ScienSage

Journal of Advanced Scientific Research

Available online through http://www.sciensage.info/jasr

ISSN
0976-9595
Research Article

# EFFECT OF PLANT GROWTH REGULATORS ON GERMINATION IN TWO ONION VARIETIES

**Lokhande A. A.*, Lokhande A. D., Gaikwad D.K.**

*K. B. P. Jr. College, Nerle Sangli (MS)*

**Corresponding author: alkalokhande6@gmail.com; aroonlokhande@gmail.com*

**ABSTRACT**

An attempt has been made to study the effect of Presowing soaking treatments with GA, SA, BA and CCC on seed germination, seedling growth and vigour index of onion variety Local white and N-53. The germination percentage of onion variety Local white and N-53 was decreased in response to GA, SA and CCC, while, it is increased in response to 6BA, Methionine and Cysteine pretreatments. The root length showed slight induction in response to GA, 6BA and Methionine pretreatments. The shoot growth was stimulated in response to these chemical growth regulators in Local white variety and N-53 variety. The seedling biomass was considerably increased in N-53 and Local white onion variety due to presowing soaking treatments of GA, methionine and cysteine, while, in response to SA, 6BA, CCC pretreatments seedling biomass was slightly decreased.

**Keywords:** Onion, GA, SA, 6BA, CCC, Methionine, Cysteine

## 1. INTRODUCTION

In the life cycle of any plant, successful seed germination is essential for development of crop stand. Germination is considered as an active growth that results in emergence of seedling due to breaking of seed coat [1]. Seed priming allows inducing some of the metabolic changes necessary for germination. Primed seeds usually displays increased germination rate, greater germination uniformity, showing greater total germination percentage [2]. Increased germination rate and uniformity have been attained due to metabolic repair during imbibition [3], a buildup of germination enhancing metabolites [4], osmotic adjustment [5] has been considered that one of the main merits of soaking treatment to increase germination and emergence rate [6]. Thus, presowing hydration treatments improve seed germination by delivering various metabolites.

Onion is a part of regular diet of common man. It is consumed in various forms. It is rich source of calcium, riboflavin, and carbohydrates. The fluctuation in the supply of onion results in the development of uncertain prices in the market. Hence, applications of growth regulators and its improvement for germination potential as well as storage life will definitely helpful to achieve these targets. Onion is mainly propagated through the nursery bed raised seedlings from seeds. It has short viability thus seeds can be stored for limited period due to seasonal variations and physical conditions. The Onion seeds shows poor germination with slow growth of seedling as well as it has short storage life hence attempt has been made to study the effects of presowing treatments and foliar applications of PGRS on germination and seeding growth of two onion verities i.e. Local white and Red N-53.

## 2. MATERIAL AND METHOD

N-53 is improved variety of onion recommended by Department of Agriculture Maharashtra State during 1990 and also released at the National level by All India Coordinated Vegetable Improvement Project in 1987. Local white variety (Phule safed variety) is released by Mahatma Krushi Vidyapith, Rahuri. Authentic and pure seeds of onion varieties Local white and N-53 were obtained from Krushi Seva Kendra of Maharashtra cooperative Agricultural Federation, Sangli.

The intact seeds were surface sterilized with 0.1% Mercuric chloride ($HgCl_2$) for 5 min and thoroughly washed with distilled water. There are six treatments of four replicates. The intact seeds were soaked in 100 ppm solutions of 6BA, GA, CCC, cysteine, SA and Methionone for 48 hours at room temperature. The ratio of seed weight to solution volume was 1:5(g /ml) [7] and seeds without any treatment served as control. These presoaked seeds were used for germination studies.

For the study of seed germination healthy seeds of the two onion varieties were sorted out and they were surface sterilized with 1% sodium hypochlorite solution and washed with distilled water. Twenty five seeds were put in each sterilized petridish for germination over Whatman filter paper no.1 and filter paper was moistened with 15 ml of distilled water (control) and various PGRs and these were kept under control conditions for germination. The emergence of radicle and plumule was considered as criterion for germination count. After every 24 h germination counts were taken upto 120 h stage. After 120 h average root length, average shoot length, fresh weight and dry weight of seedlings were recorded. Vigor index of the seedling was calculated according to the formula given [8].

**Vigor Index** (VI) =

Germination percentage × (Root length + Shoot Length)

Mobilization efficiency of reserve food material present in seeds during germination was calculated with the help of formula given [9] .

$$\text{Mobilization efficiency} = \frac{\text{Dry weight of embryonic axis}}{\text{Dry weight of residual grain}} \times 100$$

Weight of embryonic axis=

Total dry weight of the seedlings – Residual weight

$$\text{Emergence Index} = \frac{N1}{dnt}$$

Where,

N1 =number of seeds germinated after 120 h

dnt= number of days from the day of sowing (5 days)

## 3. RESULTS AND DISCUSSION

Effect of Presowing soaking treatments with GA, SA, BA and CCC on seed germination of onion variety Local white and N-53 is shown in Table 1. It is observed from table that the germination percentage of onion variety Local white and N-53 is decreased in response to GA, SA and CCC, while, germination percentage is increased in response to 6BA, Methionine and Cysteine pretreatments. Further, it is also evident from table that overall germination percentage in onion is up to 25% and this decrease in germination percentage in response to GA is more significant in Local white, while, it is unaltered in N-53 onion variety. The seeds presoaked with Methionine and Cysteine exhibits significant stimulation in the seed germination and this stimulation is more pronounced in N-53 onion variety than Local white.

Seed priming has been a common seed treatment to reduce the time between seed sowing and seedling emergence and the synchronization of emergence [10]. Seed priming allows some of the metabolic processes necessary for germination to occur without actual germination. Primed seeds usually exhibit increased germination rate, greater germination uniformity and some times greater total germination percentage [2]. Priming is the enhancement of physiological and biochemical events in seeds during suspension of germination by low osmotic potential and negligible matric potential of the imbibing medium [11].

Increased germination rate and uniformity have been attributed to metabolic repair during imbibitions[3] a buildup of germination enhancing metabolites [4], osmotic adjustment and for seeds that are not re-dried after treatment, a simple reduction in the lag time of imbibitions [5]. It has been postulated that seeds of the same or different species may contain different levels of GAs [12] CKs [13], BRs [14] and ABA [15] leading to various depths of dormancy, from no apparent dormancy to absolute dormancy. The seeds therefore should not be expected to give the same response to application of any growth regulator [16]. Cytokinins (CKs) and Gibbrellins ($GA_3$) are found in actively dividing tissues of seeds, they are important to breaking dormancy after seeds imbibitions and allowing germination and growth of dormant embryos [17, 18]. GAs promotes synthesis of enzymes that converts stored nutrients as starch to sugars needed for rapid cell respiration during germination. It has been shown that the actions of $GA_3$, ABA and CKs on lettuce *Lactuca sativa* seed germination are mediated, directly or indirectly through modulation of protein synthesis [19]. SA treatments maintain the IAA and Cytokinin levels in the plant tissues which enhanced the cell division [20]. According to [21], GA stimulates seed germination in *Swertia chirayita* as GA is known to affect physiological as well as metabolic activities of seeds resulting in early seed germination. The promoting effect of growth regulators and presowing chemicals on germination may be attributed to their indirect effect through change in membrane permeability [22, 23] concluded that gibberellins induces the production of hydrolytic enzymes responsible for endosperm degradation and causes faster germination. In the present investigation the induction of seed germination in response to 6BA, Methionine and Cysteine may be due to changes in the physiological as well as metabolic activities of seeds or due to induction of hydrolytic enzymes responsible for endosperm degradation as indicated by [24, 21, 23].

### Seedling growth and vigour index

Effect of seed priming with various PGRs treatments on seedling growth and seedling vigour is shown in Table 1. It is clear from table 1 that the root length is considerably altered due to growth regulators and chemical treatments and showed slight induction in response to GA, 6BA and Methionine pretreatments. The shoot growth is stimulated in response to these chemical growth regulators in Local white variety and N-53 variety.

Effect of PGRs on seedling vigour of onion variety is shown in Table 1. It is noticed that the vigour index is increased in response to Methionine, 6BA, Cysteine and SA in N-53 while it is decreased in response to GA, CCC on the other hand in Local white variety a slight increase in vigour index in response to these growth regulators is evident and decrease in response to GA treatment is observed. The vigour index in heat and chilling treated seeds shows elevation in seedling vigour of Local white variety.

The potential field performance and the field planting value of seed is indicated by it's vigour. The establishment of crop depends on the potential of the germinating seeds to continue to grow and survive. Speed of germination varies from variety to variety. The germination of seed in higher plant requires a number of successive steps which causes quiescent seed with a lower water content to show a rise in its general metabolic activity and to initiate the formation of seedling from embryo. In many seeds shoot is a part of embryo which protrudes and in some seeds it is a radicle. Bewley [25] speculated that when

water is imbibed by viable seeds, various metabolic activities like respiration, protein synthesis start and after certain time period, the cell division and enlargement of cell [26] results in emergence of radicle from seed. Bewley [27] stated that after completion of germination the mobilization of storage reserves takes place as post germination events to support seedling growth. They defined seedling vigour as the sum total of all seed characteristics, which indicates the capacity of metabolic activity and performance of the seed during germination and seedling emergence, and also considered as an important factor because it is an indicator of seedling establishment. The weak seedlings are produced by the seeds with low seedling vigour hence such seedlings are susceptible to various biotic and abiotic stresses. On the other hand seedling with higher vigour are able to produce early and uniform crop stand with vigorously growing seedlings tolerating various biotic and abiotic stresses.

*Table 1. Effect of presowing soaking treatments of GA, SA, 6BA, CCC, methionine and cysteine on germination percentage, vigour index, emergence index and mobilization efficiency of Allium cepa varieties Local white and N-53.*

| Treatments | Germination % | | | | | | Shoot length (cm) | Root length (cm) | Vigour index | Emergence index | Mobilization efficiency |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Onion var. | 24 h | 48 h | 72 h | 96 h | 120 h | | | | | |
| Control | W | 8±1.15 | 12±1.53 | 16±1.53 | 20±1.53 | 20±2.52 | 2.03±0.34 | 0.75±0.07 | 55.60 | 1.0 | 12.00 |
| | R | 12±0.58 | 12±3.06 | 16±2.08 | 20±3.06 | 24±3.61 | 2.16±0.02 | 0.61±0.04 | 66.48 | 1.2 | 12.50 |
| GA 100 ppm | W | 8±2.00 | 8±0.00 | 8±2.08 | 8±0.58 | 8±0.58 | 3.00±0.58 | 1.25±0.03 | 34.00 | 0.4 | 10.00 |
| | R | 0±1.53 | 12±3.06 | 12±2.08 | 20±3.06 | 24±4.04 | 1.00±0.01 | 0.30±0.02 | 31.20 | 1.2 | 20.00 |
| SA 100 ppm | W | 8±1.15 | 12±1.53 | 24±1.15 | 24±2.00 | 24±2.65 | 2.80±0.20 | 0.81±0.04 | 86.24 | 1.2 | 15.00 |
| | R | 4±0.58 | 8±3.46 | 12±2.31 | 12±2.89 | 16±1.15 | 4.30±0.10 | 0.75±0.03 | 80.80 | 0.8 | 20.00 |
| BA 100 ppm | W | 8±1.15 | 12±1.00 | 16±0.58 | 20±1.00 | 20±1.53 | 2.40±0.08 | 0.90±0.05 | 66.00 | 1.0 | 14.00 |
| | R | 4±0.58 | 20±1.15 | 20±1.53 | 20±1.53 | 24±2.08 | 3.62±1.71 | 0.90±0.01 | 108.48 | 1.2 | 12.50 |
| CCC 100 ppm | W | 8±1.15 | 12±1.15 | 16±1.53 | 16±1.00 | 20±0.58 | 3.42±0.02 | 0.67±0.01 | 81.80 | 1.0 | 18.33 |
| | R | 4±1.15 | 12±1.53 | 16±1.00 | 16±0.58 | 20±1.15 | 1.20±0.02 | 0.75±0.01 | 39.00 | 1.0 | 17.14 |
| Methionine 100 ppm | W | 16±2.00 | 24±0.58 | 28±0.58 | 32±1.00 | 32±1.15 | 2.59±0.02 | 1.77±0.02 | 139.52 | 1.6 | 21.66 |
| | R | 28±1.15 | 36±1.53 | 40±1.53 | 48±1.15 | 56±1.00 | 3.60±0.01 | 2.80±0.03 | 358.40 | 2.8 | 12.50 |
| Cysteine 100 ppm | W | 12±1.15 | 16±1.53 | 20±1.53 | 24±0.58 | 24±1.15 | 1.88±0.41 | 0.91±0.02 | 66.96 | 1.2 | 13.33 |
| | R | 16±0.58 | 20±1.9 | 28±1.00 | 32±1.53 | 40±1.15 | 3.00±0.00 | 2.00±0.58 | 200.00 | 2.0 | 13.00 |

There are several reports which show increase in vigour index due to PGRs and other chemicals. Pre-sowing treatments with PGRs have generally been applied to enhance seedling vigour [28-30] in various crop plants. Kabar [31] noticed stimulative effect of GA on seedling growth in *Hordeum vulgare, Triticum aestivum* and *Avena sativa*. Pre-sowing treatments of green gram and black gram seeds with GA and NAA showed the best results on seedling growth [32]. There are several reports that show increase in shoot length by application of GA [33, 34]. Seedling vigour of scarified dormant wild rice seeds was increased by treating them with GA and BA [35, 36] found that priming seeds of parsley with GA enhances the length of hypocotyls when they were sown in a peat like medium. Afzal [37] studied effect of seed soaking with growth regulators on wheat under saline condition. Their study revealed that seed soaking with GA significantly enhances root-shoot ratio. Seed soaking with GA (20 ppm) improves seedling height and growth in case of corn [38]. Akman [39] studied effect of GA and kinetin presowing treatments on germination and seedling growth in wheat, and he noticed that GA stimulates root length and shoot length. Gibberellic acid was observed more beneficial to the regulation of radicle and plumule elongation [40]. According to Yasmeen [41], GA (250 and 300 ppm) showed best results in respect to shoot vigour, root vigour and vigour index in *Gardenia turgida* Roxb. Hormonal effect on germination and seedling development of *Hura crepitans* seeds showed higher vigour indices with GA and thiourea [42]. Parameshwari [43] found that GA enhances seedling vigour parameters such as root length and shoot length. According to Zare [44] scarification with sulfuric acid, sandy paper and combination treatments of sandy paper and gibberellic acid at 250 and 500 mg /l showed highest seed vigour in species *Prosopis koelziana* and *Prosipis juliflora*.

As the seedling vigour is very good indicator of the potential field performance as well as seedling establishment while low seedling vigour produces weak seedlings which become susceptible to environmental stressed as indicated [27]. In case of onion variety Local white and N-53 seedling vigour may results in the production of healthy vigourous seedlings which will helps to produce early synchronized growth with uniform crop stand and may tolerate the various environmental stresses. Thus, the seeds treated with growth regulators may improve the field planting value of onion seeds which will prove beneficial for regeneration of this economically important plant.

## Seedling biomass

The effect of presowing soaking treatments of 6BA, GA, CCC, SA, cysteine and methionine on seedling biomass is shown in Table 1. The seedling biomass is considerably increased in N-53 and Local white onion variety due to presowing soaking treatment

in GA, methionine and cysteine, while, in response to SA, 6BA, and CCC pretreatments seedling biomass is slightly decreased.

Increase in dry weight of seedlings over a period of time is indicator of overall growth of seedlings. The total biomass production gives an idea about the carbon budget and productive ability of seedling during development [45]. Rashad [46] noticed that pre-sowing soaking with GA and heat treatments enhanced fresh and dry weight of shoot and shoot/root ratio of *Foenicalum vulgare*. Chauhan [47] noticed that fresh weight and dry weight of shoots increases with GA treatments in *Phaseolus mungo*. SA pretreatment increased dry weight in the barley seedlings [48], wheat seedlings [49], cucumber seedlings [50, 51]. In the present study increased biomass in terms of dry matter was evident in response to GA, methionine and cystiene pretreatments. This will improve the carbon budget and productive ability of seedling leading to development of healthy seedlings.

## 4. CONCLUSION

In the present investigation the induction of seed germination in response to 6BA, methionine and cysteine may be due to changes in physiological as well as metabolic activities of seeds. The higher seedlings vigour index due to these pretreatments results in the production of healthy seedlings of onion varieties.

## 5. ACKNOWLEDGEMENTS

Authors are very much thankful to Prof Dr. P. D. Chavan, Prof. S. S. Kamble, Prof. S. R. Yadav, Prof. D. K. Gaikwad, Head Botany Department, Shivaji University, Kolhapur for their kind help and support.

## 6. REFERENCES

1. Amen R. *Ame. Sci*, 1963; **51**:408-424.
2. Basra SMA, Farooq M, Hafeez K, Ahmad N. *Annals of Botany,* 2004; **63**: 185-193.
3. Bray CM, Davison PA, Ashraf M, Taylor RM. *Annals of Botany,* 1989; **63**:185-193.
4. Basra SMA, Farooq M, Hafeez K, Ahmad N. *Seed Sci. and Technol.*, 2005; **33**:623-628.
5. Bradford KJ. *Hort. Sci.*, 1986; **21**:1105-1112.
6. Heydecker W, Coolbear P. *Seed Sci. Technol.*, 1977; **5**:353-375.
7. Salim KM, Todd Gleen W. *Agron.*, 1968; **60**:179-182.
8. Abdul-Baki AA, Anderson JD. *Crop Sci.,* 1973; **13**:630-633.
9. Srivastava AK, Sareen K. *Seed Research,* 1974; **2**:26-32.
10. Parera CA, Cantliffe DJ. *Horticultural Reviews*. 1994; **16**:109-141.
11. Afzal I, Basra SMA, Ahmad N, Cheema MA, Warraich EA, Khaliq A. *Int.J.Agric. Biol.,* 2002; **4**:303-306.
12. Taylor JS, Wareing PF. *Plant Cell Environment,* 1979; **2**:165-172.
13. Khan AA. *Science,* 1971; **17**: 853-859.
14. Schmidt J, Altmann T, Adam G. *Phytochemistry,* 1997; **45**(7):1325-1327.
15. Bozcuk S, Topçuoğlu ŞF. *Doğa Bilim Dergisi. Seri*, 1984; A2, 8:262-272.
16. Cavusoglu K, Kabar K. *Eur Asia J Bio Sci.,* 2007; **1(1):**1-10.
17. Sondheimer E, Galson EC. *Plant Physiol.*, 1966; **14**:1397-1398.
18. Siobhan MB, McCourt P. *J Plant Growth Regul.,* 2003; **22**:25-31.
19. Fountain DW, Bewley JD. *Plant physiol*. 1976; **58**:530-536.
20. Sakhabutdinova A, Fatkutdinova DR, Bezrukova MV, Shakirova FM. *Bulg. Special Issue, J. Plant. Physiol.,* 2003; **21**:314-319.
21. Chuanren D, Bochu W, Wanqian L, Jing C, Jie L, Huan Z. *Colloids surface B: Biointerfaces,* 2004; **37**:101-105.
22. Shivanna H, Balachandra HC, Suresha NL. *Karnataka J. Agric. Sci.,* 2007; **20**(2):328-329.
23. Andreoli C, Khan AA. *Pesquisa Agropecuária Brasileira,* 1999; **34(10)**:1953-1958.
24. Tipirdamaz R, Ve-Gomurgen AN. *Turk. J. Bot.*, 2000; **24**:143-145.
25. Bewley JD, Black M. Physiology and biochemistry of seeds in relation to germination. In: J. D. Bewley and M. Black Editors, development, germination and growth. Vol. I. Springer, New York. 1978.
26. Mayer AM, Polijakoff-Mayber A. The germination of seeds. Pergamon Press, N. Y. 2nd ed. 192, 1975.
27. Bewley JD, Hampel FD, Mac Cormick S, Zambryki P. Reproductive development. In: *Biochemistry and Molecular Biology of Plants* (eds.) Buchnan B.; Gruissem, W. and Jones R. American Society of Plant Physiologists, 2000; pp988-1043.
28. Kattimani KN, Reddy YN, Rao RB. *Science and technology*, 1999; **27**: 483-488.
29. Patel VS, Kukadia MU. *J. Tree Sci.*, 1997; **16**:62-64.
30. Leite VM, Rosolem CA, Rodrigues JD. *Sci. Agric.*, 2003; **60:**537-541.
31. Kabar K. *Phyton, (Horn, Aus*tria), 1990; **30**(2):291-298.
32. Patel I, Saxena OP. *Indian Journal of Plant Physiology*, 1994; **37**(3):206-208.
33. Verma AN, Tanoon P. *Indian Journal of Forestry*, 1988; **11**:32-36.
34. Kabar K. *Tr. J. Bot.*, 1997; **21**:203-210.
35. OelkeE A, Albrecht KA. *Crop Sci.*, 1979; **20**(5):595-588.
36. Pill WG, Kilian EA. *Hort Science.,* 2000; **35**(5):907-909.
37. Afzal I, Basra SMA, Iqbal A. *Journal of Stress Physiology and Biochemistry*, 2005; **1(1)**:6-14.
38. Subedi KD, Ma BL. *Agron. J.* 2005; **97**:211-218.
39. Akman Z. J. *Anim. Vet. Adv.,* 2009; **8**:362-367.
40. Chakrabarti N, Mukherji S. *Biol. Plant.,* 2003; **46**:63-66.
41. Yasmeen A, Rao G, Bhat AV, Bikshapathi T. *BMBER,* 2005; **26(1-2):**10-20.
42. Idu M, Omonhinmin CA, Onyibe HI. A*sian J. Plant Sci.*, 2007; **6**:696-699.
43. Parameswari K, Srimathi P. *Legume Research*, 2008; **31**(4).
44. Zare S, Tavili A, Darini MJ. *Journal of Forestry Research,* 2011; **22(1):**35-38.
45. Gaikwad DK. Physiological studies in grain Amaranth, A Ph.D. Thesis submitted to Shivaji University Kolhapur (India), 1995.
46. Rashad EM, El-Sayed M, El-Soud A. *Medicinal and Aromatic Plant Science and Biotechnology*, 2009; **3**(1):14-20.
47. Chauhan JS, Tomar YK, Bandoni A, Singh NI, Ali S, Debarati AS et al. *Journal of American Science,* 2010; **1:**34-41.
48. El-Tayeb MA. *Plant Growth Regulation,* 2005; **45**:215-224.
49. Kaydan D, Yagmur M, Okut N. *Tarim Bilimleri Dergisi,* 2007; **13 (2):**114-119.
50. Yildirim E, Turan M, Guvenc I. *Journal of Plant Nutrition*, 2008; **31**:593-612.
51. Singh PK, Chaturvedi VK, Bose B. *J of Stress Physiol and Biochem.*, 2010; **6(3):**102-113.