Effect of seed priming on field performance of okra

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Received: 12.7.2018/Accepted: 16.10.2018

ABSTRACT

The present investigations were carried out in the Department of Seed Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during 2017-2018 in a randomized complete block design. The seeds of okra cv P-8 were primed with 12 treatments comprising osmo-priming with PEG 6000 (-0.5 M Pa and -1.0 M Pa) for 16, 24, 32, 40 and 48 h along with hydro-priming (24 h) and no priming (Control). The seeds were sown in the field during 2nd week of June 2017 in a RBD with three replications for assessment of different horticultural traits. Treatment of seeds with PEG 6000 (-0.5 M Pa) for 24 h proved to be the best for characters like days to 50 per cent emergence, total emergence, fruit weight, fruit length, fruit diameter, number of fruits per plant and fruit yield.

Keywords: Okra; seed priming; osmo-priming; hydro-priming; characters

INTRODUCTION

Okra (*Abelmoschus esculentus* L), a member of family Malvaceae is a native of tropical Africa. It is also called 'a perfect villager's vegetable' due to its robust nature, dietary fibre and distinct seed protein balanced in both lysine and tryptophan amino acids (Kumar et al 2010). The immature fruits are used for consumption purpose while the dried seeds, roasted or grounded are used as coffee-additive or substitute. It is medicinally used as plasma replacement or blood volume expander. Industrially okra mucilage is usually used to glace certain papers and in confectionary (Benchasri 2012). The green tender fruits of okra are highly nutritious vegetable containing appreciable amount of calcium and iron, edible portion and fair amount of vitamins A, B and C. It is also rich in protein and crude fibre (Thampi and Indira 2000).

Okra is an annual vegetable crop cultivated in tropical and sub-tropical regions of Africa and Asia. It thrives well in the hot humid season. It is mainly grown as a summer and rainy season crop in India. In contrast when okra seeds are sown in early spring season they show poor germination due to low temperature. This reduced, delayed and erratic emergence is a serious problem in okra cultivation in early spring season as it creates problem in uniform field stand and rapid germination. Another major problem in germination of okra seeds is hard seed coat which restricts the water imbibition and uniform growth and development of embryo.

The presence of hard seed coat in okra is a major physiological constraint to rapid and uniform stand establishment in the field. Some of the most recent studies have reported an interrelation between seed moisture content and hard seededness. Several reports indicate that the percentage of hard seeds showed a progressive decline with increasing moisture content. Seed producers often leave the seeds in pods until they dry completely to below 10 per cent moisture level resulting in higher proportion of hard seeds in the seed lot. Environmental factors such as inadequate or excessive soil moisture, low soil temperatures and crusting of soil also contribute to erratic germination of okra seed. Since environmental factors often cannot be controlled modification of the seed by either biological, chemical or physiological techniques should be evaluated to improve the vigour of the seedling and uniformity of stand. The problem of germination in okra can be overcome by many techniques and seed priming is one of them. Seed priming is a pre-sowing seed treatment in which seeds are allowed to imbibe water to start pre-germinative metabolic processes but insufficient for radical protrusion. The activity of many enzymes involved in mobilization of food reserves is triggered (Srinivasan et al 2009). Osmopriming has been reported to give good crop stand even under sub-optimal conditions of temperature and moisture. (Bradford 1986). Furthermore seed deterioration can also be controlled through priming prior to storage because priming activates antioxidant enzymes like catalase, peroxidase and superoxidase which lower peroxidation in seed. Therefore the present studies were undertaken to find out a suitable concentration and duration of priming solution for fruit yield and quality in okra.

MATERIAL and METHODS

The experiment was laid out at Pandah farm of the Department of Seed Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during kharif 2017-18 in a randomized complete block design with three replications. Twenty four plants were accommodated in a plot size of 2.4 x 1.2 m at recommended spacing of 60 x 20 cm. The seeds of okra cv P-8 received 12 treatments comprising osmo-priming with PEG 6000 (-0.5 M Pa and -1.0 M Pa) for 16, 24, 32, 40 and 48 h along with hydro-priming (24 h) and no priming (Control). Observations were recorded on characters like days to 50 per cent emergence, total field emergence, plant height, harvest duration, fruit weight, fruit length, fruit diameter, number of fruits per plant and fruit yield.

RESULTS and DISCUSSION

Effect of seed hydropriming and osmopriming on growth and horticultural characteristics

The effect of seed hydropriming and osmopriming on growth and horticultural characteristics of okra is shown in Table 1.

Days to 50 per cent emergence: Significantly lower number of days to 50 per cent emergence (5.00) was recorded in seed osmo-primed with PEG 6000 (-0.5 M Pa) for 24 h as compared to other priming treatments and control. The highest number of days to 50 per cent emergence (12.66) was witnessed in non-primed seeds. The results are in conformity with the work of Arif (2005) who reported that probable reason for early emergence of primed seeds was the completion of pre-germination metabolic activities making the seeds ready for radicle protrusion and thus the primed seed germinated soon after planting as compared to untreated dry seeds. On the contrary maximum number of days to 50 per cent emergence was recorded in control which may be due to the presence of growth inhibitors which did not leach and the enzymes like catalase, peroxidase, amylase and invertase which remained inactive. The present results are in line with those of Argerich et al (1989).

Total field emergence: The total field emergence was significantly higher (86.65%) in treatment involving osmo-priming with PEG 6000 (-0.5 M Pa) for 24 h as compared to all other treatments. Minimum field emergence (78.30%) was recorded in non-primed seeds (Control). Total field emergence is an important character as optimum plant population is a pre-requisite for the efficient use of resources and eventually increases yield. The maximum emergence was recorded when seeds were primed with PEG 6000 (-0.5 M Pa) for 24 h and minimum in control ie un-primed seeds. Brocklehurst and Dearman (1983) also observed that osmotic pre-treatment or priming of seed with PEG increased germination, reduced germination time and improved uniformity of germination with certain vegetable species. Enhancement of emergence in PEG-primed seeds may also be attributed to metabolic repair processes, a buildup of germination metabolites or osmotic adjustments during priming treatment (Bray et al 1989). Minimum total emergence was recorded in control (non-primed seeds) possibly because non-primed seeds had lower germination independent of their initial vigour level which justifies the use of priming (Bittencourt et al 2005).

Plant height: All the seed priming treatments significantly improved plant height at 30 DAS and at final harvest irrespective of priming treatments over hydro-priming and absolute control. The maximum plant height at 30 DAS (49.16 cm) was recorded in priming with PEG 6000 (-0.5 M Pa) for 24 h and minimum (38.63 cm) in control whereas the respective values at final harvest in the same treatments were 192.42 and 164.81 cm respectively. The increased plant height by osmo-priming may be due to beneficial effects of osmo-priming on seed structure, biochemistry, enzyme

Table 1. Effect of seed hydropriming and osmopriming on growth and horticultural characteristics in okra

Treatment	Days to 50% emergence	Total field emergence (%)	Plant height at 30 DAS (cm)	Plant height at final harvest (cm)	Days to first picking	Fruit length (cm)	Fruit diameter from centre (cm)
T_1	7.33	81.80	44.73	189.98	61.66	15.23	1.93
T_2	5.00	86.65	49.16	192.42	57.33	16.41	2.20
T_3	7.67	81.43	42.82	179.10	64.00	14.90	1.63
T_4	8.66	80.86	41.69	177.85	65.00	14.76	1.33
T_5	9.66	80.26	41.44	176.68	65.66	14.60	1.50
T_6	8.66	81.50	44.16	185.75	62.66	14.63	1.80
T_7	6.66	85.60	47.52	190.53	58.66	16.10	2.03
T_8	8.33	80.96	42.65	177.80	65.33	14.76	1.43
T_9	10.00	80.70	41.33	173.35	65.66	14.66	1.26
T_{10}	10.66	80.10	40.52	171.36	66.66	14.63	1.13
T_{11}	11.33	80.03	39.32	170.16	66.66	14.33	1.10
T_{12}	12.66	78.30	38.63	164.81	68.00	10.67	0.83
CD	1.27	0.96	1.19	4.36	2.57	0.24	0.24

T_1: Priming with PEG-6000 (-0.5 M Pa) for 16 h, T_2: Priming with PEG-6000 (-0.5 M Pa) for 24 h, T_3: Priming with PEG-6000 (-0.5 M Pa) for 32 h, T_4: Priming with PEG-6000 (-0.5 M Pa) for 40 h, T_5: Priming with PEG-6000 (-0.5 M Pa) for 48 h, T_6: Priming with PEG-6000 (-1.0 M Pa) for 16 h, T_7: Priming with PEG-6000 (-1.0 M Pa) for 24 h, T_8: Priming with PEG-6000 (-1.0 M Pa) for 32 h, T_9: Priming with PEG-6000 (-1.0 M Pa) for 40 h, T_{10}: Priming with PEG-6000 (-1.0 M Pa) for 48 h, T_{11}: Hydropriming (24 h), T_{12}: No priming

activities and organic substances in germinating seeds. The increased plant height at 30 DAS may also be attributed to early emergence and rapid cell division in meristematic region, number of cells and increase in cell elongation due to multiplication of various parts of the plant tissue, auxin metabolism, cell wall plasticity, permeability of cell membrane, increasing photosynthates, cell enlargement and rapid cell elongation as noticed by Sadawarthe and Gupta (1968) in brinjal. These findings are similar to those of Shah et al (2011) in okra.

Days to first picking: Significantly less number of days (57.33) was noticed to first picking in seed priming with PEG 6000 (-0.5M Pa) for 24 h being statistically superior to all other treatments except PEG 6000 (-1.0 M Pa) for 24 h. Contrary to this maximum days (68.00) to first picking were recorded in non-primed seeds.

Number of days to first picking is an indicator of maturity period in okra. Early maturity is desirable which fetches good returns to the growers. The data revealed that fruits were ready for marketing in 57.33 days in osmo-primed (PEG 6000 -0.5 M Pa for 24 h) seeds. These results are in agreement with the results of (Harris et al 2001) who reported that hydro-primed maize seeds flowered and matured earlier than non-primed seeds. Another possible reason for early maturity of primed seed plants may be that the plants of primed seeds took lesser number of days to emerge and flower hence these plants matured earlier to bear fruits and gave an early harvest. These results are in agreement with the findings of Lipe and Skinner (1979) who observed 10-12 days earlier maturity due to earlier emergence and more rapid growth of pre-germinated seedlings. These results have further been endorsed by Barlow and Haigh (1987) who reported earlier flowering in primed seed plants.

Fruit length: Fruit length was significantly higher (16.41 cm) in plants obtained from seeds osmo-primed with PEG 6000 (-0.5 M Pa) for 24 h as compared to all other treatments. However minimum (10.67 cm) fruit length was observed when seeds were sown without any priming treatment.

Fruit length is an important marketable trait in okra because of the preference given by the consumers. Fruit length differed significantly among osmo-primed, hydro-primed and non-primed seeds. Significantly more fruit length (16.41 cm) was recorded in treatment involving osmo-priming with PEG 6000 (-0.5 M Pa) for 24 h as compared to non-primed seeds (10.67 cm). This might be due to stimulatory effect of priming on fruit length through mediation of cell division. These results are in agreement with those of Rashid et al (2002) who also reported an increase in ear length of plants obtained from primed seeds in wheat.

Fruit diameter from centre: Significantly more fruit diameter (2.20 cm) was recorded in treatment involving osmo-priming with PEG 6000 (-0.5 M Pa) for 24 h being statistically at par with osmo-priming treatment PEG 6000 (-1.0 M Pa) for 24 h. Treatment no priming registered the lowest value (0.83 cm) for the trait fruit diameter from centre.

Fruit diameter differed significantly between osmo-priming treatments and control. The data revealed that highest fruit diameter (2.20 cm) was recorded in osmo-priming with PEG 6000 (-0.5 M Pa) and smallest fruit diameter (0.83 cm) in absolute control. This may be due to vigorous growth of the plants leading to more photosynthesis and synthesis of assimilates. Lipe and Skinner (1979) also reported 37.5 per cent increase in bulb diameter of onion due to earlier emergence and more rapid growth in pre-germinated seedlings.

Effect of seed hydropriming and osmopriming on yield attributes and economics of treatments in okra fruit production

The data on the effect of seed hydro-priming and osmo-priming on yield attributes and economics of treatments are given in Table 2.

Number of fruits per plant: Significantly more number of fruits per plant (19.56) recorded in treatment osmo-priming with PEG 6000 (-0.5 M Pa) for 24 h was found to be statistically at par (19.03) with treatment PEG 6000 (-1.0 M Pa) for 24 h. Least number of fruits per plant (13.16) was witnessed in absolute control ie non-primed seed. Increase in number of fruits par plant in PEG 6000 (-0.5 M Pa) 24 h may be due to early appearance of flowers. According to Shah et al (2011) number of pods per plant in okra is a major component which determines the final yield and number of pods has direct relationship with number of leaves. According to them higher number of leaves might have resulted in more number of pods per plant and priming had direct effect on seed emergence as well as on the seedling growth. Arshad Ullah et al (2002) also reported similar findings in which priming increased yield parameters like number of primary branches and pods per plant in Indian brown mustard [*Brassica juncea* (L) Czern and Coss]. Minimum number of fruits was recorded in control plants possibly because of delayed emergence of seedlings which resulted in slow growth and development of plant, flowering, fruiting and maturity.

Harvest duration: Significantly longer (48.00 days) harvest duration was recorded in osmo-priming with PEG 6000 (-0.5 M Pa) for 24 h which was found to be statistically at par (47.00 days) with priming treatment PEG 6000 (-1.0 M Pa) for 24 h whereas shortest harvest duration (40.66 days) was noticed in non-primed seeds.

Longer harvest duration is a more desirable trait for continuous supply of fresh okra fruits to market over longer periods and it also avoids market gluts. Harvest duration determines the time period for which the marketable fruits could be harvested so as to meet the market trends. The data revealed the longest harvest duration of 48.00 days in priming with PEG 6000 (-0.5 M Pa) for 24 h and shortest harvest duration of 40.66 days in non-primed seeds. The longer harvest duration may be due to early flowering and subsequently healthier crop growth. Early flowering leads to early fruit set thereby leading to longer duration in crop raised from osmo-primed seeds.

Fruit yield: Significantly higher fruit yield per plant (198.66 g) and per hectare (148.96 q) was recorded in osmo-priming with PEG 6000 (-0.5 M Pa) for 24 h being statistically at par (195.16 g and 148.09 q respectively) with osmo-priming treatment PEG 6000 (-1.0 M Pa) for 24 h. Contrary to this least fruit yield per plant (168.27 g) and per hectare (126.19 q) was observed in control (non-primed seed).

The yield and yield components like fruit length, fruit diameter and number of fruits per plant directly contributing to yield per hectare differed significantly between different priming treatments with maximum at PEG 6000 (0.5 M Pa) for 24 h. Increase in fruit yield may be due to early emergence, higher total emergence and more number of fruits per plant. Increased emergence due to priming might have resulted in an increase in dry matter accumulation and ultimately increased yield. The results are in conformity with those of Sharma et al (2014) in okra.

Economics of treatments: The maximum gross income of Rs 332200.00/ha was observed in treatment T_2 [PEG 6000 (-0.5 M Pa) for 24 h] followed by Rs 325798.00/ha in T_7 [PEG 6000 (-1.0 M Pa) for 24 h] and minimum of Rs 238150.00/ha in control (T_{12}). Similarly net income was maximum (Rs 239155.00/ ha) in the treatment T_2 [PEG 6000 (-0.5 M Pa) for 24 h] and minimum (Rs 150361.30/ha) in control (T_{12}).

Table 2. Effect of seed hydropriming and osmopriming on yield attributes and economics of treatments for okra fruit production

Treatment	Number of fruits/plant	Harvest duration (days)	Fruit yield /plant (g)	Fruit yield/ha	Total cost of cultivation/ha (Rs)	Gross return/ha (Rs)	Net return/ha (Rs)	B-C ratio
T_1	17.13	45.00	186.97	140.21	92667.35	308462.00	215794.70	3.33
T_2	19.56	48.00	198.66	148.96	93045.00	332200.00	239155.00	3.57
T_3	16.93	43.33	183.29	136.02	92520.70	299244.00	206723.30	3.23
T_4	16.53	42.33	179.92	133.31	92425.85	293282.00	200856.20	3.17
T_5	16.05	42.00	176.40	132.00	92380.00	290400.00	198020.00	3.14
T_6	15.53	41.00	179.46	134.35	96222.25	295570.00	199347.80	3.07
T_7	19.03	47.00	195.16	148.09	96703.15	325798.00	229094.90	3.37
T_8	16.23	45.66	180.40	135.28	96414.75	307670.00	211255.30	3.19
T_9	15.30	44.66	180.19	135.14	96337.75	302830.00	206492.30	3.14
T_{10}	14.86	43.66	174.13	130.59	96253.75	297550.00	201296.30	3.09
T_{11}	14.46	42.66	171.41	130.51	88060.00	255200.00	167140.16	2.90
T_{12}	13.16	40.66	168.27	126.19	87788.75	238150.00	150361.30	2.71
CD	2.38	1.26	12.84	9.12	-	-	-	-

Sale price Rs 2200/q

T_1: Priming with PEG-6000 (-0.5 M Pa) for 16 h, T_2: Priming with PEG-6000 (-0.5 M Pa) for 24 h, T_3: Priming with PEG-6000 (-0.5 M Pa) for 32 h, T_4: Priming with PEG-6000 (-0.5 M Pa) for 40 h, T_5: Priming with PEG-6000 (-0.5 M Pa) for 48 h, T_6: Priming with PEG-6000 (-1.0 M Pa) for 16 h, T_7: Priming with PEG-6000 (-1.0 M Pa) for 24 h, T_8: Priming with PEG-6000 (-1.0 M Pa) for 32 h, T_9: Priming with PEG-6000 (-1.0 M Pa) for 40 h, T_{10}: Priming with PEG-6000 (-1.0 M Pa) for 48 h, T_{11}: Hydropriming (24 h), T_{12}: No priming

The highest benefit-cost ratio of 3.57 was worked out in the treatment T_2 [PEG 6000 (-0.5 M Pa) for 24 h] and minimum (2.71) in control (T_{12}).

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