

Influence of Osmoconditioning on Physiological and Metabolic Aspects in Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub]

R.C. MEENA¹, KARAN SINGH, B.L. KAKRALYA, B.L. DARJI¹ AND M.K. SAXENA¹

Department of Plant Physiology, Rajasthan Agricultural University, S.K.N. College of Agriculture, Jobner 303 329
meenarc2004@yahoo.co.in

Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] is an important pulse crop of irrigated as well as rainfed areas of the world. The most important constraint that limit their production and productivity is poor quality of seed due to which proper crop stand establishment is not maintained. The seed quality is influenced by parameters like germination capacity, shoot and root length, fresh and dry weight. For improving seed quality, osmoconditioning of seed with carbowax (PEG) has been found effective in certain crops [1, 2]. However; information with respect to the duration and osmotic potential of the osmoconditioning treatment in pulses is scanty. An experiment was therefore, planned to quantify osmoconditioning treatment using PEG-6000 in cluster bean and investigated for various seed physiological and metabolic parameters under laboratory conditions.

Seeds of clusterbean were obtained from Agricultural Research Station, Durgapura (Jaipur, Rajasthan) India and were subjected to osmoconditioning treatment using carbowax (Polyethylene glycol-6000) with osmotica of -0.0, -1.0, -3.0, -5.0, and -7.0 bars for 6 h. These seeds were washed with distilled water, blotted dry followed by shade drying. Properly treated and dried seeds were stored for 24 h, 48 h, 72 h and 96 h in cloth bags under insect free ambient condition. The minimum and maximum temperature and relative humidity of the storage

environment were recorded as 20-30°C and 36-50 per cent respectively. Seed lots were then, subjected to standard germination test under laboratory conditions using ISTA method [3]. The root and shoot length and fresh and dry weight of seedling, were also recorded. The estimations of protein content and total soluble sugars were done as per methods described by Lowry *et al.* [4] and Dubois *et al.* [5] respectively.

All treatments promoted the germination of seeds, however, osmoconditioning treatments given by -5 bars of osmotic potential of PEG-6000, showed the maximum germination percentages (90 per cent in RGC-936, 89.3 per cent in Pusa Navbahar, 84 per cent in Kanchan Babaharj 86.6 per cent in RGC-1003 over control (72 to 78.6 per cent) at 24, 48, 72 and 96 h of germination in all varieties of clusterbeans (Table 1). Increasing the osmotic potential (negative) beyond -5 bars did not increase further the germination percentage. The root and shoot lengths showed different trend for germination response. The shoot length was reduced to 3.8-4.0 cm (Table 2) by -7 bars osmotic potential in all the varieties of cluster beans in comparison to control (6.5-6.8cm). In contrast, the increasing level of osmotic stress progressively increased the root length. The dry weight of five seedlings (g) of clusterbean decreased as the level of osmoconditioning treatment increased from -1 to -7 bars.

¹Department of Botany, University of Rajasthan, Jaipur.

Table 1. Seed responses to osmoconditioning treatment with PEG-6000 on germination in clusterbean at different intervals of drying

Treatments	Germination % at 24h	Germination % at 48h	Germination % at 72h	Germination % at 96h
Pusa Navbahar				
0 bar	40.0 (39.23)	56.0 (48.45)	73.3 (58.89)	74.6 (59.24)
-1 bar	41.3 (39.99)	57.3 (49.20)	76.0 (60.67)	76.0 (60.67)
-3 bar	44.0 (41.55)	61.3 (51.53)	81.3 (64.38)	82.6 (65.35)
-5 bar	49.3 (44.60)	65.6 (54.09)	88.0 (69.73)	89.3 (70.91)
-7 bar	48.0 (43.85)	65.3 (53.91)	86.6 (68.53)	88.0 (69.73)
Kanchan Bahar				
0 bar	37.3 (37.64)	53.3 (46.89)	70.6 (57.17)	72.0 (58.05)
-1 bar	38.6 (38.41)	56.0 (48.45)	72.0 (58.05)	73.3 (58.89)
-3 bar	42.6 (40.74)	60.0 (50.77)	76.0 (60.67)	76.0 (60.67)
-5 bar	48.0 (43.85)	65.3 (53.91)	82.6 (65.35)	84.0 (66.42)
-7 bar	46.6 (43.05)	64.0 (53.13)	81.3 (64.38)	82.6 (65.35)
RGC-936				
0 bar	41.3 (39.39)	58.6 (49.95)	76.0 (60.67)	78.6 (62.44)
-1 bar	42.6 (40.74)	61.3 (51.53)	78.6 (62.44)	80.0 (63.43)
-3 bar	48.0 (43.85)	66.6 (54.70)	82.6 (65.35)	84.0 (66.42)
-5 bar	53.3 (46.89)	70.6 (57.17)	89.3 (70.91)	90.6 (72.15)
-7 bar	52.0 (46.15)	69.3 (56.35)	86.6 (68.53)	88.0 (69.73)
RGC-1003				
0 bar	38.6 (38.41)	54.6 (47.64)	72.0 (58.05)	72.0 (58.03)
-1 bar	40.0 (39.23)	56.0 (48.45)	73.3 (58.89)	73.3 (58.89)
-3 bar	45.3 (42.30)	61.3 (51.53)	73.3 (61.55)	78.6 (62.44)
-5 bar	52.0 (46.15)	68.0 (55.55)	84.0 (66.42)	86.6 (68.53)
-7 bar	50.6 (45.34)	66.6 (54.70)	82.6 (65.35)	84.0 (66.42)
CD (P=0.05)	0.74	0.772	1.11	0.92

Figure in parenthesis are angular transformations.

Table 2. Effect of osmoconditioning treatment with PEG-6000 on different growth parameters at final count

Treatment	Shoot length (cm)	Root length (cm)	Dry wt/ five seedling (g)	Protein content (%)	Total soluble sugar (mg/g)
V₁ Pusa Navbahar					
0 bar	6.50	3.31	0.091	22.56	2.80
-1 bar	6.27	3.46	0.089	22.52	2.82
-3 bar	5.77	3.61	0.086	22.38	2.87
-5 bar	4.92	4.26	0.076	21.90	3.02
-7 bar	3.83	5.31	0.058	20.79	3.23
V₂ Kanchan Bahar					
0 bar	6.72	3.35	0.089	22.70	2.84
-1 bar	6.42	3.57	0.068	22.74	2.86
-3 bar	5.92	3.89	0.083	20.62	2.93
-5 bar	5.20	4.65	0.074	20.09	3.09
-7 bar	4.09	5.85	0.055	18.62	3.33
V₃ RGC-936					
0 bar	6.73	3.45	0.095	22.82	2.87
-1 bar	6.36	3.55	0.094	22.76	2.88
-3 bar	5.68	3.89	0.090	22.59	2.93
-5 bar	4.81	4.60	0.079	21.95	3.06
-7 bar	3.66	5.77	0.056	20.87	3.26
V₄ RGC-1003					
0 bar	6.87	3.65	0.098	22.89	2.92
-1 bar	6.54	3.90	0.096	22.84	2.95
-3 bar	5.97	4.27	0.091	22.66	3.02
-5 bar	5.10	5.09	0.078	22.08	3.16
-7 bar	3.90	6.32	0.056	20.93	3.39
CD (P=0.05)	0.432	0.66	0.029	0.61	0.189

Increasing levels of osmotic stress caused remarkable effects on certain biochemical parameters including protein content and total soluble sugars. The protein content was reduced

in all the varieties with increasing osmotic stress. It was interesting to note that the level of total soluble sugars progressively enhanced from 2.8-2.9 in control to 3.2-3.3 (Table 2) at -7 bars osmotic potential in all the varieties.

In the present investigation only lower tested osmoticum proved suitable for osmoconditioning in all cultivars of clusterbean. The beneficial action of mild moisture stress on germination, shoot, root and seedling was also reported [6-9] in chickpea and observed that lower osmotic potential stimulated polyethylene glycol-6000 produced beneficial effect on seed germination and related phenomena [10] whereas the higher osmotic potential caused suppressive effect on seed parameters. Similar results have also been reported in solanaceous and leguminous crops [11].

Bio-chemical observations recorded in present investigations revealed that effect of osmoconditioning treatments are not only confined to seed germination, seedling growth and dry matter accumulation, but these treatments showed marked enhanced effects on protein content and total soluble sugar also [12]. The promotory effects of osmoconditioning in treatment have already been reported in a number of cereal and pulse crops [13]. Hence, such actions should be tested and practiced in large scale.

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