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Use of growth regulators as priming agent for improvement of seed vigour in tomato (*Lycopersicum esculentum*)

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Abstract: Seeds of tomato cv. Keabi were primed with of three important growth regulators viz Gibberellic acid (GA_3), Napthlene acetic acid (NAA) and potassium nitrate (KNO_3). Four concentration of each, Gibberellic acid and Napthlene acitic acid (25ppm, 50ppm, 75ppm.100ppm) and two concentration of KNO_3 (1% and 2%) were compared with the distilled water as control. For each treatment seeds were soaked in growth regulator for 24 hrs before put for the germination test. Fifty seeds in four replications were germinated on top of paper at 20^0C in seed germinator for 14 days. Normally germinated seedlings were counted which gave an estimation of germination percentage. Data was recorded on the germination percentage, shoot length, seed vigour index. Most of the treatments had significant positive effect on all the quality parameters. NAA had showed adverse effect on the root length while other growth regulators were found to be significant role to improve the root length. Maximum seed germination (74%) was observed at 50 and 75ppm GA_3. Highest shoot length (4.83cm) was found at 25ppm of GA_3 whereas enhancement of root length occurred with the priming of 1% KNO_3 (3.52cm). Seed vigour-I, on the basis of seedling length was observed higher at 25ppm.GA_3 (720) and seed vigour –II on the basis of seedling dry weight was also observed maximum priming with 100ppmGA_3 (1460). From this study it was suggested that GA_3 priming has important growth regulator to enhance the seed germination as well as seed vigour. Before sowing seed should be priming with GA3 for obtaining high % germination and vigourous seedling that survive under adverse condition it also increase the uniformity of field plant stand.

Keywords: Growth regulators, Seed germination, Seed vigour, Tomato

INTRODUCTION

Tomato is the most popular vegetable crop in India. India hold second position after china in tomato production. It belongs to nightshade solanacae family and genus *lycopersicom.* Tomato fruits contains nutrients like vitamins and salts. Beutner *et al.* (2001) reported that tomato is beneficial to human health because of presence of phytochemicals such as lycopene β- carotene, flavonoids and many essential nutrient. Lycopene contents that an antioxidant role which minimized the danger of cancer reported by Miller *et al.* (2002) and prosate adenocaricnoma in humans as well as slow down germination, reduced plant height due to negative pleiotropic effects that might be due to high ABA which is responsible for seed dormancy. Seed from freshly harvested tomato seed lots fail to germinate due to presence of dormancy reported by Afzal *et al.* (2009 a). Seed priming with different growth regulators are an important phenomenon to enhance the uniformity during seedling emergence in all the crops including tomato. Ashrafi and Razmjoo (2010), Basra *et al.* (2006) defined the seed priming that it is pre-sowing strategy to affect the pre-germination metabolic activities to enhance the germination. Basra *et al.* (2003), Harris *et al.* (2005) , Harris (2006) and Habibi and Abdoli (2013) reported that seed priming improves germination by early DNA replication, increases RNA and protein synthesis, accelerates embryo growth, repairs the damaged and deteriorated seeds and causes a significant reduction in leakage of metabolites and finally results in better germination, seedling establishment and better yield of field crops. Priming of seed has an important role to overcome phytochorme induced dormancy and to reduce the time necessary for germination and subsequent emergence. Seed priming also improve the stand establishment in order to facilitate production management and enhance uniformity at harvest. Elaraby *et al.* (2006) reported that seed germination can be promoted

by soaking the seed with GA_3. Kucera *et al*. (2005) has recorded that gibberellic acid releases the seed dormancy and promotes the seed germination. Swaroop *et al.* (2001) estimated that Napthlene acetic acid increases the growth and yield of tomato. Nawaz *et al*. (2011) reported that Halo-priming is the technique of soaking seeds in salt solutions containing different salts like KCl, KNO and NaCl etc.

Priming is a valuable tool for the improvement of seedling quality in rootstock tomato seedling production reported by Mavi *et al*.(2006). Seed priming treatments have been used to accelerate the germination and seedling growth in most of the crops under normal and stress conditions reported by Basra *et al*. (2003). Primed crops grew more vigorously, flowered earlier and yielded higher reported by Farooq *et al*. (2008). They also found that seed priming improves emergence, stand establishment, tillering, allometry, grain and straw yields, and harvest index.

Therefore, this study was carried out to investigate the effect of priming on enhancing germination, root length, shoot length seedling vigour of tomato cultivars cv. Keabi at 20^0C temperature.

MATERIALS AND METHODS

Tomato cv. Keabi was taken from Sardar Vallabh Bhai Patel University of Agriculture and Technology, Modipuram, Meerut. The Experiment was conducted in the seed testing laboratory at Department of Seed Science and Technology Ch. Charan Singh University, Meerut. Gibberellic acid, Napthlene acitic acid and KNO_3 were used as the priming agents. Four concentration of each, Gibberellic acid and Napthlene acitic acid (25ppm, 50ppm, 75ppm and 100ppm) and two concentration of KNO_3 with 1% and 2% were compared with the distilled water as control. Before germination, seeds were soaked for 24 hrs in each treatment.

After 24 hrs excess water was removed and standard germination test was done by putting 50 seed in four replications on top of paper at 20^0C in seed germinator for 14 days. At final day of germination normal seedling counted which determine the germination percentage. For the determination of seedling length 10 seedlings were taken from each replication in all the treatment. These shoot and root length was measured with the help of scale. After measuring these seedling were dried at 100^0 C for twenty four hour in oven for determination of seedling dry weight.

Seedling vigour index was computed by adopting method of Abdul-Baki and Anderson (1973) by using formula:

Seedling vigour index-II = Root length + Shoot length (in cm) x Germination (%)

Seedling vigour index-I = seedling dry weight (in mg) x Germination (%)

RESULTS AND DISCUSSION

Analysis of variance showed that all the treatments were significant differences for the seed quality parameters. The mean value of various quality parameters of different seed treatment at 20^0C in keabi variety is given in Table 1. The mean germination percentage were significantly different for all the treatments as well as all the concentrations.

Effect on seed germination: The percent germination in tomato for control treatment was found 25%. The highest germination percent was recorded for GA_3 treatment (74%) at 50 and 75ppm followed by 72% and 73% at 25ppm and 100ppm; respectively. The germination percentages for NAA were recorded between the range 66% to 72% for different concentration of the growth regulator. The mean germination percentages for KNO_3 were recorded 40% and 60% at 1% and 2% concentration respectively (Table 1). Priming with all growth regulators showed significant difference and GA_3 was found to be the best growth regulator to enhance the germination percentage whereas the NAA ranked second and KNO_3 was found to be the least effective. Different concentration of same growth regulator did not showed significant difference on

Table 1. Effect of priming on seed germination, shoot length, root length, and seed vigour index of tomato (Values are means of four replicates).

Treatments	Germination %	Root length (cm)	Shoot length (cm)	Seed vigour index -I	Seed vigour index-II
GA_3-25ppm	72	4.83	3.27	583.20	720
GA_3-50ppm	74	4.41	2.73	528.36	740
GA_3-75ppm	74	4.53	2.35	509.12	1110
GA_3-100ppm	73	4.12	2.50	483.26	1460
NAA-25ppm	66	1.23	2.83	267.96	1320
NAA-50ppm	72	2.00	2.50	324.00	1080
NAA-75ppm	70	1.74	3.34	355.60	1050
NAA100ppm	72	2.74	3.26	432.00	720
KNO_3-1%	40	4.34	3.32	305.60	400
KNO_3-2%	60	3.80	3.52	379.20	900
Control	25	2.20	1.50	92.50	250
CD1%	1.29	0.158	0.409	2.24	4.57
CD 5%	0.95	0.116	0.301	1.65	3.36
CV	0.888	2.10	0.629	0.252	0.224

Note-GA_3. Gibberellic acid; NAA- Napthlene acitic acid; KNO_3 –potassium nitrate.

germination percentage.

Effect on root length: Significant differences were observed among the treatment for root length. The ranged root length varies from 1.74cm to 4.83cm after by priming. The highest root length 4.83 cm was recorded for GA_3 treatment at 25ppm followed by 4.53cm, 4.41cm,and 4.12cmat 75ppm, 50ppm and 100ppm; respectively. It showed that GA_3 has a role in root length growth along with the improvement on germination percentage. For KNO_3 mean root length recorded was 4.32cm and 3.80cm at 1% and 2% concentration. The root length recorded for NAA treatments were 2.74cm at 100ppm followed by 2cm, 1.73cm and 1.23cm at 50ppm, 75ppm, and 25ppm respectively. The lowest root length (1.23cm) was observed with NAA treatment at 25ppm, concentration (Table 1). NAA has got adverse effect on root length. Priming with all growth regulators except NAA showed significant difference and GA_3 was found to be the best growth regulator to enhance the root length whereas KNO_3 ranked second and NAA showed negative effect on root development. For root length there was non- significant difference among the different concentrations (25ppm to 100ppm) of a growth regulators but it significantly differ between the growth regulators.

Effect on shoot length: All the treatments were significantly different for shoot length. The highest shoot length was recorded 3.52 cm with KNO_3 at 2% followed by 3.32cm at 1% concentration. The mean shoot length with NAA treatment were 2.83cm, 2.50cm, 3.34cm,and 3.26cm at 25, 50, 75and 100ppm; respectively. The highest shoot length (3.34cm) was recorded with NAA treatment at 75ppm and lowest root length 2.0cm with 50ppm. The shoot length with GA_3 treatments were 3.27cm, 2.73cm, 2.35cm and 2.50cm at 25, 50, 75 and 100ppm (Table 1). Priming with all growth regulators showed significant difference and KNO_3 was found to be the best growth regulator to enhance the shoot length whereas NAA ranked second and GA_3 was found to be the least effective. Shoot length did not show significant differences at different concentration (25ppm to 100ppm) within a growth regulators but it significantly differs between the growth regulators.

Effect on seedling vigour: The mean seed vigour index –I (on the basis of seedling length) and vigour index –II (on the basis of seedling dry weight) were significantly improved by priming with growth regulators. The improvement of seedling vigour index -I was highest with GA_3 (583.20) at 25ppm followed by 528.38, 509.12 and 483.26 at 50ppm, 75ppm, 100ppm respectively. Lowest seedling vigour index-II (267.96) with NAA at 25ppm followed by 324, 355.6, and 432 at 50ppm, 75ppm,100ppm; respectively The mean seedling vigour index -II for KNO_3 were recorded 305.6 and 379.2 at 1% and 2% respectively . The mean seedling vigour index –II was also improved by the GA_3 treatment at 100ppm. The highest seed vigour index -II was recorded (1460mg) with GA_3 at 100ppm followed by 720mg, 740mg, 1110mg at 25ppm, 50ppm, 75ppm respectively. The seedling vigour index -II with NAA priming ranged from 720mg to 1320mg and for KNO_3 were ranged from 400mg to 900mg which were inferior to the GA_3 but superior to the control.

It is quite evident that soaking of seeds with hormones improves the performance of agronomic and vegetables seeds by improving stand establishment and ultimately yield of plants reported by Farooq *et al*.(2005) and Afzal *et al*. (2009a). In the present study priming with GA_3 enhanced germination percentage, shoot length and seed vigour in tomato cultivar (Table 1). Similar findings were reported by Afzal *et al*. (2011) who noticed vigorous growth of seedlings raised from primed seeds that showed rapid and higher germination rate at initial. Afzal *et al*. (2009a) found that earlier and superior germination due to hormonal priming is related with dormancy breakdown in tomato cultivars. Moreover enhancement of germination and subsequent seedling growth of primed seeds at 100 ppm GA_3 and Kinetin is attributed more likely due to improved chlorophyll contents of seedlings as compared to other priming agents including control reported by Basra *et al*. (2011). Hussain *et al*. (2012) also reported that priming with 100 ppm GA_3 improve the root (3.91 and 3.76cm) and shoot length (4.61 and 4.72) on tomato cultivars viz roma and nigina respectively.

In the present study shoot length was increased with the priming of KNO_3 as compared to control. Our finding agree with the Afzal *et al*. (2011) who reported that primed seed with 1% and 2% KNO3 produce largest shoot length (4.04 cm and 4.18 cm., respectively). Gubis *et al.* (2004) also reported that KNO_3 primed seed produce vigorous shoot length in tomato.

Conclusion

From the present investigation GA_3 was found to be the most important growth regulators to increase seed germination, shoot length, and seedling vigour of tomato. GA_3 play an important role to improve the seed vigour index of tomato. It releases the seed dormancy, promotes seed germination, and reduces time for germination. It is also important to increase the root length. KNO_3 was found very effective to increase the shoot length. So priming of seed with various growth regulators has an important approach to enhance the seed quality parameters. It is suggested before sowing seed should be soaked in growth regulators for 16-18 hours. This process may enhance the enzymes that are responsible for germination. So priming with GA_3 before sowing is very effective for obtaining maximum seed germination and healthy seedling that produce higher yield.

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