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Original Research Article

Evaluation of Anatomical, Molecular and Physiological Potential of Primed and Non-Primed Seeds of Solanaceous Vegetables

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A B S T R A C T

The experiments were conducted at the Department of Seed Science and Technology during 2017 on mechanization of seed priming by standardizing the spin drying duration of the Seed Priming cabinet, to enhance the seed viability per cent, embryonic growth of the solanaceous vegetables *viz*., brinjal, chilli and tomato seeds. The seeds were subjected to conventional hydropriming which involves manual soaking, draining and shade drying and it was compared with mechanized seed priming and spin drying for 1, 2, 3, 4 and 5 min. The drought resistance of hydroprimed + spin dried seeds was evaluated through the physiological vigour parameters *viz*., speed of emergence, germination (%), root length (cm), shoot length (cm), dry matter production (mg/g seedlings^{-10}) and vigour index. The results on physiological vigour parameters expressed that hydroprimed and spin dried seeds excelled by registering high seed quality characters when compared to control seeds at 40 and 60 per cent water holding capacity. In chilli hydroprimed (48h) + 1 min. spin dried seeds showed 321.8 per cent increase in speed of emergence over untreated seeds, while the same parameter under 60 per cent water holding capacity revealed 90.0 per cent hike over 40 per cent water holding capacity. In brinjal 101.9 per cent increase in speed of emergence was noticed in hydroprimed (48h) + 2 min. spin dried seeds over non primed seeds and 61.8 per cent increase was noticed in 60 per cent water holding capacity over 40 per cent water holding capacity. Tomato seeds hydroprimed (48h) + 2 min. spin dried revealed 244.0 per cent increase in speed of emergence over nonprimed seeds and 43.0 per cent hike was noticed in 60 per cent water holding capacity over 40 per cent water holding capacity.

Keywords

Solanaceous, anatomical, seeds

Introduction

Plant growth, development and production are affected by natural stresses in the form of biotic and abiotic stresses such as drought, salinity and freezing, inversely (Abdalla and El-Khoshiban, 2007). Water deficit and salt stresses are global issues to ensure survival of agricultural and horticultural crops and sustainable food production (Jaleel *et al*., 2007). With increasing drought stress, water availability decreases, changing the percentage and velocity of germination and growth of seedlings adversely (Kaya *et al*., 2006). Seedling growth and establishment (Gamze *et al*., 2005), root/shoot ratio and root length at early stages of plant growth (Dhanda *et al*., 2004). Hence, the study was made to access the drought resistance potential with the standardized results from the previous experiments the best performing hydropriming (48 h) followed by spin drying treatments (spin dry for 1 min. in chilli and 2 min. in brinjal, tomato) along with nonprimed seeds were taken to assess the capability of treated seeds to survive under water stress condition.

Priming increases resistance to abiotic stresses (Farooq *et al.,* 2008). Primed seeds have been reported to give rise to crops, which matured earlier, and gave higher yields (Ndunguru and Rajabu, 2004). On-farm seed priming (Hydro-priming) can significantly be helpful in order to obtain good crop establishment in many crops of tropical region such as sorghum, rice, maize and pigeon pea. Inducing resistance against stresses like drought stress, heat stress etc. is one of the prominent advantages of seed priming in many important field crops (Javid Nawaz *et al.,* 2013). Seed priming sets in motion germination-related activities (e.g. respiration, endosperm weakening, and gene transcription and translation, etc.) that facilitate the transition of quiescent dry seeds into germinating state and lead to improved germination potential. Secondly, priming imposes abiotic stress on seeds that represses radicle protrusion but stimulates stress responses (e.g. accumulation of LEAs), potentially inducing cross-tolerance. Together, these two strategies constitute a 'priming memory' in seeds, which can be recruited upon a subsequent stress-exposure and mediates greater stress-tolerance of germinating primed seeds (Chen and Arora, 2013).

Materials and Methods

Genetically pure fresh seeds of brinjal (CO 2), chilli (K 2), and tomato (Arkavikas) were used in the experiments. Seed priming cabinet was used for standardization of spin drying duration. The major advantage of the machine is automatic draining of the priming solution and 'hands free' partial drying of the seeds, which enables hassle free handling of soaked seeds for further drying to original moisture content.

Effect of seed priming on seed vigour under water stress conditions

The seeds of all the test crops were subjected to the following treatments.

Seven replications of 25 seeds were subjected to seed germination test in sand medium having a water holding capacities of 40 and 60 percentage by using Factorial completely randomised block design.

Estimation of water holding capacities

For preparing the sand media at the above said water holding capacities, a known quantity (weight basis) of sand was taken in aluminium tray. The trays filled with sand were weighed initially on a sensitive platform balance. Then, known quantity of water was added till the media reached saturation and weighed again. The difference in weight was noted and the total quantity of water added to reach saturation was noted. This ratio of sand: water was taken as 100 % moisture holding capacity and from this 40 and 60 per cent of water was added to sand media to create sand media with 40 and 60 per cent water holding capacities. The sand water ratio was given below.

Observations

Germination (%)

Three replicates of 100 seeds each were germinated by using roll towel method (Between paper) under the test conditions of 25 ± 2 °C temperature and 90 ± 3 % RH maintained in a germination room illuminated with fluorescent light. After the test period of above mentioned crops, the number of normal seedlings in each replication was counted and expressed in percentage (ISTA, 2007). For the drought resistance experiment sand media was used with above said same environment condition instead of between paper method.

Speed of emergence, Root length and Shoot length

Speed of emergence was calculated by using Maguire (1962) method. Whereas, ten normal seedlings were selected at random from each replication and used for measuring the root length and shoot length and expressed in centimetre.

Dry matter production (mg seedlings^{-10})

Ten normal seedlings used for measuring root and shoot length were dried in shade for 24 h and then, in a hot air oven maintained at 85 °C for 48 h and allowed to cool in a desiccator for 30 min. The dried seedlings were weighed in an electronic digital balance and the mean values were expressed in mg seedlings^{-10} (Gupta, 1993).

Vigour index

Vigour index value was computed using the following formula and the mean values were expressed in whole number (Abdul-Baki and Anderson, 1973).

Vigour index = Germination (%) x Dry matter production (mg seedlings^{-10})

Statistical analysis

The data obtained from various experiments were analysed for the ‘F’ test of significance adopting the procedure described by Panse and Sukhatme (1985). Wherever necessary, the per cent values were transformed to angular (Arc-sine) values before analysis. The critical difference (CD) was calculated at 5 per cent (P = 0.05) probability level and wherever ‘F’ value is non-significant it is denoted by ‘NS’.

Results and Discussion

Chilli (Table 1& 2)

Speed of emergence

The analysis of variance showed highly significant difference in speed of emergence due to water holding capacity (W), hydropriming + spin drying treatments (T) and the interaction between the factors. Among the water holding capacity treatments, 60 per cent found to be superior withthe mean value of 2.66, than 40 per cent water holding capacity (1.40). Hydroprimed +spin dried for 1 min. showed quickest germination (3.29) over the control seeds (0.78) which has 76.3 percent reduction in speed of germination over the best treatment. Withrespect to the interactions between the factors hydroprimed + spin dried seeds for 1 min.sown in 60 per cent water holding capacity showed quickest germination of 3.37, followed by hydroprimed + spin dried seeds for 1 min. sown in 40 per cent water holding capacity (2.81). The control seeds sown in 40 per cent water holding capacity showed nil speed of germination (0).

Germination (%)

The analysis of variance showed highly significant difference in germination due to hydropriming + spin drying treatments (T) and water holding capacities (W) and the interaction between the factor T x W. Data on different water holding capacities revealed that, 60 per cent water holding capacity was found to be significant with the mean germination percentage of 45 %, over the 40 per cent water holding capacity (23 %). Among the treatments (T) highly significant difference was found in hydroprimed + spin dried for 1 min. with mean germination of 57%, over the control seeds (0 %). With respect to interactions between the factors hydroprimed + spin dried seeds for 1 min. sown in 60 per cent water holding capacity showed highest germination of 67 %, followed by hydroprimed + spin dried seeds for 1min. sown in 40 per cent water holding capacity (46 %). The control seeds sown in 40 percent water holding capacity showed nil germination.

Root length (cm)

The differences in root length were highly significant due to hydropriming + spin drying treatments (T), water holding capacities (W) and the interaction between T x W. Among the treatments, seeds hydroprimed + spin dried for 1 min. produced the longest root of 8.94 cm. whereas the nonprimed seeds recorded the shortest root length of 3.96 cm. As the water holding capacity increased (W_1 to W_2), the root length was increased significantly from 4.00 to 8.89 cm. With respect to interactions between the factors hydroprimed + spin dried seeds for 1 min. sown in 60 per cent water holding capacity showed longest root length of 9.87 cm, followed by hydroprimed + spin dried seeds for 1min. sown in 40% water holding capacity (8.01 cm). The control seeds sown in 40 per cent water holding capacity showed nil.

Shoot length (cm)

The shoot length of the seedlings showed highly significant differences due to hydropriming + spin drying treatments (T), water holding capacities (W) and the interaction between T x W. The seedlings obtained from hydropriming + spin drying for 1 min. recorded the maximum shoot length (5.13 cm). Whereas the minimum mean value was recorded by nonprimed seed (2.29 cm). Over the 40 per cent and 60 per cent water holding capacities advanced, the mean shoot length increased significantly from 2.31 cm to 5.11 cm. With respect to the interactions between the factors hydroprimed + spin dried seeds for 1 min. sownin 60 per cent water holding capacity showed longest shoot length of 5.64 cm, followed by hydroprimed + spin dried seeds for 1 min. sown in 40 per cent water holding capacity (4.62 cm). The control seeds sown in 40 per cent water holding capacity showed nil.

Dry matter production (mg seedlings^{-10})

The differences in dry matter production of seedlings were highly significant due to hydropriming + spin drying treatments (T) and water holding capacities (W) and for their interaction between T x W. Among the treatments (T), seeds hydroprimed + spin dried for 1 min. produced the highest dry matter production of (28.3 mg), while the lowest dry matter was produced by nonprimed seeds (12.9 mg). As the water holding capacity advanced from 40 per cent to 60 per cent the increase in dry matter production was noticed from 13.2 mg to 28.0 mg. With respect to the interactions between the factors hydroprimed + spin dried seeds for 1 min. sown in 60 per cent water holding capacity showed maximum dry matter production of 30.2 mg, followed by hydroprimed + spin dried seeds for 1 min. sown in 40 per cent water holding capacity (26.4 mg). The control seeds sown in 40 per cent water holding capacity showed nil.

Vigour index

Highly significant variations were observed in vigour index due to hydropriming + spin drying treatments (T), and water holding capacities and their interaction (T x W). The analysis of variance revealed highly significant improvement in seeds hydroprimed + spin dried for 1 min. (T_1) with a mean vigour index of 1618 over the (T_0) non primed seeds (298). Among the water holding capacities, the mean vigour index value reduced concomitantly from 1309 (W_2– 60 % water holding capacity) to 607 (W_1 – 40 % water holding capacity).

Brinjal (Table 3 & 4)

Speed of emergence

The analysis of variance showed highly significant difference in speed of emergence due to water holding capacity (W), hydropriming + spin drying treatments (T) and the interaction between the factors was nonsignificant.

Among the water holding capacity treatments, 60 per cent found to be superior with the mean value of 3.77, than 40 per cent water holding capacity (2.33). Hydroprimed + spin dried for 2 min. showed quickest germination (4.08) over the control seeds (2.02).

Germination (%)

The analysis of variance showed highly significant difference in germination due to hydropriming + spin drying treatments (T) and water holding capacities (W). Whereas, the interaction between T x W was nonsignificant. Among the different water holding capacities, 60 per cent water holding capacity was found to be significant with the mean germination percentage of (77 %), over the 40 per cent water holding capacity (54 %). Among the treatments (T) highly significant difference was found in hydroprimed + spin dried for 2 min. with mean germination percentage of 84 %, over the control seeds (47 %).

Root length (cm)

The differences in root length were highly significant due to hydropriming + spin drying treatments (T), water holding capacities (W). Whereas, the interaction between T x W was nonsignificant. Among the treatments, seeds hydroprimed + spin dried for 2 min. produced longest root of 7.95 cm. whereas the nonprimed seeds recorded the shortest root length of 6.35 cm. As the water holding capacity advanced (W_1 to W_2), the root length was increased significantly from 6.65 to 7.65 cm.

Shoot length (cm)

The shoot length of the seedlings showed highly significant differences due to hydropriming + spin drying treatments (T), water holding capacities (W). Whereas, the interaction between T x W was nonsignificant. The seedlings obtained from hydropriming + spin drying for 2 min. recorded the maximum shoot length (5.35 cm). Whereas the minimum mean value was recorded by nonprimed seed (2.75 cm). Over the 40 per cent and 60 per cent water holding capacities advanced, the mean shoot length increased significantly from 3.65 cm to 4.45 cm.

Dry matter production (mg seedlings-^{10})

The differences in dry matter production of seedlings were highly significant due to hydropriming + spin drying treatments (T) and water holding capacities (W) and for their interaction between T x W was nonsignificant.

Among the treatments (T), seeds hydroprimed + spin dried for 2 min. produced the highest dry matter production of (18.7 mg), while the lowest dry matter was produced by nonprimed seeds (15.4 mg). As the water holding capacity advanced from 40 per cent to 60 per cent the increase in dry matter production was noticed from 15.8 mg to 18.3 mg.

Table.1 Effect of hydropriming and spin drying on speed of germination, germination (%) and root length (cm) of chilli under water stress condition

Parameters	**Speed of germination**			**Germination (%)**			**Root length (cm)**		
Treatments	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**
T_0	0	1.56	**0.78**	0 (0)	23 (28.65)	**12 (14.32)**	0	7.92	**3.96**
T_1	2.81	3.77	**3.29**	46 (42.70)	67 (54.94)	**57 (48.82)**	8.01	9.87	**8.94**
Mean	**1.40**	**2.66**	**2.03**	**23 (21.35)**	**45 (41.79)**	**34 (31.57)**	**4.00**	**8.89**	**6.45**
	W	**T**	**W x T**	**W**	**T**	**W x T**	**W**	**T**	**W x T**
SEd	0.02	0.02	0.03	0.32	0.33	0.46	0.06	0.06	0.09
CD (P = 0.05)	0.05	0.05	0.07	0.70	0.71	1.00	0.13	0.14	0.19

(Figures in parentheses indicates arcsine values)

Table.2 Effect of hydropriming and spin drying on shoot length (cm), dry matter production (mg seedlings^{-10}) and vigour index of chilli under water stress condition

Parameters	**Shoot length (cm)**			**Dry matter production (mg seedlings^{-10})**			**Vigour index**		
Treatments	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**
T_0	0	4.59	**2.29**	0	25.9	**12.9**	0	596	**298**
T_1	4.62	5.64	**5.13**	26.4	30.2	**28.3**	1214	2023	**1618**
Mean	**2.31**	**5.11**	**3.71**	**13.2**	**28.0**	**20.6**	**607**	**1309**	**958**
	W	**T**	**W x T**	**W**	**T**	**W x T**	**W**	**T**	**W x T**
SEd	0.03	0.03	0.05	0.25	0.25	0.35	10.1	10.1	14.32
CD (P = 0.05)	0.07	0.08	0.11	0.54	0.55	0.77	22.0	22.0	31.21

(Figures in parentheses indicates arcsine values)
W_1 - 40 % Water holding capacity; W_2 – 60% Water holding capacity
T_0 – Control (Raw seeds); T_1- Hydro priming & best spin duration (1 min.)

Table.3 Effect of hydropriming and spin drying on speed of germination, germination (%) and root length (cm) of brinjal under water stress condition

Parameters	**Speed of germination**			**Germination (%)**			**Root length (cm)**		
Treatments	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**
T_0	1.35	2.70	**2.02**	34 (35.66)	61 (51.35)	**47 (43.50)**	5.80	6.90	**6.35**
T_1	3.32	4.85	**4.08**	75 (60.00)	94 (75.82)	**84 (67.91)**	7.50	8.40	**7.95**
Mean	**2.33**	**3.77**	**3.05**	**54 (47.83)**	**77 (63.58)**	**66 (55.70)**	**6.65**	**7.65**	**7.15**
	W	**T**	**W x T**	**W**	**T**	**W x T**	**W**	**T**	**W x T**
SEd	0.01	0.01	0.02	0.47	0.48	0.68	0.07	0.07	0.10
CD (P = 0.05)	0.03	0.03	NS	1.04	1.04	NS	0.15	0.15	NS

(Figures in parentheses indicates arcsine values) NS: Non Significant

Table.4 Effect of hydropriming and spin drying on shoot length (cm), dry matter production (mg seedlings^{-10}) and vigour index of brinjal under water stress condition

Parameters	Shoot length (cm)			Dry matter production (mg seedlings^{-10})			Vigour index		
Treatments	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**
T_0	2.4	3.1	**2.75**	14.2	16.6	**15.4**	483	1013	**748**
T_1	4.9	5.8	**5.35**	17.4	20.1	**18.7**	1305	1890	**1597**
Mean	**3.65**	**4.45**	**4.05**	**15.8**	**18.3**	**17.0**	**894**	**1451**	**1172**
	W	**T**	**W x T**	**W**	**T**	**W x T**	**W**	**T**	**W x T**
SEd	0.03	0.03	0.05	0.17	0.17	0.24	14.3	14.4	20.35
CD (P = 0.05)	0.07	0.07	NS	0.39	0.38	NS	31.3	31.3	NS

(Figures in parentheses indicates arcsine values) NS: Non Significant

W_1 - 40 % Water holding capacity; W_2 – 60% Water holding capacity

T_0 – Control (Raw seeds); T_1- Hydro priming & best spin duration (2 min.)

Concomitantly from 1451 (W_2 – 60 % water holding capacity) to 894 (W_1 – 40 % water holding capacity) accounting for 62.3 per cent reduction.

Table.5 Effect of hydropriming and spin drying on speed of germination, germination (%) and root length (cm) of tomato under water stress condition

Parameters	Speed of germination			Germination (%)			Root length (cm)		
Treatments	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**
T_0	0.43	1.07	**0.75**	15 (22.78)	31 (33.83)	**23 (28.30)**	11.2	13.7	**12.4**
T_1	2.31	2.86	**2.58**	79 (62.72)	86 (68.02)	**82 (65.37)**	17.3	18.1	**17.7**
Mean	**1.37**	**1.96**	**1.66**	**47 (42.75)**	**58 (50.92)**	**52 (46.83)**	**14.2**	**15.9**	**15.0**
	W	**T**	**W x T**	**W**	**T**	**W x T**	**W**	**T**	**W x T**
SEd	0.01	0.01	0.02	0.33	0.34	0.48	0.08	0.08	0.12
CD (P = 0.05)	0.03	0.03	NS	0.74	0.74	NS	0.19	0.18	NS

(Figures in parentheses indicates arcsine values) NS: Non Significant

Table.6 Effect of hydropriming and spin drying on shoot length (cm), dry matter production (mg seedlings^{-10}) and vigour index of tomato under water stress condition

Parameters	Shoot length (cm)			Dry matter production (mg seedlings^{-10})			Vigour index		
Treatments	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**	**W_1**	**W_2**	**Mean**
T_0	3.50	4.44	**3.97**	19.4	23.7	**21.5**	291	735	**513**
T_1	5.07	6.12	**5.59**	29.2	32.8	**31.0**	2307	2821	**2564**
Mean	**4.28**	**5.28**	**4.78**	**24.3**	**28.2**	**26.2**	**1299**	**1778**	**1538**
	W	**T**	**W x T**	**W**	**T**	**W x T**	**W**	**T**	**W x T**
SEd	0.05	0.05	0.07	0.16	0.16	0.23	25.6	25.6	36.2
CD (P = 0.05)	0.11	0.11	NS	0.36	0.35	NS	55.8	55.7	NS

(Figures in parentheses indicates arcsine values) NS: Non Significant

W_1 - 40 % Water holding capacity; W_2 – 60% Water holding capacity

T_0 – Control (Raw seeds); T_1- Hydro priming & best spin duration (2 min.)

Plate.1 Effect of 'hydro priming and spin drying' on seed germination and seedling growth of chilli under water stress condition

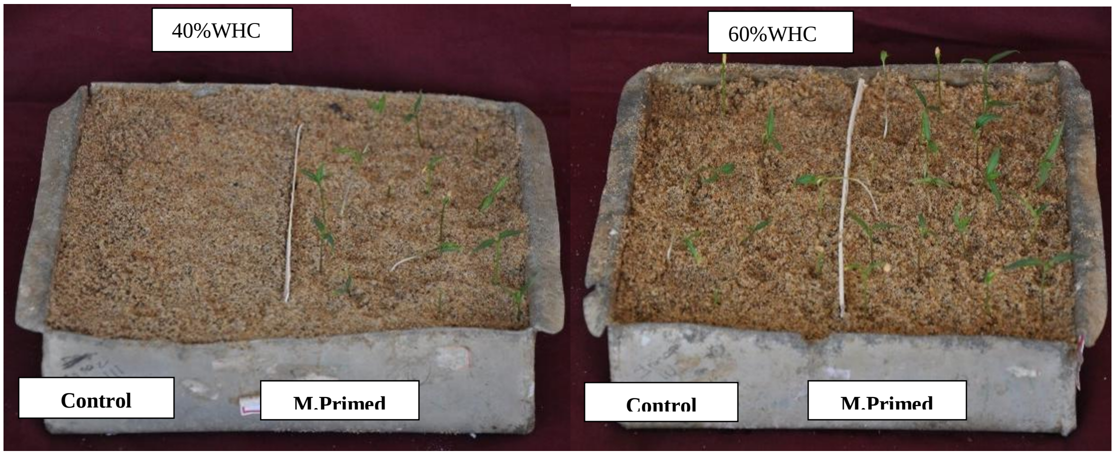


Plate.2 Effect of 'hydro priming and spin drying' on seed germination and seedling growth of muskmelon under water stress condition

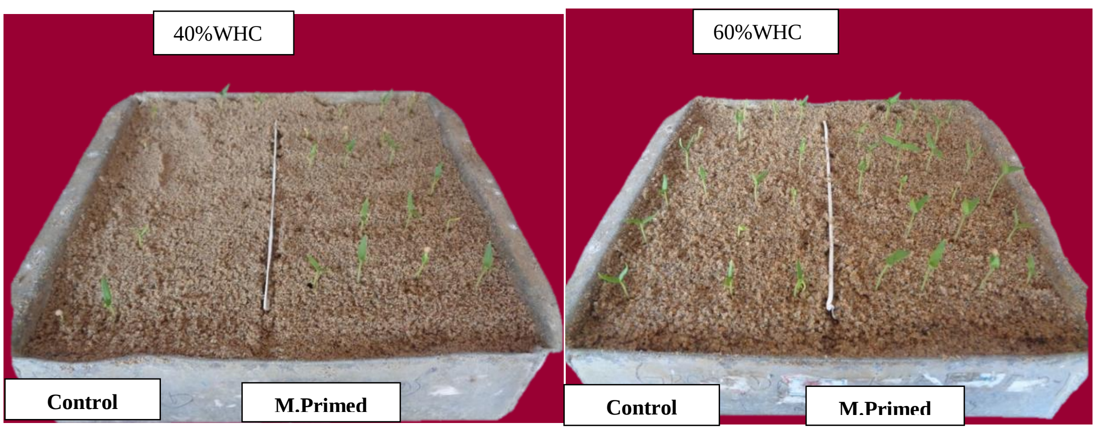
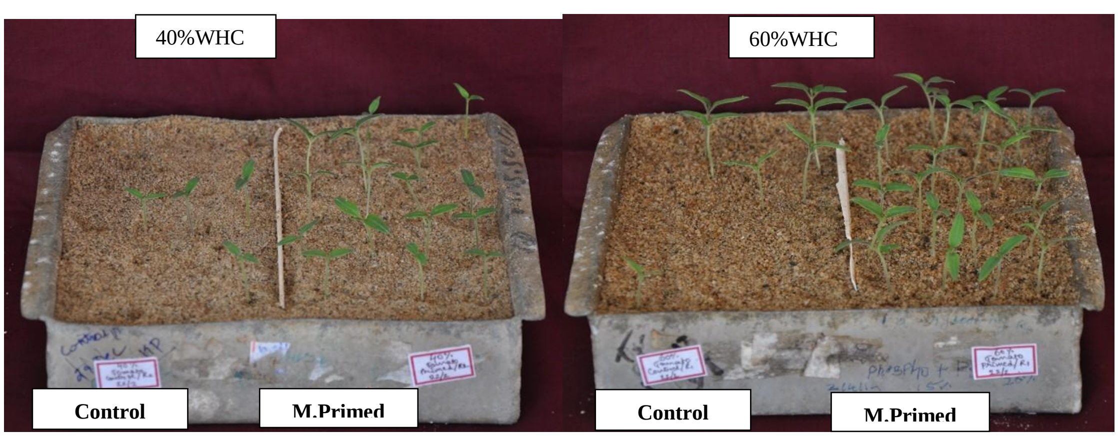


Plate.3 Effect of 'hydro priming and spin drying' on seed germination and seedling growth of tomato under water stress condition



Effect of seed priming on seed vigour under water stress conditions

	Treatments	Description
T1	Mechanized priming	The best spin drying duration (Hydropriming 48h + 1 min.)
T0	Control	Unprimed raw seeds

Estimation of water holding capacities

Water holding capacity (%)	Water(ml) /kg of sand
40	120
60	180

Vigour index

Highly significant variations were observed in vigour index due to hydropriming + spin drying treatments (T), and water holding capacities and their interaction (T x W) was nonsignificant.

The analysis of variance revealed highly significant improvement in seeds hydroprimed + spin dried for 2 min. (T_1) with a mean vigour index of 1597 over the (T_0) non primed seeds (748). Among the water holding capacities, the mean vigour index value reduced

Tomato (Table 5 & 6)

Speed of emergence

The analysis of variance showed highly significant difference in speed of emergence due to water holding capacity (W), hydropriming + spin drying treatments (T) and the interaction between the factors was nonsignificant.

Among the water holding capacity treatments, 60 per cent found to be superior with the mean value of 1.96, than 40 per cent water holding capacity (1.37). Hydroprimed + spin dried for 2 min. showed quickest germination (2.58) over the control seeds (0.75).

Germination (%)

The analysis of variance showed highly significant difference in germination due to hydropriming + spin drying treatments (T) and water holding capacities (W). Whereas, the interaction between T x W was nonsignificant.

Among the different water holding capacities, 60 per cent water holding capacity was found to be significant with the mean germination of 58 per cent, over the 40 per cent water holding capacity (47 %). Among the treatments (T) highly significant difference was found in hydroprimed + spin dried for 2 min. with mean germination of 82 per cent, over the control seeds (23 %).

Root length (cm)

The differences in root length were highly significant due to hydropriming + spin drying treatments (T), water holding capacities (W). Whereas, the interaction between T x W was nonsignificant.

Among the treatments, seeds hydroprimed + spin dried for 2 min. produced longest root of 17.7 cm. whereas the nonprimed seeds recorded the shortest root length of 12.4 cm. As the water holding capacity advanced (W_1 to W_2), the root length was increased significantly from 14.2 to 15.9 cm.

Shoot length (cm)

The shoot length of the seedlings showed highly significant differences due to hydropriming + spin drying treatments (T), water holding capacities (W). Whereas, the interaction between T x W was nonsignificant. The seedlings obtained from hydropriming + spin drying for 2 min. recorded the maximum shoot length (5.59 cm). Whereas the minimum mean value was recorded by nonprimed seed (3.97 cm). Over the 40 per cent and 60 per cent water holding capacities advanced, the mean shoot length increased significantly from 4.28 to 5.28 cm.

Dry matter production (mg seedlings^{-10})

The differences in dry matter production of seedlings were highly significant due to hydropriming + spin drying treatments (T) and water holding capacities (W) and for their interaction between T x W was nonsignificant. Among the treatments (T), seeds hydroprimed + spin dried for 2 min. produced the highest dry matter production of (31.0 mg), while the lowest dry matter was produced by nonprimed seeds (21.5 mg). As the water holding capacity advanced from 40 per cent to 60 per cent the increase in dry matter production was noticed from 24.3 to 28.2 mg.

Vigour index

Highly significant variations were observed in vigour index due to hydropriming + spin drying treatments (T), and water holding capacities and their interaction (T x W) was nonsignificant. The analysis of variance revealed highly significant improvement in seeds hydroprimed + spin dried for 2 min. (T_1) with a mean vigour index of 2564 over the (T_0) non primed seeds (513). Among the water holding capacities, the mean vigour index value reduced concomitantly from 1778 (W_2 – 60 % water holding capacity) to 1299 (W_1 – 40 % water holding capacity) accounting for 36.9 per cent reduction.

In the present study, a lab experiment was conducted under 40 per cent and 60per cent water holding capacities to evaluate the performance of spin dried seeds of chilli, brinjal and tomato. In chilli hydroprimed + 1 min. spin dried seeds showed 321.8 per cent increase in speed of germination over untreated seeds, while the same parameter under 60 per cent water holding capacity revealed 90.0 per cent hike over 40 per cent water holding capacity. Among the interactions between water holding capacities and the treatments, hydroprimed + 1 min. spin dried seeds sown in 60 per cent water holding capacity was found to be superior followed by hydroprimed + 1 min. spin dried seeds sown in 40 per cent water holding capacity (Plate 1). In brinjal 101.9 per cent increase in speed of emergence was noticed inhydroprimed + 2 min. spin dried seeds over non primed seeds and 61.8 per cent increase was noticed in 60 per cent water holding capacity over 40 per cent water holding capacity (Plate 2). Tomato seeds hydroprimed + 2 min. spin dried revealed 244.0 per cent increase in speed of emergence over nonprimed seeds and 43.0 per cent hike was noticed in 60 per cent water holding capacity over 40 per cent water holding capacity (Plate 3).

The germination potential is the basic requirement for any seeds. The viability and vigour are the two important factors of seed quality and they go hand in hand while judging the seed quality. The results of the present study indicated that chilli seeds hydroprimed + spin dried for 1 min. had maintained the germination at higher level by recording 240.9 per cent higher over nonprimed seeds, while under 60 per cent water holding capacity the germination was found to be increase at 95.7 per cent over 40 per cent water holding capacity. Among the interactions between the water holding capacities and treatments, seeds hydroprimed + spin dried for 1 min. sown in 60 per cent water holding capacity recorded significant germination per cent followed by seeds hydroprimed + spin dried for 1 min. sown in 40 per cent water holding capacity. In brinjal 56.1per cent increase in germination was noticed in hydroprimed + 2 min. spin dried seeds over non primed seeds and 32.9 per cent increase was noticed in 60 per cent water holding capacity over 40 per cent water holding capacity. Tomato seeds hydroprimed + 2 min. spin dried revealed 130.9 per cent increase in germination over nonprimed seeds and 19.1 per cent hike was noticed in 60 per cent water holding capacity over 40 per cent water holding capacity.

The results on physiological vigour parameters expressed that all the treatments exert a negative association with the water stress condition. The seedling growth parameters observed *viz.,* root length, shoot length, dry matter production and vigour index showed a positive response to the spin drying treatment, which were higher compared to control seeds.

Hydropriming have profound effects on germination rate and uniformity in emergence of seedlings specifically under stressful conditions (Wahid *et al.,* 2007). Similarly significant improvement in germination and early growth of wheat (cv. Darab) due to hydropriming treatment, soaking seeds for 36 h resulted in in vigourate of germination under salinity and drought stress as well as normal conditions (Hamid *et al.,* 2010). The germination improvement with hydropriming might be due to hydrolysis of complex nutrients into simple sugars that are readily utilized in the synthesis of auxins and proteins. The auxins so produced help to soften cell walls to facilitate growth and the proteins readily utilized in the production of new tissues (Sabongari and Aliero, 2004). The beneficial effects of hydropriming have been attributed to the mobilization in embryonic tissues of enzyme activities required for rapid seed germination and of compounds such as free amino acids, proteins, and soluble sugars from storage organs (Ashraf and Foolad, 2005).

Conclusion

The seeds were evaluated for drought resistance of hydroprimed + spin dried seeds of twelve vegetable crops as compared with nonprimed seeds under 40 and 60 percent water holding capacities. The result revealed that chilli seeds spin dried for 1min. and 2 min. for brinjal and tomatoshowed321.8, 244.0 and 168.4per cent faster emergence as compared to nonprimed seeds. Among the two water holding capacities *viz.,* 40 and 60 per cent in co-ordinance with the above said crops in sequence, 60 per cent water holding capacity recorded 90.0, 61.8 and 43.1 percent increase in speed of emergence over non primed seeds, respectively. All the above said crops in sequence hydroprimed+ spin dried seeds recorded the germination at higher level by 240.9, 56.1 and 130.9 per cent over nonprimed seeds.

The salient findings of the study as follows:

The hydroprimed seed subjected to spin drying can able to survive even under water stress condition.

Significant difference was observed in seed quality parameters in ‘hydroprimed + spin dried seeds’ over conventional priming and nonprimed seeds.

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