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EFFECT OF DIFFERENT SEED PRIMING TREATMENTS ON GERMINATION OF OKRA [ABELMOSCHUS ESCULENTUS (L.) MOENCH]

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Abstract: An experiment was conducted at farm of School of agriculture in Lovely Professional University, Phagwara, Punjab, (India) during 2018-2019 and 2019-2020 in kharif season. Seeds were collected from the Punjab Agricultural University (Ludhiana). The variety used for this research trial was Punjab- Suhawani. The experiment was laid down in randomized block design (RBD) with three replications. The eight treatments comprise T0-Control (un-primed seeds), T1-hydro-priming, T2- osmo-priming with 5% polyethylene glycol (PEG), T3- osmo-priming with 3% KCl, T4-Halo-priming with 5% KNO3, T5- Halo-priming with 1.5% Mg (NO3)2, T6-Hormonal-priming with 50 ppm GA3, T7- Hormonal-priming with 50 ppm of NAA. The seeds were soaked for 24 hrs with each solution. Significant variations observed by priming treatments in okra seeds were germination percentage (92.17%), number of days to germination (5.17 days), shoot length (16.43 cm), root length (8.81 cm), seedling length (25.09 cm), seedling vigor index (i) (2262.14) and seedling vigor index (ii) (2729.15). Significantly best result was recorded in T2-Osmo-priming with 5% polyethylene glycol (PEG) followed by T1-Hydropriming and T5- Halo-priming with 1.5% Mg (NO3)2 for 24hrs soaking. Whereas, unprimed control seeds showed the least results.

Keywords: Okra, seed priming, germination, osmo-priming, seedling vigour index (i) and (ii).

1. Introduction: Okra [Abelmoschus esculentus (L.) moench] commonly known as “Dheros” is a famous vegetable crop in in India which belongs to Malvaceae family (Tania et al., 2020). It has somatic chromosome number 2n=130. Okra is also called as “lady finger” and “a perfect villager’s vegetable” (Anuj et al., 2021). In India in the year of 2019-2020 the area under cultivation of okra was 519 thousand hectares (ha) and production 6371 thousand metric tonnes. Okra receives production of around 54.88 million tonnes from 5.31 million hectares in the Punjab. Okra requires temperature for its normal growth is 200C and for its development germination percentage, speed of emergency is most favorable at 30 - 350C. The initiation of flower and flower are delayed with enhance temperature. The edible part of okra is pod and the length of the pods reaches nearly, 15-20 cm long. The immature fruits of okra are commonly eaten up as vegetables as well as for salads, for soups and stews, for fried or dried and finally, for fried or boiled (Elkhalifa et al., 2021). The okra plant is also useful for oil and for biofuel (Anwar et al., 2020) as well as for its medicinal products (Schafleitner, R. et al., 2021). Various diseases likely, digestive diseases, cardiovascular diseases, diabetes etc are estimating because of the leaves of okra. The okra pods contain iron (Fe), calcium (Ca) and phosphorous (P) at different amount of 84, 90 and 1.20 mg, respectively (Sharma et al., 2020). The phenolic compounds are present in the fruit extract of okra such as protocatechuic acid, rutein, catechin, quercetin and quercetin-3-o-gentiobioside (Wu, D. et al., 2020). Slow and erratic emergence is the major problem found in okra seeds. Therefore, result of this effect in low fertilizer efficiency, unsynchronized harvesting as well as low yield (Rahman et al., 2016). Hard seed coat is believed to disturbed seed germination, stable growth of embryo and development of coleoptiles due to restricted water imbibtion. The seed priming plays crucial role during emergence of seeds and seedling growth. In seed priming, seeds are inflated due to which α-amylase enzymes products that is plays an extensive role in starch mobilization and, it also has contributed in the embryo with carbohydrates for respiration (Sibeko Nomkhosi B et al., 2021). In the seed priming firstly, seeds are soaked in pre-sowing treatment in which seed is permitted to imbibe required water which start its pre-germinative metabolic activities however, inadequate of radical protrusion as a consequence, radical protrusion seed loses its desiccation tolerance. There are various methods of priming but among of them in the method of osmo-priming, the low water potential of osmotic solutions permits the seeds to slow down its imbibitions of water within seeds which consequently, help the embryo to start their pre-germinative metabolic processes without any radical protraction. Generally, seeds are treated with various osmotic solutions such as PEG (polyethylene glycol), KH2PO4, MgSO4, KNO3, CaCl2, NaCl, KCl, PEG and mannitol etc. (Vishvanathan et al., 2020). Therefore, a study was carried out to address the problem of okra about poor seed germination and low yield performance and to evaluate the effects of different priming treatments on germination of okra.

2. Materials and methods:

A field experiment was conducted at Experimental Farm of School of Agriculture in Lovely Professional University, Phagwara, district Kapurthala (Punjab) during 2018-2019 and 2019-2020. The agriculture farm is situated at 31.2462582° North attitude and 75.6966031°East longitude. To assess the effects of seed priming treatments on germination percentage (%), shoot length, root length, seedling length, seedling vigour index (i) and seedling vigour index (ii) of okra [Abelmoschus esculentus (L.) Moench]. The experiment was laid out in randomized block design (RBD). The variety used for this research trial was Punjab- Suhawani. Seeds were collected from Punjab Agricultural University (Ludhiana). Priming treatments incorporated likely, T0-Control (un-primed seeds), T1- Hydro-priming, T2- Osmo-priming with 5% polyethylene glycol,T3-Osmo-priming with 3% KCl,T4-Halo-priming with 5% KNO3, T5- Halo-priming with 1.5% Mg(NO3)2, T6- Hormonal-priming with 50 ppm GA3, T7- Hormonal-priming with 50 ppm NAA. Seeds were completely submerged in priming solutions for 24 hours. Finally, the primed seeds were air-dried for about 3 hours at the room temperature to bring the moisture level down to normal. The germination percentage was calculated based on the following equation.

$$\textbf{Germination percentage} = \frac{\text{Total number of germinated seeds}}{\text{Total number of seeds sown}} \text{ X } 100$$

Number of days to germination was counted from the number of days to sowing to the day of emergence of the first leaf. Additionally, shoot and root length was measured to calculated seedling vigour index. For this, seedlings were allowed to grow normally to record the response of growth. After the 11 DAE (days after emergence) the seedling (shoot+ root) length was noted and it was expressed in centimetres. The length of the shoot is measured from the collar part to the cotyledon attachment point. Root length is considered as the length of the plant from the collar to the root tip. Seedlings were allowed to grow continued in such a way that; it could be checked response to the growth. Seedling vigour index (i) and (ii) (SVI) was calculated by following modified formula.

Seed Vigour index (i) = Germination (%) X Seedling length in cm

Seed Vigour index (ii) = Germination (%) X seedling dry weight in mg

Data analysis had been completed by Analysis of Variance (ANOVA) in RBD in OPSTAT software. Treatments significant difference was determined at $p \leq 0.05$ in three replications according to OPSTAT. Critical difference among treatments was done by Fishers –post hoc test.

3. Results and discussions:

3.1 Germination percentage (%)

The observation recorded on germination percentage of okra for the years 2019, 2020 and also in pooled analysis has been presented in Table no. 4.1. Seed priming treatments had significant difference on germination percentage of okra. T2 (priming with 5% PEG solution) treatment followed by T6 (priming with 50% GA3 solution) treatment showed the maximum germination percentage (92.17%) and (86.00%) which was statistically higher than the other priming treatments. The minimum germination percentage (50.50%) was found from T0 (control) treatment. Imbibition, the lag phase, and radicle growth and emergence are the three processes that typically characterize seed germination. Due to seed priming, the lag period is prolonged, causing physiological and biochemical pre-germinating processes to occur, preventing the seed from germination. Similar to other researcher's findings, we found that seed priming significantly increased the percentage of seeds that germinated (Muhammad & Shik Rha, 2007; Mohammadi et al., 2014; Oliveira et al., 2019).

3.2 Number of days to germination

The observation recorded on number of days to first germination of okra for the years 2019, 2020 and also in pooled analysis has been presented in Table no. 4.1 and Graph no. 4.1. It was evident that there was a significant variation in different treatments of seed priming on number of days to germination of okra. On the basis of pooled analysis, minimum number of days to germination (5.17) was recorded in T2 (priming with 5% PEG solution) treatment which was at par with the treatment T6 (priming with 50% GA3 solution) (5.67). The maximum number of days to germination (9.50) was found from T0 (control) treatment followed by T7 (priming with 500 ppm NAA) treatment (8.25). In contrast, this study found that priming okra seeds with PEG had no effect on shortening the mean germination time, which is consistent with the findings of Rahman et al., (2016).

3.3 Effect on shoot length of seedlings (cm)

The observation recorded on shoot length of okra seedlings of okra for the years 2019, 2020 and also in pooled analysis has been presented in Table no. 4.1. The longest shoot (16.43 cm) was recorded from T2 (priming with 5% PEG solution) treatment followed by T6 (priming with 50% GA3 solution) treatment (14.45 cm) and the shortest shoot (7.55 cm) was found from T0 (control) treatment. The shoot lengths were significantly lower in untreated control seedlings in the present investigation. In the primed seeds, the noteworthy increase in shoot length may be due to meristematic growth, cell division or its involvement in cell elongation (Kaur et al., 2015).

3.4 Effect on root length of seedlings (cm)

The observation recorded on root length of okra seedlings of okra for the years 2019, 2020 and also in pooled analysis has been presented in Table no. 4.1. Different priming treatments showed significant effect on root length of okra seedlings. The longest root (8.81cm) was recorded from T2 (priming with 5% PEG solution) treatment followed by T6 (priming with 50% GA3 solution) treatment (7.59 cm) and on the other hand the shortest root (3.57 cm) was found from T0 (control) treatment. These results are similar with the results of several workers (Jisha et al., 2013; Baque et al., 2016; Faijunnahar et al., 2017).

3.5 Seedling length (cm)

The observation recorded on seedling length of okra for the years 2019, 2020 and also in pooled analysis has been presented in Table no. 4.1. Seed priming treatments had significant difference on seedling length of okra. T2 (priming with 5% PEG solution) treatment showed the maximum seedling length of okra (25.09 cm) which was statistically higher than the other priming treatments. The minimum seedling length of okra (12.68 cm) was found from T0 (control) treatment. Root and shoot lengths were used to evaluate the growth of seedlings grown from primed and unprimed seeds. According to reports, the osmo-priming and hydro priming enable soybean and cumin plants to expand their roots and shoots vigorously (Yuan-Yuan et al., 2010). Its role in cell elongation, cell division, and meristematic growth may explain the primed seeds' considerable rise in shoot and root length (Kaur et al., 2015).

3.6 Seed vigor index-I

The observation recorded on seed vigor index-I of okra for the years 2019, 2020 and also in pooled analysis has been presented in Table no. 4.1. Seed priming treatments had significant difference on seed vigor index-I of okra. T2 (priming with 5% PEG solution) treatment showed the maximum seed vigor index-I of okra (2262.14) which was statistically higher than the other priming treatments. The minimum seed vigor index-I of okra (721.50) was found from T0 (control) treatment. The establishment and productivity of crops are greatly influenced by the seedling vigour index of germinating seeds (Tabrizian and Osareh, 2007). Priming treatment plays an important role in increasing the vigour index by enhancing the capability of the plants to compete for the primary needs of nutrients, water and light. According to (Kaur et al., 2015), seed priming treatment and soaking times had a substantial impact on seed vigour index.

3.7 Seed vigor index-II

The observation recorded on seed vigor index-II of okra for the years 2019, 2020 and also in pooled analysis has been presented in Table no. 4.1. Seed priming treatments had significant difference on seed vigor index-II of okra. T2 (priming with 5% PEG solution) treatment showed the maximum seed vigor index-II of okra (2729.15) followed by treatment T6 (priming with 50 ppm solution) (2503.61). The minimum seed vigor index-II of okra (1358.57) was found from T0 (control) treatment. The establishment and productivity of crops are greatly influenced by the seedling vigour index of germinating seeds (Tabrizian and Osareh, 2007). Priming treatment plays an important role in increasing the vigour index by enhancing the capability of the plants to compete for the primary needs of nutrients, water and light. According to (Kaur et al., 2015), seed priming treatment and soaking times had a substantial impact on seed vigour index.

4. Conclusion:

These results have recommended that osmo-priming is an acceptable technique for germination improvement in okra. Seed priming with T2-Osmo-priming with 5% polyethylene glycol (PEG) treatment may be used for enhancing germination percentage (92.17 %), number of days to germination (5.17 days), shoot length (16.43 cm), root length (8.81 cm), seedling length (25.09 cm), seedling vigour index (i) (2262.14) and seedling vigour index (ii) (2729.15) in okra, but both T1 and T2 treatments gave almost similar and superior results. It has been concluded from the study that T2 osmo-priming with 5% polyethylene glycol of seeds for 24 hours showed highest percent of germination as compared to the unprimed seeds. Highest degree of tolerance to biotic - abiotic factors also observed in osmo-priming seeds that might be due to increasing activities of antioxidant enzymes, so, it can be recommended to the farmers in future.

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Table no. 1: Effect of various priming treatments on germination percentage (%), number of days to germination, shoot length (cm), root length (cm), seedling length (cm), seed vigour index – I and seed vigour index- ii in okra.

Treatments detail	Germination percentage (%)	Number of days to germination	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Seedling vigour index-i	Seedling vigour index-ii
	Pooled	**Pooled**	**Pooled**	**Pooled**	**Pooled**	**Pooled**	**Pooled**
T_0 (un-primed)	50.50	9.50	7.55	3.57	12.68	721.50	1358.57
T_1 (hydro priming)	76.17	7.05	11.02	6.44	17.38	1320.16	2090.25
T_2 (PEG 5%)	92.17	5.17	16.43	8.81	25.09	2262.14	2729.15
T_3 (KCl) 3%	68.33	6.63	12.15	6.33	18.48	1193.92	1730.28
T_4 (KNO_3) 5%	75.33	6.50	12.85	7.45	20.91	1663.00	2164.70
T_5 ($MgNO_3)_2$ 1.5%	82.33	6.00	14.15	7.47	22.31	1749.40	2365.17
T_6 (GA_3) 50ppm	86.00	5.67	14.45	7.59	22.68	2014.22	2503.61
T_7 (NAA) 50ppm	58.00	8.25	9.74	5.16	15.52	978.47	1623.66
C.D.	1.17	9.50	1.34	0.01	1.43	96.92	120.84
C.V.%	1.90	15.28	6.18	8.65	4.18	3.68	3.30