

## Effect of hydro-priming and halo-priming on seed quality of faba bean varieties

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**ABSTRACT** Farmers and researchers have recognized that poor crop establishment is a major constraint for crop production. Effect of seed priming treatments on physiological seed quality and seed health of faba bean varieties was investigated. The experiment was laid out with priming treatment (*i.e.* unprimed, 6, 12, 18 and 24 hrs with water and with  $\text{KH}_2\text{PO}_4$  at 0.5% solution for 12 hrs) and faba bean varieties (*i.e.* CS20DK, Gachena and Moti) in CRD factorial arrangement with four replications. The laboratory and green house results field experiments revealed significant differences at ( $P < 0.001$ ) for standard germination percentage, field emergence index, shoot length, seedling dry weight, vigour index I and II, speed of germination and electrical conductivity. However, halo-priming improved all seed vigour parameters except seedling dry weight, electrical conductivity and field emergence index for CS20DK did improve root length (17.73 cm) for Moti and had improved electrical conductivity ( $87.99 \mu\text{scm}^{-1}\text{g}^{-1}$ ) and field emergence index (27.77%) for Gachena variety. Improvement made by hydro-priming was better than unprimed seed. The seed health status showed that incidence of *Rhizopus* sp. was higher among primed seeds. The present study concluded that 12h hydro-priming can set up economical benefit of faba bean growing farmers under field conditions.

**Key words:** Priming, hydro-priming, halo-priming, seed quality, vigour

Good crop stand establishment utilization a prerequisite for efficient resources for high yield. It is particularly true in the moisture supply where there is a delicate balance between availability and requirement for water due to unpredictable rainfall conditions. Faba bean is grown under rain fed agriculture, especially primarily moisture under low conditions. The crop needs to be re-sown; incurring additional production cost and labor.

Soaking has never been done on a regular basis at farmer's level and the duration of soaking is highly variable. Despite lack of research in Ethiopia, this practice is known to some farmers. Information about seed priming treatment and time analysis on seed quality of faba bean produced limited under moisture supply is meager. Rapid germination and emergence are essential for successful crop establishment, for which seed priming was reported to help in rapid,

uniform germination, emergence and to increase seed tolerance to adverse environmental conditions. The present study was conducted to identify seed priming treatment in faba bean for improved germination and stand establishment.

### MATERIALS AND METHODS

The research was conducted at Haramaya University, Ethiopia. Three improved faba bean (*Vicia faba* L.) varieties namely CS20DK, Gachena and Moti seeds were used for the study. The seeds of each variety were soaked in water for 6, 8, 12 and 24 hrs and  $\text{KH}_2\text{PO}_4$  @ 0.5% solution for 12 hrs along with unprimed seeds as control. After soaking seeds were dried in shade. The observations were taken for standard germination [1] shoot and root length, seedling dry weight [2], vigour index I & II [3], speed of germination and field emergence index [4], conductivity test and seed health test [1]. The results were statistically analyzed [5].

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## RESULTS AND DISCUSSION

In the present study it has been found that seeds of the faba bean varieties showed different responses to the priming treatment. Analysis of variance revealed that these seed invigoration techniques had influenced seed quality significantly. There was a highly significant interaction effect between varieties and priming treatments in enhancing standard germination percentage. The highest standard germination percentage was recorded when the variety CS20DK was primed with water for 18 hrs (100%) and which was at par (97%) with CS20DK primed with  $\text{KH}_2\text{PO}_4$  (Table 1). Similar results have also been reported by different scientists [6-16]. It could be due breaking of dormancy, hydrolysis or metabolism of inhibitors, imbibition and enzymes activation. The highest shoot length was recorded when the Gachena variety was hydro-primed for 12 hr (17.02cm, Table 1). The halo-priming with  $\text{KH}_2\text{PO}_4$  and hydro-priming did increase relative shoot length compared to untreated seeds [13]. The highest root length was recorded in hydro-primed Moti (19.25 cm), which was at par with the variety CS20DK (hydro-primed)(18.68cm, Table 2). The increase in root length could be due to activation of cell respiration, repair of macro molecules, activation of cell cycle activities [11, 17]. There was a highly significant interaction effect between varieties and seed priming treatment in enhancing seedling dry weight (Table 2). The highest dry weight was recorded hydro-primed Moti variety (3.45 g) which was at par with the hydro-primed Gachena (3.25g) and halo-primed Gachena variety {(3.15g) Table 2}. An increase in dry weight might be due to increase in metabolic activities in the hydro-primed seeds [6-7]. The highest speed of germination was recorded in the variety CS20DK (primed with water for 18hr, 47.5%) which was at par with Gachena (primed with water for 24hr, 47.33%). 18hr (45.16%) and 24 hr (44.31%) seed primed with water were also having highest speed of germination [4] (Table 3).

Variety Moti had recorded lowest electrical conductivity (16.05) as compared to the other two varieties (Table 3). There was a highly significant ( $P<0.001$ ) interaction effect between varieties and seed priming treatments in electrical conductivity. The low electrical conductivity for primed seed was due to better integrity. The varieties showed highly significant differences ( $P<0.001$ ) for vigour index I, wherein the highest vigour Index I were recorded on variety CS20DK (1470.20) as compared to the Gachena and Moti varieties, and among priming treatments ( $P<0.001$ ) 12hr (1558.51) and 18hr (1508.85) seed hydro-priming had recorded highest vigour Index I (Table 4). Results of the present study suggested that seed priming was effective tools for seed quality enhancement in faba bean (*Vicia faba* L.) [18].

The highest vigour Index II was recorded (Table 4) when the varieties CS20DK was primed with  $\text{KH}_2\text{PO}_4$  at 0.5% solution for 12 hr (305.30) which was at par with Moti (303.40). Similar results have been reported by Dornbos [8].

The highest field emergence Index was recorded from Gachena variety primed with water for 12hr (28.3) which was at par with Gachena primed with  $\text{KH}_2\text{PO}_4$  at 0.5% for 12hr (27.77) and CS20DK primed with water for 24hr (25.9) (Table 5). The priming has an effect in enhancing field emergence index [11, 17]. Similar results have been reported by researchers [16 - 18].

### *Fungi associated with Faba bean seeds*

Seven fungi and one bacterium were found to be associated with faba bean seed (Table 6). These fungi were detected using the agar (PDA) plate test method. Similar results were reported for field pea [8]. Surface sterilization of seeds could reduce the fungi found on the surface of the seed. The highest detected percentage infection, fungi of the seed was observed an *Rhizopus* spp. (24.44%) detected in variety Gachena which was hydro-primed

**Table 1. Effect of hydro-priming and halo-priming in faba varieties on per cent germination and seedling shoot length**

Variety	Standard germination (%)										Seedling shoot length (cm)			
	unprimed	6hr	12hr	18hr	24hr	12p <sup>2</sup>	mean	unprimed	6hr	12hr	10hr	24hr	12p <sup>2</sup>	mean
Cs20DK	88.5	93.5	94.0	100.0	93.5	97.0	94.4	10.55	12.75	16.07	15.13	12.3	15.53	13.72
Gachena	74.0	77.0	86.5	87.0	84.5	87.0	82.6	12.77	15.58	17.03	15.73	15.4	11.9	14.73
Moti	84.0	94.5	88.0	92.0	91.0	85.5	89.1	12.0	13.2	14.85	12.35	10.55	14.23	12.86
Mean	82.1	88.3	89.5	93.8	89.6	89.5		11.77	13.84	15.98	14.40	12.75	13.88	
LSD		2.43		3.43					5.96		0.62		0.88	1.52
CV %									2.42					7.8

The data is mean of four replications; 12 p<sup>2</sup> is haloprimed (KH<sub>2</sub>P<sub>4</sub>)

**Table 2. Hydro-priming and halo-priming durations with faba bean varieties interaction effect on seedling root length and dry weight**

Variety	Seedling root length (cm)										Seedling dry weight (g)			
	unprimed	6hr	12hr	18hr	24hr	12p <sup>2</sup>	mean	unprimed	6hr	12hr	10hr	24hr	12p <sup>2</sup>	mean
Cs20DK	16.63	17.40	18.68	18.35	14.85	18.13	17.33	2.48	2.75	2.83	2.8	3.13	3.15	2.85
Gachena	16.40	17.90	18.68	18.08	18.53	15.5	17.51	1.05	3.13	3.25	3.05	2.6	3.15	2.85
Moti	16.43	17.15	19.25	17.73	15.50	17.75	17.30	2.1	2.53	3.45	2.43	3.1	2.83	2.73
Mean	16.48	17.48	18.86	18.05	16.29	17.12		2.17	2.80	3.17	2.75	2.93	3.04	
LSD		0.84		1.19					0.12		0.17			0.29
CV %									8.41					7.4

The data is mean of four replications; 12 p<sup>2</sup> is haloprimed (KH<sub>2</sub>P<sub>4</sub>)

**Table 3. Effect of hydro and halo-priming durations on seedling and electrical conductivity in faba bean**

Variety	Standard germination										Electrical conductivity ( $\mu\text{s} / \text{cm}^2$ )			
	unprimed	6hr	12hr	18hr	24hr	12p <sup>2</sup>	mean	unprimed	6hr	12hr	10hr	24hr	12p <sup>2</sup>	mean
Cs20DK	9.54	14.57	34.8	47.5	47.13	41.17	32.45	4.22	7.29	7.23	10.68	9.19	65.42	17.37
Gachena	7.9	24.58	40.27	45.43	47.33	31.4	33.32	4.48	7.84	8.03	14.72	15.45	87.99	23.13
Moti	5.1	9.65	26.63	42.55	38.48	23.4	24.30	3.74	5.48	7.35	9.88	10.55	59.27	16.05
Mean	7.52	16.26	33.90	45.16	44.31	33.0		4.15	6.87	7.63	11.82	11.73	70.89	
LSD		1.43		2.02		3.508			0.82		1.69		2.03	
CV %						7.05								7.59

The data is mean of four replications; 12 p<sup>2</sup> is haloprimed ( $\text{KH}_2\text{PO}_4$ )

**Table 4. Hydro priming and osmopriming durations with faba bean varieties interaction effect on**

Variety	Vigour - I (%)										Vigour - II (%)			
	unprimed	6hr	12hr	18hr	24hr	12p <sup>2</sup>	mean	unprimed	6hr	12hr	10hr	24hr	12p <sup>2</sup>	mean
Cs20DK	1203.13	1408.30	1632.95	1673.75	1269.95	163310	1470.20	219.2	256.75	26.54	280.6	292.15	305.3	269.80
Gachena	1081.78	1286.58	1541.18	1469.58	1433.85	1191.93	1334.15	144.4	239.7	280.8	265.15	220.35	273.85	237.37
Moti	1194.55	1432.70	1501.4	1383.23	1185.75	1366.18	1343.97	176.6	238.45	303.4	223.25	280.0	242.0	243.95
Mean	1159.82	1357.86	1558.51	1508.85	1296.52		180.06	244.96	283.2	256.13	264.16	273.71		
LSD		62.97		89.05		154.25		11.95			16.90		29.28	
CV %						7.87								8.24

The data is mean of four replications; 12 p<sup>2</sup> is haloprimed ( $\text{KH}_2\text{PO}_4$ )

**Table 5. Effect of hydro and halo priming on field emergence of faba bean**

Variety	Field emergence (%)						mean
	unprimed	6hr	12hr	18hr	24hr	12p2	
Cs20DK	15.6	19.57	23.13	24.1	25.93	23.8	22.02
Gachena	16.97	18.73	28.3	29.62	23.7	27.77	22.84
Moti	14.76	17.3	23.76	22.87	21.8	22.17	20.45
Mean	15.77	18.53	25.06	22.86	23.83	24.57	
LSD	1.23	1.74	3.01				
CV %			8.37				

**Table 6. Incidence of fungal flora on hydro-primed and osmoprimed faba bean varieties**

Fungal species	Variety	Priming treatment					
		unprimed	6hr	12hr	18hr	24hr	12 <sup>2</sup> P
<i>Fusarium spp</i>	CS20DK	1.11	0	0	0	0	0
	Gachena	1.11	0	0	0	0	0
	Moti	0	0	0	0	0	0
<i>Rhizopus</i>	CS20DK	2.22	12.22	6.66	7.77	11.11	2.22
	Gachena	0	10	16.66	10	24.44	17.78
	Moti	2.22	18.89	6.66	10.0	6.66	1.11
<i>Penicillium</i>	CS20DK	2.22	0	0	0	0	0
	Gachena	0	0	16.67	0	0	0
	Moti	0	0	0	0	0	0
<i>Aspergillus niger</i>	CS20DK	2.22	0	4.44	0	0	2.22
	Gachena	0	0	0	0	0	0
	Moti	2.22	0	0	1.11	0	0
<i>Aspergillus flavus</i>	CS20DK	2.22	0	0	0	0	0
	Gachena	2.22	0	0	0	0	0
	Moti	0	0	0	0	0	0
<i>Aspergillus fumigatus</i>	CS20DK	0	0	1.11	0	0	0
	Gachena	0	0	0	0	0	0
	Moti	0	0	1.11	0	0	0
<i>Aspergillus ochraceus</i>	CS20DK	0	0	0	0	0	0
	Gachena	0	0	0	0	0	0
	Moti	0	0	0	0	0	0
<i>Bacreium</i>	CS20DK	3.33	0	0	0	0	0
	Gachena	0	5.56	0	0	0	0
	Moti	0	0	0	7.78	1.11	0

The data is mean of four replications; 12 p<sup>2</sup> is haloprimed (KH<sub>2</sub>PO<sub>4</sub>)

for 24hr and which was at par with (18.89%) detected the variety Moti and detected the variety Gachena primed with KH<sub>2</sub>PO<sub>4</sub> at 0.5% solution for 12hr (Table 4). *Aspergillus niger* and *A. flavus*, *Penicillium*, *Fusarium* and *Phialophora* pathogens were also detected from faba bean.

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