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Effect of hydropriming and biopriming on seed germination of Brinjal and Tomato seed

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Abstract

In the life cycle of plant- seed germination and seedling growth are critical stages, especially under conflicting abiotic stress. Seed germination negatively affected by stress condition, the seed priming techniques have been used to improve germination in many field crops under stressed conditions. An experiment was conducted in order to evaluate the effect of red seaweed extract of Gracilaria corticata J Ag., Kappaphycus alvarezii and mixture of both as a biopriming agents, that alters the responses of vegetables seeds germination under water stress. In hydropriming treatment seeds were treated with water, in biopriming treatment different dosages of red seaweed extracts were used and untreated seed used as a control. The present paper indicates the seed parameters such as germination percentage, germination index, mean germination time, seedling length, radical length, plumule length, seedling vigour index and seed stamina index are found to be positive effect by priming treatment and biopriming treatment was better than hydropriming treatment as compare to control.

Keywords: Hydropriming, Biopriming, *Gracilaria corticata J Ag., Kappaphycus alvarezii*, Brinjal and Tomato seed, % Germination.

Introduction

Germination is considered as a critical stage in the development of plant cycle and several factors of the environmental such as salinity can affect it. The negatively effect on seed germination under stress conditions reported in many crops[1,2]. Priming is a pre-sowing, seed priming technique is a physiological method based in a controlled hydration treatment to absorb water before radical swelling[3,4] and improve plant growth under stressed conditions[5]. Different priming treatment such as hydropriming- seeds were soaked in water, halopriming refers to seeds soaked in inorganic salts (i.e. NaCl. $CaCl_2$, KNO_3 etc.) and osmaticpriming- in this process to use of osmotic solutions with a low water potential to control water uptake (eg. polyethylene glycol). Many researchers have concluded that the consistency of seed germination by priming technique and the final germination percentage of seeds compared with control[6-10]. Priming technique enhances seed performance under normal as well as saline conditions and it is considered as feasiable and very cheap[11]. Seed priming techniques have been used to increase seed reverse utilization, seed reverse depletion percentage and seedling dry weight in mountain rye[12] and wheat[13]. Many reports showed that the resultant effect of priming depends on duration of seed soaking[14,15], hormonal priming of pigeon pea under Cd stress[16], hydropriming on Bambara groundnut[17]. Seed priming has been proved to advance germination for many plant species in agriculture[18-22]. Priming is a valuable technique for the improvement of seedling of tomato seedling production[23]. The osmopriming treatment showed notably improved the germination of 'Wolska' onion seed lot[24].

During this priming study evaluated the effect on the germination process to induce by soaking seeds in water and in bio-material of seaweeds extract different like 1%, 2%, 3%, 4% & 5% concentration percentage germination (laboratory under natural condition) of two vegetables of brinjal and tomato seeds as a hydropriming and biopriming treatment respectively and un-treated seed used as a control. Primed seeds to show better germination and growth even when inflict to stressful conditions.

Materials and methods

This study was conducted in a laboratory of Biology department, V.P. & R.P.T.P. Science College, Sardar Patel University, India in 2016. The seed of vegetables of brinjal and tomato were collected from Vegetable Scientific research center, Anand Agriculture University, Anand, Gujarat. The treatments included 2 levels of seed priming hydropriming (water), biopriming (*Gracillaria corticata* J Ag*., Kappaphycus alverazii* and mixture of both extract) and control (un-treated).

Preparation of seaweed extract: Red Seaweeds of *Gracillaria corticata* J Ag*., Kappaphycus alverazii* were collected from Okha, Gujarat. First of seaweeds were washed with sea water to remove all epiphytes and sand particles and again washed with

tap water to remove salinity. Seaweed was sun dried and powdered. Each seaweed extract was boiled in water in precaution of 1:20 (w/v) for one hour. After boiling, mixture was filtered with muslin cloth[25]. The prepared liquid was standard solution. Seaweeds extract of different dosages of 1%, 2%, 3%, 4% & 5% were prepared.

Figure-1: Seeds of Brinjal.

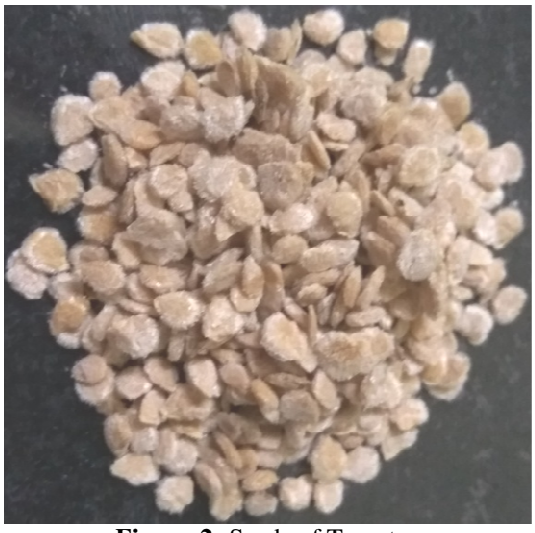

Figure-2: Seeds of Tomato.

The Seeds were thoroughly sterilized with 0.1% $HgCl_2$ for 2-5 minutes and several times washed with water before use in experiment. The 50 of sterilized seeds were immersed in water and extract of *Gracillaria corticata* J Ag.*, Kappaphycus alvarezii* and its mixtures of different concentration for 48 hours at room temperature. Thereafter the seeds from each solution were removed and dried on filter paper for one minute and left their moisture content reached to the original weight[26]. After priming seeds treatment, soaked seeds were transferred on tissue paper and tissue paper fold two times and put into zip locked bag carefully. The experiment was run up to 12 days at room temperature and measured percentage germination[27] formula:

$$\text{Germination percentage (GP)} = \frac{n}{N} \times 100 \quad (1)$$

Whereas, n= number of seeds that were germinated, N: total number of seed in each experiment.

The germination Index (GI) was calculated by formula was[28]:

$$GI = \frac{\text{No.of germinated seed}}{\text{Days of first count}} + \cdots + \frac{\text{No.of germinated seed}}{\text{Days of final count}} \quad (2)$$

Mean germination time (MGT) was calculated by formula was[29]:

$$MGT = \frac{\Sigma Dn}{\Sigma n} \quad (3)$$

Where as, n= number of seeds that were germinated on day D, D= number of days counted from beginning of germination.

At the final day of germination normal seedling counted which determine percentage germination. The radicle and plumule length was measured with scale. After measuring seedling were sun dried for determination of seedling dry weight. Seedling vigour index and Seed Stamina Index (SSI) were calculated formula was [30, 31] respectively:

$$\text{Seedling vigour index} = \text{Seedling length (cm)} \times \text{\% germination} \quad (4)$$

Whereas, Seedling length= Radicle length+ Plumule length (cm)

$$SSI = \frac{[GP(RL+PL)]}{100} \quad (5)$$

Where as, RL= Radicle length; PL= Plumule length

Electrical conductivity of seed: 1 gm of vegetables seed of brinjal and tomato were weighed and sterilized as above mentioned treatment and washed thoroughly in distilled water. The clean seeds are immersed in 10ml of water for 10-12 hours at 25±°C temperature. The immersed seeds were removed and measurements of EC were expressed in mmhos/cm/1g seed (Conductivity meter Model No: 181).

Results and discussion

Results of the experiment with hydropriming and biopriming agent such as *Gracillaria corticata* J Ag.*, Kappaphycus alvarezii* and its mixtures showed in Figure-3 to 19, which indicate uniform and rapid improvement in seed germination.

Effect on seed germination: The germination percentage in brinjal and tomato for comparison of control and hydropriming treatment was found 20% and 100% respectively (Figure-3). The highest percentage of germination was recorded 100% at 4% concentration for all biopriming agents of *Gracillaria*

corticata J Ag., *Kappaphycus alvarezii* and its mixture extract treatment in brinjal and tomato seed germination (Figure-4). Different concentrations of same bioagents did not showed significant difference on seed germination percentage. The lowest seed germination percentage was recorded 20% at 1% of biopriming agent of extract of *Gracillaria corticata* J Ag. At 5% concentration of all agents of biopriming treatment result was found similarly in tomato seed germination. The maximum and minimum germination index (GI) was found at 4% and 1% concentration of all bioagents treatment that greater than control in brinjal and tomato seed (Figure-6). The mean germination time was recorded 9.88 and 10.4 that was lowest value as compare to 10.54 and 10.25 in hydropriming treatment value in brinjal and tomato seed (Figure-7). In brinjal, the lowest mean germination time (MGT) was observed at 4% that was 9.44, 9.09 and 9.05 in treatment of *Gracillaria corticata* J Ag., *Kappaphycus alvarezii* and its mixture. The highest MGT was observed in tomato seed germination in *Gracillaria corticata* J Ag. at 4%, *Kappaphycus alvarezii* at 2% and its mixture at 5% concentration of extract treatment that was showed 11.67, 9.47 and 9.26 respectively (Figure-8). Some researcher reported in an acceleration of onion seeds germination in delayed conditioning period by priming treatment[32-34]. The fastest, earlier and synchronized germination might be connected with metabolic activities increased in hydropriming treatment of seed[35]. Sometime, in priming treatment of seed the rate of hydration is difficult to control and some types of seeds may actually invite imbibitional damages if the hydration rate of too rapid. Increase of early germination emergence induced by priming treatment as compared to un-primed seeds[22]. Some authors are reported to improve of plant growth characters with salicylic acid priming treatment[36-38].

Seedling growth: In this present study, priming treatment improved the seedling growth of brinjal and tomato as compare to control and biopriming treatment was better than hydropriming treatment. In brinjal, maximum and minimum radicle length was found in all biopriming agents of *Gracillaria corticata* J Ag., *Kappaphycus alvarezii* and its mixtures at 4% and 1% concentration (Figure-10). The highest plumule length was observed at 5% concentration that was 3.72±0.29, 3.94±0.27 and 4.2±0.22 in *Gracillaria corticata* J Ag., *Kappaphycus alvarezii* and its mixtures respectively (Figure-12). Seedling length was highest at 4% concentration in all bioagents treatments (Figure-14). In tomato seed germination experiment, highest radicle length, plumule length and seedling length was found at 4% concentration of all bioagents treatment.

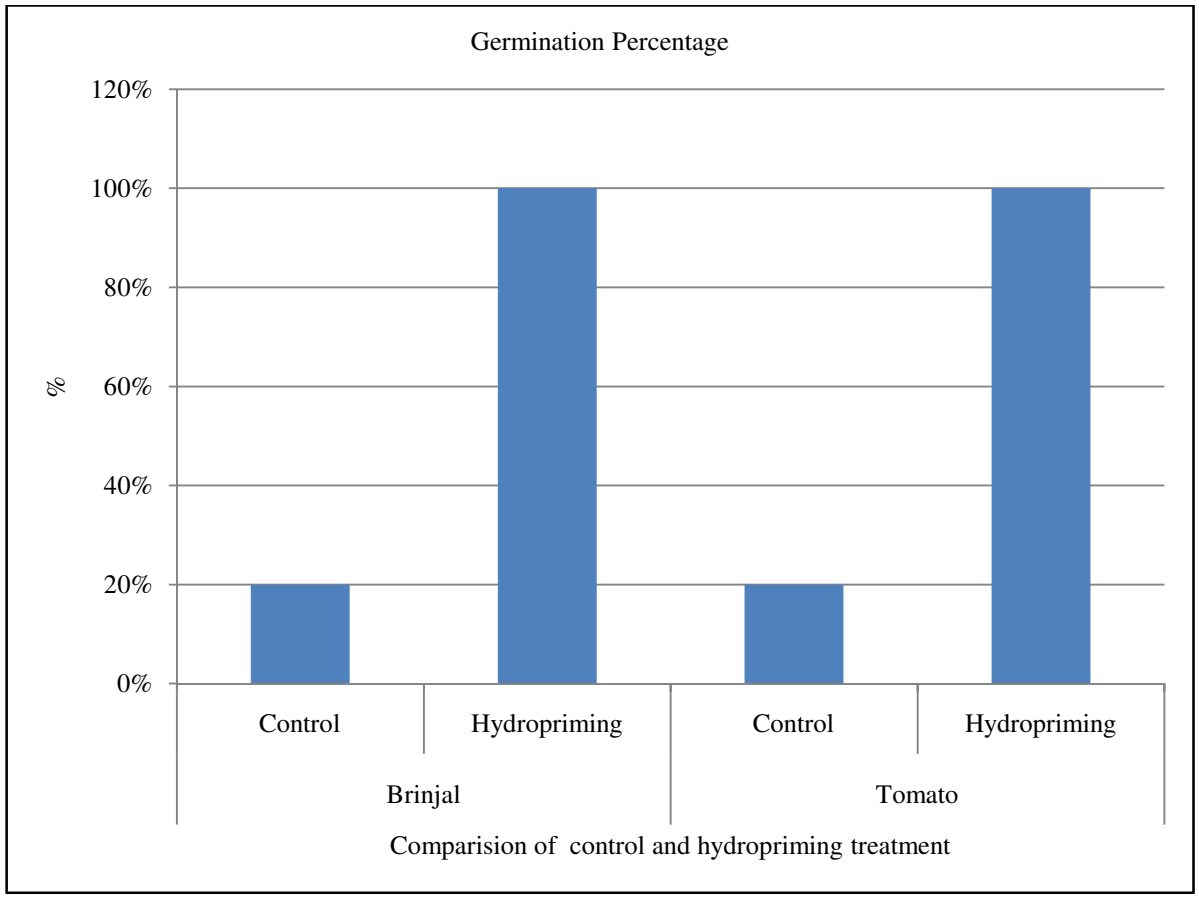

Figure-3: Comparison of control and hydropriming treatment on seed germination percentage of brinjal and tomato.

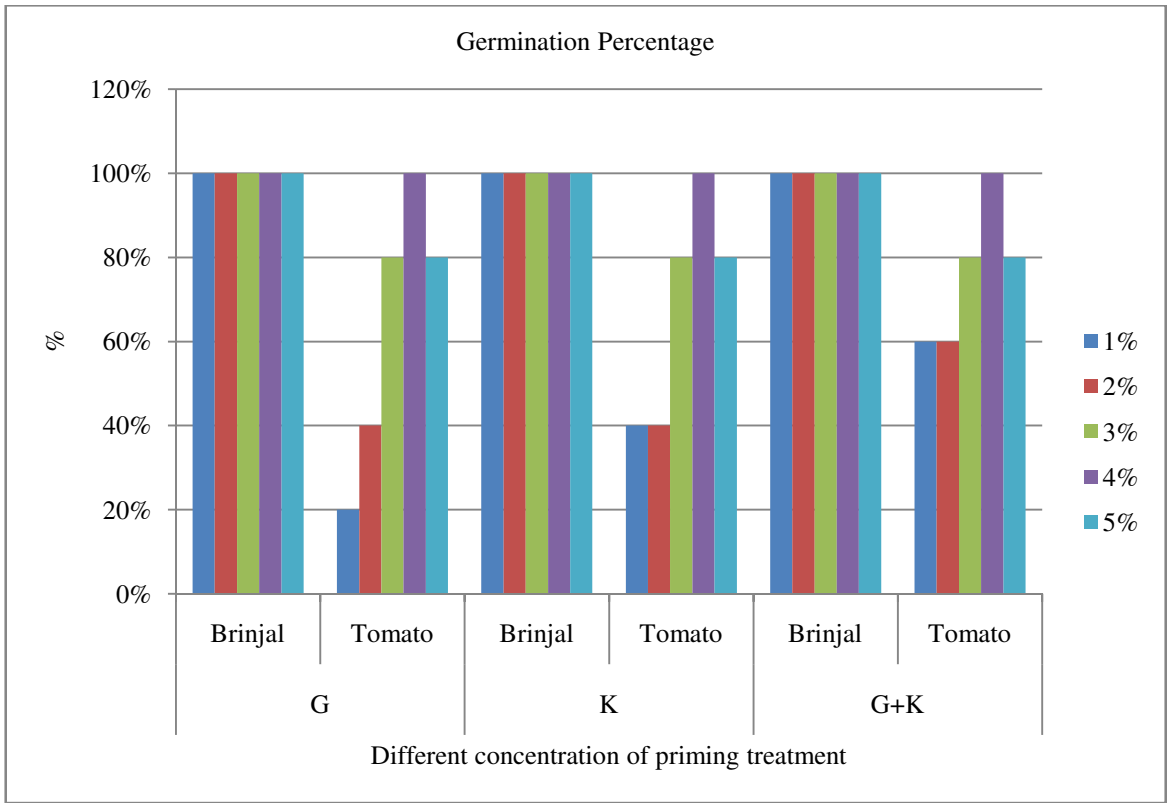

Figure-4: Effect of different concentration of priming treatment on seed germination percentage of brinjal and tomato.

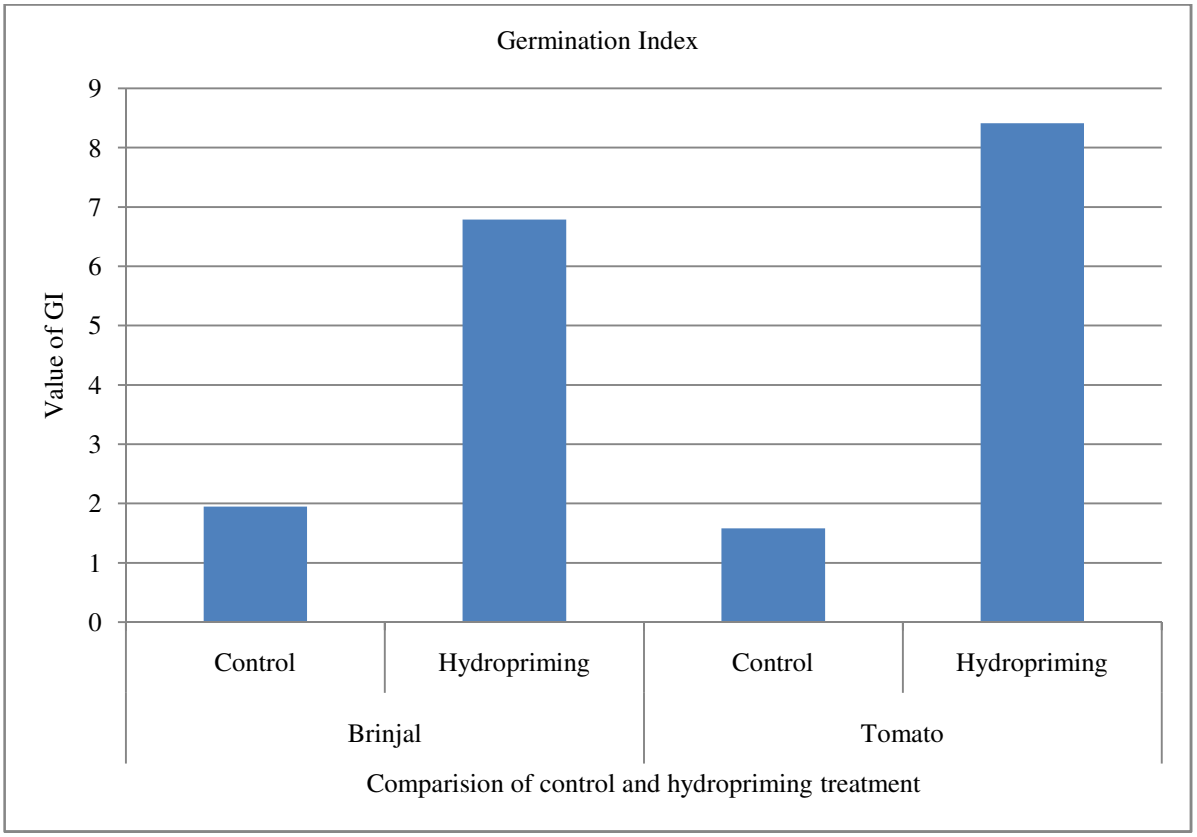

Figure-5: Comparison of control and hydropriming treatment on seed germination index of brinjal and tomato.

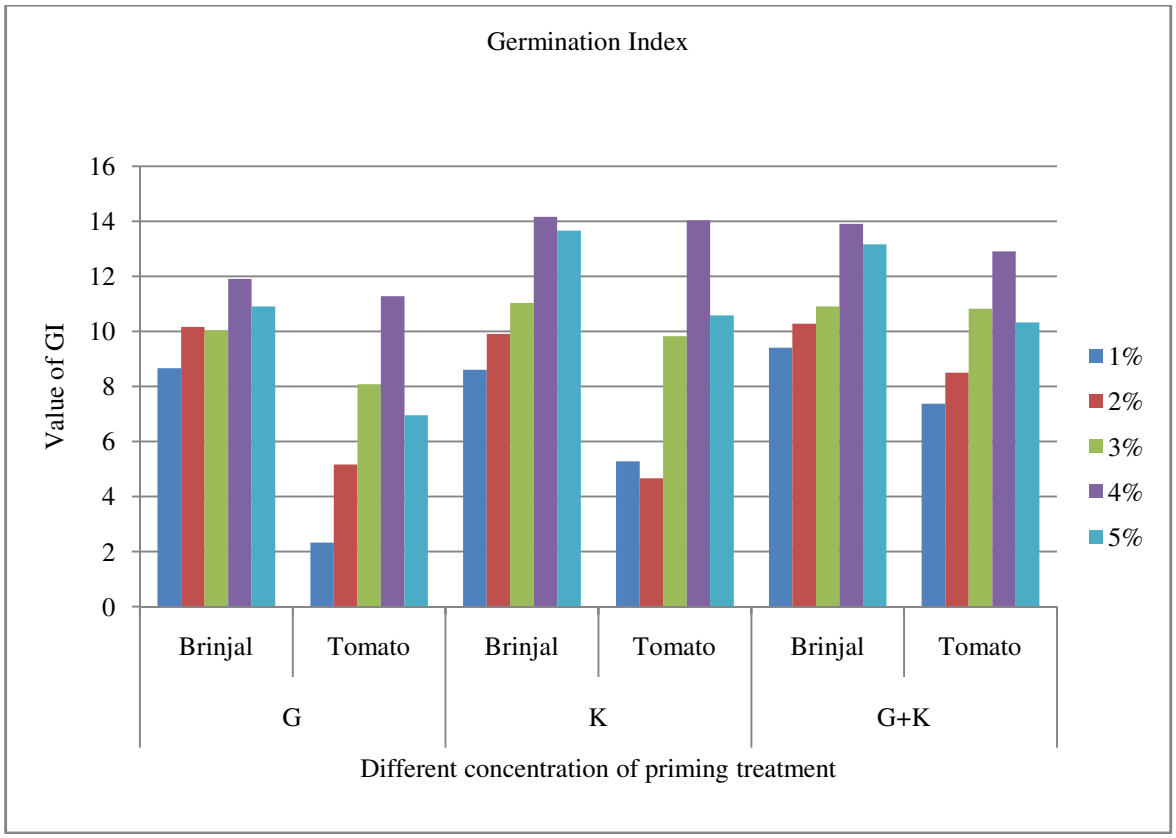

Figure-6: Effect of different concentration of priming treatment on seed germination index of brinjal and tomato.

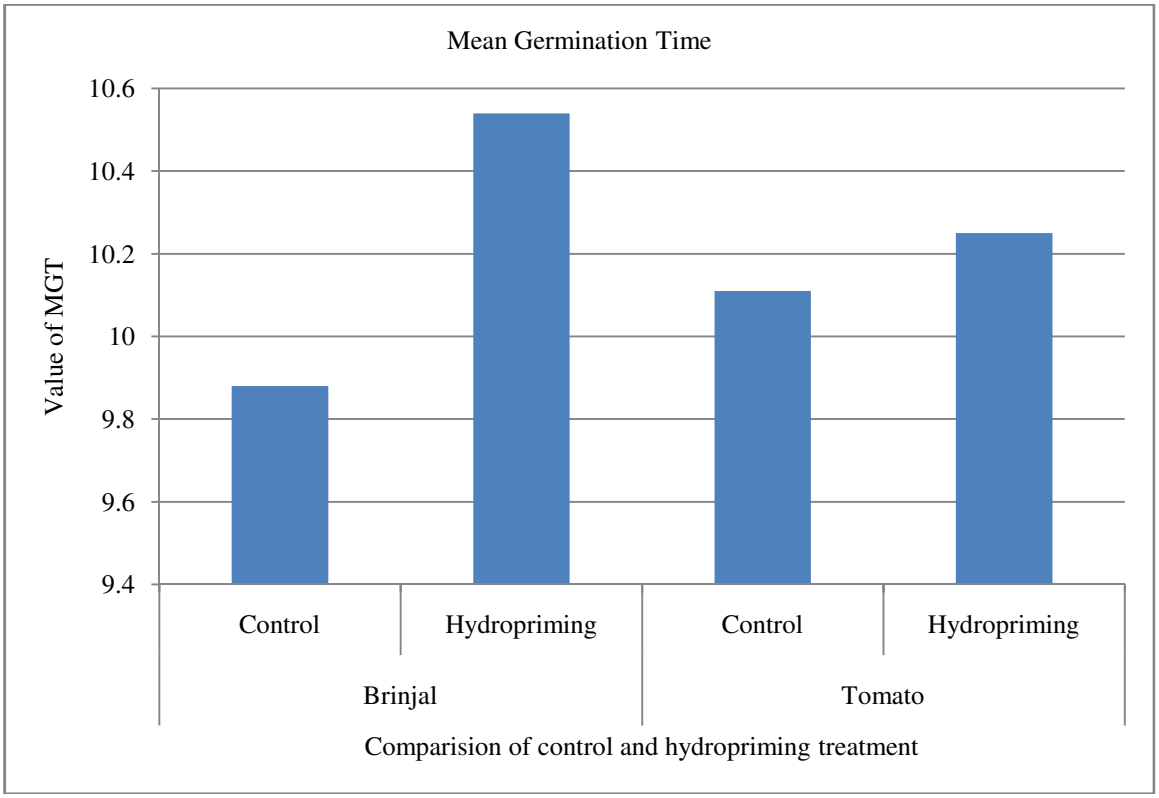

Figure-7: Comparison of control and hydropriming treatment on seed mean germination time of brinjal and tomato.

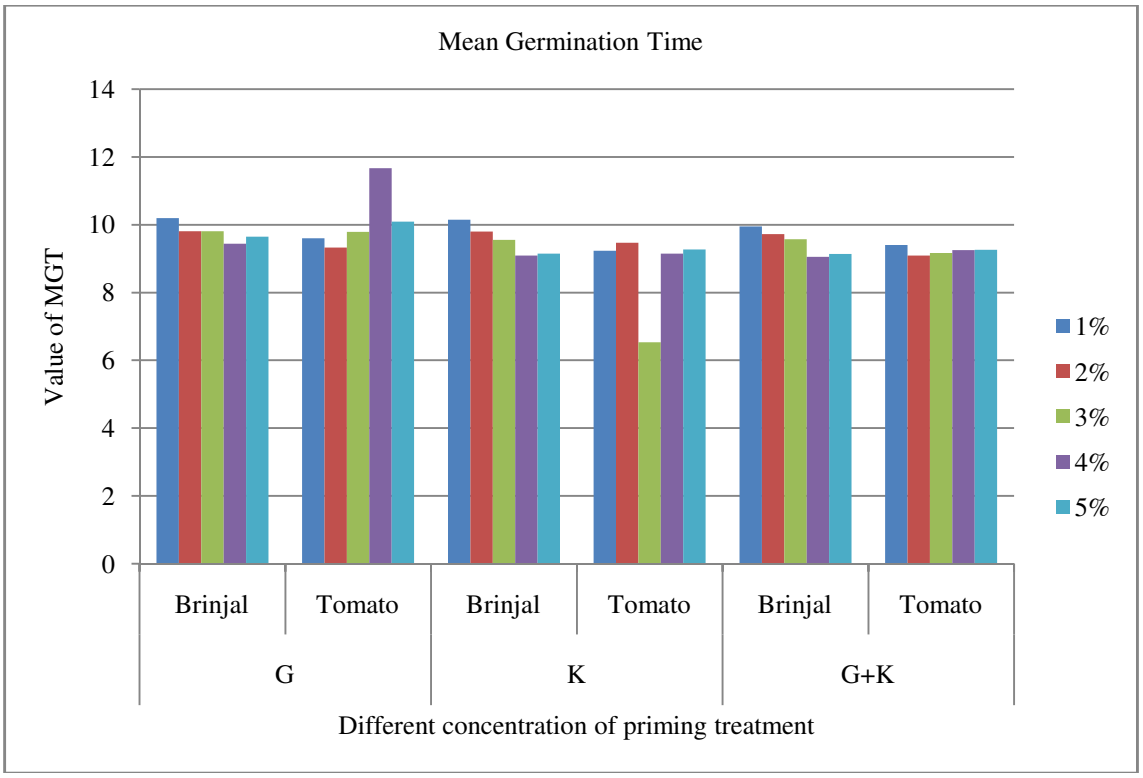

Figure-8: Effect of different concentration of priming treatment on seed mean germination time of brinjal and tomato.

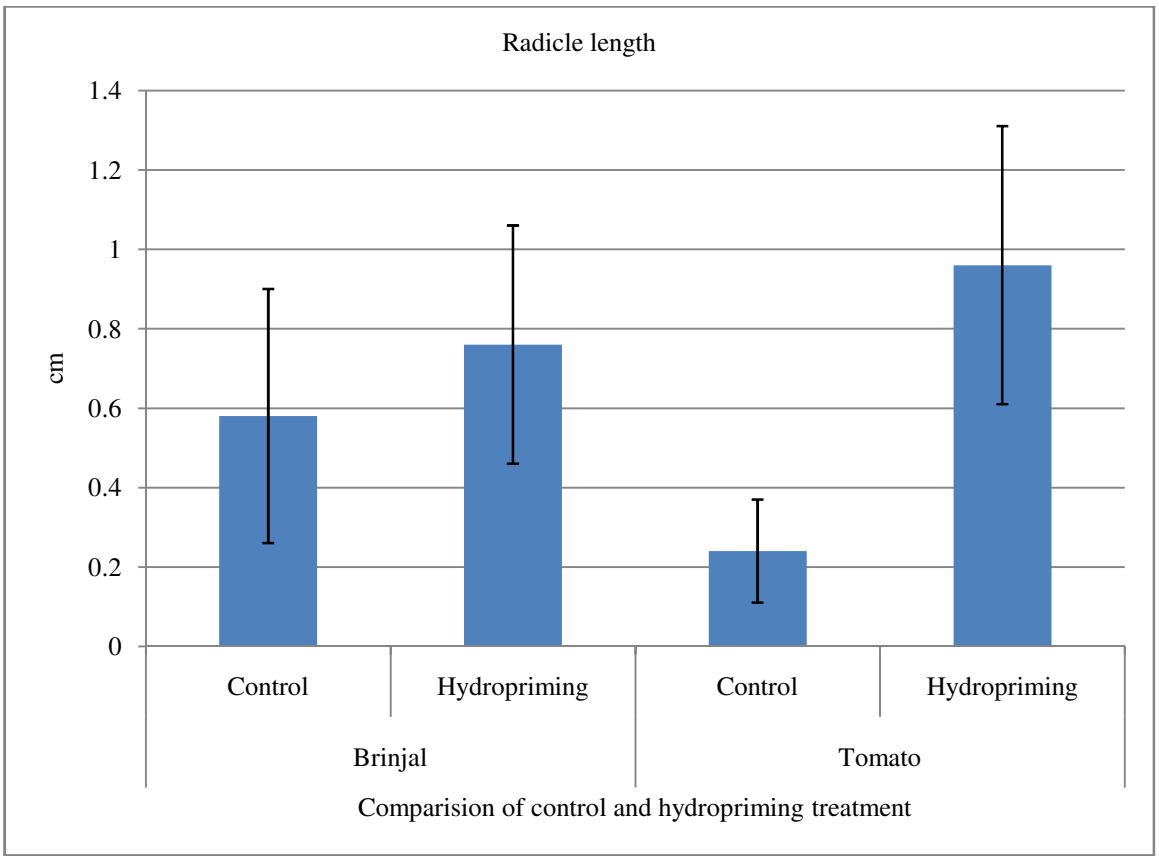

Figure-9: Comparison of control and hydropriming treatment on radicle length of brinjal and tomato.

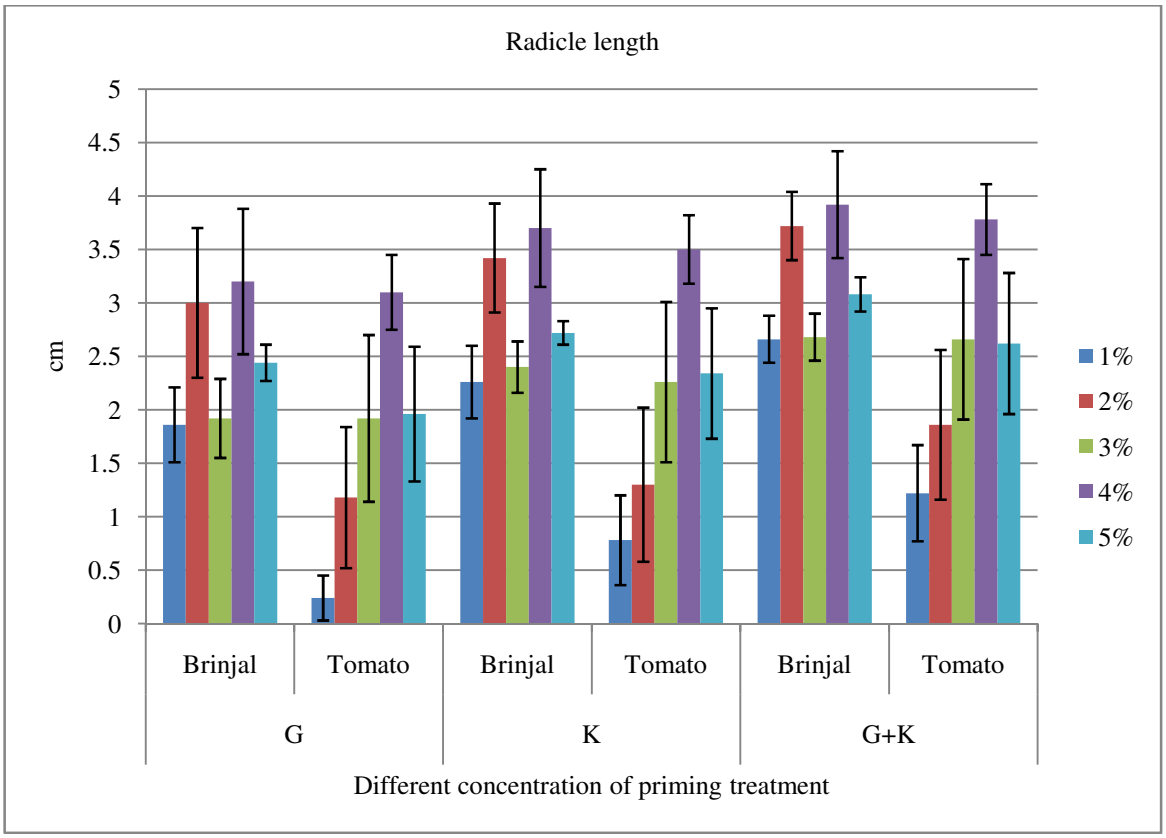

Figure-10: Effect of different concentration of priming treatment on radicle length of brinjal and tomato.

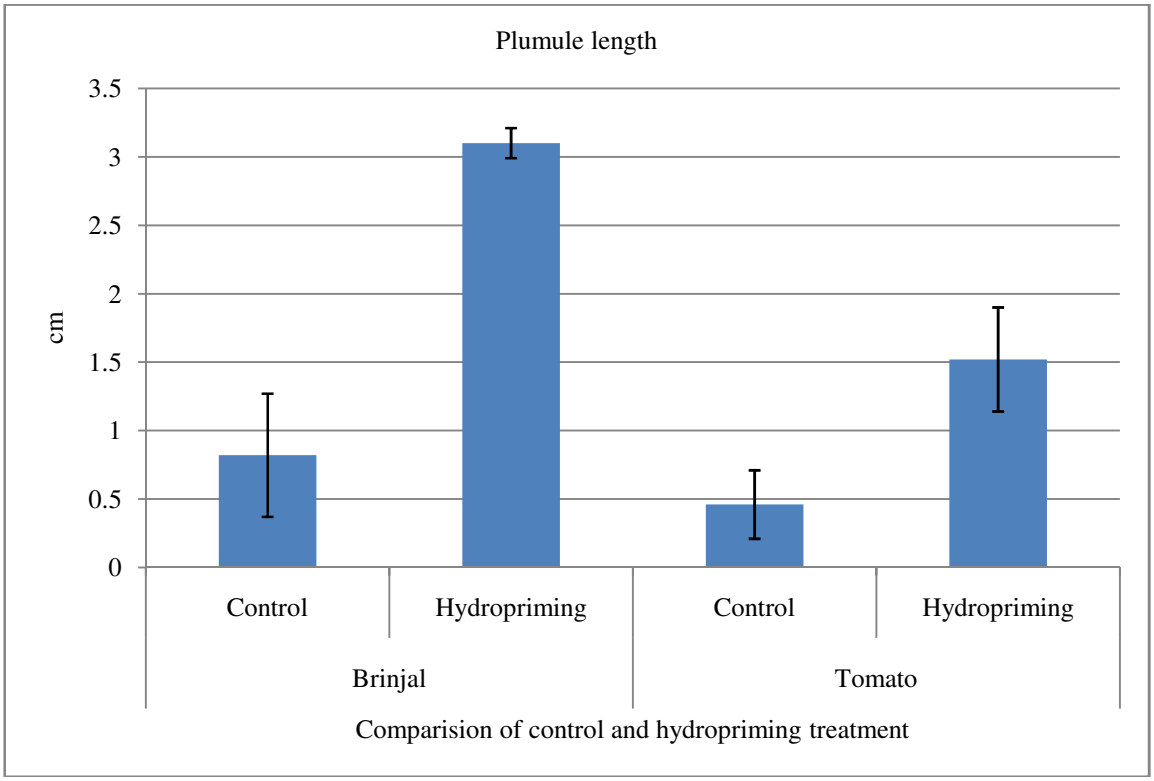

Figure-11: Comparison of control and hydropriming treatment on plumule length of brinjal and tomato.

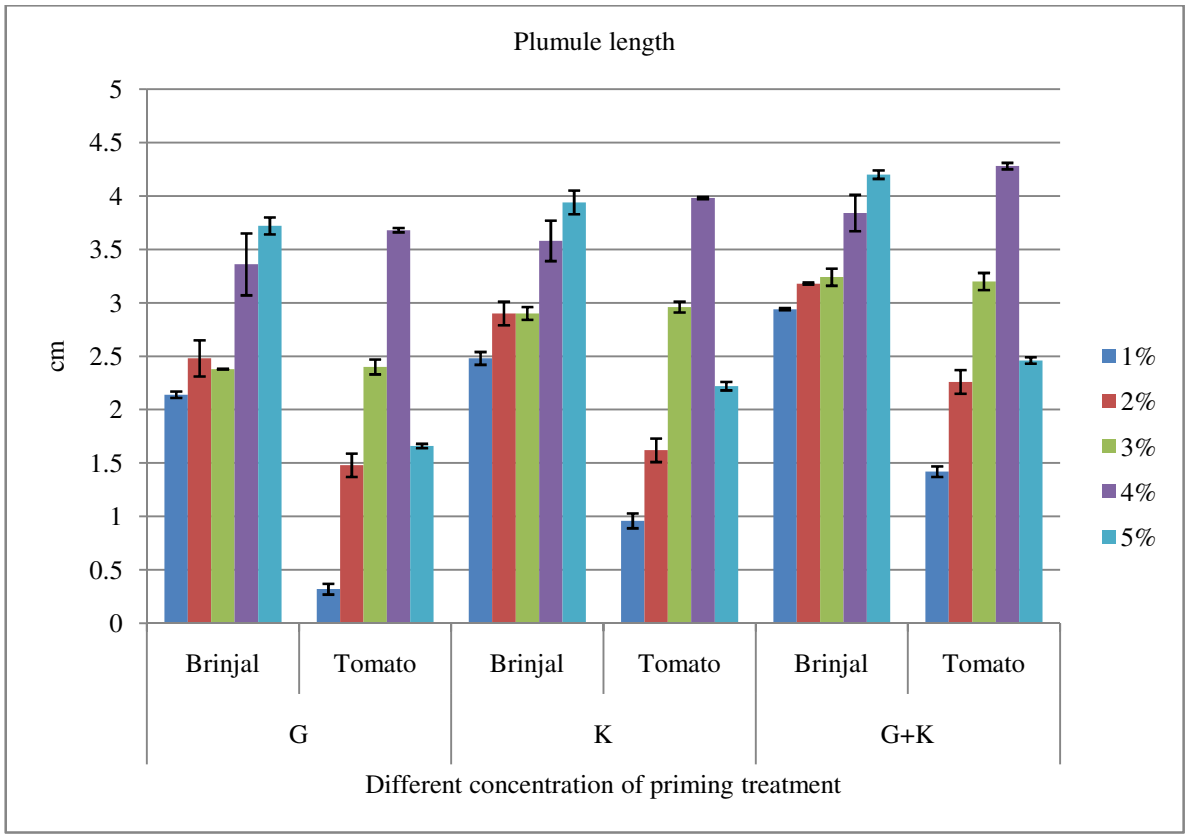

Figure-12: Effect of different concentration of priming treatment on seed plumule length of brinjal and tomato.

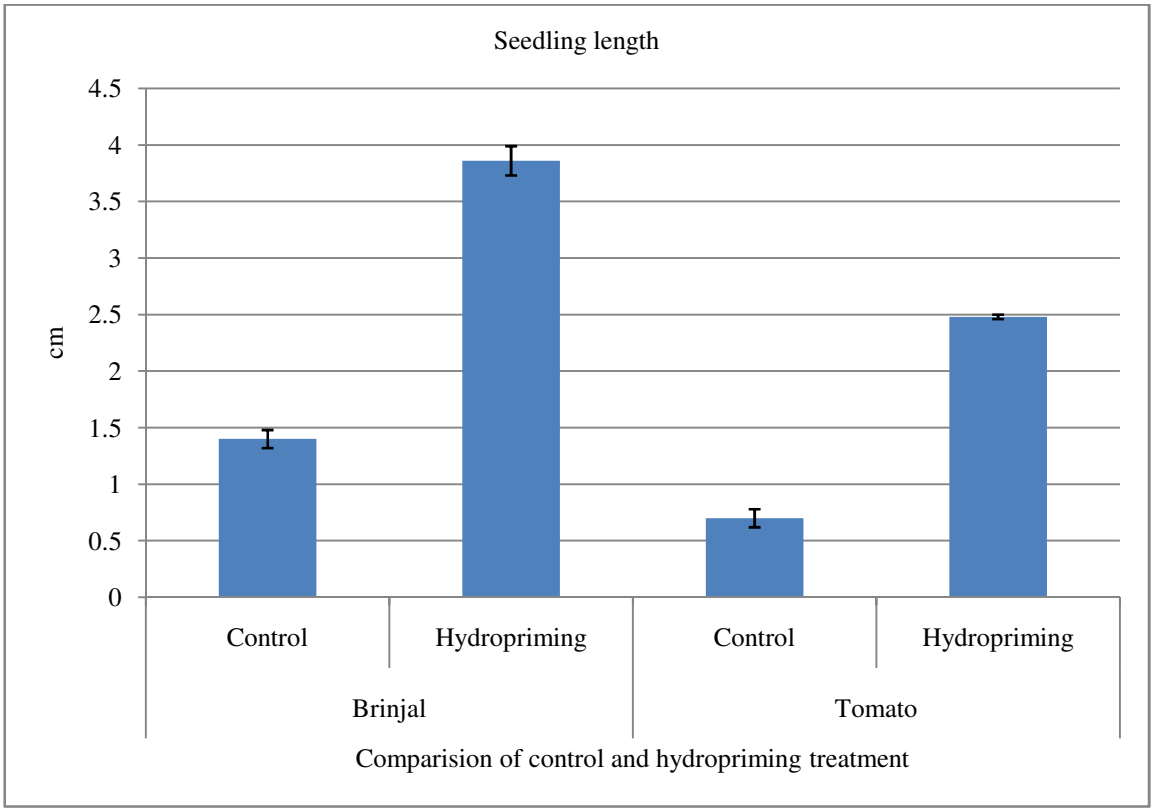

Figure-13: Comparison of control and hydropriming treatment on seedling length of brinjal and tomato.

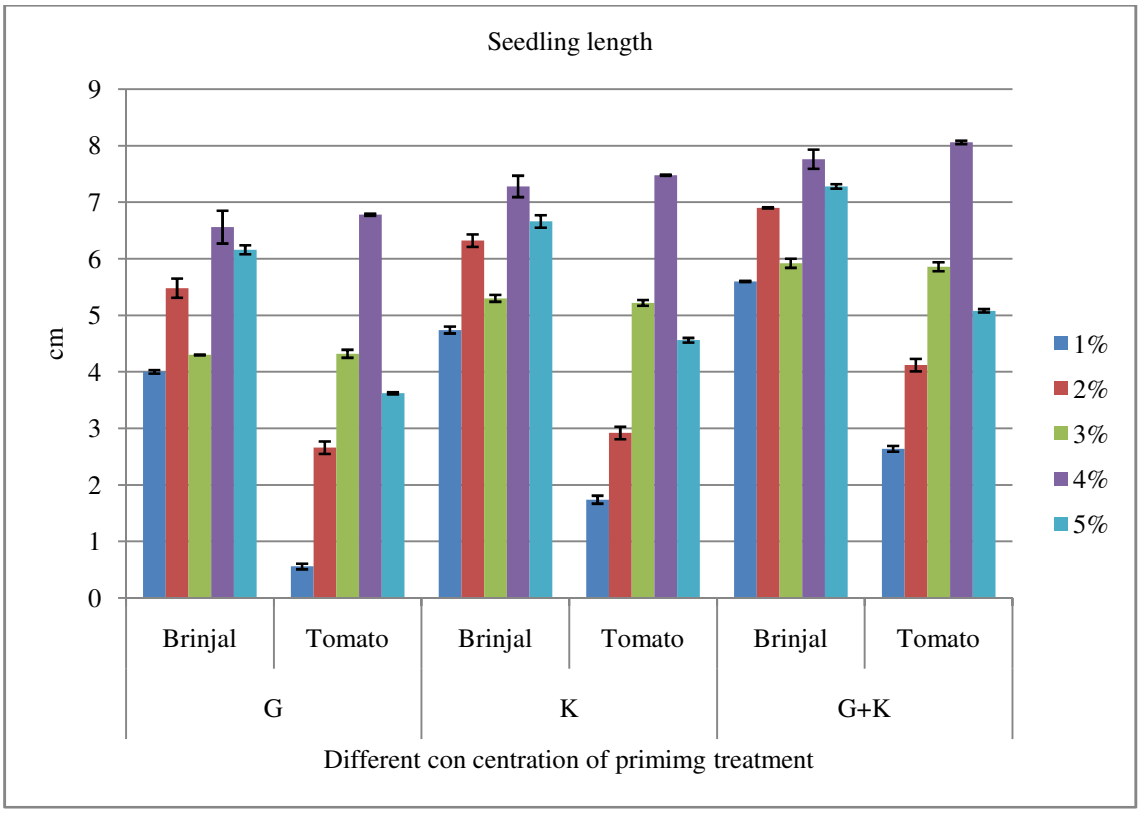

Figure-14: Effect of different concentration of priming treatment on seedling length of brinjal and tomato.

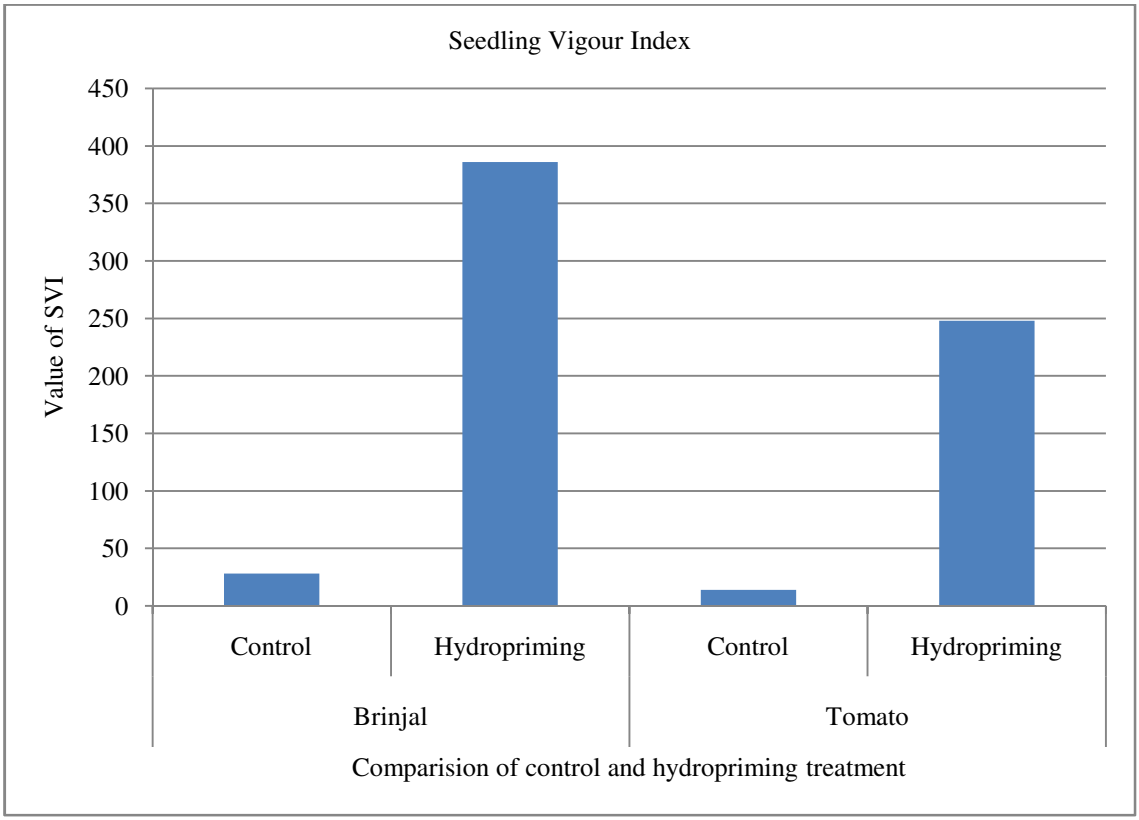

Figure-15: Comparison of control and hydropriming treatment on seedling vigour index of brinjal and tomato.

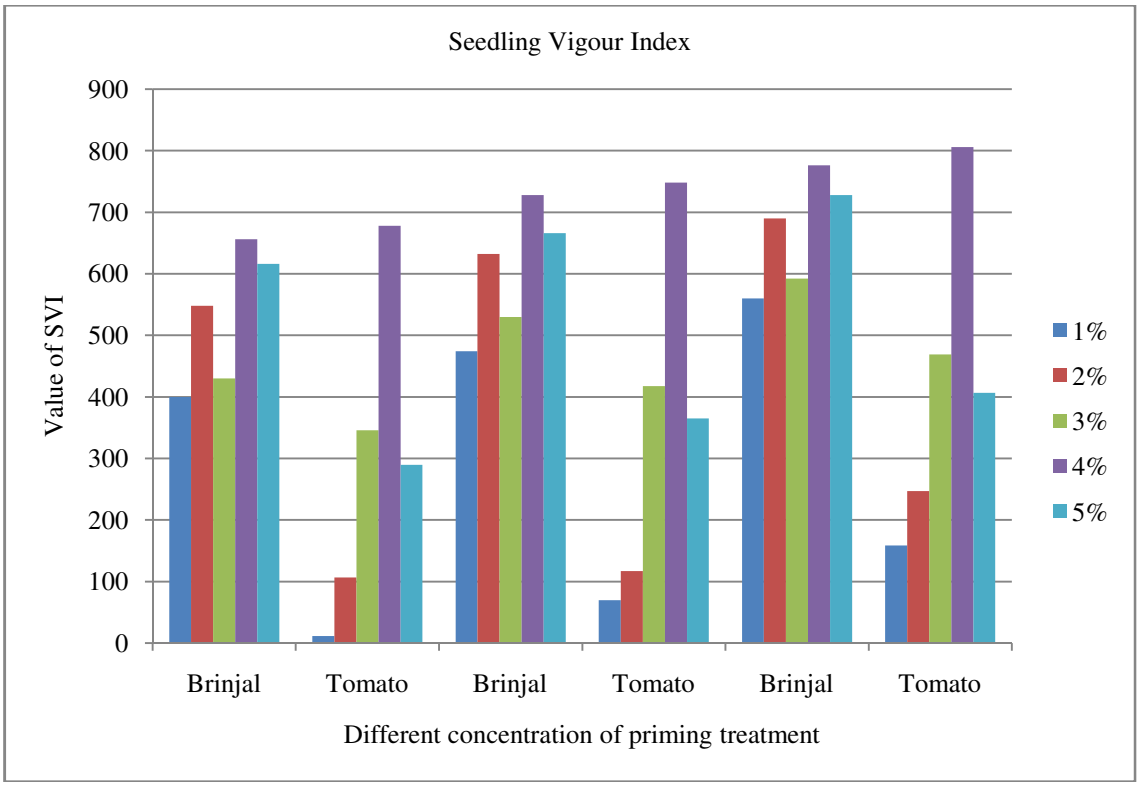

Figure-16: Effect of different concentration of priming treatment on seedling vigour index of brinjal and tomato.

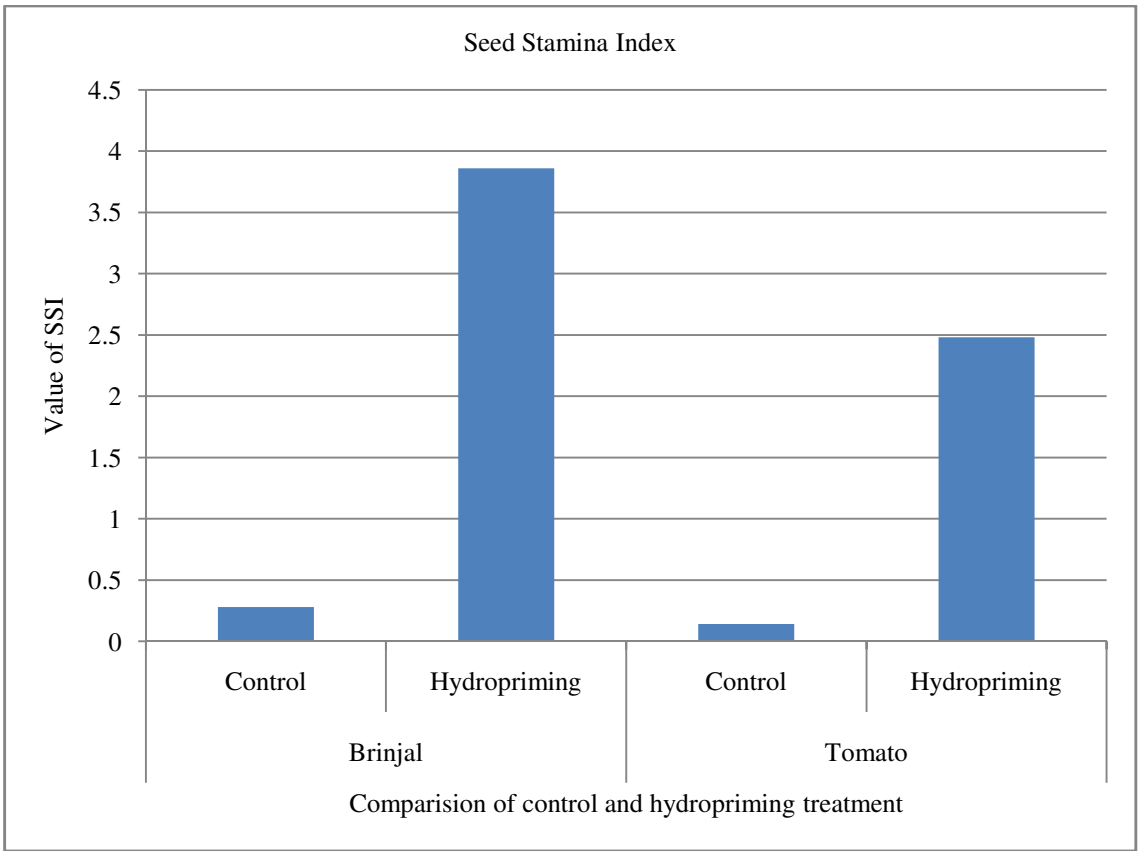

Figure-17: Comparison of control and hydropriming treatment on seed stamina index of brinjal and tomato.

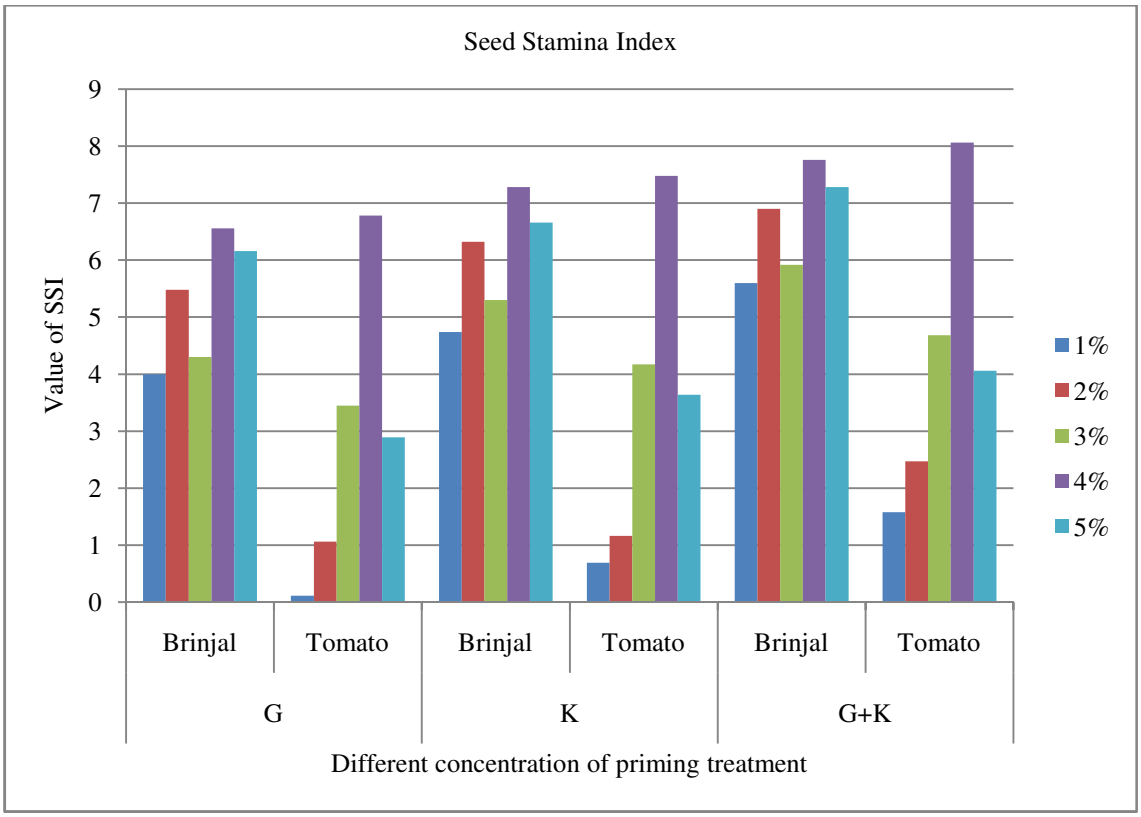

Figure-18: Effect of different concentration of priming treatment on seed stamina index of brinjal and tomato.

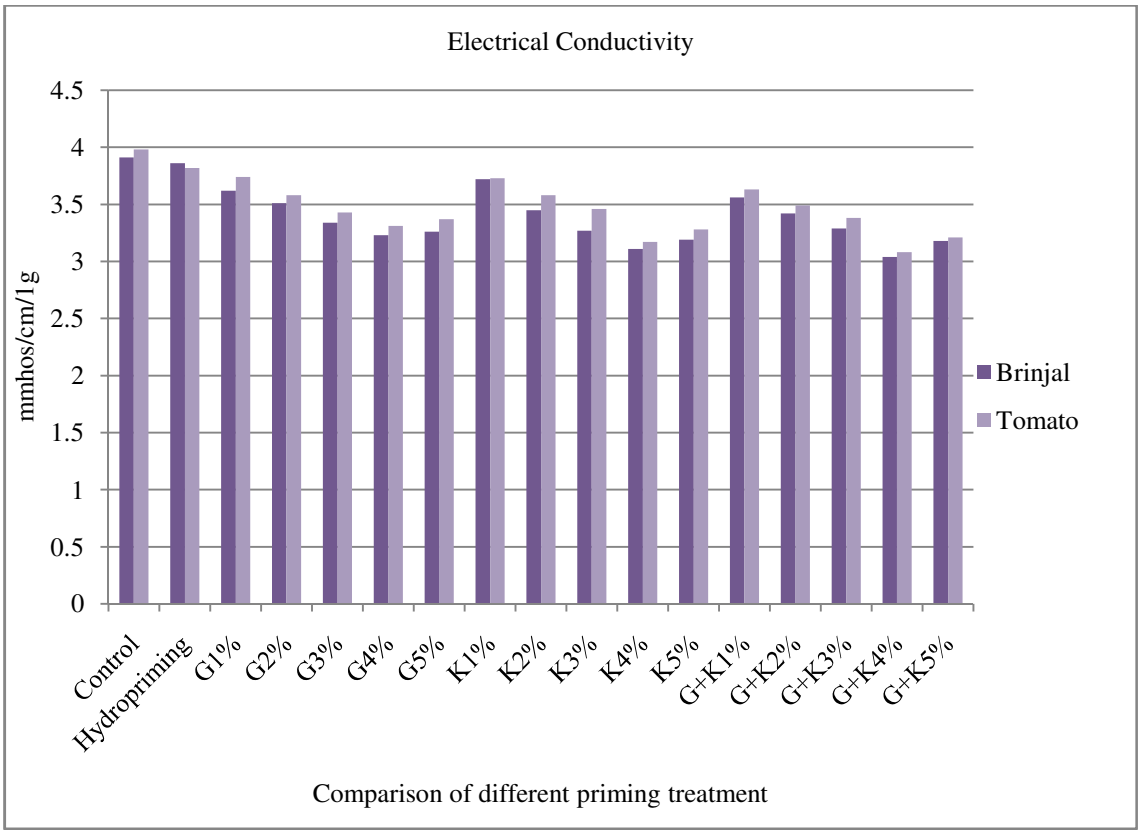

Figure-19: Effect of control, hydropriming and different concentration of priming treatment on seed EC of brinjal and tomato.

Seedling Vigour Index: Figure-15 and 16, represent the seedling vigour index of brinjal and tomato seed. In brinjal and tomato, seedling vigour index lowest value was show 28 and 14 in control as compare to 386 and 248 in hydropriming treatment (Figure-15). After biopriming seedling stamina index highest value was found at 4% concentration treatment of all biopriming agents in both experimental materials of seed (Figure-16). Seedling vigour index of germinating seeds have profound impact on the establishment and crop yield[39].

Seed Stamina Index: According to the Figure-17, show Seed Stamina Index (SSI) was significantly affected by seed hydropriming treatment as compare to control. In brinjal, the greatest increasing of germination at 4% concentration of *Gracillaria corticata* J Ag.*, Kappaphycus alvarezii* and its mixtures that was 6.56, 7.28 and 7.76 respectively. In tomato, also highest SSI results was observed at 4% and lowest and significantly at 1% concentration that was 0.11, 0.69, 1.58 (Figure-18).

Electrical conductivity of seeds: Figure-19, represent the electrical conductivity of brinjal and tomato seeds in control, hydropriming and different concentration of all biopriming agents of *Gracillaria corticata* J Ag.*, Kappaphycus alvarezii* and its mixtures treatment. The maximum EC was recorded 3.91 mmhos/cm/1g and 3.98 mmhos/cm/1g in control as compare to hydropriming treatment EC value of 3.86 mmhos/cm/1g and 3.82 mmhos/cm/1g in brinjal and tomato seeds. The lower EC was found in biopriming treatment of brinjal and tomato seeds of all concentration of all agent mixture of red seaweed extract 4% concentration that was 3.04 mmhos/cm/1g and 3.08 mmhos/cm/1g. The great growth of seedling at lower EC of seed so, 1% concentration of all bioagents are lowest vigourous.

Nowadays, different techniques have been developed of seed priming that was hydropriming, osmopriming, halopriming, thermo priming, biopriming and solid matrix priming (Ashraf, Foolad, 2005). Each treatment have affected to include various concentrations of priming agent and incubation period depending upon plant species, on different stage of plant development and its advantages and disadvantages. The present study, the results of the experiment of priming treatment shows possibility to develop anadvantageous techniques that significantly improves brinjal and tomato seed germination parameters such as germination percentage, germination index, mean germination time, radical length, plumule length, seedling length, seedling vigour index and seed stamina index. However, this pre-sowing treatment must be selected on trial and error base to specific seed lot, especially when the germination capacity of the seeds is low. In our present study, experiment on biopriming treatment affect on brinjal and tomato seed germination. This technique is an economical, very cheap and easily applicable by nursery workers and farmers in developing planting stock as compared to costly plant growth regulators and associated techniques.

Conclusion

It has been concluded from the research work that seed priming treatments resulted in increase germination than un-primed seed of brinjal and tomato. Seed biopriming with 4% concentration of both red seaweed extract mixture as a bio-agent may be used for enhancing germination index, seedling growth, seedling vigour index, seed stamina index as compare to other treatment, but *Gracillaria corticata* J Ag. and *Kappaphycus alvarezii* treatment gave better results as compare to seed with treated in hydropriming.

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