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# ENHANCEMENT OF SEED QUALITY THROUGH HORMO-PRIMING IN OAT (*AVENA SATIVA* L.)

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## SUMMARY

Present study was carried out on two seed lots (Fresh and one year old) of two oat varieties *i.e.* OS 6 and HFO 611 in the Department of Seed Science and Technology, CCS HAU Hisar during 2022-23. The seed was hormo-primed with different concentrations of $GA_3$ (200, 400, 600, 800 and 1000 ppm). The results revealed that hormo-priming resulted in enhancement in seed quality parameters in both the lots of both varieties as the concentration increased from 200 ppm to 600 ppm and thereafter it starts decreasing. Maximum enhancement in germination was observed in seeds hormo-primed with $GA_3$ @ 600 ppm. The more enhancement in germination was observed in the hormo-primed seeds of old seed lot as compared to fresh seed lots in both the varieties. In variety OS 6, 1.4% enhancement in germination was recorded in hormo-primed seeds over control in fresh seed lot while enhancement was 16.96 % in hormo-primed seeds with $GA_3$@ 600 ppm over control in old seed lot. In variety HFO 611, enhancement in seed germination of hormo-primed seeds over control was 1.7 % in fresh seed lot and 16.26 % in old seed lot with same concentration. It is concluded from the study that hormo-priming with $GA_3$ @ 600 ppm is very effective in enhancing the seed quality parameters of oat, hence this hormo-priming practice should be used to enhance the germination/ vigour of marginal/old seeds lots.

**Key words:** Priming, hormo-priming, *Avena sativa,* seed quality

Oat (*Avena sativa* L.) belonging to the Poaceae family, is widely cultivated cereal fodder crop of winter season. With its high fiber content and numerous health benefits, oats are consumed in various forms such as rolled oats, oatmeal, and oat flour, making them a versatile ingredient in breakfast cereals, baked goods, and granola bars. Oats are also valued as animal feed and are frequently grown as a cover crop to enhance soil health. Their adaptability and nutritional value have made oats a staple crop across the globe. It ranks around sixth in world cereal production after wheat, maize, rice, barley and sorghum. The green plants have good roughage and used to make hay and silage. Green fodder contains about 10-12% protein and 30-35% dry matter whereas grain contains 66% Carbohydrate, 11% fiber. Green fodder is used to feed animals by mixing it with berseem or lucerne green fodder while grains are used as concentrate to fed ruminants such as horses, poultry, cattle, sheep and other animals. Major oat-producing nations, including Russia, Canada, the United States, Australia, and Poland, benefit from favorable climates and effective agricultural practices for oat cultivation. Despite the growing demand for oat grain among consumers, the cultivation area and production of oats have steadily decreased over the past few decades in the majority of countries (Stewart and McDougall, 2014, Achleitner *et al.,* 2008). The popularity of oat is continuously increasing because of its excellent and quick re-growth habit, yield potential and high nutritive value. India is home to 536 million livestock (Anonymous, 2020) facing a green fodder shortage of 11.3% (Roy *et al*., 2019). The shortage of fodder influences the economic viability of dairy sector. As a consequence, fodder crops occupy only 4% of the total cultivable area in the country. The choice for increasing area under fodder cultivation is very limited. Hence, there is an urgent need to increase fodder production which is possible through availability of quality seed of fodder crops. There is a wide gap between requirement and availability of forage seeds in the country. Fodder production in India is varies considerably across the country and its use mainly depends on cropping pattern, soils, climate and socio-economic condition and cattle type. Inadequate vigour and viability, often exacerbated by unfavorable environmental conditions, lead to insufficient crop establishment and ultimately result in reduced yield. Occasionally, when fresh seeds are unavailable, the necessity to resort to carryover/ revalidated seeds can further contribute to subpar yield outcomes. Several methods of seed priming are commonly used to improve germination rates which include hydro-priming (soaking seeds in water), halo-priming (soaking seeds in an inorganic salt solution), osmo-priming (soaking seeds in a solution with low water potential), solid matrix priming (treating seeds with solid materials possessing specific chemical and physical characteristics), thermo-priming (subjecting seeds to high or low temperatures), and biopriming (hydrating seeds using microorganisms or their biological compounds) (Ashraf and Foolad, 2005). These priming techniques can be influenced by factors such as the volume of the priming solution, duration of soaking, temperature, priming method, and drying of seeds. Controlling these factors is crucial to optimize the priming treatment and enhance its effectiveness. Furthermore, contemporary agricultural strategies aim to enhance crop yields per unit of land while minimizing pre and post-harvest losses attributed to detrimental abiotic stresses. Seed priming facilitates germination, even in challenging conditions, boosts crop performance, and increases the potential for higher yields (Ajouri *et al.,* 2004; Ibrahim, 2016; Marthandan *et al.,* 2020). Seed priming is a cost-effective and straightforward pre-sowing method utilized to enhance seed performance by modifying physiological processes and metabolic concentrations through the application of natural and synthetic compounds. Priming offers several advantages, such as quicker emergence, the ability for seeds to germinate and sprout in unfavorable agro-climatic conditions, enhanced uniformity for optimal harvesting efficiency, heightened vigour leading to rapid and robust plant development, and an overall increase in yield potential. The priming procedure involves managing temperature and seed moisture content, encompassing three distinct stages: seed imbibition, seed metabolism, and seed drying. Various seed priming methods have been identified, including hydro-priming, halo priming, osmo-priming, chemical priming, hormo-priming, and redox priming, all of which contribute to enhancing plants' resistance to cold conditions. The success of seed priming is influenced by factors such as the type of solute used, solution concentration, priming duration, temperature, presence or absence of light, priming methodology, aeration, and the initial condition of the seeds. Researchers have increasingly focused on pre-sowing techniques like seed priming due to their effectiveness in addressing issues such as slow and uneven germination, low seed vigour, poor crop stand, and exposure to biotic and abiotic stresses (Zulfiqar, 2021). Gibberellic acid ($GA_3$) is a plant hormone recognized for its ability to stimulate the cells of germinating seeds, inducing the production of mRNA molecules responsible for encoding hydrolytic enzymes. Gibberellic acid can promote the elongation of stems and roots, the expansion of leaves, the initiation of flowering, the aging of fruit, and the processes of seed germination or dormancy (Hedden and Sponsel, 2015). This process ultimately fosters and enhances seed germination. Keeping in view the above, the present study was planned to standardize the concentration of Gibberellic acid ($GA_3$) for hormo-priming in oat seeds.

## MATERIALS AND METHODS

Present study was carried out on two seed lots (Fresh and one-year old) of two oat varieties *i.e.* OS 6 and HFO 611 during 2021-23. The above seed was procured from Forage section of Department of Genetics and Plant Breeding and the study was conducted at laboratories of Department of Seed Science and Technology, CCS HAU, Hisar. For hormo-priming, seeds of both the lots of these varieties were placed on germination substratum moistened with solutions of different concentrations of $GA_3$ (200, 400, 600, 800 and 1000ppm). The hormo-primed seeds were evaluated for germination percent, seedling length, seedling dry weight and vigour indices just after drying back to original moisture content (10.2%). Germination test was conducted using 3 replications of hundred seeds from each variety and treatments as per International Seed Testing Association rules (ISTA, 2019). The seeds were placed between sufficient moistened germination papers and kept at 20°C in seed germinator and final count was taken on the $8^{th}$ day where only normal seedlings were considered for per cent germination. Ten normal seedlings were randomly selected from each replication of both lots of two varieties at the time of final count of germination test and average seedling length was measured in centimeters. These ten seedlings from each replication were then dried in a hot air oven for 48 hrs at 80°C and average seedling dry weight was calculated in milligrams. Seedling vigour indices were calculated according to the method given by Abdul-Baki and Anderson (1973):

TABLE 1
Effect of hormo-priming ($GA_3$) on germination (%) of oat seeds

| Treatments | OS 6 | | | HFO 611 | | |
|---|---|---|---|---|---|---|
| | Fresh lot (2022-23) | Old lot (2021-22) | Mean | Fresh lot (2022-23) | Old lot (2021-22) | Mean |
| Control | 97.33 | 57.00 | 77.17 | 97.33 | 55.33 | 76.33 |
| $GA_3$ @ 200 ppm | 98.00 | 58.00 | 78.00 | 98.67 | 58.33 | 78.50 |
| $GA_3$ @ 400 ppm | 98.00 | 59.00 | 78.50 | 98.67 | 59.33 | 79.00 |
| $GA_3$ @ 600 ppm | 98.67 | 66.67 | 82.67 | 99.00 | 64.33 | 81.67 |
| $GA_3$ @ 800 ppm | 98.00 | 63.00 | 80.50 | 98.00 | 63.00 | 80.50 |
| $GA_3$ @ 1000 ppm | 97.67 | 62.00 | 79.84 | 97.67 | 61.00 | 79.34 |
| C. D. (P=0.05) | T= 2.90, L=1.68, TxL=4.10 | | | T= 1.50, L=0.86, TxL=2.11 | | |
| S. Em± | T= 0.99, L=0.57, TxL=1.40 | | | T= 0.51, L=0.29, TxL=0.72 | | |

Vigour index-I = Germination (%) x Average seedling length (cm)

Vigour index-II = Germination (%) x Average seedling dry weight (g)

The experiment was conducted in randomized block design as per standard method suggested by Panse and Sukhatme (1985). The data was analyzed by using the online statistical tool (OPSTAT) developed by Sheoran (2010) and the means were compared at $p$=0.05.

## RESULTS AND DISCUSSION

The results of the study revealed that hormo-priming resulted in enhancement in seed quality parameters in both the lots of both varieties as the concentration increased from 200ppm to 600ppm and thereafter it starts decreasing. Maximum enhancement in germination was observed in seeds hormo-primed with $GA_3$ @ 600 ppm indicating the optimum concentration of $GA_3$ for hormo-priming. The more enhancement in germination was observed in the hormo-primed seeds of old seed lot as compared to fresh seed lots in both the varieties. In variety OS 6, 1.4% enhancement in germination was recorded in hormo-primed seeds with $GA_3$@ 600 ppm over control in fresh seed lot while enhancement was 16.96 % in hormo-primed seeds with $GA_3$@ 600 ppm over control in old seed lot. In variety HFO 611, enhancement in seed germination of hormo-primed seeds with $GA_3$@ 600 ppm over control was 1.7 % in fresh seed lot and 16.26 % in old seed lot. The fresh seed lot had already high germination with high vigour content which consequences in lower enhancement as compared to old seed lots where there were more possibilities of improvement. The improvement in seed quality parameters observed in hormo-primed seeds with $GA_3$ could be attributed to acceleration in the conversion of starch into sugars. This process is associated with increased amylase activity, resulting in greater energy availability that fosters expedited germination and heightened vigor (Afzal *et al.,* 2008). Verma *et al.* (2014) conducted study with various priming methods in oat seeds including hydro-priming, osmo-priming with $KNO_3$, hormone priming with $GA_3$, and vitamin priming with two different doses of Ascorbic acid and results indicated that $GA_3$@100ppm demonstrated superior results compared to the other treatments. The seed quality parameters were improved through hydropriming (Bhuker *et al.,* 2022) and halo-priming (Bhuker *et al.,* 2024) in oat. The probable mechanism is that $GA_3$ can break seed dormancy and stimulate

TABLE 2
Effect of hormo-priming ($GA_3$) on seedling length (cm) and seedling dry weight (mg) of oat

| Treatments (T) | Seedling Length (cm) | | | | | | Seedling Dry Weight (mg) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OS 6 | | | HFO 611 | | | OS 6 | | | HFO 611 | | |
| | Fresh lotx (2022-23) | Old lot (2021-22) | Mean | Fresh lotx (2022-23) | Old lot (2021-22) | Mean | Fresh lot (2022-23) | Old lot (2021-22) | Mean | Fresh lot (2022-23) | Old lot (2021-22) | Mean |
| Control | 35.77 | 14.77 | 25.27 | 33.93 | 14.10 | 24.02 | 0.120 | 0.088 | 0.104 | 0.107 | 0.083 | 0.095 |
| $GA_3$ @ 200 ppm | 36.07 | 15.43 | 25.75 | 34.20 | 15.63 | 24.92 | 0.123 | 0.093 | 0.108 | 0.106 | 0.089 | 0.098 |
| $GA_3$ @ 400 ppm | 36.10 | 16.30 | 26.20 | 34.40 | 15.90 | 25.15 | 0.127 | 0.094 | 0.111 | 0.109 | 0.091 | 0.100 |
| $GA_3$ @ 600 ppm | 43.67 | 21.93 | 32.80 | 40.60 | 22.27 | 31.44 | 0.129 | 0.105 | 0.117 | 0.111 | 0.104 | 0.108 |
| $GA_3$ @ 800 ppm | 41.47 | 21.40 | 31.44 | 38.60 | 20.87 | 29.74 | 0.124 | 0.099 | 0.112 | 0.095 | 0.093 | 0.094 |
| $GA_3$ @ 1000 ppm | 40.73 | 20.40 | 30.57 | 39.17 | 20.77 | 29.97 | 0.121 | 0.102 | 0.112 | 0.102 | 0.098 | 0.100 |
| C. D. (P=0.05) | T= 1.43, L=0.83, TxL=NS | | | T= 1.44, L=0.83, TxL=NS | | | T= 0.007, L=0.004, TxL=NS | | | T= 0.008, L=0.005, TxL=NS | | |
| S. Em± | T= 0.49, L=0.28, TxL=0.69 | | | T= 0.49, L=0.28, TxL=0.69 | | | T=0.002, L=0.001, TxL=0.003 | | | T= 0.003, L=0.002, TxL=0.004 | | |

TABLE 3
Effect of hormo-priming ($GA_3$) on Vigour Index-I and Vigour Index-II of oat

| Treatments | Vigour Index-I | | | | | | Vigour Index-II | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OS 6 | | | HFO 611 | | | OS 6 | | | HFO 611 | | |
| | Fresh lotx (2022-23) | Old lot (2021-22) | Mean | Fresh lotx (2022-23) | Old lot (2021-22) | Mean | Fresh lot (2022-23) | Old lot (2021-22) | Mean | Fresh lot (2022-23) | Old lot (2021-22) | Mean |
| Control | 3302 | 804 | 2053 | 3303 | 736 | 2020 | 10.39 | 4.73 | 7.56 | 10.38 | 4.59 | 7.49 |
| $GA_3$ @ 200 ppm | 3356 | 907 | 2132 | 3376 | 897 | 2137 | 10.40 | 5.38 | 7.89 | 10.46 | 5.21 | 7.84 |
| $GA_3$ @ 400 ppm | 3371 | 938 | 2155 | 3394 | 927 | 2161 | 10.65 | 5.81 | 8.23 | 10.72 | 5.40 | 8.06 |
| $GA_3$ @ 600 ppm | 4006 | 1485 | 2746 | 4019 | 1561 | 2790 | 10.96 | 6.94 | 8.95 | 10.99 | 6.68 | 8.84 |
| $GA_3$ @ 800 ppm | 3783 | 1315 | 2549 | 3783 | 1369 | 2576 | 9.89 | 5.74 | 7.82 | 9.34 | 5.84 | 7.59 |
| $GA_3$ @ 1000 ppm | 3825 | 1287 | 2556 | 3825 | 1344 | 2585 | 9.64 | 5.53 | 7.59 | 9.96 | 6.01 | 7.99 |
| C. D. (P=0.05) | T= 172.2, L=99.4, TxL=NS | | | T= 156.6, L=90.4, TxL=NS | | | T= 0.71, L=0.41, TxL=NS | | | T= 0.63, L=0.36, TxL=0.89 | | |
| S.Em± | T= 58.6, L=33.9, TxL=82.9 | | | T= 53.4, L=30.8, TxL=75.4 | | | T= 0.24, L=0.14, TxL=0.34 | | | T= 0.21, L=0.12, TxL=0.30 | | |

seed embryos, which in turn promotes plant metabolic reactions, repairs damaged cell integrity, and enhances seed viability. The improvement in seed germination and vigour parameters, attributed to $GA_3$ as observed in the current study, aligns with findings reported by numerous previous researchers in different cereal crops (Akman, 2009; Ghobadi *et al.,* 2012).

## CONCLUSION

It is concluded from the study that hormo-priming with $GA_3$ @ 600 ppm is very effective in enhancing the seed quality parameters of oat, hence this pre-sowing practice can be used to enhance the germination/vigour of marginal/old seeds lots.

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