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Influence of seed priming on germination, phenology, and early growth behavior in late sowing Kabuli chickpea (*Cicer arietinum* L.)

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Abstract
Due to the nature of their seed coat and bold seediness, Kabuli chickpeas have a problem with prior germination. Seed priming is the one of the most important approaches to improve germination and seedling emergence in various crops. Therefore, the field experiment was carried out to find out the influence of various seed priming treatments on germination, phenology and early growth behavior in late sowing Kabuli chickpea in *rabi* season 2020-21 at department of Plant Physiology, AB & MAPs, COA, Indira Gandhi Krishi Vishwavidyalaya at Raipur, Chhattisgarh. Ten seed priming treatment have been used with three replications in randomized block design and two genotypes of Kabuli chickpea ***i.e.,*** ICCV-171309 and ICCV-181318 have been used. The germination, phenological observations and growth behavior were recorded and it was found that T_2 (Hydro priming) and T_7 (GA_3 @500ppm) performed significantly effective for improving germination percentage and reducing the days required to germination, flower initiation, 50% flowering, pod initiation, 50% podding and first picking of pod in both ICCV-181318 and ICCV-171309.

Keywords: Chickpea, seed priming, phenology, germination

Introduction
Chickpea (*Cicer arietinum* L.) is the most nutritional pulse crop in India grown in Rabi season having two distinct type desi and Kabuli chickpea. Chickpea belong to family Fabaceae. In India, total production of chickpea is 11.08 million tons with a 1142 kg/ha yield and an area of 9.68 million ha in 2019-20, according to the Agricultural Statistics Division, Directorate of Economics and Statistics, Department of Agriculture and Cooperation. In Chhattisgarh, chickpea has been grown in an area of 381.77 thousand hector and has an average production of 88.19 thousand tons with a yield of 887 kg/ha.

Chickpea seeds take 10 to 14 days for germination under optimum temperature and moisture. Desi chickpea is more suitable to germination response than Kabuli chickpea due to small seed seeds germinate more rapidly than medium and large seeds. Kabuli chickpea has a problem of prior germination due to presence of their seed coat and bold seediness. (Kaya *et al.* 2008) [20] reported that there is a positive relationship between seed size and mean germination time, germination s and root and shoot length.

To overcome this problem, seed priming is the most effective approach for boosting seed germination (Heydecker *et al.* 1975) [11]. Seed priming improves germination and increases seedling emergence in charging soil maintains regime, especially in the optimal range. Therefore, the efforts were made to reduce the time needed for germination and recover from the deteriorating soil physical conditions using various seed priming treatments and neutropriming (Seed soaked in solution of micro and macronutrient) to improve germination, growth behavior and phenology to achieve more productivity in Kabuli chickpea.

There are several types of seed priming that are very effective for germination, such as hydro priming (using water to double the volume of the seed), halo priming (using a salt solution such as NaCl), osmo priming (using an osmotic solution such as PEG, NaCl, KCl, KNO_3, K_3PO_4, KH_2PO_4, $MgSO_4$, and $CaCl_2$), sand matric priming (using moist sand), biological priming (use of bacterial agent) (use of beneficial micro and macronutrient). Hydro priming is the ideal priming technique because it provides adequate water to begin the metabolic process but insufficient water to complete germination (Heydecker *et. al.*, 1975) [11].

Material and Methods

The field experiment having two Kabuli chickpea genotypes ICCV-171309 and ICCV-181318 was carried out in a randomized block design during the *rabi* season of 2020-21 with ten treatments with two replications department of Plant Physiology, Agricultural Biochemistry, Medicinal and Aromatic plants, Collage of Agriculture, Raipur (C.G.). The seeds are soaked in treatment solution with specific time of incubation which required for imbibition of seeds. The treatments used in this experiment were depicted below in table 1. After imbibing the seeds was dried at room temperature to regain its normal moisture and sown manually with a sickle at a depth of 4-5 cm with a uniform spacing of 6 cm×15 cm (plant× row). After sowing irrigation was done to provide appropriate moisture to seed required for germination. A (RDF) recommended dose of fertilizer (N: P_2O_5: K_2O 20:50:20 kg ha^{-1}) was applied by urea and SSP (Single Super Phosphate) respectively at the time of the vegetative stage. The observations were recorded at the time of germination and at different phenophase such as 1st flower initiation, 50% flowering, 1st pod initiation, 50% podding and 1st picking of pod.

Table 1: Treatments

Treatment no.	Treatment name	Time of incubation of seeds
T_1	Control	
T_2	Hydro priming	24 hrs
T_3	Sodium molybdate @ 500 ppm	12 hrs
T_4	*Trichoderma harzianum* @ 1.5%	8 hrs
T_5	Vitavax @ 0.02%	8 hrs
T_6	H_3BO_4 @ 0.4%	12hrs
T_7	GA_3 @ 500ppm	12hrs
T_8	$ZnSO_4$ @ 0.4%	12 hrs
T_9	KNO_3 @ 2%	12 hrs
T_{10}	$Cacl_2$ @ 2%	12 hrs

Results

The data of germination percentage was recorded after 7 DAS as germination period of chickpea is 7 to 14 DAS and depicted in table no. 1 and 2. The days required to germination showed that T_2 (hydro priming) was significantly effective to reduce the required days for germination in the both genotypes (fig no. 2) (2 days and 12 hrs.) followed by T_4 (*Trichoderma harzianum* @1.5%) (3 days and 12 hrs.). However, T_5 (Vitavax @ 0.02%) and T_7 (GA_3 @ 500ppm) and T_{10} ($Cacl_2$ @ 2%) were at par in both the species. Similarly, the germination percentage was significantly improved in T_2 (hydro priming) in genotype 1 (ICCV-171309). However, in T_7 (GA_3 @500ppm) the germination percentage was higher in the both genotypes. The minimum germination percentage was observed in T_6 (H_3BO_4 @ 0.4%) in the both experimental genotypes (fig no. 1). Every priming treatment can reduce days to germination as compared control which is reviewed by (Harris *et al*. 2004) [8].

The days required for first flower initiation and 50% flowering significantly reduced in priming treatment T_7 (GA_3 @ 500 ppm) in both the experimental genotypes which was followed by T_3 (Sodium molybdate @ 500 ppm) and its effect more prominent in ICCV-181318 over its counterpart (fig no. 3 and 4). These treatments *i.e.*, T_7 (GA_3 @ 500 ppm) was also found most prominent and significantly effective in reducing days required to pod initiation in ICCV-181318 and T_3 (Sodium molybdate @ 500 ppm) was equally effective in reducing days required to pod initiation in both experimental genotypes (fig no. 5). Similarly, the treatment T_7 (GA_3 @ 500 ppm) was quite effective and significantly reduced the days required to 50% podding and first picking of pod in the both experimental genotypes followed by T_3 (Sodium molybdate @ 500 ppm) than other priming treatments (fig no. 6 and 7). Khairul Mazed *et al*. (2015) [21] observed similar results in chickpea (Bari chola-6).

Table 2: Impact of seed priming on germination and phenology of Chickpea (*Cicer arietinum* L.) Genotype 1

T	G	DTG	DTF	DTF (50%)	DTP	DTP (50%)	DTPP
T_1	41.25	8.00	47.00	63.50	57.50	75.00	95.50
T_2	67.45	2.50	35.50	50.50	47.50	60.50	88.00
T_3	77.55	4.50	37.50	51.00	45.50	61.00	77.50
T_4	86.05	3.50	43.50	59.50	54.50	69.50	88.50
T_5	75.65	4.00	39.00	53.50	45.50	63.50	85.00
T_6	15.55	9.50	50.00	61.50	56.50	71.50	92.50
T_7	90.40	4.00	38.50	50.00	44.50	64.00	76.50
T_8	27.00	9.50	46.50	62.50	56.00	72.50	90.50
T_9	39.85	4.00	46.00	62.00	56.50	72.00	79.50
T_{10}	53.61	4.00	45.50	55.50	49.00	66.50	90.00
Mean	57.42	5.30	42.90	57.35	51.30	67.60	86.35
C.D. (5%)	7.92	2.22	6.87	2.30	2.84	2.51	10.46
SE (m)±	2.44	0.97	2.12	0.71	0.88	0.78	3.22
SE (d)	3.45	0.69	3.00	1.00	1.24	1.10	4.56
CV (%)	6.01	18.11	6.98	1.75	2.41	1.62	3.22

Genotype 2

T	G	DTG	DTF	DTF (50%)	DTP	DTP (50%)	DTPP
T_1	41.25	8.00	47.00	63.50	57.50	75.00	95.50
T_2	67.45	2.50	35.50	50.50	47.50	60.50	88.00
T_3	77.55	4.50	37.50	51.00	45.50	61.00	77.50
T_4	86.05	3.50	43.50	55.50	54.50	69.50	88.50
T_5	75.65	4.00	39.00	53.50	45.50	63.50	85.00
T_6	15.55	9.50	50.00	61.50	56.50	71.50	92.50
T_7	90.40	4.00	38.50	50.00	44.50	64.00	76.50
T_8	27.00	9.50	46.50	62.50	56.00	72.50	90.50
T_9	39.85	4.00	46.00	62.00	56.50	72.00	79.50
T_{10}	53.61	4.00	45.50	59.50	49.00	66.50	90.00
Mean	57.42	5.30	42.90	57.35	51.30	67.60	86.35
C.D. (5%)	7.92	2.22	6.87	2.30	2.84	2.51	10.46
SE (m)±	2.44	0.97	2.12	0.71	0.88	0.78	3.22
SE(d)	3.45	0.69	3.00	1.00	1.24	1.10	4.56
CV(%)	6.01	18.1	6.98	1.75	2.41	1.62	3.22

Note- G- Germination percentage DTG- Days required to germination, DTF- Days required to flower initiation, DTP- Days required to pod initiation, DTF (50%)- Days required to 50%flowering, DTP (50%)- Days required to 50% podding, DTPP- Days to first picking of pod, T- Treatments

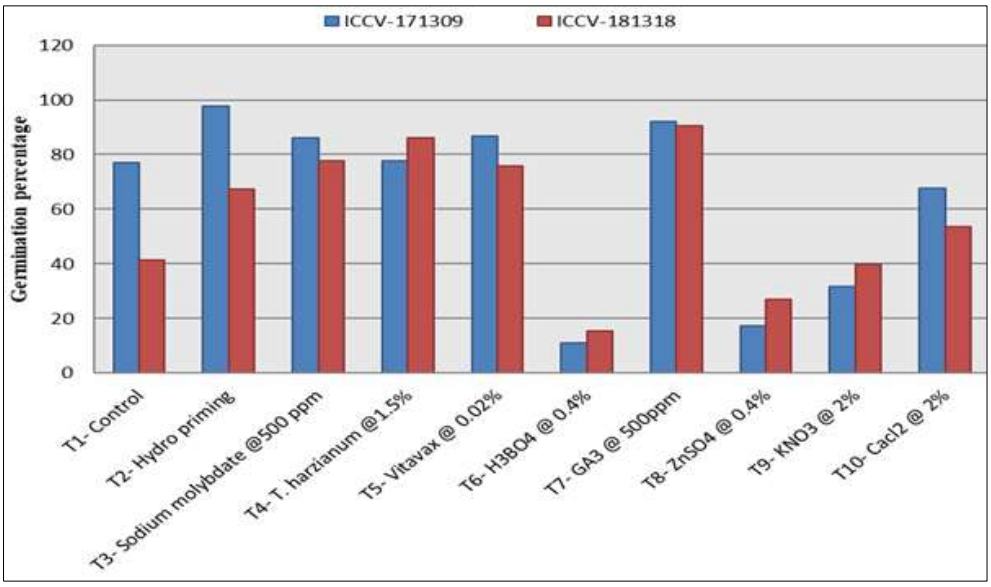

Fig 1: Impact of seed priming on germination percentage of chickpea (*Cicer arietinum* L.)

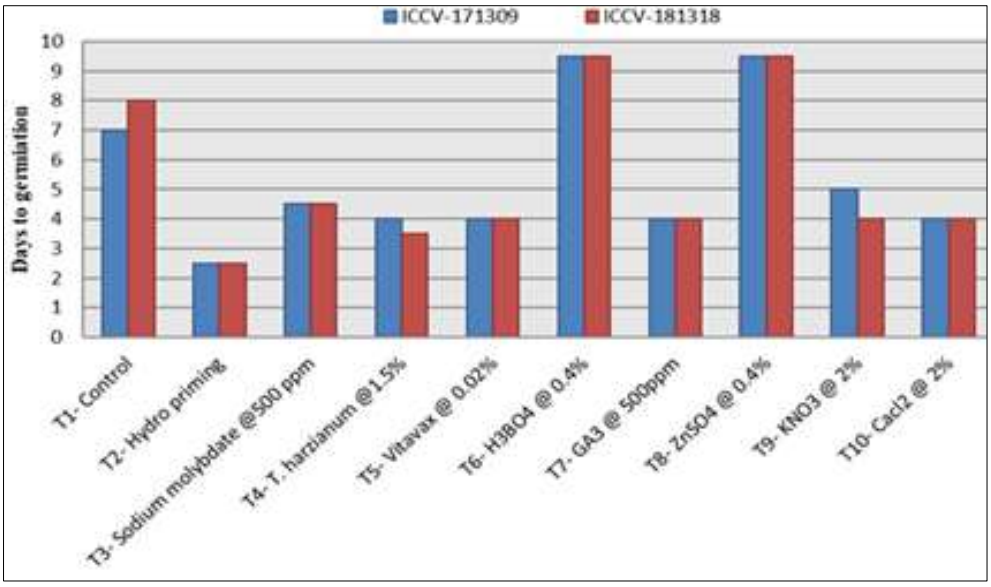

Fig 2: Impact of seed priming on days required to days to germination of chickpea (*Cicer arietinum* L.)

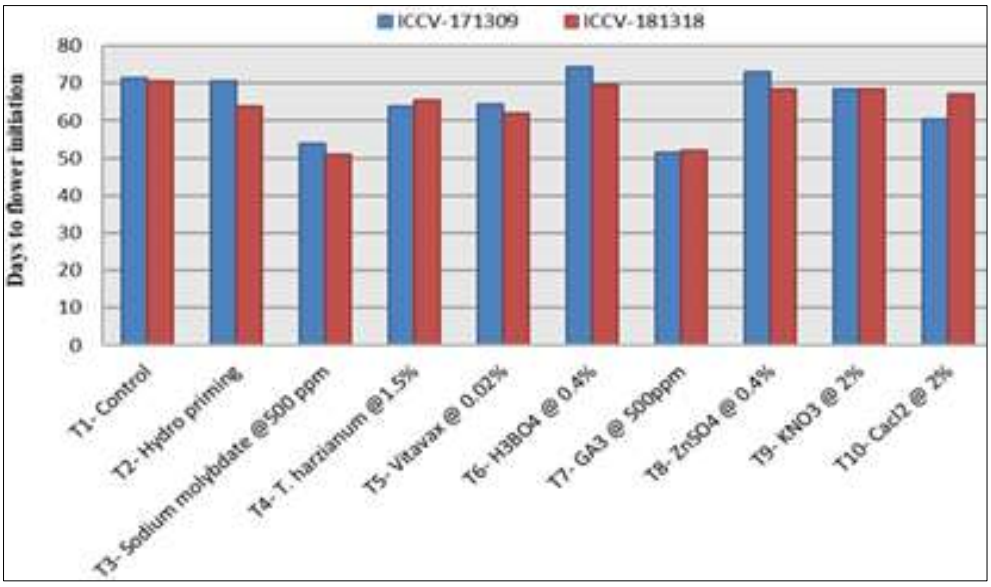

Fig 3: Impact of seed priming on days required to flower initiation of chickpea (*Cicer arietinum* L.)

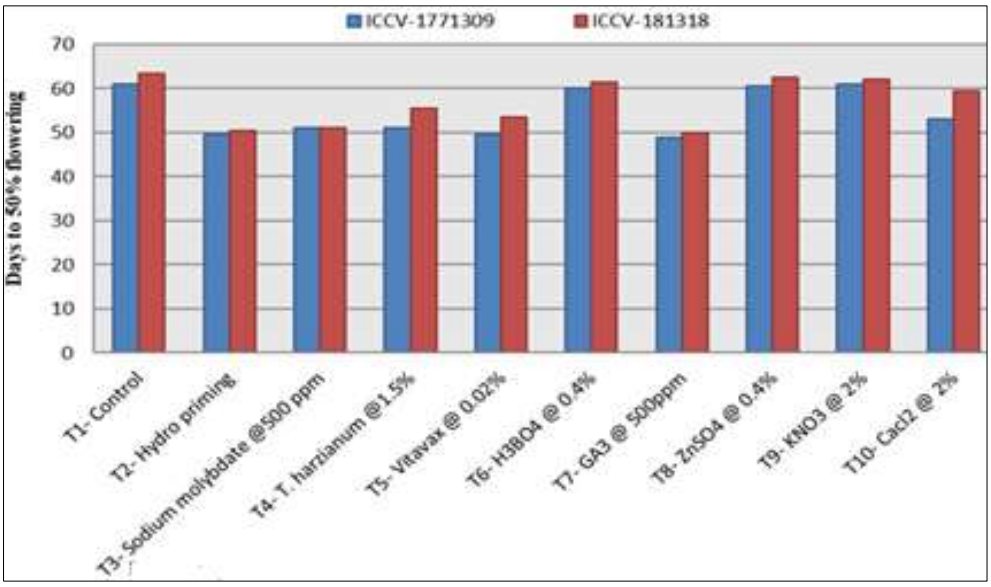

Fig 4: Impact of seed priming on days required to 50% flowering of chickpea (*Cicer arietinum* L.)

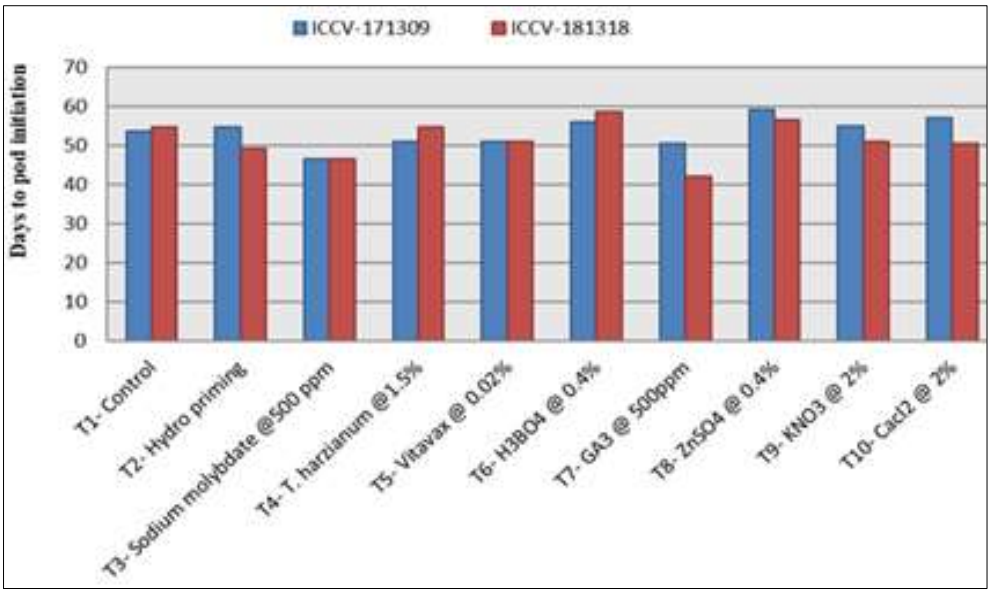

Fig 5: Impact of seed priming on days required to pod initiation of chickpea (*Cicer arietinum* L.)

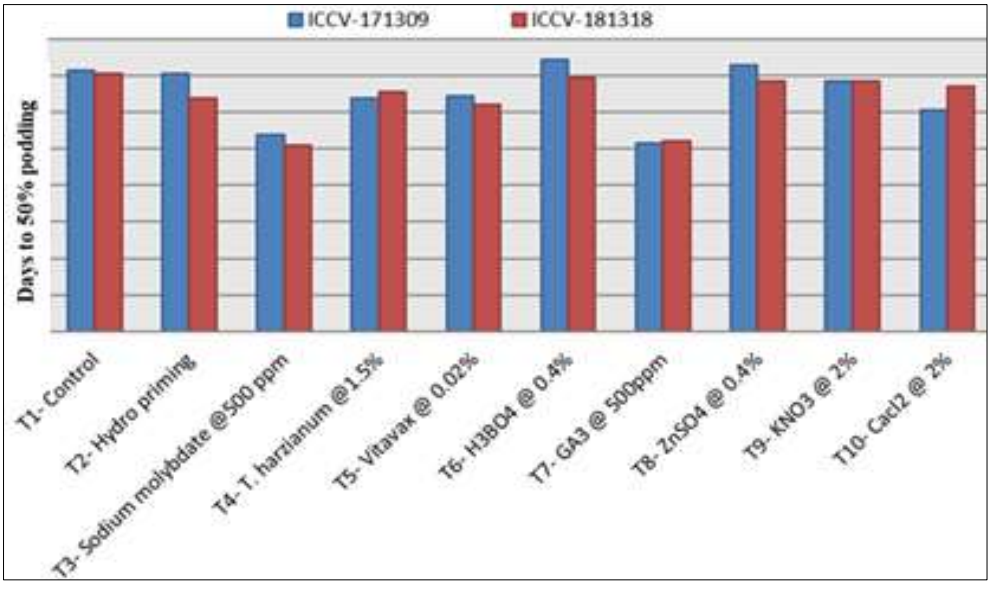

Fig 6: Impact of seed priming on days required to 50% podding of chickpea (*Cicer arietinum* L.)

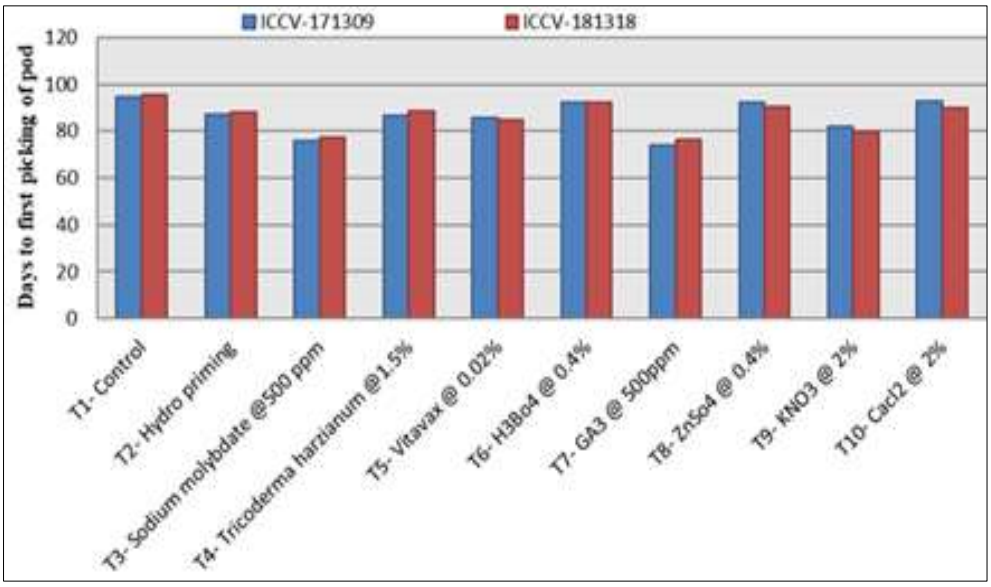

Fig 7: Impact of seed priming on days required to first picking of pod of chickpea (*Cicer arietinum* L)

Discussion

(Harris *et al*. 2001) [7] reported improvement in germination, reduction in germination time and enhanced emergence in water primed seed. The impact of hydro priming is to shorten the time taken for seeds to germinate, which may be related to the stimulatory influence of the germination process. When dry seed is immersed in water, the water absorption occurs in three stages: inhibition, steady incline, and considerable increase (Varier *et al.* 2010) [19]. According to (Bewley *et al.* 1997) [5], the first stage involves fast water uptake owing to the seed's low water potential, the third stage involves radical emergence, and the second stage involves biochemical processes. The priming characteristics of the pre-germination process, such as enhanced RNA and protein synthesis, higher ATP availability, and quicker embryo development, stimulate germination (Bewley and Black 1997) [5]. (Musa *et al.* 2021) [17] discovered that seed priming resulted in earlier crop flowering on chickpea. Early flowering might be associated with emergence time, thus treatments that emerge quickly have early flowering (Basu *et al*. 2005) [3]. The activity of enzymes amylase, catalase, and protease increased under GA_3 as compared to control, resulting in an increase in nucleic acids such DNA and RNA (Thakare *et al*. 2010) [18]. GA_3 causes release of enzymes amylase and protease. These enzymes participate in the breakdown of stored starch to simple sugars. These sugars are then translocated to growing embryo where they provide energy for growth. Thus GA_3 enhance seed germination. (Marth *et al.* 1956) [1] discovered that GA_3 may stimulate the development of floral buds and early flowering as a result of accelerated vegetative growth. Early flowering due to *Trichoderma harzianum* @1.5% may be ascribed, as it easier uptake of nutrients and transport of growth promoters like cytokinins to axillary buds resulting in breakage of apical dominance. As a result, there is a better sink for quicker photosynthetic mobilization and early transformation of plant parts from vegetative to reproductive phase (Bhargava *et al.* 2015) [7].

Conclusion

The seed priming treatment can be used as an efficient tool for in enhancing the germination percent, seedling growth and to achieved early phenophases *i.e.,* flower initiation, 50% flowering, pod initiation, pod filling as well as to reduces the time requirement for germination. Amongst the experimental treatments T_2 (Hydro priming), T_7 (GA_3 @ 500ppm) were found most effective in reducing the days requirement for germination, flower initiation, 50% flowering, pod initiation, 50% podding and pod filling over other treatments and control.

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