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Effect of seed hardening on growth and yield of chickpea (*Cicer arietinum* L.)

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Abstract. A field experiment was conducted to study the effect of seed hardening with various chemicals on morpho-physiological traits and yield in chickpea (*Cicer arietinum* L.) during *Rabi* 2007, under rain fed conditions. Significantly higher seed yield was recorded in seed hardening with $CaCl_2$ 2% (26.32q per ha), followed by Cycocel 1000 ppm (23.54 q per ha) and succinic acid 20 ppm (23.44 q per ha) as compare to control (19.04 q per ha). The increased seed yield in seed hardening with $CaCl_2$ 2% may be attributed to increase in the morpho-physiological traits like plant height, number of leaf lets, leaf dry matter and total dry matter accumulation, leaf area per plant and Harvest index. In addition to increase in the physiological traits like LAI, LAD, CGR, NAR and RGR and yield parameters like 100 seeds weight, seed yield per plant and Harvest index.
Key Words: seed hardening, chickpea, $CaCl_2$, Cycocel, LAI, LAD, NAR, CGR.

Introduction. Chickpea (*Cicer arietinum* L.) is a major *Rabi* season pulse crop in southern peninsular India. It is generally grown on conserved moisture and moisture in the soil profile gradually recedes as the crop grows. As a consequence, plant experiences progressively increasing degree of terminal moisture stress. Thus, soil moisture stress assuming a major limiting factor for determining the growth and yield of chickpea (Verma & Pramilakumari 1978).

Therefore there is a need to identify suitable ameliorative measures to overcome the moisture stress effect. The pre-sowing seed hardening with chemicals is one of the simple technique being employed to modify the morpho-physio-biochemical nature of seed, so as to induce the characters that are favorable for drought resistance. Keeping these views the investigation was undertaken to study the effect of seed hardening chemicals on growth and yield in chickpea.

Material and Method. A field experiment was conducted during Rabi 2007 at college of agriculture farm UAS, Dharwad, under rain fed conditions. The trial was laid out in RBD with three replications.

A day before sowing, seeds of chickpea variety, ICCV-2 were soaked for three hours separately in water, and solution of $CaCl_2$ (1% and 2%), KH_2PO_4 1%, KNO_3 100 ppm, KCl 0.1%, Sodiummolybdate 100 ppm, Zinc sulphate 100 ppm, Cycocel 10 000 ppm, succinic acid 20 ppm, Ascorbic acid 20 ppm. Later seeds were dried under shade and used for sowing.

The plant height was recorded from base of the plant to tip of the main stem. The leaf area per plant was computed by graphic method. Number of leaf lets, total dry matter and its distribution in leaf stem and reproductive parts were worked out from the tagged five plants and average. The leaf area index (LAI) was worked out at 80 DAS as per Sestak et al (1971). The crop growth rate (CGR g/dm^2 of ground area/day) and net assimilation rate (NAR g/dm^2 leaf area/day) were computed for 60-80 DAS as per Watson (1952). The leaf area duration in days (LAD) was calculated as per Power et al (1967).

The relative growth rate in g/g/day for 60-80 DAS (NAR) was worked out as per Radford (1967). Harvest index was calculated as a ratio of seed yield per plant to the total dry matter per plant and was presented in percent form.

Results and Discussion. The data on morpho-physiological parameters of chickpea revealed significantly higher plant height (48.1cm) in seed hardening with $CaCl_2$ 2%, whereas lower plant height in cycocel 1000 ppm. This clearly indicates mode of action differs for the chemicals studied. Similarly in finger millet seed hardening with $CaCl_2$ 2% improved the plant height and was due to redistribution of resources leading to cell enlargement and cell division (Kamala Thirumalaiswamy & Sakharam Rao 1977; Karivartharaju & Ramkrishna 1985). The mechanism of reduction in plant height in seed hardening with Cycocel 1000 ppm seems to be due to reduced cell size and cell thickening (Ginzo et al 1977). Similar results were reported by Dighe et al (1983) in wheat. Increase in TDM, leaf dry matter, stem dry matter and redistribution of dry matter in reproductive parts is noticed with seed hardening with $CaCl_2$ 2% as compare to control.

In addition, more number of leaf lets and leaf area is also more with seed hardening with $CaCl_2$ 2%. Thus TDM and its partition and leaf area were important parameters to boosting the source sink relationship, which is evident from the improvement in the yield and yield parameters (Table 1).

Table 1

Effect of seed hardening chemicals on morho-physiological traits in chickpea

Treatments	Plant height (cm)	No. of leaf lets per plant at 80 DAS	Leaf area at 80 DAS (cm^2)	Leaf dry matter (g/Pl.)	Stem dry matter g/Pl.)	Total dry matter (g/Pl.)
T_1 : Control	40.6	201.7	393	1.48	4.05	22.2
T_2 : Water soaking	43.5	216.0	408	1.85	4.92	26.5
T_3 : $CaCl_2$ (1%)	43.7	210.3	403	1.35	5.11	24.6
T_4 : $CaCl_2$ (2%)	48.1	298.0	492	2.16	8.14	36.1
T_5: KH_2PO_4 (1%)	44.7	247.7	438	1.96	5.64	30.6
T_6:KNO_3 (100 ppm)	46.0	297.0	456	20.9	6.16	31.6
T_7:KCl (100 ppm)	45.0	222.0	432	1.48	4.26	27.8
T_8: Sodium molybdate (100 ppm)	43.8	231.7	405	1.98	5.04	26.0
T_9: Zinc sulphate (100 ppm)	44.7	256.0	438	2.00	5.13	27.1
T_{10} : Cycocel (1000 ppm)	39.6	285.0	399	2.08	7.43	32.7
T_{11}: Succinic acid (20 ppm)	40.3	269.0	399	2.02	7.78	30.9
T_{12}: Ascorbic acid (20 ppm)	45.6	239.3	444	1.93	5.07	27.8
S. E.	0.91	8.9	12.5	0.06	0.37	1.57
CD at (5%)	2.63	25.6	36.2	0.17	0.95	4.53

The data on physiological growth analysis parameters of chickpea (Table 2) revealed significantly higher LAI (1.64), LAD (36.0) and NAR (0.0176) in seed hardening with $CaCl_2$ 2% followed by Cycocel 1000 ppm and Succinic acid 20 ppm as compare to control.

Thus it indicates that the infrastructure of plant has been modified so as to intensify the process photosynthesis which is evident from the higher mean value of CGR and RGR.

The results are in agreement with the reports of Kalubarme & Pandey (1979), who reported the increased yield of green gram due to higher LAI, NAR, CGR and LAD.

Significantly higher seed yield was recorded in seed hardening with $CaCl_2$ 2% (26.32q/ha) fallowed by Cycocel 1000 ppm (23.54q/ha.) and Succinic acid 20 ppm (23.44q/ha.) over control (Table 3).

Table 2

Physiological growth indices as effected by seed hardening with various chemicals in Chickpea

Treatments	LAI at 80 DAS	SLW g/cm^2 at 80 DAS	LAD days at 60-80 DAS	CGR (g/dm^2 of GA/day) at 60-80 DAS	RGR (g/g/day) at 60-80 DAS	NAR (g/dm^2 of LA/ day) at 60-80 DAS
T_1 : Control	1.52	5.09	28.3	13.4	0.0183	0.130
T_2 : Water soaking	1.68	5.54	30.4	14.4	0.0154	0.198
T_3 : $CaCl_2$ (1%)	1.75	5.02	31.4	12.7	0.0144	0.208
T_4 : $CaCl_2$ (2%)	1.96	7.52	36.0	23.8	0.0176	0.276
T_5: KH_2PO_4 (1%)	1.82	6.26	32.8	13.2	0.0130	0.189
T_6:KNO_3 (100 ppm)	1.86	7.13	33.8	19.9	0.0173	0.264
T_7:KCl (100 ppm)	1.76	5.65	32.0	14.6	0.0147	0.191
T_8: Sodium molybdate (100 ppm)	1.78	5.63	31.3	14.5	0.0140	0.261
T_9: Zinc sulphate (100 ppm)	1.79	5.23	32.5	13.7	0.0135	0.181
T_{10} : Cycocel (1000 ppm)	1.53	8.80	28.6	22.5	0.174	0.206
T_{11}: Succinic acid (20 ppm)	1.66	8.65	29.9	23.5	0.0197	0.339
T_{12}: Ascorbic acid (20 ppm)	1.84	6.33	33.2	18.0	0.0164	0.255
S. Em $\pm$	0.07	0.50	1.19	0.53	0.007	0.025
CD (5%)	0.19	1.44	3.43	1.53	0.0022	0.073

Table 3

Influence of seed hardening chemicals on yield and yield traits in chickpea

Treatments	Seed yield (g plant $^{-1}$)	100 seed weight (g)	Harvest index (%)	Seed yield (q ha^{-1})
T_1 : Control	9.12	26.64	41.1	19.04
T_2 : Water soaking	11.11	28.69	42.0	19.41
T_3 : $CaCl_2$ (1%)	11.58	29.22	47.1	19.12
T_4 : $CaCl_2$ (2%)	19.15	30.77	53.1	26.32
T_5: KH_2PO_4 (1%)	13.48	26.66	44.0	22.02
T_6:KNO_3 (100 ppm)	13.77	30.33	43.6	23.73
T_7:KCl (100 ppm)	12.85	24.89	46.2	20.65
T_8:Sodium molybdate (100 ppm)	12.63	24.52	48.6	21.71
T_9: Zinc sulphate (100 ppm)	13.2	26.36	48.7	22.34
T_{10} : Cycocel (1000 ppm)	16.10	27.70	49.2	23.54
T_{11}:Succinic acid (20 ppm)	14.67	27.20	47.5	23.44
T_{12}: Ascorbic acid (20 ppm)	12.96	26.63	46.6	22.45
S E	0.62	0.73	2.05	1.16
CD at (5%)	1.81	2.11	5.95	3.38

The increase in the yield in seed hardening with $CaCl_2$ 2% may be attributed to increase in the yield components mainly 100 seeds weight, seed yield per plant and harvest index coupled with higher mean value of growth parameters in general. However, control recorded lower yield and lower mean value for yield components.

The results are in agreement with the findings of Mishra & Dwivedi (1980), who reported that treating wheat seeds with 0.25% $CaCl_2$ or 2.5% KCl increased the grain yield compare to control. On the other hand increased drought tolerance and grain yield in sorghum over control under dry condition was reported by Patil et al (1987).

Conclusion. Seed hardening with $CaCl_2$ 2% recorded significantly higher yield hence this technique may be employed for boosting the productivity of chickpea under rainfed conditions.

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