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Impact of halo-priming and Panchagavya on seed quality parameter in tomato (*Solanum lycopersicum* L.) seeds

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Abstract
Seed priming is a cutting-edge technique for increasing germination by hydrating seeds without utilising actual germination seeds. Priming was studied in two tomato varieties, Kashi Vishesh and Arka Vikas, in the postgraduate laboratory of the Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences, SHUATS, Naini, Prayagraj, Uttar Pradesh in 2021. With two kinds, nine treatments, and four replications, the experiment is set up in a completely randomised design (CRD) way. Tomato seeds are treated with several amounts of Panchagavya and halopriming treatments to determine the best priming treatment. The seeds are soaked for 12 hours in T_0- Control, T_1- NaCl 1%, T_2- NaCl 2%, T_3- NaCl 3%, T_4- KNO_3 1%, T_5- KNO_3 2%, T_6- KNO_3 3%, T_7- Panchagavya 6%, T_8- Panchagavya 10% for the measurement of germination percentage, root length, shoot length, seedling length, fresh weight of seedling, dry weight The study was carried out using the top paper approach. In comparison to the control, Panchagavya 10% delivers a better outcome in total observations, followed by KNO_3 2%. It was found that all priming treatments showed variance with the control.

Keywords: Panchagavya, halopriming, replication, priming

Introduction
The tomato (*Solanum lycoperscion*) is the most well-known member of the Solanaceaceae family. It has chromosomal number 2n=24 and is from South America. It's an annual herbaceous crop that's grown from seed. Dicot plants have a series of branching stems with a terminal bud at the tip. Veins are protected by very short hairs, and most plants have complex leaves with 5 to 9 leaflets on petioles that are long and odd-pinnate. Yellow flowers with anthers united along edges appear on the apical meristem, forming a column around the pistil is style. Tomatoes are typically considered as berries.

Tomatoes may be a good source of vitamin A, C, and minerals like calcium, phosphorus, and iron (Dhaliwal *et al*., 2003) [4]. In comparison to meat, milk, fruits, and other high-priced fruit goods, it also plays an important role in boosting the nutrition resources of the poor population. In everyday diets, tomatoes are a major source of antioxidants such as carotenoids (particularly lycopene and Bcarotene), phenolics, ascorbic acid (vitamin C), and a minor amount of vitamin E. (Rai *et al*., 2012) [10]. The tomato is commonly referred to as a "poor man's apple." Vitamins A and C are abundant in this fruit (Buckseth, 2012) [3].

Tomatoes are widely used in canning and are used in soups, pickles, ketchup, sauces, and juices, among other things. Tomato juice has grown in popularity as an appetiser and beverage. Water (94.1%), energy (23 calories), calcium (1.0 g), magnesium (7.0 mg), vitamin A (1000 IU), ascorbic acid (22 mg), thiamine (0.09 mg), riboflavin (0.03 mg), and niacin (0.8 mg) are all present in a well-ripened tomato (per 100 g of wholesome meal) (Uddain *et al*, 2009) [15]. Tomato assembly and productivity in the world is 160850.683 tonnes per hectare. In an area of 4778.406 hectare, and 33.7 tonnes/ha, respectively. China, Turkey, Italy, India, the United States, Iran, Brazil, and Spain are all major tomato producers.

Priming aids in extending enzyme activity and mitigating the effects of seed ageing. De novo production of - amylase is also known to occur during priming, according to (Lee and Kim 2000). As a result of enhanced -amylase activity, better vigour of primed seeds corresponds to metabolic processes in seeds. Priming improves seed performance by boosting germination rate and consistency, which has been shown to result in faster and better seedling development in a variety of agricultural seeds (Pill, 1995; Warren and Bennet, 1997; Taylor *et al*., 1998; Powell *et al*, 2000) [7, 16, 14, 8].

Material and Methods

The current study, titled "Effect of Halo-Priming and Panchagavya on seed quality parameter in Tomato (*Solanum lycopersicum* L.) Seeds," was carried out in the Post Graduate Laboratory of Seed Science and Technology at Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, between 2020 and 2021. Under laboratory conditions, the lab experiment was analysed using C.R.D (Completely randomised design) with 4 replications and 9 treatments using two tomato varieties (V_1- Kashi Vishesh & V_2- Arka Vikash). T_0- Control, T_1- NaCl- 1 percent, T_2- NaCl- 2 percent, T_3- NaCl- 3 percent, T_4- KNO_3- 1 percent, T_5- KNO_3- 2 percent, T_6- KNO_3- 3 percent, T_7- Panchagavya- 6 percent, T_8- Panchagavya- 10 percent, Tomato seeds are dipped for 12 hours to obtain the quality criteria, primed seeds are dried back to their original moisture content in the shade. The experiment is conducted using the Top Paper approach.

The following characteristics were observed: Germination percent (ISTA 2004) [5], Root length (cm), Shoot length (cm), Seedling length (cm), Seedling fresh weight (mg), Seedling dry weight (mg), Seedling vigour index I and II (Baki and Anderson, 1973) [1]. The experimental data were recorded and statistical analysis was performed to determine the analysis of variance, range, and mean, as well as the critical Difference and coefficient of variation (Fisher, 1936).

Result and Discussion

The seed invigoration therapy has an influence on all seedling traits, and the results are entirely significant. In both varieties, panchagavya 10% gives the best results, followed by KNO_3 2%, while Kashi vishesh out performed Arka vikash.

Table 1: Mean performance of Kashi vishesh & Arka vikas variety tomato seeds

Treatments	Germination percentage		Root length		Shoot length		Seedling length		Fresh weight		Dry weight		Seed vigour index I		Seed vigour index II	
	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2
T_0	76.25	74.5	3.425	3	3.725	3.5	6.875	6.475	72.25	67.5	7.45	6.875	523.825	482.475	568.45	512.1
T_1	77	75.5	3.175	3.275	4.025	3.75	7.45	6.95	78.75	73.75	7.95	7.225	573.75	524.3	612.175	545.425
T_2	79.5	78	3.6	3.425	4.175	3.875	7.575	7.35	85	75.5	8.725	7.575	602.55	579.3	693.7	590.95
T_3	82.25	80	3.95	3.6	4.425	4.175	8.175	8	86.5	79.5	9.1	8	672.55	640.1	748.325	639.775
T_4	78.5	76.5	3.425	3.225	4.15	4.2	7.775	7.125	86.75	79.75	8.1	7	610.55	539.1	635.975	535.3
T_5	86.25	83.25	4.15	4.05	5	5.075	9.57	9.45	104.25	96.25	10.35	10.25	826.05	786.325	893	853.675
T_6	84.25	82	4.1	3.825	4.625	4.85	9.09	8.975	97.75	93	9.85	9.3	751.675	735.8	830.1	762.475
T_7	81.25	78.5	3.975	3.5	4.375	4.425	8.75	8.375	92	83.5	9.025	8.475	711.025	663.525	733.4	671.875
T_8	88	86.5	4.6	4.175	5.45	5.5	10.575	10.225	109.5	102	11.1	11.025	930.775	884.625	976.86	942.475
Mean	81.4722	79.4167	3.83333	3.56389	4.43889	4.37222	8.40833	8.09444	90.4167	83.4167	9.08611	8.4	689.194	648.467	743.553	672.672
Max.	88	86.5	4.6	4.175	5.45	5.5	10.575	10.225	109.5	102	11.1	11.025	930.775	884.625	976.86	942.475
Min.	76.25	74.5	3.175	3	3.725	3.5	6.875	6.475	72.25	67.5	7.45	6.875	523.825	482.475	568.45	512.1
C.V	1.24434	1.60286	7.76141	6.17469	7.31282	7.50866	5.64017	5.71109	2.99693	1.69928	3.8897	5.64925	6.00473	5.79562	4.35605	5.87579
C.D	1.97137	2.47528	0.57854	0.42791	0.63121	0.63838	0.92219	0.89893	5.26917	2.75636	0.68725	0.92276	80.4735	73.0812	62.9828	76.8577

From table.1 it can be say that, the maximum germination percentage was observed by the treatment of panchagavya (10%) V_1- 88%, V_2- 86.5% followed by KNO_3 (2%) V_1- 86.25%, V_2- 83.25%. The maximum root length was observed by the treatment Panchagavya (10%) V_1- 4.6 cm, V_2- 4.175 cm followed by KNO_3 (2%) V_1- 4.15 cm, V_2- 4.05 cm. The maximum shoot length was observed by the treatment Panchagavya (10%) V_1- 5.45 cm, V_2- 5.5 cm followed by KNO_3 (2%) V_1- 5 cm, V_2- 5.075 cm. The maximum seedling length was observed by the treatment Panchagavya (10%) V_1- 10.575 cm, V_2- 10.225 cm followed by KNO_3 (2%) V_1- 9.57 cm, V_2- 9.45 cm. The maximum fresh weight was observed by the treatment Panchagavya (10%) V_1- 109.5 mg, V_2- 102 mg followed by KNO_3 (2%) V_1- 104.25 mg, V_2- 96.25 mg. The maximum dry weight was observed by the treatment Panchagavya (10%) V_1- 11.1 mg, V_2- 11.025 mg followed by KNO_3 (2%) V_1- 10.35 mg, V_2- 10.25 mg. The maximum seed vigour index I was observed by the treatment Panchagavya (10%) V_1- 930.775, V_2- 884.625 followed by KNO_3 (2%) V_1- 826.05, V_2- 786.325. The maximum seed vigour index II was observed by the treatment Panchagavya (10%) V_1- 976.86, V_2- 942.475 followed by KNO_3 (2%) V_1- 893, V_2- 853.675.

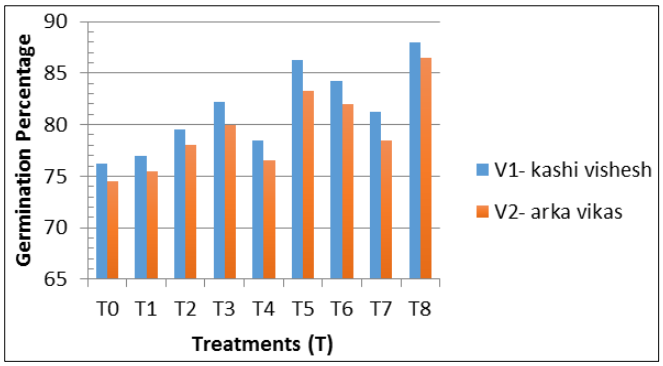

Fig 1: Germination percentage.

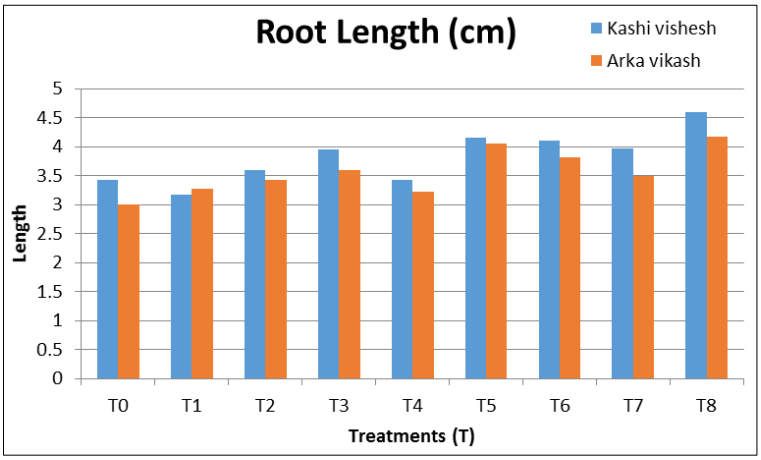

Fig 2: Root length.

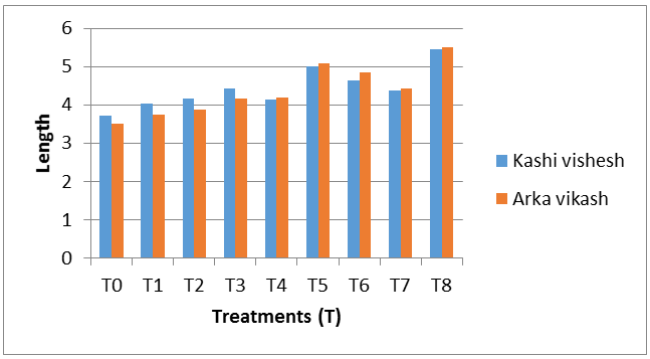

Fig 3: Shoot length.

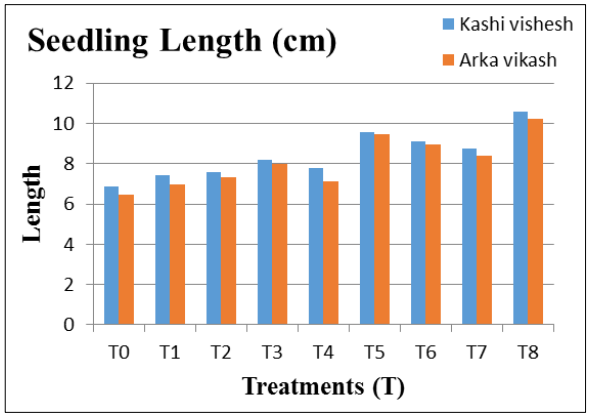

Fig 4: Seedling length.

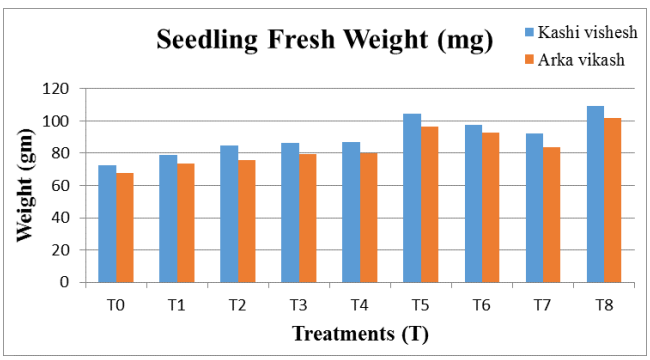

Fig 5: Seedling fresh weight.

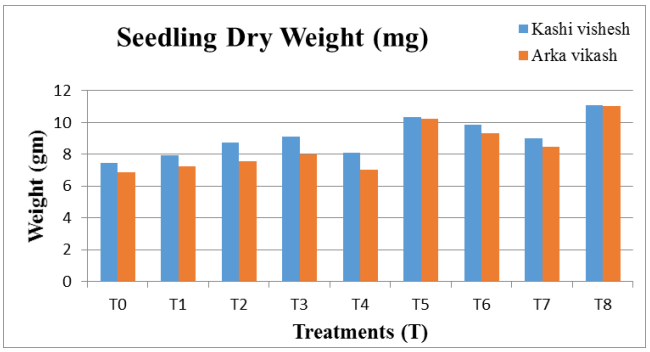

Fig 6: Seedling dry weight.

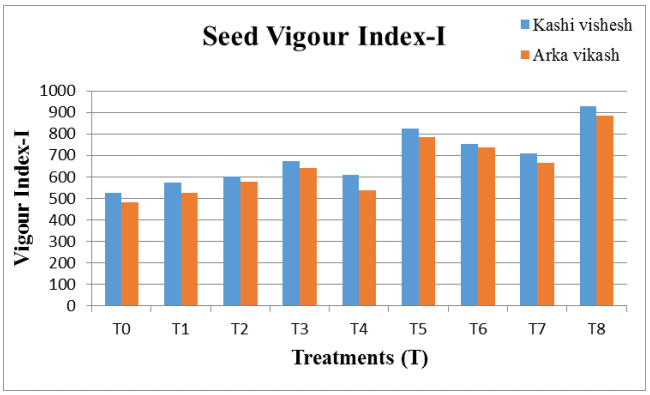

Fig 7: Seed vigour I.

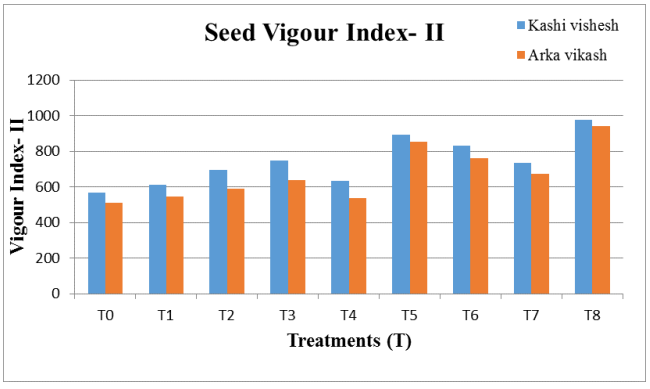

Fig 8: Seed vigour II.

A Similar result was found in (Sreenivasasareddy and Chaurasia; 2021) [13] where Panchagavaya treatment shows the better results as compare to other treatments. R. Ebenezer Babu Rajan et.al. (2020) [9] found that Panchagavya 6% shows better results in comparison to all other biological treatments in seed quality parameters. (Sowmeya TV *et al*. 2018) [12] found that Panchagavya 5% seed treatment shows better results than other seed treatments in carrot seeds. (S.Shubha *et al*. 2014) [11] found that seed treatment with panchagavya 3% shows better results in soil microbial population, growth and yield in maize crop. (B. Kamatchi Kala & R. Esakiammal Alias Eswari 2019) [2] found that seed primed with 1% Panchagavya shows effective results in leafy vegetables.

Seed priming is an effective approach to overcome halo priming and panchagavaya's inhibition of seed germination and seedling growth. These findings support the conclusions of this study by demonstrating that a variety of chemicals can be utilised as seed priming agents and can improve seed germination under various conditions. The effects of priming treatments on seed germination potential, germination index, and vigour index were stronger than their effects on ultimate germination rate, showing that priming primarily increased seed vigour rather than the quantity of germinated seeds under stress.

Conclusion

It was concluded that all the priming treatments, seed priming with panchagavya (10% solution for 12 hours) performed better among all the different priming treatments. Moreover, priming treatments have more pronounced effect on variety V_1- Kashi vishesh maintained highest seedling parameters in comparison with V_2- Arka vikash of tomato seeds. The variety Kashi vishesh can be beneficial for the farmer as its germination percentage is good it may be grown in farmer field so that they can get more production.

Future Scope

In Future, there is a need for investigating the mechanisms of seed improvement due to salinity stress with different chemical concentrations and biological treatments along with different duration of priming, with these priming techniques, if any in field crops for a better understanding of physiological seed enrichment. It is better to develop a package for on-farm priming that can be adoptable by the farmers for value addition and improved crop performance.

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Competing interests

Authors have declared that no competing interests exist.

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