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**Akash Bhargaw**
Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

**Priyamvada Chauhan Joshi**
Assistant Professor, Seed Science and Technology, Teerthankar Mahaveer University, Moradabad, Uttar Pradesh, India

**Corresponding Author:**
**Akash Bhargaw**
Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

# Effect of various seed priming techniques on seed physiology and vigor association in baby corn (*Zea mays* L)

**Akash Bhargaw and Priyamvada Chauhan Joshi**

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**Abstract**
Seed priming is one of the most common and economical methods to enhance seed quality. One of the major challenge of seed deteoriation can be also overcome by priming method. There are several type of priming out of which four type Hydro priming, Osmo priming, Halo priming, Hormonal priming were evaluated on baby corn fresh and artificial accelerated aged seeds and were compared with each other. Several physiological character determining seed quality were observed like germination percent, germination speed, seedling length, seedling dry matter and vigor index. But use of G.$A_3$ a@ 150 ppm for 24 h was most effective in all priming treatment followed by other. Hydro priming methods was also useful and it is easy to use. All priming method showed better results in compare to unprimed seeds in both slot but however Hormonal priming proved best out of all followed by Hydro priming.

**Keywords:** Accelerated ageing, baby corn, metabolic activity, priming, vigour index

## Introduction
It is observed that seeds generally start losing their metabolic and physiological character with passing time (Carvalho *et al.*, 2011) [6]. There can be several reasons for poor germination as well as low vigor index of seeds like abiotic stress and unfavorable environmental conditions. To overcome these challenges seeds priming is best option as priming help the seeds to repair damaged embryo and to complete its pre germination metabolic activity which further help it to tolerate abiotic stress (Mc Donald, 2000). Several methods are used to enhance seed vigor like Hydro priming, Halo priming, Osmo priming Hormonal priming. All priming methods are useful in compare to control seed deterioration with ageing. But there is a lack of proper comparison between all this priming methods and their positive impact on baby corn (Kamithi *et al.*, 2016) [15]. In this research a proper comparison is done to evaluate each priming technique and its impact on various physiological seed vigor attributes. By most successful priming method farmer can reduce dependency on excess use of fertilizer up to some limit and can save their valuable money (Pawar and Laware, 2018) [22].

## Material and Methods
Eight hundred gram of seeds were accelerated aged (Delouche and Baskin, 1973) [11] method and prosier followed by seed priming (Bhargaw *et al.*, 2019) [55]. 100 grams of seeds for each treatment were taken from fresh and aged seeds slots. Hydro priming was done with normal tap water for $T_1$ (12 hours) and $T_2$ (24 hours) (Ahammad, 2014) [3]. For Osmo priming $KNO_3$ @1% solution was used for $T_3$ (12 hours) and $T_4$ (24 hours) (Kumari *et al.*, 2017) [18]. For Halo priming $CaCl_2$ @ 1% solution was made and $T_5$ was primed for 12 hours and $T_6$ for 24 hours (Debnath *et al.*, 2017). In Hormonal priming, Gibberellic acid ($GA_3$) was used @100 ppm for 12 ($T_7$) and for 24 hours ($T_8$) and another concentration of $GA_3$ @150 ppm was used for 12 hours ($T_9$) and 24 hours ($T_{10}$) (Kumari *et al.*, 2017) [18].

## Data collection
Germination data were collected from 3 replication of each treatment from both fresh and aged seed slots. Temperature of germination chamber was set at 25 $\pm 2^0$C for 12 days (Rao, *et al.*, 2006).

Length of seedling (cm) was measured by selecting 10 seedling randomly from each replication of a treatment. Root was measured from prime root and shoot was measured from cotyledon to collar. Seedling were collected randomly by method mention above and were kept in hot air oven for 24 hours at 60 ℃. Ounce seedling were dried up dry weight was measured by a electronic beam balance in mg (Afzal *et al.*, 2008) [2]. Seedling vigor index-I was calculated by measuring average dry weight of 10 normal seedling gram and germination per cent by using following formula.

Seedling vigor index-I = Seedling dry matter (g) x Germination percentage

To calculate Seedling vigor index-II, 10 normal seedlings were selected at the end of germination test. Their root and shoot length data were taken in record.
Seedling vigor index-II = Seedling length (cm) x Germination percentage (Abdul Baki and Anderson, 1973) [1].

**Seedling length and dry weight test at cm (4th, 7th, 10th day)**

This experiment was conducted to test the vigor index of various primed seeds after 4th day, 7 th day and 10 th day. Purpose of this experiment is to test the germination speed, time
Needed to secrets growing hormones by different priming agents. 22 big Petri dishes were taken and a thick layer of cotton was spread as a substrate. 50 seeds were put in each petri-dish. For each treatment, germination was allowed under germination chamber at $28^0$C. After 5th day of sowing random 3 samples were taken. Data of root and shoot were written followed by 8th day and 11th day. Seedling length and dry weight were calculated as per the process mentioned above.

## Result and discussion

### Germination percent

Embryo inside the seed will develop into a plant sapling only when it will get favorable environmental conditions to start their metabolism for their life cycle (Mongy. E.I 2008) [13]. There are some abiotic factor which inhibits germination like light, moisture and temperature. Apart from this slow hormonal synthesis also affect germination and maintain seed dormancy for longer time. Data were collected from all three replications and was calculated (table 1). From collected data it is cleared that seeds primed by hormonal priming method showed maximum germination percent, followed by hydro priming and least germination was observed in control of both the slots. Possible reason of high germination percent in $GA_3$ treatment was as gibberellic acid helps seed to overcome its dormancy (Bewley, 1997) [4]. Kucera *et al.* (1997) [17] Reported that use of $GA_3$ of affects the seeds in two different ways, first it increase the growth proteins of embryo and second it induces hydrolytic enzyme.

**Table 1:** Standard germination

| Treatment | Fresh seed | Aged seed |
|---|---|---|
| $T_0$ | 69.3e ± 2.7 | 61.0e ± 0.57 |
| $T_1$ | 80.0abcde ± 2.08 | 73.6cde ± 0.88 |
| $T_2$ | 81.3Babcd ± 1.4 | 75.0Acd ± 1.52 |
| $T_3$ | 70.6de ± 1.7 | 66.6de ± 0.66 |
| $T_4$ | 72.3cde ± 0.88 | 68.0de ± 1.00 |
| $T_5$ | 70.0de±2.08 | 68.0de ± 1.00 |
| $T_6$ | 74.0bcde ± 2.08 | 70.3de ± 1.76 |
| $T_7$ | 84.0ab ± 2.64 | 79.3cd ± 0.88 |
| $T_8$ | 86.0a ± 1.52 | 83.6c ± 5.17 |
| $T_9$ | 83.0abc ± 1.52 | 77.0cd ± 0.57 |
| $T_{10}$ | 83.abc ± 1.15 | 78.0cd ± 1.52 |

The mean followed by different letters are significantly different at $p< 0.01$ according to tukey LSD for separation of mean.

### Length and weight of seedling.

Seedling length and weight were collected and it was observed that hormonal priming with $GA_3$ @ 150 ppm for 24 hours has showed maximum seedling length and dry mass fallowed by hydro priming (table 2). This may be possible due to seeds embryo damage control and enhance the rate of metabolism of seeds. As $GA_3$ act as a growth regulator for cereals crops (Rahemi, 1999) [23]. Swain *et al.* (1996) [23] Repoted that several researches have been conducted and it is proven that use of $GA_3$ impaired with biosynthesis as well as phenotypic characterization in cell elongation of plant.

**Table 2:** Length of seedling and dry weight

| Treatment | Length of seedling (cm) | | Weight of seedling (mg) | |
|---|---|---|---|---|
| | Fresh seed | aged seed | Fresh seed | Aged seed |
| $T_0$ | 8.85f ± 0.01 | 7.84c ± 0.07 | 137.3a ± 10.58 | 122d ± 3.46 |
| $T_1$ | 9.3d ± 0.02 | 8.25abc ± 0.05 | 159.3ab ± 4.09 | 142.6abc ± 4.84 |
| $T_2$ | 9.39 d ± 0.01 | 8.48abc ± 0.01 | 160ab ± 4.04 | 143.6abc ± 1.76 |
| $T_3$ | 9.03e ± 0.02 | 8.01bc ± 0.01 | 147.0ab ± 2.30 | 130.3de ± 4.80 |
| $T_4$ | 9.12 ± 0.01 | 8.06bc ± 0.02 | 155.3ab ± 1.33 | 138.6abcd± 4.17 |
| $T_5$ | 9.04e ± 0.01 | 8.04bc ± 0.01 | 148.6ab ± 3.71 | 132.0cd ± 4.00 |
| $T_6$ | 9.08e ± 0.05 | 8.06de ± 0.01 | 152.6ab ± 3.92 | 133.3bcd ± 1.66 |
| $T_7$ | 9.66bc ± 0.02 | 8.61ab ± 0.03 | 164.3ab ± 5.17 | 147.3abc ± 1.76 |
| $T_8$ | 9.94a ± 0.01 | 8.89a ± 0.01 | 172.6a ± 2.66 | 156a ± 3.21 |
| $T_9$ | 9.59c ± 0.01 | 8.58abc ± 0.10 | 162.3ab ± 8.08 | 147abc ± 2.00 |
| $T_{10}$ | 9.740b ± 0.01 | 8.89a ± 0.01 | 167.3ab ± 2.90 | 150.3ab ± 1.20 |

The mean followed by different letters are significantly different at $p< 0.01$ according to tukey LSD for separation of mean.

### Seedling vigor Index I & II

As from above parameters like germination per cent seedling length and seedling dry weight it is clear that use of $GA_3$ is useful physiological and metabolic activities of seedlings. In present study also $GA_3$ showed better results in compare to other priming methods. These results indicate that physiological and biochemical changes due to increase in physiological activities of the embryo and stored food mobility reserves into the growing seedling (Katsumi *et al.*, 1983) [16]. This ultimately led to development of strong root and shoot system and effectively reduce physiological deterioration. These changes have resulted in repair of protein, membranes and enzymes during germination and imbibition.

**Table 3:** Seed vigour Index I & II

| Treatment | Vigour Index 1 | | Vigour Index II | |
|---|---|---|---|---|
| | Fresh seed | Aged seed | Fresh seed | Aged seed |
| $T_0$ | 613.5e ± 23.31 | 478.2e ± 4.50 | 9577.33d ± 107.66 | 7440f ± 120.00 |
| $T_1$ | 744.03bcd±20.99 | 608.06bcde±10.58 | 12762.33abcd± 644.85 | 10518bcde ± 475.33 |
| $T_2$ | 763.7abc ± 13.77 | 636.26abcd ± 18.58 | 13001.66abc ± 100.61 | 10769.66bcd± 92.88 |
| $T_3$ | 638.12de ± 16.09 | 534.2de ± 4.95 | 10390.66bcd ± 344.98 | 8693.33ef± 386.26 |
| $T_4$ | 659.63cde ± 7.52 | 548.46cde ± 16.63 | 11238bcd ± 231.91 | 9441cdef ± 527.83 |
| $T_5$ | 632.66e ± 19.45 | 547cde ± 10.01 | 10392.66cd ± 134.28 | 8968def ± 144.00 |
| $T_6$ | 671.9cde ± 19.16 | 564.83bcde ± 11.96 | 11297bcd ± 434.55 | 9376.66cdef± 245.05 |
| $T_7$ | 811.33ab ± 24.66 | 683.81ab ± 32.43 | 13810.66ab ± 693.21 | 11688ab ± 176.77 |
| $T_8$ | 854.83a ± 16.30 | 744.43a ± 46.47 | 14854.66a ± 449.76 | 13020.33a ± 541.68 |
| $T_9$ | 769.23ab ± 15.70 | 660.83abcd ± 4.62 | 13471.66abc ± 685.19 | 11317abc ± 89.84 |
| $T_{10}$ | 806.47ab ± 12.45 | 675.66abc ± 11.80 | 13884.66ab ± 211.7 | 11729.66ab ± 321.81 |

The mean followed by different letters are significantly different at p< 0.01 according to tukey LSD for separation of mean.

**Germination speed**

**Seedling length on 4th, 7th and 10th**

There are few disadvantages of performing germination test through germinating paper method. Biggest one is that we can't collect data at different stages. So to interoperate data at Different stages we have to perform experiment in open petri dish. So that length of seedling could be measured at different stages. Significant different was observed in length of seedling in both slots affected by different Treatments. Reason for higher average height in fresh seedling in comparison to average height then aged seeds is discoursed earlier days of germination (Chadha, 2001). Only few aged seed mostly which are treated with $GA_3$ (hormonal priming) showed response towards dormancy yet their response is much slow in comparision to fresh seeds. Those seed which are germinated in aged slot were still in their inertial stages because their height was below 1 cm. On other hand in comparison with fresh seeds, much better response was reorded as most of the treated seed were germinated except control. Among fresh seeds, maximum height was recorded in T8 ($GA_3$ @ 150 ppm for 24 hours) i.e. 2.7 cm followed by T7 (2.7 cm). All the seeds primed with $GA_3$ showed better results as compare to other seeds. It was noticed that at 4th day most of the fresh seeds came out of dormancy (table 4). Seeds treated with hormonal priming ($GA_3$) showed better results in both the slot. Seedling showed good growth in 10th day and on an average most of the seeds reached a height of 3 cm which can be considered a good speed of development as at 4th day average height of most seedlings was below 0.4 cm and seeds showed almost 90% growth. Maximum growth was observed in hormonal priming in all the stages of growth in both slots.

**Table 4:** Seedling length (cm)

| | Seedling length (cm) | | | | | |
|---|---|---|---|---|---|---|
| | Fresh seed | | | Aged seed | | |
| Treatment | Fresh 4th day | Fresh 7th day | Aged 10th day | Fresh 4th day | Aged 7th day | Aged 10thday |
| $T_0$ | $0^{d}$ ± 0.0 | $2.6^{c}$ ± 0.2 | $4.8^{d}$ ± 0.3 | $0^{a}$ ± 0.0 | $1.8^{b}$ ± 0.1 | $3.8^{ab}$ ± 0.3 |
| $T_1$ | $1.6^{abc}$ ± 0.0 | $3.7^{abc}$ ± 0.1 | $8.2^{abc}$ ± 0.1 | $0.3^{a}$ ± 0.0 | $2.9^{ab}$ ± 0.3 | $7.2^{a}$ ± 0.1 |
| $T_2$ | $1.7^{abc}$ ± 0.2 | $3.8^{ab}$ ± 0.1 | $8.6^{abc}$ ± 0.1 | $0.3^{a}$ ± 0.0 | $3^{ab}$ ± 0.1 | $7.5^{a}$ ± 0.0 |
| $T_3$ | $1^{cd}$ ± 0.2 | $3.2^{bc}$ ± 0.1 | $7.6^{c}$ ± 0.1 | $0^{a}$ ± 0.0 | 2.2a ± 0.1 | $6.2^{a}$ ± 0.9 |
| $T_4$ | $1.3^{bcd}$ ± 0.3 | $3.3^{abc}$ ± 0.1 | $7.7^{a}$ ± 0.1 | $0^{a}$ ± 0.0 | $2.8^{ab}$ ± 0.1 | $6.6^{a}$ ± 0.0 |
| $T_5$ | $1.1^{cd}$ ± 0.3 | $3.2^{bc}$ ± 0.2 | $7.7^{c}$ ± 0.0 | $0^{a}$ ± 0.0 | $2.7^{ab}$ ± 0.0 | $6.7^{a}$ ± 0.0 |
| $T_6$ | $1.3^{bc}$ ± 0.3 | $3.4^{abc}$ ± 0.0 | $7.8^{bc}$ ± 0.1 | $0^{a}$ ± 0.0 | $2.6^{ab}$ ± 0.2 | $6.8^{a}$ ± 0.2 |
| $T_7$ | $2.7^{a}$ ± 0.0 | $4.2^{ab}$ ± 0.1 | $9.2^{a}$ ± 0.1 | $0.8^{a}$ ± 0.4 | $3.2^{a}$ ± 0.1 | $7.8^{a}$ ± 0.2 |
| $T_8$ | $2.8^{ab}$ ± 0.0 | $4.3^{a}$ ± 0.1 | $9.3^{a}$ ± 0.1 | $0.8^{a}$ ± 0.1 | $3.3^{a}$ ± 0.1 | $8.1^{a}$ ± 0.1 |
| $T_9$ | $2.4^{ab}$ ± 0.3 | $4^{ab}$ ± 0.1 | $8.9^{ab}$ ± 0.2 | $0.4^{a}$ ± 0.0 | $3.1^{ab}$ ± 0.0 | $7.9^{a}$ ± 0.1 |
| T10 | $2.6^{ab}$ ± 0.1 | $4.2^{ab}$ ± 0.1 | $9^{a}$ ± 0.2 | $0.5^{a}$ ± 0.1 | $3.3^{ab}$ ± 0.1 | $8^{a}$ ± 0.0 |

The mean followed by different letters are significantly different at p< 0.01 according to tukey LSD for separation of mean.

**Seedling dry weight on 4th, 7th and 10th**

Significant difference in dry weight was measured between the fresh and aged seed slots and the difference significant variation among the treatments were observed due to difference in vigour index between fresh and aged seed (table 5). As it was discussed about possible results for the difference in seedling length earlier so mostly the possible results are also valid for the difference in seedling dry weight (Mohamedy *et al.*, 2008) [12]. Mean dry weight of seedling in fresh seed slot was calculated for 4th day (109.9 mg) in which highest dry weight was observed in T8, halo priming (120 mg) and lowest was observed in T0, control (96 mg). Meanwhile on aged seed slot average weight was calculated as 98 mg in which highest dry weight was observed in T8, halo priming (109.2 mg) and minimum was observed T0, control (85.4 mg). Mean dry weight at 7th day was calculated as 141.3 mg in which highest was observed in T8 (155.4 mg) and lowest in T0 control (109.8 mg). On 10th day, mean value for fresh and aged seed slot was 188 mg and 168.3 mg with highest and lowest observation continued by T8 and T0, respectively. It should be clear that it is not always justifiable that greater the length of seedling greater will be mass. As mass is directly associated with total bio-mass accumulation (Singh *et al.*, 2011) [24].

**Table 5:** Weight of dry seedling in (mg)

| | Fresh seed | | | Aged seed | | |
|---|---|---|---|---|---|---|
| **Treatments** | **4 day** | **7 day** | **10 day** | **4 day** | **7 day** | **10 day** |
| $T_0$ | $96^{b} \pm 7.5$ | $123.6^{b} \pm 9.6$ | $164.8^{b} \pm 12.8$ | $85.4^{e} \pm 1.4$ | $109.8^{e} \pm 1.8$ | $146.4^{e} \pm 1.4$ |
| $T_1$ | $111.5^{ab} \pm 2.8$ | $143.4^{ab} \pm 3.6$ | $191.2^{ab} \pm 4.9$ | $99.8^{abcd} \pm 3.3$ | $128.4^{abcd} \pm 4.3$ | $171.8^{abcd} \pm 4.4$ |
| $T_2$ | $112^{ab} \pm 2.8$ | $144^{ab} \pm 3.6$ | $192^{ab} \pm 4.8$ | $100.5^{abcd} \pm 1.2$ | $129.3^{abcd} \pm 1.5$ | $172.4^{abcd} \pm 4.5$ |
| $T_3$ | $102.9^{ab} \pm 1.6$ | $132.3^{ab} \pm 2.0$ | $176.4^{ab} \pm 2.7$ | $91.2^{de} \pm 3.3$ | $117^{de} \pm 4.3$ | $156.4^{de} \pm 5.7$ |
| $T_4$ | $108.7^{ab} \pm 0.9$ | $139.8^{ab} \pm 1.2$ | $186.4^{ab} \pm 1.6$ | $97^{bcd} \pm 2.9$ | $124.8^{bcd} \pm 3.7$ | $166.4^{bcd} \pm 5.0$ |
| $T_5$ | $104^{ab} \pm 2.5$ | $133.8^{ab} \pm 3.3$ | $178.4^{ab} \pm 4.4$ | $92.4^{bcd} \pm 2.8$ | $118.8^{de} \pm 3.6$ | $158.4^{de} \pm 4.8$ |
| $T_6$ | $106^{ab} \pm 2.7$ | $137.4^{ab} \pm 3.5$ | $183.2^{ab} \pm 4.7$ | $93.3^{cde} \pm 2.2$ | $120^{cde} \pm 1.5$ | $160^{cde} \pm 2.0$ |
| $T_7$ | $115^{a} \pm 3.6$ | $147.9^{a} \pm 4.6$ | $197.2^{a} \pm 6.2$ | $103.1^{abc} \pm 1.2$ | $132.6^{abc} \pm 1.5$ | $176.8^{abc} \pm 2.1$ |
| $T_8$ | $120^{a} \pm 1.8$ | $155.4^{a} \pm 2.4$ | $207.2^{a} \pm 3.2$ | $109.2^{a} \pm 2.2$ | $140.4^{a} \pm 2.8$ | $187.2^{a} \pm 3.8$ |
| $T_9$ | $113^{ab} \pm 5.6$ | $146.1^{ab} \pm 7.2$ | $194.8^{ab} \pm 9.7$ | $102.9^{abc} \pm 1.4$ | $132.3^{abc} \pm 1.8$ | $176.4^{abc} \pm 2.4$ |
| T10 | $117^{a} \pm 2.0$ | $150.6^{a} \pm 2.6$ | $200.8^{a} \pm 3.4$ | $105.2^{ab} \pm 0.8$ | $135^{ab} \pm 1.0$ | $180.4^{ab} \pm 1.4$ |

The mean followed by different letters are significantly different at $p< 0.0$according to tukey LSD for separation of mean

## Conclusion

From above research we can evaluate that all type of priming methods are useful in compare to unprimed seeds. Priming methods are especially useful against aged seed which start losing its metabolism. But use of $G.A_3$ at 150 ppm for 24 hrs. was most effective in all priming treatment followed by other $G.A_3$ treatment. Hydro priming methods was also useful and it is easy to use. It can be concluded that priming is very useful for better germination and to detain vigor of plant and it is easy to use.

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