Environment & Ecology 35 (2) : 703—707, April—June 2017
Website: environmentandecology.com ISSN 0970-0420

Seed Hardening, Nipping and Foliar Spray of Cycocel on Growth, Yield and Quality of Chickpea (*Cicer arietinum* L.)

M. Sujatha, D. S. Uppar, V. K. Deshpande, C. M. Nawalagatti

Received 4 May 2016; Accepted 30 June 2016; Published online 15 July 2016

Abstract Present investigation was undertaken in order to know the effect of seed hardening, nipping and foliar spray of cycocel on growth and seed yield in chickpea. The experiment was conducted during *rabi* 2013-14. The results revealed that the seed hardening with $CaCl_2$ (2%) + foliar spray of cycocel (500 ppm) at 45 DAS recorded lesser plant height (38.45 cm), more number of branches per plant (26.10), number of pods per plant (38.84), number of seeds per pod (1.48), 100 seed weight (25.042 g), seed yield per plot (1.38 kg) and per hectare (1274.31 kg) as compared to other treatments. The seed quality parameters such as germination (99.33%), root length (21.50 cm), shoot length (12.70 cm), vigor index (3273) and dry weight of seedlings were significantly higher in the treatment of seed hardening with $CaCl_2$ (2%) + foliar spray of cycocel (500 ppm) at 45 DAS (395.90 g).

Keywords Seed hardening, Nipping, Cycocel, Days to 50% flowering, Chickpea.

M. Sujatha*, D. S. Uppar, V. K. Deshpande,
C. M. Nawalagatti
Department of Seed Science and Technology,
University of Agricultural Sciences,
Dharwad, Karnataka 580005, India
e-mail : sujumanjunath@gmail.com
*Correspondence

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. Thus, soil moisture stress assuming a major limiting factor for determining the growth and yield of chickpea. Seed hardening is one of the techniques to enhance chickpea yield, particularly under drought conditions. Pre-sowing seed hardening brings about physiological reorganizations, metabolic, anatomical and morphological changes. Physiological reorganization that takes place are increase in the hydrophilic property of the protoplasmic colloids namely the viscosity and elasticity, increase in the osmotic pressure, changes in the quality of proteins and overall increase in the water holding capacity of seed. Hardened seeds produce plants with xeromorphic morphology more extensive and denser network of veins and midribs, epidermis and stomatal cells are smaller, number of stomata per unit leaf area is more, foliage area is

Table 1. Effect of seed hardening, nipping and foliar spray of cycocel on plant growth parameters in chickpea cv A-1.

Treatments	Plant height (cm)			Chlorophyll content		Number of branches per plant		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	30 DAS	60 DAS	90 DAS
T_1-Control (untreated)	19.81	35.98	45.13	14.9	23.5	3.52	18.00	21.43
T_2-Control (untreated)+nipping at 25 DAS	18.12	32.31	38.50	26.2	35.6	3.53	19.87	22.65
T_3-Control (untreated)+foliar spray of cycocel (500 ppm) at 45 DAS	19.33	31.27	36.28	29.4	38.9	3.58	20.65	23.75
T_4-Water soaking	21.10	36.03	46.05	21.4	29.4	3.52	19.07	22.25
T_5-Water soaking + nipping at 25 DAS	18.10	32.34	38.68	31.2	42.5	3.65	21.11	24.40
T_6-Seed hardening with $CaCl_2$ (2%)	21.25	38.35	47.08	28.4	38.3	3.58	20.19	23.47
T_7-Seed hardening with KCl (0.1%)	20.25	37.35	46.58	27.6	38.1	3.65	20.00	23.04
T_8-Seed hardening with $CaCl_2$ (2%) + nipping at 25 DAS	18.05	33.39	39.86	35.7	51.9	3.67	22.21	25.48
T_9-Seed hardening with KCl (0.1%) + nipping at 25 DAS	17.79	32.88	39.36	33.4	49.6	3.66	22.17	25.25
T_{10}-Water soaking + foliar spray of cycocel (500 ppm) at 45 DAS	19.90	31.60	36.59	32.9	46.3	3.65	21.13	24.87
T_{11}-Seed hardening with $CaCl_2$ (2%) + foliar spray of cycocel (500 ppm) at 45 DAS	21.27	31.81	38.45	37.5	58.2	3.74	23.43	26.10
T_{12}-Seed hardening with KCl (0.1%) + foliar spray of cycocel (500 ppm) at 45 DAS	20.13	31.69	37.43	36.5	53.4	3.69	22.44	25.67
Mean	19.61	33.75	40.83	29.59	42.14	3.62	20.86	24.03
SEm ±	0.43	0.75	0.91	0.69	0.99	0.09	0.54	0.54
CD (p=0.05)	1.27	2.21	2.68	2.02	2.89	NS	1.57	1.59

increased, faster recovery from atmospheric drought, greater total and absorbing surface into root system, as well as more number of primary roots and leaves of these plants will have more starch [1]. Seed hardening chemicals improve seedling vigor, establishment and consequently crop performance in field. Application of cycocel had an inhibitory effect on plant height, increased the number of branches and nodules per plant in green gram. Keeping these views the investigation was under taken to study the effect of seed hardening chemiclas, nipping and foliar spray of cycocel on growth and yield in chickpea.

Materials and Methods

A field experiment was conducted during *rabi* of 2013-14 at college of agriculture farm UAS, Dharwad, under rani fed conditions. The trial was laid out in RBD with three replications. The experimental site consisted of medium black clay loam soil. The experiment consisted of twelve treatments viz., T_1-Control (untreated), T_2-Control (untreated) + nipping at 25 DAS, T_3-Control (untreated) + foliar spray of cycocel (500 ppm) at 45 DAS, T_4-Water soaking, T_5-Water soaking + nipping at 25 DAS, T_6-Seed hardening with $CaCl_2$ (2%), T_7-Seed hardening with KCl (0.1%), T_8-Seed hardening with $CaCl_2$ (2%) + nipping at 25 DAS, T_9-Seed hardening with KCl (0.1%) + nipping at 25 DAS, T_{10}-Water soaking + foliar spray of cycocel (500 ppm) at 45 DAS, T_{11}-Seed hardening with $CaCl_2$ (2%) + foliar spray of cucocel (500 ppm) at 45 DAS and T_{12}-Seed hardening with KCl (0.1%) + foliar spray of cycocel (500 ppm) at 45 DAS. A day before sowing, seeds of chickpea cv Annigeri-1 were soaked for three hours in 1:2 ratio (W/V) of seed to chemical solution [Water, $CaCl_2$ (2%) and KCl (0.1%) for 3 hours and dried back to their original weight at room temperature. The apical tender growing buds of all the plants in nipping treatment were removed acropetally at flower initiation stage without causing any damage to the plant. The growth regulator, cycocel (CCC) (Lihocin 50%) at 500 ppm was sprayed at 45 DAS as per the treatment with the help of Knapsack hand operated sprayer. Chlorophyll content (SPAD readings) were recorded from first fully expanded flag leaf from the top of the plant. The mean data of the experiment were statistically analyzed by adopting appro-

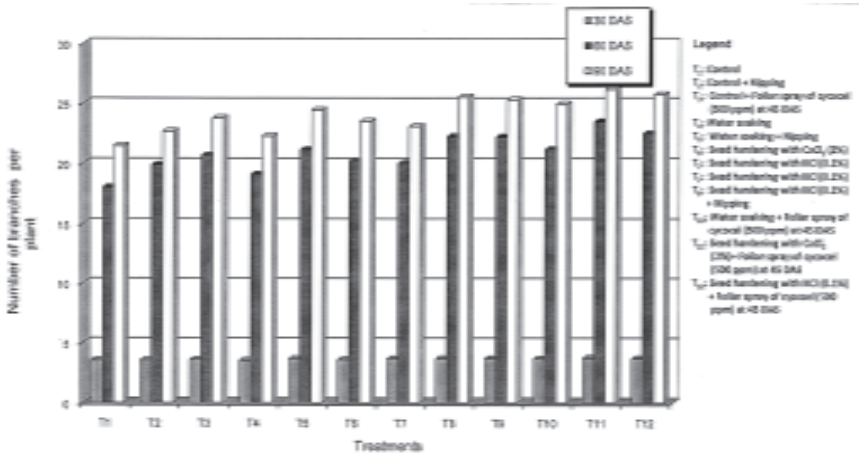

Fig. 1. Effect of seed hardening, foliar spray of plant growth regulator and nipping on number of branches per plant in chickpea.

priate statistical methods.

Results and Discussion

Plant growth parameters

In the present study, the seeds hardened with 2% $CaCl_2$ recorded significantly more plant height at 30 DAS (21.27 cm), 60 DAS (38.35 cm) and 90 DAS (47.08 cm) (Table 1). These results are in accordance with the research findings of Manjunath and Dhanoji [2] in chickpea. The decreased in plant height with cycocel (500 ppm) may be attributed to its anti-auxin activity, reduction in the cell division activity and blocking of IAA synthesis. The reduction of plant height in nipped plants is mainly due to elimination of apical dominance and diversion of the plant metabolites from vertical growth to horizontal growth and recording more number of branches per plant. Similar results were obtained in pigeonpea by Arjun Sharma et al. [3] and in cowpea by Reddy [4]. Initially at 30 DAS, none of the treatments showed significant differences in number of branches per plant. Significant differences in number of branches per plant were noticed among the treatments from 60 DAS to harvest. Highest number of branches per plant were recorded in the treatment, seed hardening with $CaCl_2$ (2%) + foliar spray of cycocel (500 ppm) (26.10) followed by seed hardening with KCl (0.1%) + foliar spray of cycocel (500 ppm) (25.67) (Table 1, Fig. 1) compared to control. These results of the present investigation are in conformity with the earlier findings of Prasad and Srihari [5] in okra.

In the present investigation, plant received seed hardening with $CaCl_2$ (2%) + foliar spray of cycocel (500 ppm) (58.2) showed the highest chlorophyll content followed by seed hardening with KCl (0.1%) + foliar spray of CCC (500 ppm) (53.4) (Table 1) as compared to control. Similar results have been reported by Manjunath and Dhanoji in chickpea [2]. There has been significant increase in chlorophyll content in treatments with growth retardants. This finding is in conformity with reports of Chikkappaiah in wheat [6] who opined that growth retardants in addition to the inhibition of cell division caused induction of grana and initiated the development of chloroplasts.

Seed yield parameters

It was observed in the present investigation that the seed hardening with $CaCl_2$ (2%) + foliar spray of cycocel (500 ppm) significantly increased the number of pods per plant (37.29) and seed yield per ha (1274.31 kg), which are the important yield determining com-

Table 2. Effect of seed hardening, nipping and foliar spray of cycocel on seed yield and quality parameters in chickpea cv A-1. Figures in parentheses indicate arcsine transformed values.

Treatments	Number of pods per plant	Seed yield (kg/ha)	Germination (%)	Seedlings vigor index	Field emergence (%)	Dry weight of seedling (mg)
T_1-Control (untreated)	31.09	1046.23	90.67 (72.27)	2949	83.00 (65.71)	193.50
T_2-Control (untreated) + nipping at 25 DAS	35.39	1163.41	92.00 (73.77)	2955	84.76 (67.07)	225.10
T_3-Control (untreated) + foliar spray of cycocel (500 ppm) at 45 DAS	35.67	1164.45	94.67 (76.74)	3060	85.33 (67.62)	261.30
T_4-Water soaking	35.33	1161.32	91.33 (72.94)	2975	84.00 (66.54)	201.30
T_5-Water soaking + nipping at 25 DAS	35.74	1164.98	95.33 (77.62)	3064	85.62 (67.75)	287.80
T_6-Seed hardening with $CaCl_2$ (2%)	35.49	1164.04	93.33 (75.11)	3043	85.00 (67.25)	252.60
T_7-Seed hardening with KCl (0.1%)	35.43	1163.72	92.67 (74.36)	3041	85.67 (67.09)	236.30
T_8-Seed hardening with $CaCl_2$ (2%) + nipping at 25 DAS	36.37	1182.24	98.00 (81.91)	3178	89.19 (70.95)	376.90
T_9-Seed hardening with KCl (0.1%) + nipping at 25 DAS	36.51	1180.15	97.33 (80.78)	3161	88.00 (69.84)	347.30
T_{10}-Water soaking + foliar spray of cycocel (500 ppm) at 45 DAS	36.2	1169.69	96.67 (79.64)	3135	87.01 (69.04)	311.30
T_{11}-Seed hardening with $CaCl_2$ (2%) + foliar spray of cycocel (500 ppm) at 45 DAS	38.84	1274.31	99.33 (86.22)	3273	92.00 (73.63)	395.90
T_{12}-Seed hardening with KCl (0.1%) + foliar spray of cycocel (500 ppm) at 45 DAS	37.29	1197.93	98.33 (82.71)	3260	91.12 (72.71)	391.50
Mean	35.78	1169.37	94.97 (77.84)	3091	86.64 (68.77)	290.07
SEm ±	0.81	26.38	0.73	71.21	1.54	6.57
CD (p=0.05)	2.37	77.36	2.15	208.85	4.53	19.26

ponents in chickpea, followed by seed hardening with KCl (0.1%) + foliar spray of cycocel (500 ppm) and $CaCl_2$ (2%) + nipping as compared to control (Table 2). These results are in agreement with the findings of Manjunath and Dhanoji [2], who reported that treating chickpea seeds with 2% $CaCl_2$ followed by seed treatment with 1,000 ppm cycocel increased the seed yield compared to control. The increase in seed yield with respect to seed hardening treatments was probably due to maximum water absorbing capacity of seeds, more intense photosynthetic activity and more tissue hydration thereby, enabling the plant to resist soil moisture stress more efficiently. This data clearly indicated that seed hardening treatments are very effective for increasing the yield and yield attributes compared to in control. It was also observed that there was an increase in chlorophyll content due to growth retardants, which might have contributed for increase in the yield and yield components. Maximum seed yield with cycocel might be due to more and efficient translocation of photosynthates from source (leaves) to sink (pods) which supported the results of Kalyankar et al. [7]. Increase in the seed yield by nipping might be due to increase in the number of productive branches, leaf thickness, number of pods per plant, number of seeds per pod and total dry matter accumulation. Arjun Sharma et al. [3] in redgram noticed the increase in seed yield due to significant reduction in plant height and increase in the number of primary and secondary branches and pods per plant in pigeon pea [3]. Similar results were also obtained by Sudeep Kumar [8] in field bean. The above results suggests that seed hardening with 2% $CaCl_2$ and foliar spray of cycocel (500 ppm) at 45 DAS given higher quantity of quality seeds in chickpea.

Seed quality parameter

Seed hardening with $CaCl_2$ (2%) + foliar spray of cycocel (500 ppm) at 45 DAS recorded significantly higher germination percentage (99.33), followed by plots having sown with seeds hardened in KCl (0.1%)+ foliar spray of cycocel (500 ppm) at 45 DAS (98.33),s hardening with $CaCl_2$ (2%) + nipping (98) over control (90.67) (Table 2). All the treatments significantly varied for field emergence, the highest field emergence

(92%) was noticed in seed hardening $CaCl_2$ (2%) + foliar spray of cycocel (500 ppm) at 45 DAS and which was on par with treatments receiving seed hardening with KCl (0.1%) + foliar spray of cycocel (500 ppm) at 45 DAS (91.12%), seed hardening with $CaCl_2$ (2%) + nipping (89.19%), the lowest field emergence was noticed in control (83%) (Table 2).

Higher seedling vigor index was observed in the treatments of seed hardening with $CaCl_2$ (2%) + foliar spray of cycocel (500 ppm) at 45 DAS (3273) which was on par with seed hardening KCl (0.1%) + foliar spray of cycocel (500 ppm) at 45 DAS (3260), seed hardening with $CaCl_2$ (2%) + nipping (3178) and these were recorded significantly higher seedling vigor index as compared to control (2949) (Table 2). Seed hardening with $CaCl_2$ (2%) + foliar spray of cycocel (500 ppm) at 45 DAS significantly registered maximum seedling dry weight (395.90 mg) and it was found to be on par with the treatments receiving seed hardening with KCl (0.1%) + Foliar spray of cycocel (500 ppm) at 45 DAS (391.50 mg), seed hardening with $CaCl_2$ (2%) + nipping (376.90 mg). Significantly lower seedling dry weight (mg) was registered in control (193.50 mg) (Table 2).

Significantly higher germination, field emergence were reported by Bharati [9] in sunflower. The beneficial effects of pre-sowing invigoration seed treatment with $CaCl_2$ have been primarily attributed to an advancement of germination process and improvement in other seed quality traits. The above results suggests that seed hardening with 2% $CaCl_2$ and foliar spray of cycocel (500 ppm) at 45 DAS given higher quantity of quality seeds in chickpea. The increase in seedling vigor index and seedling dry weight was due to increased germination percentage, root length and shoot length of seedlings. These growth regulator are known to increase sink and source relationship due to increase translocation of assimilates/photosynthates towards the seeds leading to more number of well developed, matured pods per plant with higher test weight and germination performance.

References

1. Vanangamudi K, Srimathi P, Natarajan N, Bhaskaran M (2003) Current scenario of seed coating polymer. ICAR-Short Course on Seed Hardening and Pelleting Technologies for Rain Fed or Garden Land Ecosystems, pp 80—100.
2. Manjunath BL, Dhanoji MM (211) Effect of pre-sowing seed hardening with chemicals on drought tolerance traits and yield in chickpea. J Agric Sci 3 : 186—189.
3. Arjun Sharma, Potdar MP, Pujari BT, Sharmaraj PS, Sharma A (2003) Studies on response of pigeon pea to canopy modification and plant geomerry. Karnataka J Agric Sci 16 : 1—3.
4. Reddy P (2005) Effect of growth retardants and nipping on growth and yield parameters in cowpea (*Vigna unguiculata* L.). MSc (Ag) thesis. Univ Agric Sci, Dharwad, Karnataka India.
5. Prasad KR, Srihari D (2008) Effect of seed soaking and foliar spray of cycocel on germination, growth and yield of okra. J Res Angrau 23 : 23—27.
6. Chikkappaiah (2010) Seed hardening techniques to improve drought tolerance in rainfed wheat (*Triticum aestivum* L.). MSc (Ag) thesis. Univ Agric Sci, Dharwad, Karnataka, India.
7. Kalyankar SV, Kadam GR, Borgaonkar SB, Deshmukh DP, Kadam BP (2008) Effect of foliar application of growth regulators on seed yield and yield components of soybean (*Glycine max* (L.) Merill). Asian J Bio-Sci 3 : 229—230.
8. Sudeep Kumar E (2010) Influence of nipping and hormonal spray on seed yield and quality in field bean [*Lablab purpureus* (L.)sweet] genotypes. MSc (Ag) thesis. Univ Agric Sci, Dharwad, Karnataka, India.
9. Bharati VB (2009) Effect of seed treatment with calcium salts on crop growth, seed yield, quality and storability of soybean cv JS-335 under ambient condition. MSc (Ag) thesis. Univ Agric Sci, Bangalore, Karnataka India.