	58.6	68.5
Neem leaf powder	75.6	73.7	70.8	66.1	71.5
KH_2PO_4 (2.0%)	73.7	70.4	65.4	57.3	66.7
KNO_3 (1.0%)	73.9	69.5	64.1	56.0	65.9
K_2SO_4 (1.0%)	73.3	70.5	67.7	57.9	67.3
Captan (2.5g/kg)	76.1	75.5	72.4	66.8	72.7
Mean	74.7	71.9	68.1	60.5	

CD at 5% priming × storage: 1.2.

Priming enhances the antioxidant activity in the seeds, which results in reduced lipid peroxidation, improves seed quality (Chiu *et al.*, 2006). Davison and Bray (1991) have observed some changes in the protein pattern in the primed seeds. Helaly *et al.* (2016) also reported the highest germination in primed onion seeds. The toxic effect of potassium salts on the germinating seeds during storage is the reason that KNO_3, KH_2PO_4 and K_2SO_4 were the least effective treatments. A similar finding has also been reported by other researchers where it has a negative effect on germinating embryos that reduces germination and seedling death (Yari *et al.,* 2011).

CONCLUSION

It is concluded that the standard germination, seedling length and vigour indices could be used as reliable predictors of seed quality because of easiness, quickness and accuracy in their execution. Hydro priming and dry dressing with Captan at 2.5 g/kg seed followed by Neem leaf powder @ 100g/kg seed was found to be best priming treatment that maintained the germination up to 8 months above the Indian Minimum Seed Certification Standards.

Conflict of interest: None.

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