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EFFECT OF DIFFERENT PRIMING ON SEED GERMINATION IN CHILLI

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ABSTRACT

In order to determine the effect of different priming on seed germination in chilli, an experiment was conducted at the Department of Biochemistry, College of Basic Science and Humanities, Sardarkrushinagar Dantiwada Agricultural University, S. K. Nagar, Gujarat, India in Completely Randomized Block Design having three replications. In the current investigation, various seed priming methods were applied, excluding the use of 2.0% silver nitrate, exhibiting favorable impacts on the seed germination in GCh-1 and BhutJolokia chilli cultivars during the germination phase. Notably, the most substantial germination rates (92.33% for GCh-1 and 70.33% for BhutJolokia) were observed when seeds were primed with 100 ppm of silver nanoparticles (AgNPs) for 24 hours. Moreover, this particular treatment displayed the shortest mean germination duration (5.12 days for GCh-1 and 7.46 days for BhutJolokia) and the highest germination index (1.89 for GCh-1 and 1.10 for Bhut Jolokia) in both cultivars.

Key words : Germination, BhutJolokia and GCh-1.

Introduction

Seed is a primary requirement for crop production, which carries the genetic potential of the variations and determine the ultimate productivity. Therefore, seed production is always the basic pre-requisite of any food security undertaking, but poor germination of seed is a major problem in vegetable cultivation. Rapid and uniform germination and emergence of seeds and normal and vigorous seedlings are important determinants of successful stand establishment and ultimately increased yield and quality (Cantliffe, 2003).

As per IMSCS, chilli has average 60 percent germination, so it's important to increase the germination above 60 percent, which will be an incremental achievement in seed quality attributes as poor, delayed, and erratic germination of chilli seeds is one of the reasons for the low yield of chilli. To increase seed vigour and crop production, different chemical-based fertilizers and pesticides are used extensively in agriculture. In light of the leaching, degradation, hydrolysis and pollution associated with conventional chemical based practices, they are being discouraged. There is an urgent need to develop a sustainable technology that can contribute to the green revolution to address these growing concerns and to restore the damage caused to the ecosystem.

Seed priming is an innovative, sustainable seed technology to increase seed vigour and crop production without harming the ecosystem. This method was first proposed by Hydecker in 1973. Seed priming involves hydration of the seed in different ways, thus improving germination rate, uniformity in emergence and germination under a wide range of environmental and climatic conditions (Subramanian and Umarani, 2010).

Materials and Methods

Seed materials used in the experiment

The seeds of two cultivars of chilli, namely Gujarat chilli hybrid-1 (GCh-1) and BhutJolokia were used for

this study.

Seed surface sterilization

Seeds of chilli varieties *viz*., GCh-1 and BhutJolokia were 3-4 times washes with double distilled water after that seeds were deep in 0.1% mercury chloride solution for 1 min. Then washed thrice with distilled water and blotted on sterile blotting paper for drying.

Seed priming procedure

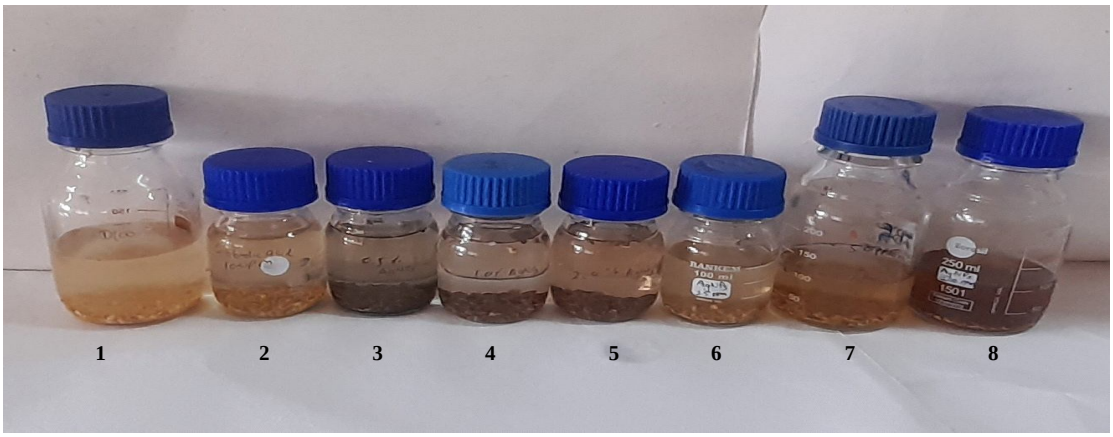
The sterilized seeds were treated with different priming and different concentration for 24.00 hrs duration under the aseptic condition mentioned in Table 1. The 10 g seeds of each cultivar were soaked in 100 ml of solution for each treatment. The seeds were fully immersed in the solution at a room temperature in the dark condition. After that treated seeds were thoroughly rinsed with distilled water for 2 minutes. Then, it was labeled and keep in air dried on blotting paper at room temperature overnight (Plate 1).

Table 1 : Treatment details.

Treatments	Soaking periods (hrs)
T_1: AgNPs @ 25 ppm	24
T_2: AgNPs @ 50 ppm	24
T_3: AgNPs@100 ppm	24
T_4: $AgNO_3$@0.5%	24
T_5: $AgNO_3$@1.0%	24
T_6: $AgNO_3$@2.0%	24
T_7: GA_3@100 ppm	24
T_8: H_2O	24
T_9: Control	-

until no further germination occurred for 24 hrs after the last record.

After the lapse of the experimental period, germination percentage, mean germination time and germination index were evaluated by the following method.



1. **Hydro priming (Distilled Water)**
2. **Gibberellic Acid (100 ppm)**
3. **AgNO3 (0.5 %)**
4. **AgNO3 (1.0 %)**
5. **AgNO3 (2.0%)**
6. **AgNPs (25 ppm)**
7. **AgNPs (50 ppm)**
8. **AgNPs (100 ppm)**

Plate 1 : Seed soaking in different priming for 24 hrs.

Seed germination test

The germination test was conducted using three replications of 100 primed seeds of each treatment in a sterilized plastic tray on autoclaved Whatman no. 1 filter paper and incubated at room temperature. Sufficient time was given for the seeds to germinate and produce all essential structures showing potentiality to develop into normal plant under favorable conditions. Germination of individual seeds with the suitable control (non-primed seed) were measured at 24 hrs interval and continued

Seed germination percentage

The seed germination percentage was calculated by the following method given by ISTA (Anonymous, 2011):

$$\text{Germination}(\%) = \frac{\text{Number of seeds germinated}}{\text{Total number seeds for tested}} \times 100$$

The final germination percentage (FGP) was calculated at the end of the experiment.

Mean germination times (Day)

Mean germination times (MGT) were calculated according to the following equation:

$$MGT = \sum (n \times d) / N$$

Where,

n is the number of seeds germinated on each day,

d is the number of days counted from the beginning of germination and

N is the total number of seeds germinated at the termination of the experiment.

Seed germination index

The seed germination index was calculated as described in the Association of Official Seed Analyst (AOSA, 1983) as follows:

$$SGI = \frac{Number\ of\ germinated\ seed + ... + Number\ of\ germinated\ seed}{Days\ to\ first\ count + ... + Days\ to\ first\ count}$$

Results and Discussion

Different priming during the investigation period significantly influenced the differences in the germination percentage, germination time and germination index of the GCh-1 and BhutJolokia cultivars of chilli (Table 2). The observations on germination parameters were counted at 24-hour intervals and continued until no further germination occurred for 24 hours after the last record.

Effect of priming on seed germination percentage

The highest percentage of seed germination (92.33%) was observed in seeds primed with AgNPs@ 100 ppm for a full day. These seeds were then treated with GA_3@ 100 ppm, which produced 86.33 percent germination, which was statistically equivalent to AgNPs@ 50 ppm (85.00%) germination. Under $AgNO_3$@ 2.0 percent, the least amount of germination (65.33%) was observed, which was comparable to the control (70.33%) of the GCh-1 cultivar.

On the other hand, the BhutJolokia cultivar exhibited a maximum germination of 70.33% in seed treated with AgNPs@ 100 ppm for 24 hours, which was followed by GA_3@ 100 ppm with a germination rate of 65.10%, which was statistically equivalent to the germination rate of AgNPs@ 50 ppm (63.33%). $AgNO_3$@ 2.0% showed the lowest germination (46.00%), which was statistically equivalent to the control (47.33%). $AgNO_3$@ 2.0% produced the lowest germination percentage. Which may have been caused by the greater concentration's harmful effects. In comparison to the GCh-1 cultivar, the BhutJolokia cultivar generally displayed less germination. This effect is in complete agreement with Chandrashekara *et al.* (2020) in chilli and Prazak *et al.* (2020) in Bali and Delfina cultivars of bean.

Effect of priming on mean germination time

The minimum mean germination time (5.12 days) was observed in seed primed with AgNPs@ 100 ppm for 24 hrs which was remain statistically at par with GA_3@ 100 ppm (6.04 days), while significantly maximum mean

Table 2 : Effect of priming on germination percent, mean germination time and germination index of GCh-1 and BhutJolokia cultivars.

Treatment	Germination (%)		Mean germination time (days)		Germination index	
	GCh-1	BhutJolokia	GCh-1	BhutJolokia	GCh-1	BhutJolokia
T_1: AgNPs @ 25 ppm	83.33^{bc}	59.00^{cd}	7.73^{cd}	10.00^{cd}	1.10^{d}	0.78^{c}
T_2: AgNPs @ 50 ppm	85.00^{b}	63.33^{bc}	6.34^{b}	9.52b^{bc}	1.27^{c}	0.62^{d}
T_3: AgNPs @ 100 ppm	92.33^{a}	70.33^{a}	5.12^{a}	8.52^{a}	1.89^{a}	1.10^{a}
T_4: $AgNO_3$@ 0.5%	76.00^{d}	52.00^{ef}	6.96^{bc}	12.30^{e}	0.97^{e}	0.54^{e}
T_5: $AgNO_3$@ 1.0%	75.33^{de}	55.33^{de}	8.21^{cd}	10.63^{d}	1.14^{d}	0.53^{e}
T_6: $AgNO_3$@ 2.0%	65.33^{f}	46.00^{g}	10.00^{f}	15.00^{f}	0.68^{g}	0.37^{f}
T_7: GA_3@ 100 ppm	86.33^{b}	65.10^{b}	6.04^{ab}	9.02^{ab}	1.43^{b}	0.87^{b}
T_8: H_2O	79.33^{cd}	57.33^{de}	9.10^{c}	10.23^{cd}	0.85^{f}	0.59^{e}
T_9: Control	70.33^{ef}	47.33^{fg}	10.55^{f}	15.25^{f}	0.72^{g}	0.35^{f}
SEm ±	1.81	1.74	0.30	0.34	0.03	0.02
CD @ 5%	5.38	5.17	0.89	1.01	0.09	0.06
CV%	3.96	5.26	6.68	5.28	4.65	5.42

Treatment means with the common letters(s) are non-significant by Duncan's New Multiple Range Test at 5% level of significance.

germination time were recorded in control (10.55 days) of GCh-1 cultivar.

In contrast, in the BhutJolokia cultivar, the maximum mean germination time was observed in the control group (15.25 days), when compared to other priming treatments. The minimum mean germination time (8.52 days) was observed in seed treated with AgNPs @ 100 ppm for 24 hours, which was statistically at par with GA_3 @ 100 ppm (9.02 days). Similar trends were observed by Hojjat and Hojjat (2015) in Fenugreek as well as Acharya *et al.* (2020) in two varieties of watermelon (*Citrullus lanatus*) seed, Riverside and Maxima.

Effect of priming on germination index

The observations recorded on germination index under imposing various seed priming was found significant. When seed primed with AgNPs@ 100 ppm for 24 hours, the largest germination index (1.89) was recorded in GCh-1 cultivars. This was followed by GA_3@ 100 ppm, AgNPs@ 50 ppm, and $AgNO_3$@ 1.0 percent, all of which had germination indices of 1.43, 1.27 and 1.14, respectively. On the other hand, seeds primed with $AgNO_3$@ 2.0% showed a minimum germination index of 0.68, which was comparable to the control value of 0.72.

AgNPs@ 100 ppm for 24 hours produced the highest germination index (1.10) in BhutJolokia cultivar seeds, which was followed by GA_3@ 100 ppm (0.87), AgNPs@ 25 ppm (0.78) and AgNPs@ 50 ppm (0.62). On the other hand, the control group had a minimum germination index of 0.35, which was statistically equivalent to $AgNO_3$ at 2.0% (0.37). Anandaraj and Natarajan (2017) also showed similar trend with different concentration of AgNPs on onion.

Conclusion

Seed primed with different priming treatments significantly influenced the morpho-physiological characters of both GCh-1 and BhutJolokia chilli cultivars. The maximum seed germination, minimum mean germination time and maximum germination index was recorded in AgNPs @ 100 ppm of GCh-1 and BhutJolokia. Whereas, minimum seed germination, maximum mean germination time and minimum germination index was recorded in $AgNO_3$ @ 2% of GCh-1 and BhutJolokia. Which may have been caused by the greater concentration's harmful effect. In comparison to the GCh-1 cultivar, the BhutJolokia cultivar generally displayed less germination percentage, more mean germination time and low germination index.

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