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Impact of seed hydro priming duration on germination and seedling performance of Okra (*Abelmoschus esculentus* L. var. Punjab Suhawani)

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ABSTRACT

An experiment was conducted at main Horticulture Research Farm, Lovely Professional University Phagwara, Punjab during the period from February-May 2021 and 2022. To overcome the problem of seed germination in okra, it can treated with water which are farmers friendly and cost effective. The objective of the experiment was to determine how long okra seeds should be hydroprimed in order to influence germination percentage and seedling performance in okra. There were eight treatments in which one is unprimed and other seven are primed with distilled water for different durations [T_1, 2 hours hydroprimed seeds; T_2, seeds hydroprimed for 4 hours; T_3, seeds hydroprimed for 6 hours; T_4, seeds hydroprimed for 8 hours; T_5, seeds primed for 10 hours; T_6, seeds primed for 12 hours; T_7, seeds primed for 14 hours]. The experiment was laid downin a Randomized Complete Block Design (RCBD) with three replications. Data of various parameter likes germination percentage (%) and seedling parameters were recorded to find out the suitable duration of seed hydropriming in okra. Result of the study showed that hydropriming duration of 12 hours recorded maximum seed germination percentage (83.33%), minimum days for germination (7.17), length of shoot (16.56 cm), length of root (8.64 cm), seedling length (25.20 cm), seedling dry weight (25.26 mg), seed vigour index-I (1823.89) and seed vigour index-II (2105.35) as compared to other hydro priming durations. It was concluded that 12 hours of hydropriming duration had positive effect on germination and seedling growth parameters of okra.

Key words : *Okra, Hydropriming, Germination, Seed vigour index-I and seed vigour index-II.*

Introduction

Okra (*Abelmoschus esculentus* L. moench), belonging to the family Malvaceae (Benchasri S., 2012), is commonly known as Lady's finger, bhindi in the different geographical regions of its cultivation (Jain *et al.,* 2012). It is also known as "the ideal villager's vegetable." (Kumar *et al.,* 2010). The young fruits are eaten, while the dried seeds are roasted or powdered and used as a coffee ingredient or alternative. It is utilised as a plasma replacement or blood volume expander in medicine. Okra mucilage is commonly used in industry to glaze certain papers and in confectionery (Benchasri, 2012). India is considered first in the world for okra production by 6371 thousand metric tonnes in an area of 534 thousand hectares (NHB, 2019-20). Uttar Pradesh, Andhra Pradesh, West Bengal, Bihar, Maharashtra, and

Karnataka are the top okra-growing states in India (Chittora and Singh, 2016).

In India, it is primarily grown during the summer and wet seasons (Singh, 2018). The seeds of okra do not germinate below 20 °C. The slow and uneven germination of okra seed is the main hurdle in the early spring planting (Pandita *et al.,* 2010). Reduced, delayed, and erratic emergence is a major problem in okra crop cultivation caused by seed hardness as it creates problems in rapid germination and uniform field stand (Purquerio *et al.,* 2010).

Seed priming can help to overcome the problem of reduced germination in okra which is due to the hard seed coat. Seed priming is the controlled hydration of seeds with the goal of promoting faster and more consistent seed germination and plant growth (Sharma *et al.,* 2014). In hydro-priming technique only water is used to prime the seeds where water penetrate freely into the seed.

Hydro-priming may enhance seed germination percentage and seedling emergence under both saline and non- saline conditions (Nawaz *et al.,* 2013). Response of seed to priming is also affected by different priming duration (Moradi and Younesi, 2009), osmotic potential of seed priming solution (Yari *et al.,* 2010). Each cultivar of crop has a critical soaking time that is less than the safe limit. Prolonged soaking duration can show adverse effects which is may be because of decrease in Deoxyribonucleic Acid(DNA) repair activity (Carrillo *et al.,* 2021). To get the best results, it's important to know how long seed should be primed.

Methodology

Experimental design and treatments

The experiment was conducted at main Horticulture Research Farm, Lovely Professional University Phagwara, Punjab, located at 31° 15′ N latitude, 75041′ E longitude and at an altitude of 245 m above mean sea level. Jalandhar is situated between the intensively irrigated and very fertile agricultural land of river the Beas and the Satluej and spread over a huge area of 2624 sq.km, it occupies 5.3% of the total geographical area of the state. There were eight treatments in which one is unprimed and other seven are primed with distilled water for different durations [T_1, 2 hours hydroprimed seeds; T_2, seeds hydroprimed for 4 hours; T_3, seeds hydroprimed for 6 hours; T_4, seeds hydroprimed for 8 hours; T_5, seeds primed for 10 hours; T_6, seeds primed for 10 hours; T_7, seeds primed for 12 hours]. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Data were recorded on following parameters:

Data collection

Number of days to germination : Number of days to germination is calculated after the sowing of okra seed in the main field and when the seedling start to germinate.

Seed germination (%) : Seed germination (%) tests were conducted using seeds from okra, which were placed on top layers of germination towel papers and then these seeds were covered with another layer of germination towel paper. After then these were allowed to incubate at 25 °C and 90-95 percent relative humidity in the germination chamber. On the 11th day, the number of normal seedlings was counted, and the seed germination (percentage) was calculated using the formula below.

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

Length of shoot (cm) : After fifteen days of growth, the seedlings were up rooted and washed with distilled water to remove the foreign particles of sand. Shoot length of five randomly selected seedlings from each replicate was measured in centimetres (cm) from the base of hypocotyls to the tip of the shoot with the help of meter rod. The average of each replication was calculated.

Length of root (cm): After fifteen days of growth, the seedlings were up rooted and washed with water to remove the foreign particles of sand. Root length of five randomly selected seedlings from each replicate was measured in centimetres (cm) from the base of hypocotyls to the tip of the longest root with the help of meter scale. The average of each replication was calculated.

Seedling length (cm) : Five normal seedlings, selected at random at first count were used to work out the seedling length. Seedling length was worked out by taking the total length of seedlings from the tip of the primary leaf to the tip of primary root with the help of scale and expressing the mean value in centimetre (cm).

Seeding dry weight (mg) : Seedling dry weight was calculated using five seedlings chosen for measuring seedling length. Seedlings were placed in an oven at 60°C for 48 hours before being weighed and the

mean value stated in grams.

Seed vigour index-I: Seed vigour index-I was calculated as per the formula given

Seed vigour index-I = Germination (%) × Seedling length (cm).

Seed vigour index-II: Seed vigour index-II was calculated as per the formula given below

Seed vigour index-II = Germination (%) × Seedling dry weight (mg).

Statistical analysis

Obtain data were analysed by using OPSTAT software, HAU and mean comparison were done by Duncan multiple range test(DMRT)at 0.05 level of significance.

Results and Discussion

The purpose of this study was to see how various seed hydropriming duration affected on germination and seedling performance of okra.The data collected for various characters was statistically evaluated, and the relevance of the results was confirmed. The following is a list of the findings obtained by characters:

Number of days to germination

The observation recorded on number of days to germination of okra for the year 2021 and 2022 and also in pooled analysis has been presented in Table 1. Results of various soaking durations showed that maximum number of days to germination (12.17 and 11.50) recorded in un-primed *at par* with the 2 hrs duration soaking seed plot while minimum number of days to germination (7.17 and8.00) is recorded in 12h *at par* with the 14h soaked seeds plot (Table 1). Shah *et al.*,(2011) also suggested the same thing. These results are in agreement with work of Arif *et al.,* (2005) who reported that the probable reason for early emergence of the water primed seeds may be the completion of pre-germinative metabolic activities during priming process, making the seed ready for radical emergence and the seeds germinated soon after planting compared with untreated dry seeds. Similarly, Bradford (1990) recorded that when seed imbibe, water contents reach a plateau and changes little until radical emerge.

Germination percentage (%)

The results pertaining to seed germination percentage (%)as affected by different durations of hydropriming in the year of 2021 and 2022 and also in pooled analysis has been presented in Table 1. The maximum (83.33) germination was recorded in 12 hours of seed hydropriming which was *at par* with the 14 hours (81.67), whereas minimum (58.33) germination was recorded in 0 hours *at par* with the 2 hrs (61.67) of seed hydropriming. Shah *et al.,* in 2011 also suggested the same thing. These results indicate that seed priming with different duration improved the germination percentage of seeds as compared with non-primed control seeds. It is well known that different priming durations affect germination percentage because seeds of need a specific amount of water to get into the lag phase of germination in which all the pre-germinative metabolic processes occurs (Rahman *et al*. 2016). So, if priming is done for a short period, then seed would not get enough water that is required for getting seed into the lag phase of germination. On the other hand, prolong period of priming will allow excess of water that may exceed the quantity required for the

Table 1: Effect of different hydropriming duration on number of days to germination, germination percentage (%).

	Number of days to germination (days)			Germination Percentage (%)		
Treatments	2021	2022	pooled	2021	2022	pooled
T_0 (0 hours)	12.67	11.67	12.17	53.33	63.33	58.33
T_1 (2 hours)	12.00	11.00	11.50	56.67	66.67	61.67
T_2 (4 hours)	11.33	10.33	10.83	60.67	72.67	66.67
T_3 (6 hours)	10.00	10.43	10.22	66.67	75.00	71.67
T_4 (8 hours)	10.33	9.00	9.67	70.00	76.67	73.33
T_5 (10 hours)	9.67	8.33	9.00	73.33	80.00	76.67
T_6 (12 hours)	7.00	7.33	7.17	78.33	86.67	83.33
T_7 (14 hours)	7.33	8.67	8.00	80.00	83.33	81.67
CD (P=0.05)	2.25	1.53	1.15	4.70	4.53	4.80
SE_M (±)	0.73	0.50	0.38	1.53	1.48	1.60
CV (per cent)	12.70	9.03	0.53	3.94	3.39	3.74

initiation of lag phase of germination and radicle protrusion will occur due to which seed loses its desiccation tolerance thereby results in loss of seed viability (Dekkers *et al.* 2015).

Seedling length (cm)

The data on seedling length of okra for the year of 2021 and 2022 and also in pooled analysis as influenced by different seed hydropriming durations has been presented in Table 2. The maximum (25.20) seedling length is recorded in 12 hours of seed hydropriming whereas minimum (14.05) seedling dry weight was recorded in control i.e. no priming. Seed quality parameters increased with increase in soaking period up to twelve hours. There after decline in seed quality parameters was observed. Pushaplatha in 2008 also suggest the same thing. This may be attributed to the physiological and biochemical changes occurred and increased physiological activity of the embryo and mobilization of food reserves into the growing seedlings (Gough, R. E. 2020) that led to development of stronger and efficient root and shoot system and effectively reduced physiological deterioration (Rudrapal and Nakumura, 1988). This might have resulted in repair of DNA, protein membranes and enzymes occur during imbibition (Zhang *et al.*,2021). Prolonged soaking period had shown adverse effects may be because of decrease in DNA repair activity (Van *et al.*, 1996).

Seedling dry weight (mg)

The results pertaining to effect of different seed hydro priming durations on seedling dry weight of okra for the year of 2021 and 2022 and also in pooled analysis are presented in Table 2. The maximum (25.26 mg) seedling dry weight is recorded in 12 hours of seed hydro priming whereas minimum (17.93 mg) seedling dry weight was recorded in unprimed i.e. controlled *at par* with the 2 hrs. Ghassemi-Golezani *et al.,* (2010) also reported that the lowest mean germination time and the highest germination percentage and seedling dry weight of pinto bean were achieved with 7 and14 hours priming duration which was significantly different from 21 hours of hydro-priming.

Shoot length (cm)

The results on shoot length of okra for the year of 2021 and 2022 and also in pooled analysis as influenced by soaking duration are presented in Table 3. The seeds soaked for 12 hour duration recorded maximum shoot length (16.56 cm) followed by 14 hour soaking duration (15.34 cm). The minimum shoot length of **(**9.41, 10.47, 11.31 12.66, 13.15 and 14.06 **c**m is recorded in 0, 2, 4, 6 8 and10 hour soaking duration, respectively. Pushaplatha in 2008 also suggest the same thing.

Root length (cm)

The data on root length of okra for the year of 2021 and 2022 and also in pooled analysis as influenced by soaking duration are presented in Table 3. The seeds soaked for 12 hours recorded higher root length (8.64 cm), followed by 14 hour soaking (7.83 cm). The lower root length of (4.64, 5.33, 6.09, 6.44, 7.16 and 7.72 cm respectively) is recorded by 0, 2, 4, 6, 8, 10 hours of soaking. Puspalatha in 2008 also suggest the same thing.

Seed vigour index-I

The data on seed vigour index-I for the year of 2021

Table 2. Effect of different hydropriming duration on seedling length (cm) and seedling dry weight (mg).

	Seedling length (cm)			Seedling dry weight (mg)		
Treatments	2021	2022	Pooled	2021	2022	Pooled
T_0 (0 hours)	13.23	14.86	14.05	18.04	17.81	17.93
T_1 (2 hours)	14.17	17.42	15.80	18.29	18.78	18.54
T_2 (4 hours)	17.10	17.71	17.40	20.16	20.86	20.51
T_3 (6 hours)	17.96	20.23	19.10	20.73	21.17	20.95
T_4 (8 hours)	19.22	21.39	20.31	21.77	21.56	21.66
T_5 (10 hours)	21.15	22.40	21.78	22.78	21.77	22.28
T_6 (12 hours)	24.73	25.66	25.20	24.92	25.60	25.26
T_7 (14 hours)	21.79	24.54	23.16	22.85	23.23	23.04
CD (P=0.05)	2.51	0.58	1.23	0.86	0.91	1.08
SE_M (±)	0.82	0.19	0.40	0.28	0.30	0.35
CV (per cent)	7.66	1.61	3.56	2.30	2.41	2.86

and 2022 and also in pooled analysis as influenced by different seed hydropriming durations have been presented in Table 4. The maximum (2100.45) seed vigour index-I of seed hydropriming which was significantly higher than all other durations whereas minimum (849.78) seed vigour index-I is recorded in 0 hours of seed hydropriming.

Seed vigour index-II

The data on seed vigour index-II for the year of 2021 and 2022 and also in pooled analysis as modified by varied seed hydropriming durations are reported. The maximum (2105.18) seed vigour index-II was recorded in 12 hours of seed hydropriming which was significantly higher than all other durations whereas minimum (1017.20) seed vigour index-II was recorded in 0 hours which is *at par* with the 2 hours (1144.12) of seed hydropriming.

Conclusion

Hydropriming of okra seeds might be best option to overcome the delay germination of fresh seeds cases of seed hardness. Hydropriming of okra seeds facilitates not only germination even also growth,quality and yield of the crop can also be enhanced.Seedsis subjected to different hydropriming durations from 0 to 14 hours. The seeds is then tested for germination and vigour parameters to standardize the best hydropriming duration. Hydropriming duration of 12 hours recorded maximum seed germination % (83.33%) *at par* with the 14 hours duration (81.67), minimum days for germination (7.17), length of shoot (16.56 cm), Length of root (8.64 cm), seedling length (25.20 cm), seedling dry weight (25.26 mg), seed vigour index-I (2100.45) and seed vigour index-II (2105.35) as compared to other hydro priming durations. As a consequence, hydropriming okra seeds for 12 hours was determined to be the best of all seed hydropriming durations evaluated, resulting in highest early germination, growth, yield, and quality characteristics. As a result, these hydro prim-

Table 3. Effect of different priming treatments on length of the shoot (cm) and length of the root (cm).

Treatments	Length of shoot (cm)			Length of root (cm)		
	2021	2022	pooled	2021	2022	pooled
T_0 (0 hours)	8.48	10.33	9.41	4.75	4.53	4.64
T_1 (2 hours)	9.06	11.87	10.47	5.11	5.55	5.33
T_2 (4 hours)	10.69	11.93	11.31	6.38	5.81	6.09
T_3 (6 hours)	11.55	13.76	12.66	6.41	6.56	6.44
T_4 (8 hours)	12.54	13.75	13.15	6.68	7.63	7.16
T_5 (10 hours)	13.45	14.66	14.06	7.71	7.72	7.72
T_6 (12 hours)	15.89	17.22	16.56	8.84	8.44	8.64
T_7 (14 hours)	14.06	16.61	15.34	7.24	8.08	7.83
CD (P=0.05)	2.03	0.62	0.70	1.06	0.26	0.38
SE_M (±)	0.66	0.20	0.23	0.35	0.09	0.13
CV (per cent)	9.60	2.56	3.08	9.05	2.19	3.23

Table 4. Effect of different hydropriming duration on Seed vigour index-I (SVI) and Seed vigour index-II (SVI)

Treatments	Seed vigour index-I (SVI)			Seed vigour index-II (SVI)		
	2021	2022	pooled	2021	2022	pooled
T_0 (0 hours)	731.48	915.80	849.20	992.02	1098.49	1017.20
T_1 (2 hours)	855.18	1103.17	974.99	1097.40	1189.40	1144.12
T_2 (4 hours)	1110.33	1210.37	1159.97	1310.62	1425.21	1369.38
T_3 (6 hours)	1255.65	1490.73	1371.12	1451.10	1552.71	1501.89
T_4 (8 hours)	1414.70	1566.67	1476.62	1559.94	1616.75	1589.13
T_5 (10 hours)	1519.52	1783.83	1644.42	1670.29	1741.87	1708.25
T_6 (12 hours)	2014.48	2182.23	2100.45	2035.41	2175.72	2105.18
T_7 (14 hours)	1728.08	1975.33	1854.17	1904.44	1858.13	1881.29
CD (P=0.05)	221.02	159.95	108.12	114.10	150.68	152.09
SE_M (±)	72.17	52.23	35.30	37.26	49.20	49.66
CV (per cent)	9.45	5.93	4.29	4.32	5.39	5.58

Figure 1: Number of days to germination

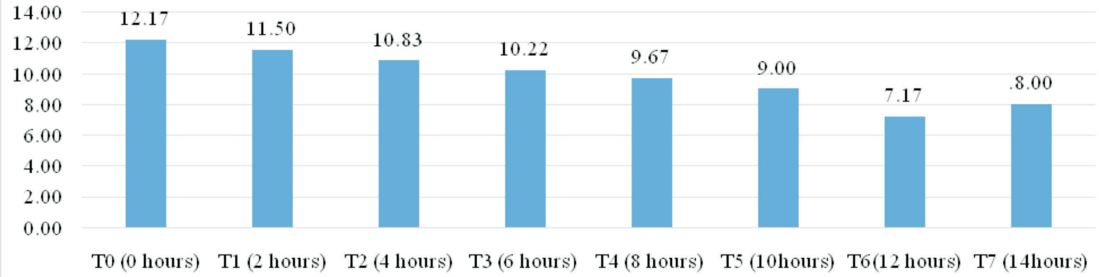


Figure 2: Germination percentage (%)

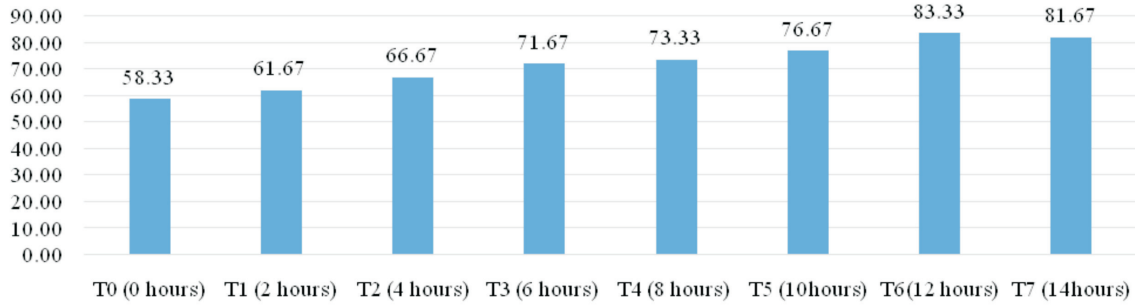


Figure 3:Seedling length (cm)

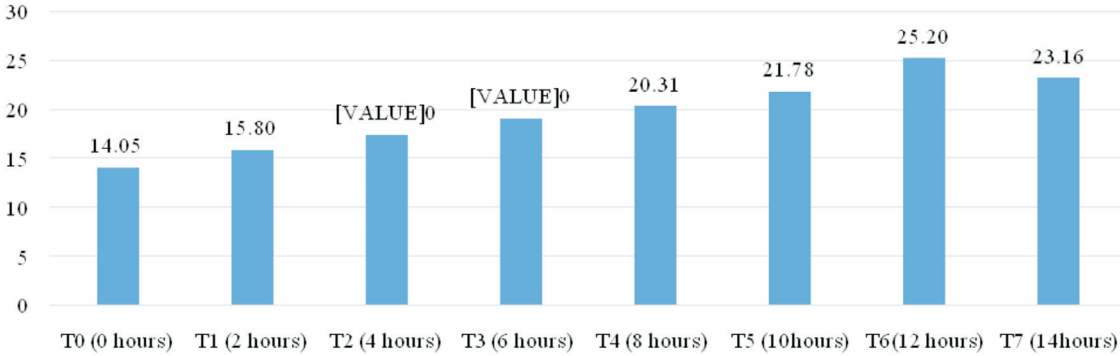


Figure 4: Seedling dry weight (mg)

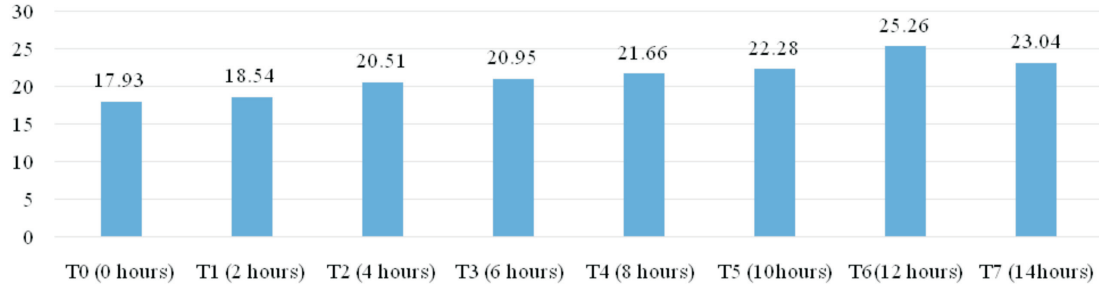


Figure 5:Length of shoot (cm)

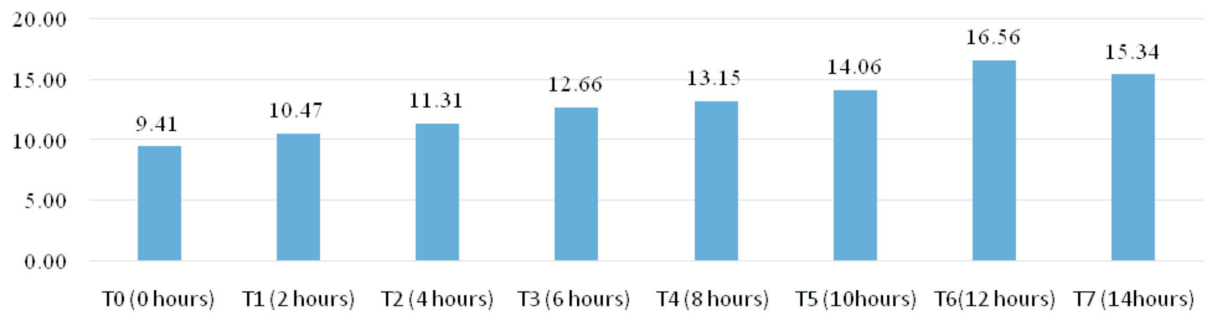


Figure 6: Length of root (cm)

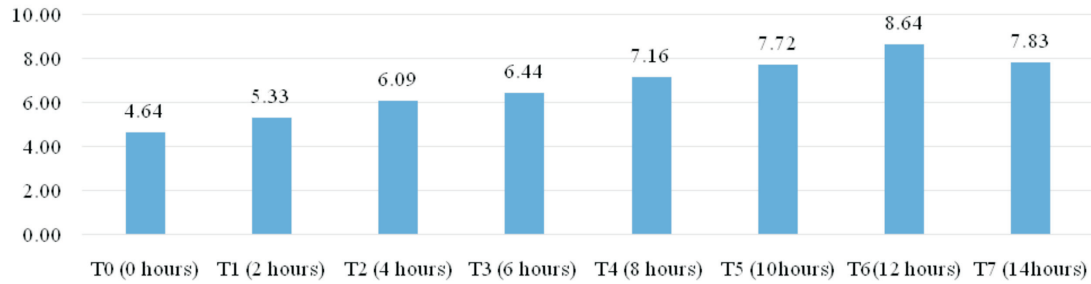


Figure 7: Seed vigour index-I (SVI)

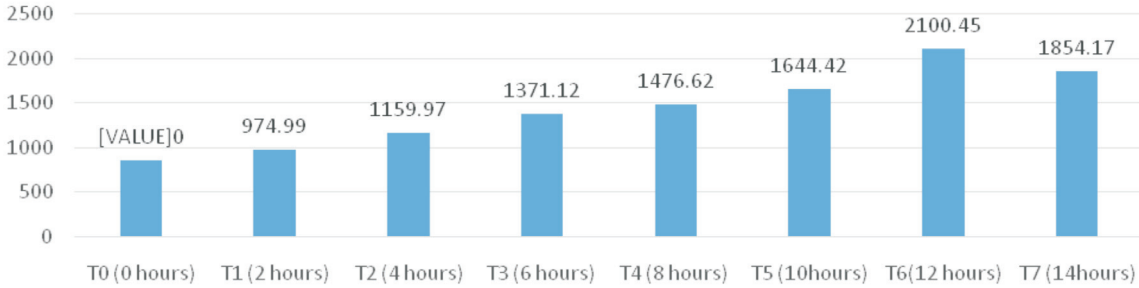
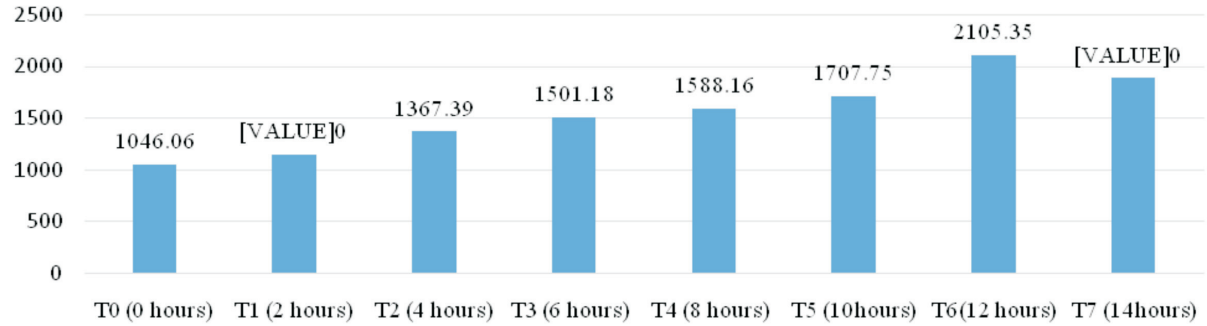


Figure 8 :Seed vigour index-II (SVI)



ing duration can also be used in future research.

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