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Short Communication

Seed priming durations and concentrations influence on germination and seedling growth of bitter gourd

Arshia Debbarma, Jyotsna Devi, Meghali Barua*

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Bitter Gourd (*Momordica charantia* L.) is one of the most important seasonal summer vegetable crop cultivated extensively in tropical and sub-tropical parts of the country and is believed to have been originated in India. Bitter gourd is very bitter in taste due to the presence of cucurbitacin. The crop requires warm and hot climate for its optimum growth, hence in colder region, poor and slow seedling emergence is always a problem. Another reason for poor germination is its thick seed coat enclosing embryo, which affect germination by imposing mechanical restriction on embryo growth. To overcome these problems, various pre-sowing seed treatments can be practiced (Muhammad et al. 2014, Wang et al. 2002) such as seed priming (Pandita and Nagarajan 2004). Priming as described by Bradford (1986) is a pre sowing seed treatment where soaking followed by partial dehydration triggers the germination process but prevents radicle emergence. After priming, the seeds are dried back to enable normal handling, storage and planting. The objective of this technology is to increase the percentage and rate of germination, expand the range of temperature over which the seed will germinate and increase the uniformity of stand establishment. Priming has proven successful in enhancing seed performance for a number of crops including vegetables. But before priming any crop seeds, the knowledge of safe limits of priming duration and concentrations is very important to get maximum benefit of priming. Hence, the present research work was conducted in order to study the effect of hydropriming, GA_3 priming and PEG 6000 priming with different concentrations and durations on germination and seedling growth of bitter gourd.

Department of Plant Breeding & Genetics, Assam Agricultural University, Jorhat 785013, Assam

*Corresponding author, Email: meghalibarua@aau.ac.in

Present investigation was carried out in the laboratory of the Department of Plant Breeding and Genetics, Assam Agricultural University, Jorhat during 2016 and 2017 in a completely randomized design with three replications. Seeds of bitter gourd cv. Daspur Karela were surface sterilized by dipping in Mercuric Chloride (0.1%) solution for two minutes, then rinsed three times in distilled water and dried on blotting paper. These seeds were then primed in distilled water (hydro priming), GA_3 (50, 100, 150 ppm)solutions and PEG 6000 (-1.1 MPa, -1.5 MPa) solutions for 12, 24 and 36 hours at 25°C constituting nineteen treatments viz., hydropriming for 12 hours, 24 hours and 36 hours; GA_3 50 ppm for 12 hours, 24 hours, 36 hours; GA_3 100 ppm for 12 hours, 24 hours, 36 hours; GA_3 150 ppm for 12 hours, 24 hours, 36 hours; PEG 6000 -1.1 MPa for 12 hours, 24 hours, 36 hours; PEG 6000 -1.5 MPa for 12 hours, 24 hours, 36 hours and untreated control. After priming, seeds were dried back to their original moisture content by forced air under shade. Unprimed seeds served as control. 50 seeds per replication were then used for germination test as per ISTA procedure (ISTA 1985) in each treatment. Observations were taken for germination percentage (GP), hard seed (HS), seed vigour index (SVI) computed by multiplying GP and seedling length (SL+RL), root length (RL), shoot length (SL), seedling fresh weight (SFW) and seedling dry weight (SDW). Seeds which remained hard in the end of germination test were observed as hard seed. Radicle emergence (2 mm) was recorded daily for 14 consecutive days to calculate the mean germination time (MGT) and germination index (GI). For seedling emergence (SE), about 2-3 cm thick layer of sterilized soil was placed in plastic tray and then germination test was carried out. Data were analysed by factorial completely randomized design experiment by using MS Excel.

The interaction between priming agents, concentrations and durations had significant effect on germination and seedling growth of bitter gourd (Table1). All the priming

Table 1: Germination and seedling growth parameters of bitter gourd as influenced by different priming treatments

Treatments	Hours	GP	HSP	MGT (day)	GI	SVI	RL (cm)	SL (cm)	SFW (mg)	SDW (mg)	SE (%)
Hydro priming	12	53.33	25.33	5.90	2.43	985.01	11.17	7.30	636.67	84.67	45.33
	24	45.33	30.00	5.45	2.26	672.24	9.23	5.60	546.67	80.67	34.67
	36	34.67	34.00	4.56	1.67	445.16	7.97	4.87	496.67	75.67	34.67
GA_3 50 ppm	12	52.00	25.33	6.46	2.53	1476.28	13.36	15.03	1273.33	116.00	53.33
	24	47.33	30.00	6.86	2.23	1263.71	11.43	15.27	1350.00	106.33	52.00
	36	50.67	22.00	7.60	2.53	1045.32	12.03	8.60	583.33	84.00	48.67
GA_3 100 ppm	12	44.00	28.00	5.63	2.23	907.72	10.23	10.40	893.33	93.00	62.67
	24	40.33	23.33	6.93	2.40	806.60	9.90	10.10	606.67	105.33	46.67
	36	45.33	26.00	5.83	1.16	777.86	6.16	11.00	693.33	95.67	44.00
GA_3 150 ppm	12	48.33	23.33	7.30	2.70	916.82	8.90	10.07	550.04	93.67	36.00
	24	42.67	28.67	5.20	1.67	749.71	7.30	10.27	516.67	73.67	37.33
	36	39.33	32.00	4.70	1.43	732.71	9.10	9.53	713.33	95.33	34.67
PEG 6000 -1.1	12	52.00	23.33	8.83	2.10	994.76	10.40	8.73	550.00	84.33	53.33
MPa	24	54.67	22.67	8.80	2.53	1386.43	11.46	13.90	843.33	92.67	54.67
	36	46.67	24.67	8.36	2.13	932.00	9.40	10.57	730.00	93.33	58.67
PEG 6000 -1.5	12	42.67	27.33	4.33	2.13	773.61	8.46	9.67	576.67	75.67	42.67
MPa	24	48.00	26.67	9.30	2.23	974.40	8.67	11.63	650.00	90.67	44.00
	36	49.33	28.00	8.73	2.16	923.95	9.63	9.10	610.00	88.33	38.67
Control	-	29.33	38.00	10.37	1.07	356.95	7.17	5.00	490.00	52.33	29.33
Range		54.67-29.33	38.00-22.00	10.37-4.33	2.70-1.07	1476.28-356.95	13.36-6.17	15.27-4.87	1350.00-490.00	116.00-52.33	62.67-29.33
SE(M)		2.37	1.41	0.20	0.10	82.95	0.57	0.53	39.62	1.97	2.68
$CD_{0.05}$		6.78	4.04	0.57	0.28	237.50	1.64	1.52	113.44	5.64	14.26

GP=Germination percentage, HSP=Hard seed percent, MGT=Mean germination time, GI=Germination index, SVI=Seed vigour index, RL=Root length, SL=Shoot length, SFW=Seedling fresh weight, SDW=Seedling dry weight, SE=Seedling emergence

methods significantly increased the germination parameters compared to control. PEG priming enhanced germination by 66.69%, GA_3 by 55.32% and hydropriming by 51.53% over control. Primed seed showed higher germination, emergence and GI with low hard seed and MGT as primed seeds complete first two phases of germination during the priming process and after sowing, enter immediately into third phase of germination i.e. radicle emergence once rehydrated (Varier et al. 2010). Primed seeds also showed high SVI, shoot and root length, seedling fresh and dry weight since priming also leaches growth inhibitors and enhances the activity of different enzymes like malate synthase, iso-citrate lyase, malate dehydrogenase, increases anti oxidative response, decreases lipid peroxidation (Islam et al. 2012), repairs membranes and organelles and mobilizes stored materials (Sarika et al. 2013), hence facilitating faster and uniform germination and growth. Variation in all the germination and seedling growth parameters was found significant in response to different priming agents, their durations and concentrations.

Germination percentage (48.89%), seed emergence (48.67%), GI (2.21) and SVI (997.53) were enhanced most by PEG 6000 priming (Table 2). Seedling growth traits viz. shoot and root length (11.14 cm and 9.82 cm, respectively), seed fresh and dry weight (797.78 mg and 95.89 mg, respectively) were enhanced most by GA_3 priming. GA_3 priming also produced low hard seed (25.45%). For MGT (5.30) hydropriming was found best. PEG priming improved germination, not only due to hydration but also due to increase in protein,

Table 2: Best priming agent, best durations and concentrations for each agents with reference to bitter gourd germination and seedling performance

	GP	HSP	MGT (day)	GI	SVI	RL (cm)	SL (cm)	SFW (mg)	SDW (mg)	SE (%)
Best priming agent	PEG (48.89)	GA_3 (25.45)	HP (5.30)	PEG (2.21)	PEG (997.53)	GA_3 (9.82)	GA_3 (11.14)	GA_3 (797.78)	GA_3 (95.89)	PEG (48.67)
Best duration										
Hydro priming (HP)	12 hr (53.33)	12 hr (25.33)	36 hr (4.56)	12 hr (2.43)	12 hr (985.01)	12 hr (11.17)	12 hr (7.30)	12 hr (636.67)	12 hr (84.67)	12 hr (45.33)
GA_3 priming (GA_3)	12 hr (48.11)	12 hr (25.55)	36 hr (6.04)	12 hr (2.49)	12 hr (1100.27)	12 hr (10.83)	12 hr/24hr (11.83/11.88)	12 hr (905.57)	12 hr (100.89)	12 hr (50.67)
PEG priming (PEG)	24 hr (51.34)	24 hr (24.67)	12 hr (6.58)	24 hr (2.38)	24 hr (1180.4)	24 hr (10.06)	24 hr (12.76)	24 hr (746.67)	24 hr (91.67)	24 hr (49.34)
Best concentration										
GA_3 priming	50 ppm (50.0)	50 ppm (25.78)	150 ppm (5.73)	50 ppm (2.43)	50 ppm (1261.77)	50 ppm (12.27)	50 ppm (12.97)	50 ppm (1068.89)	50 ppm (102.11)	50 ppm (51.33)
PEG priming	-1.1 MPa (51.11)	-1.1 MPa (23.56)	-1.5 MPa (7.45)	-1.1 MPa (2.25)	-1.1 MPa (1104.4)	-1.1 MPa (10.42)	-1.1 MPa (11.07)	-1.1 MPa (707.78)	-1.1 MPa (90.11)	-1.1 MPa (55.56)

(In the parenthesis mean value for corresponding trait is provided) sugar and RNA synthesis; also PEG unlike other salts, is toxic less since it is an inert compound with high molecular weight and cannot enter seed due to its large molecular size. The possible reason for higher seedling growth traits with GA_3 treatment may be that GA_3 is a very potent hormone which occurs naturally in plants and have effects on cell growth and elongation and have great impact on germination, vigor and nutrient uptake. Lower hard seed in GA_3 priming indicates its ability to break dormancy. Islam et al. (2012) also reported higher shoot length, shoot mass and vigour in GA_3 primed seed. GA_3 is also responsible for extensive accumulation of nucleic acid (Islam et al. 2012) and increased catalase activity (Sarika et al. 2013) which is responsible for the germination acceleration. GA_3 enhanced water uptake capability of the sugar beet seed (Jamil and Rha 2007).

Many studies reported influence of different priming concentration on seed germination and seedling growth performance (Thirusenduraselvi and Jerlin 2009, Selvarani and Umarani 2011). In our study (Table 2), all the germination and seedling growth traits except for MGT were enhanced most by lower concentrations i.e. 50 ppm of GA_3 priming and-1.1 MPa of PEG priming. This may be due to the reason that concentration affects the imbibition rate, higher the concentration slower is the imbibition rate hence seeds took less time to reach phase II of germination in less concentration and more time in higher concentration. Though for MGT, 150 ppm of GA_3 and -1.5 MPa of PEG were found to be better concentration. Thirusenduraselvi and Jerlin (2009) also reported maximum speed of germination with -1.5 MPa PEG 6000 priming in bitter gourd.

Soaking duration is of utmost importance as soaking for too short duration may not complete metabolic repair processes or stimulate the enzyme activities, which are an important feature of priming; and too long may promote radicle emergence even after drying and once radicle emerges seed becomes desiccation sensitive. Selvarani and Umarani (2011) reported significant influence of soaking durations on seed performance of onion and carrot. In our investigation (Table 2), 12 hours of hydropriming and GA_3 priming and 24 hours of PEG priming was found most effective for enhancing all the traits studied except MGT, for which 36 hours was found best in hydropriming and GA_3 priming and 12 hours in PEG priming. Muhammad et al. (2014) also reported potentiality of 12 hours water soaking to improve germination and seedling growth of bitter gourd cultivars. Longer time taken in PEG priming to achieve similar result as in hydro and GA_3 priming may be due to low osmotic potential of the PEG solution (Dezfuli et al. 2008) hence slower water uptake resulting in less progressed metabolic processes. It is in conformity with the result of Kaur et al. (2015) who reported that 24 hours of PEG priming increased biochemical components like crude protein, total minerals, dry matter, iodine phosphorous in okra. It can be concluded that there is marked influence of different priming agents, concentrations and durations on seed germination and seedling growth of bitter gourd. Hydropriming and GA_3 (50 ppm) priming for 12 hours and -1.1 MPa PEG priming for 24 hours were observed to be the best for most of the traits studied in the present investigation.

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