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Seedling emergence and vigour improvement by priming muskmelon (*Cucumis melo*) seeds under diverse environments

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ABSTRACT

Priming is known to improve the germination of seed even under stress conditions. The present investigation was conducted at vegetable Research Farm, PAU, Ludhiana during 2016-17. Seeds of Punjab Sunehri variety of muskmelon (*Cucumis melo* L.) were treated with eleven priming treatments (hydration, GA_3, KNO_3, KH_2PO_4 and ethrel along with placing in wet gunny bags for 24 h and 48 h and hydration + FYM for 48 hours) along with control were sown in two diverse environments. Seeds sown during third week of February shows better germination and vigour than January sown seeds. Seed priming treatments were significantly better over the control. Treating the seed with potassium dihydrogen orthophosphate for 12 hr and then placing in wet gunny bags for 48 hr resulted in maximum germination (%), speed of germination, seedling length, dry weight and vigour indices in January sown seeds and par with GA_3 and at ethrel treatments in February sown seeds.

Key words: Environments, Emergence, Muskmelon, Seed priming, Vigour

Muskmelon (*Cucumis melo* L.) one of the most important cash crop in northern plains of India. Farmers prefer raising muskmelon in polythene bags during last week of January- first week of February to get high price of early produce but germination is a major problem due to low temperature prevailing during that period. For successful seedling emergence, temperature range is 25-28ºC. It may fail or take a long time to emerge if the soil temperature is below 20ºC and it altogether ceases below 15ºC (Reyes *et al.* 1994). Due to low temperature prevailing in January- February, patchy germination and growth gives undesirable look in the field. Therefore, in order to improve its germination, treatment is given to seeds before sowing. Priming treatments are successfully applied either to poor germinating seed lots or to seeds, which are sown under different stress conditions. Priming offers an effective means for counter acting sub-optimum temperature induced oxidative injury and raising seed performance in several crop species (Chen and Sung 2001). Application of plant growth regulators induces breakdown of seed reserves in storage tissue and increases the activity of enzymes for their mobilization, resulting in improved seed germination (Ajouri *et al.* 2004). Seed priming is a seed treatment given to seed before sowing which involves the initiation of pre-germinative metabolic enzyme activities by control hydration of seeds to prevent radical protrusion (Heydecker *et al.* 1973).

In muskmelon, various studies reported enhanced germination by seed priming treatments (Edelstein *et al.* 1995, Nascimento 2003). The seed priming response depends upon concentration of priming solution, duration, temperature and aeration of priming solution. Muskmelon has been primed in different priming agents like KNO_3 (Singh *et al.* 1999), KH_2PO_4 + KNO_3 (Sathish *et al.* 2011), NaCl (Sivritepe *et al.* 2005), salicylic acid and proline (Kaur and Gupta, 2017) and KNO_3 (Nawaz *et al.* 2011). The seed priming is limited on the commercial scale farming which may be due to inconsistency in emergence at field conditions (Kausar *et al.* 2009). Since the choice of farmers is different for their growing season, hence response to different seed priming treatments under different environments was investigated.

MATERIALS AND METHODS

The region is characterized by hot summer and cold winter with semi-arid and sub-tropical climate conditions prevailing in central districts of Punjab. The mean maximum and minimum temperatures show considerable fluctuations, while minimum temperature falls below freezing point having frosty spells during winter. The month wise meteorological data during investigation period is given in Table 1 for the year 2016-17. The experiment was laid out as a randomized complete block design (RCBD) with a factorial arrangement and replicated three times. The treatments consisted of two environments (sowing in the third week of January and third week of February) and 11

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Table 1 Mean weekly metrological data from January to March 2016-17

Standard Meteorological Week		2016					2017				
		Temperature (° C)			Rainfall (mm)	Sun shine (hrs)	Temperature (° C)			Rainfall (mm)	Sun shine (hrs)
No.	Dates	Max.	Min.	Mean			Max.	Min.	Mean		
1	Jan 15-21	13.0	8.0	10.5	0.0	0.2	16.0	6.2	11.1	1.6	4.5
2	Jan 22-28	14.1	5.2	9.7	0.4	2.9	19.5	10.3	14.9	40.4	3.6
3	Jan 29-Feb 4	20.5	7.6	14.1	3.0	6.4	19.8	8.7	14.3	5.2	4.5
4	Feb 5-11	21.4	8.2	14.8	0.8	6.5	20.7	8.2	14.5	0.0	6.0
5	Feb 12-18	21.7	7.5	14.6	0.6	7.8	24.3	9.7	17.0	0.0	8.1
6	Feb 19-25	24.2	11.7	18.0	7.4	8.1	24.8	10.6	17.7	0.0	8.8
7	Feb 26-Mar 4	28.1	12.9	20.5	0.0	7.9	25.5	9.5	17.5	0.0	9.6
8	March 5-11	26.7	14.5	20.6	23.0	7.8	20.9	10.5	15.7	40.8	7.3
9	March 12-18	24.2	14.2	19.2	14.9	6.5	23.2	8.9	16.1	0.0	8.3
10	March 19-25	29.8	14.5	22.2	3.2	8.8	30.4	14.8	22.6	0.0	9.8

priming treatments, i.e. seeds were soaked in water, 100 ppm GA_3, 100 ppm KNO_3, KH_2PO_4/10 M and 250 ppm ethrel for 12 h and then placed in wet gunny bags for 24 or 48 h, and hydration for 12 h along with placing in farmyard manure (FYM) for 48 h along with control. The cultivar Punjab Sunehari was selected for the study. Following the treatment, seeds were air dried at room temperature until their original weight was restored. After drying, the seeds were taken to field immediately for sowing in polythene bags. These polythene bags were protected from cold conditions by covering with polythene sheets during night. Observations were recorded on per cent field emergence, speed of emergence, seedling length (cm), seedling fresh weight (g), seedling dry weight (g), vigour index-I and vigour index-II.

For calculation germination (%), three replications of 100 seeds each were taken and incubated at 25±1ºC temperature in the germination incubator by between the paper method as per ISTA rules (ISTA 1999). The speed of germination was calculated by top the paper method. Three replications of the 100 seeds are taken to check speed of germination in germination incubator at 25±1ºC temperature. Daily observation for the germination was taken till the final day count. The number of seed germinated divided by the days taken to germination for calculation of speed of germination. To determine field emergence, 100 seeds/replication for each priming treatment were sown in polythene bag containing coco peat, vermiculite and perlite in equal ratio. The number of seeds emerged and developed into seedlings after 24 days was counted. Speed of emergence was computed by recording daily observations on 100 seeds sown in polythene bags until the final count day (24 days). The speed of emergence was calculated as total number of seeds emerged on day basis, and the mean was calculated as suggested by Maguire (1962). For determining seedling length, 10 normal seedlings from each replication of field emergence test were taken at random, and seedlings length was measured. Seedling dry weight was taken after drying ten normal seedlings at 110ºC for 17 h and mean dry weight was calculated. The vigour index-I and II were calculated as per the formulae suggested by Abdul Baki and Anderson (1973). Analysis of variance for the data recorded was conducted using CPCS-1 package.

RESULTS AND DISCUSSION

The priming treatments had significant influence on the germination of muskmelon seed and all the treatments recorded significantly increased germination over control (Table 2). The purpose of testing the seed in lab was to know actual germination and vigour of the seed. The data clearly indicated that seed lot used for study has good viability and vigour. Amongst various priming treatments, seeds treated with GA_3 100ppm, KH_2PO_4 along with placing in wet gunny bags for 48 h resulted in maximum germination

Table 2 Effect of seed priming treatments on germination (%) and speed of germination in muskmelon under laboratory conditions

Treatment	Germination (%)	Speed of germination
Control	88.83	10.92
Hydration + 24 hr (s) in wet gunny bags	91.92	12.09
Hydration + 48 hr (s) in wet gunny bags	93.13	19.38
GA_3 + 24 hr (s) in wet gunny bags	93.92	12.31
GA_3 + 48 hr (s) in wet gunny bags	95.54	21.00
KNO_3 + 24 hr (s) in wet gunny bags	91.92	12.42
KNO_3 + 48 hr (s) in wet gunny bags	93.00	20.95
KH_2PO_4 + 24 hr (s) in wet gunny bags	94.08	12.36
KH_2PO_4 + 48 hr (s) in wet gunny bags	95.00	20.97
Ethrel + 24 hr (s) in wet gunny bags	92.13	12.14
Ethrel + 48 hr (s) in wet gunny bags	92.46	20.74
Hydration + 48 hr (s) in FYM	90.67	20.42
Mean	92.72	16.31
$CD_{(0.05)}$	2.43	1.06

and were significantly better than other treatments and untreated seeds. The speed of germination was also better with priming treatments and it was revealed that seed treated with GA_3 100ppm, KH_2PO_4 and KNO_3 along with placing in wet gunny bags for 48 h resulted in maximum speed of germination. The increased germination and speed of germination due to priming treatments might be due to the initiation of activities of alpha amylase and maltase enzyme by gibberellic acid. The alpha amylase hydrolysis the starch into the maltose which later converts into the glucose by the enzyme maltase. This glucose so converted into the sucrose is available to the embryo for growth. The external application of gibberellic acid to seed by priming may enhanced the activities of gibberellic acid in seeds which may trigger the germination. Similar results were observed on the effect of priming on germination of different vegetable crops (Edelstein *et al.* 1995, Kang *et al.* 2010, Kumar and Singh 2013).

The real test of results on germination and speed of germination observed under laboratory conditions also tested under field conditions. It is evident that environment 2 (E2) was better in field emergence and speed of emergence than environment 1 (E1) (Fig 1(a)). This may be due to favorable temperature during third week of February (Table 1) than January for germination of seed. Further seeds treated with different priming treatments also shown positive influence on germination of seeds in both the environments than untreated seeds. Seed treated with KH_2PO_4 and keeping for 24 and 48 hr in wet gunny bags resulted in maximum field emergence of seeds even under environment 1. However in environment 2 all priming treatments resulted in increased field emergence in both the years. Minimum field emergence was observed in untreated seeds in both the environments. The increased field emergence due to priming treatments might be due to enhanced activities of enzymes like alpha amylase and maltase which increased the sugar, protein and DNA content of seed and counteract the adverse effect of low temperature (Ajouri *et al.* 2004). The availability of food reserve to embryo for development increased by rapid hydrolysis of starch and emergence percentage improved. The speed of emergence as given in fig 1(b) was significantly better in environment 2 than environment 1 due to conducive temperature for germination and growth of seedlings. The priming treatments improved the speed of emergence significantly than control. Even in environment 1 the seeds treated with KH_2PO_4 and keeping for 24 and 48 h in wet gunny bags resulted in maximum speed of emergence and better than all the priming treatments in both the years. However in environment 2 where temperature was favourable for germination, seeds treated with GA_3, ethrel and KH_2PO_4 also enhanced the speed of emergence over control. Minimum speed of emergence was noticed in untreated seeds in both the years in two environments. The increase in speed of emergence due to priming treatments might be due to increase in de novo synthesis of alpha amylase content (Farooq *et al.* 2006) and early synthesis of protein and DNA content (Bray *et al* 1989) that resulted in early initiation of germination process of seed. The rate of radical protrusion increased many folds with seed priming treatment due to increase in metabolic activities compared to non primed seed (Arif 2005). Umair *et al.* (2012) reported that seed priming with KH_2PO_4 enhanced the speed of emergence in mung bean. The activity of enzymes like superoxidase dismutase and catalase was enhanced by seed

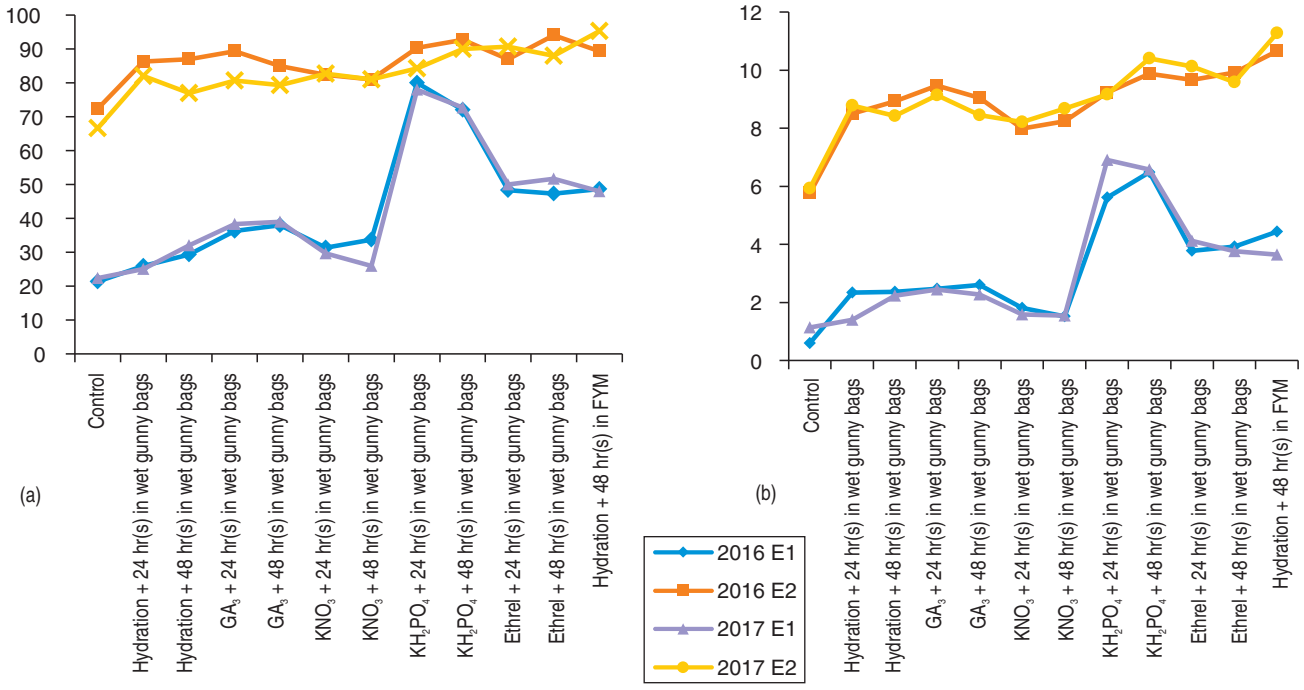

Fig 1 (a) Effect of different priming treatments on field emergence (%) and; (b) on speed of emergence of muskmelon seed in diverse environments.

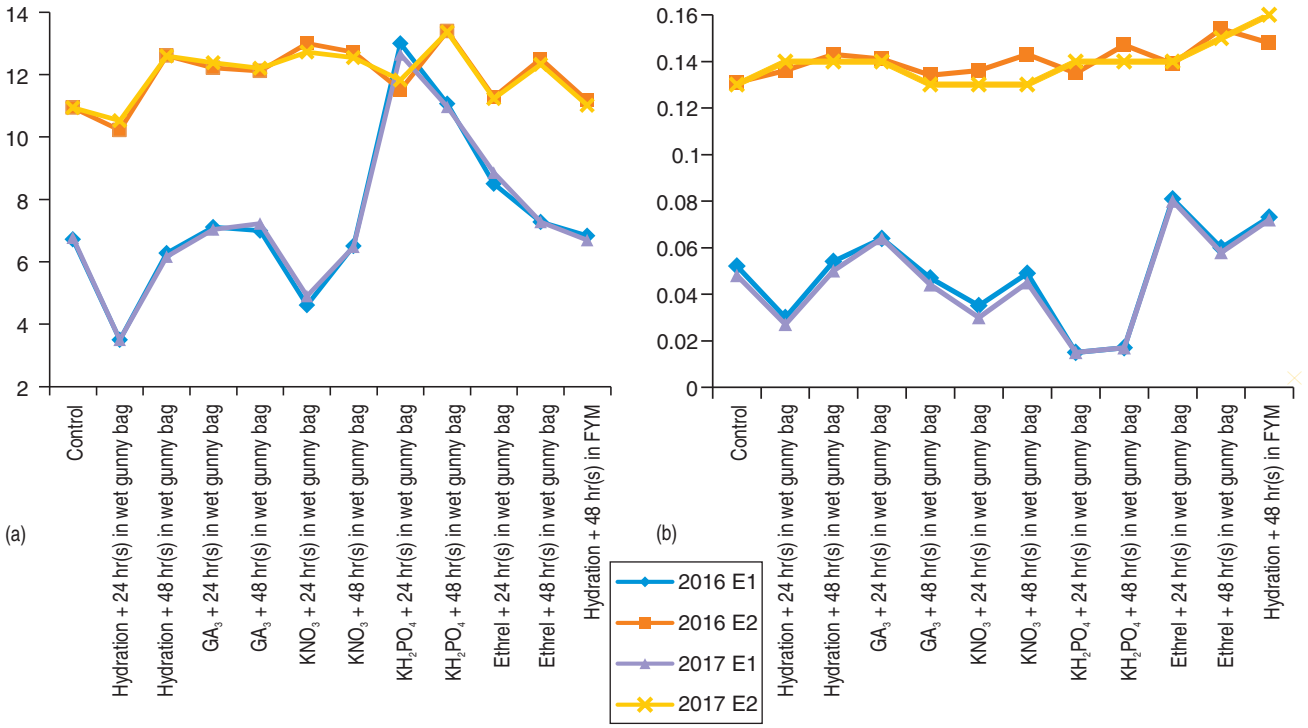

Fig 2 (a) Effect of different priming treatments on seedling length (cm) and (b) seedling dry weight of muskmelon seed in diverse environments.

priming in mung bean with KH_2PO_4.

Seedling length and dry weight (Fig 2 (a) and (b)) were significantly better in environment 2 than environment 1. This might be due to ideal temperature for germination of seed in Feburary than January as a result seeds germinated early and developed more biomass than seed sown in low temperature. Priming treatments improved the seedling length and dry weight considerably than unprimed seeds. The seedling length was observed maximum when seeds were treated with KH_2PO_4 and kept in gunny bags for 48 hours in both the environments, however in environment 2, KNO_3 and GA_3 treated seeds also recorded significantly better seedling length. The seedling dry weight was also maximum when seeds treated with ethrel and GA_3 in environment 1 but other priming treatments also improved seedling dry weight considerably in environment 2 as compared to control. The lowest seedling length and dry weight was recorded in untreated seeds in both the environments and years. The increase in shoot length may be due to increase in metabolic activities of enzyme which results in increased availability of food reserve to the seedling and enhanced the seedling length by seed priming with KH_2PO_4 comparing to untreated seeds. Enhanced germination and its speed contributed lot in increasing seedling length and dry weight of treated seeds. Similar studies were reported by the Kumar and Singh (2013) in bitter gourd, Jabbarpour *et al.* (2014) in wheat (1999) in muskmelon, Peyvast *et al.* (2010) in cucumber. The seedling dry weight was enhanced by the increase in volume of the seedling which indicates positive correlation between dry weight and seedling length. The seed priming with KH_2PO_4 increased the dry weight content. Similar results were reported by Kumar and Singh (2013) in bitter gourd, Peyvast *et al.* (2010) in cucumber for increased seedling length and dry weight by seed priming.

Vigour index I and vigour index II are also better in environment 2 than environment 1 because of conducive environment for germination and growth of seedlings. Similarly seed treatments proved to be better in increasing the vigour of the seed than untreated seeds. It was revealed that seeds treated with KH_2PO_4 and keeping in gunny bags for 24 and 48 hr recorded maximum vigour in environment 1 and significantly better than all other treatments. However in environment 2 other priming treatments like ethrel and GA_3 also improved the vigour considerably. The lowest vigour was noticed in untreated seeds in both the environments and years. The vigour indices are directly correlated with the emergence and seedling length and dry weight. The factors responsible for improving the emergence and growth of seedlings will increase the vigour of the seeds. The priming treatments increased the metabolic and enzymatic activities of the seed which led to availability of stored food material to plants that led to increase in vigour of the seedlings. Similar results were reported by the Ananthi (2008) in maize, Kumar and Singh (2013) in bitter gourd.

From the two years data presented here, it can be concluded that treating the seeds of muskmelon with potassium dihydrogen orthophosphate/10 M for 48 h will improve the germination and vigour when sown under optimal and sub optimal conditions.

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