

Short Communication

## Response of Pre-soaked Seeds of Chickpea (*Cicer arietinum* L.) Genotypes to Varying Levels of Calculated Soil Moisture

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Chickpea (*Cicer arietinum* L.) is one of the most important legumes grown in India and within cultivated species, Kabuli and Desi types are two distinct groups of practical importance [1]. Desi types are mostly planted as a winter crop in the tropics while kabuli types are generally planted as a summer crop in temperate climates [2]. However, low yield in chickpea is a serious problem in the Indian subcontinent and it has been grown in this part of the world under marginal conditions of moisture-stress and low soil fertility, which could also play a deleterious role in its low yield [3]. Chickpea crop is usually sown with the onset of cooler temperatures in October and November, utilizing moisture from the preceding monsoon rains in field that were fallowed during the rainy season [3, 4] and therefore, germination and seedling growth (pre-flowering growth) have been major constraints towards low productivity of chickpea for decades [5-7]. There is some time difference between withdrawal of monsoon and the falling ambient temperature causing evaporative losses of moisture from the soil. Consequently, soil moisture in seeding zone may be often reduced and this reduced soil moisture in seeding zone becomes very critical for proper germination and seedling emergence [8]. In the light of above facts, this study was taken up with an objective to see the effect of pre-soaked seeds on germination and seedling growth of chickpea cultivars at four levels of soil potential regimes.

The study was carried out at Water Technology Centre, IARI, New Delhi by using sandy loam soil in the months of November-December (Day length: 10-11 h Temp. 8.2-29.3°C, RH; 39.1-32.3%, Light: 1160-980 Hmol m<sup>-2</sup> s<sup>-1</sup>). Soil was poor in organic carbon (0.17%) and N (220 kg/ha), medium in P (19 kg/ha) and rich in K (182 kg/ha) with slightly alkaline in reaction. For this study, four soil matric potentials (SMP) of 0.02 MPa, 0.05 MPa, 0.10 MPa and 0.40 MPa with their respective soil moisture (%) of 21.0, 13.8, 10.35 and 7.50, respectively were chosen following moisture release curve determined with the help of a pressure membrane apparatus [9]. This moisture percentage is within the range of available water for sandy loam soil used in the present study and is well-reported [10]. Also, seeds of cultivars JG 62 (desi), BG 261 (cross of P-827 and C 235) and BG 267 (kabuli) were obtained from the Division of Genetics, IARI, New Delhi and multiplied at WTC. Seeds were then treated with *Rhizobium* strain.

For each SMP, a homogenous mixture of dry soil and water was made and put into 45 x 11 cm PVC columns in five replicates each for soaked and unsoaked seeds for each genotype. In each column, 10 seeds (treated and untreated) were put. Seeds were soaked in water overnight and were used for treatment next day. All the columns were maintained by taking weight initially and the same weight maintained subsequently every 24 h. To

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check evaporation initially, columns were covered with polythene sheet and a plastic (50 cm long and 1 cm dia) pipe punctured with many holes around was put vertically into each column to facilitate equal distribution of water. Observations on root and shoot growth were recorded 20 days after emergence (DAE) along with leaf growth. Daily observations recorded the first germination when the first true-leaf emerged. Necessary statistical calculation was carried out by the method of analysis of variance.

The computation of Anova revealed significant difference among varying levels of soil matric potential and genotypes in respect of germination, root, shoot and leaf growth (Table 1). There was significant effect of pre-soaked seeds on germination in all the genotypes. Germination was maximum at 0.05 MPa in all the genotypes for both pre-soaked and unsoaked seeds. Among genotypes, JG 62 had maximum germination of 59.7 per cent and 43.7 per cent for pre-soaked and unsoaked seeds, respectively followed by BG 261 (47.4% and 41.5%) and BG 267 (43.3% and 34.6%). There was no germination at 0.02 MPa in all the genotypes under both the conditions (Table 1). Rate of germination was in the order of  $0.05 > 0.10 > 0.40 > 0.02$  MPa. Previously in earlier studies it was stated that water uptake and seed germination were better in BG 267, but JG 62 was the best in seedling establishment [3, 11, 12]. In that study pre-soaking of seed was not done but on the contrary in the present study when the seeds were pre-soaked and then sown, JG 62 exhibited better germination than BG 267 (Table 1).

Assuming that these seeds are viable, the behaviour of the genotypes could be due to a particular soil matric potential of 0.02 MPa in which moisture was maintained to 21 per cent (calculated) and that resulted into an anaerobic condition and thereby no germination did occur. Also, seeds displayed highly uniform behaviour and majority of seeds completed the germination process over a relatively short time period. There are reports that soaking seeds in water prior to planting in soil stimulated them to germinate [13] and greater reductions in germination at soil water potentials below 0.05 MPa in herbaceous, species, whereas those of some species from dry habitats

germinated at 1.0 or 1.5 Mpa [15]. The lowest water potential at which seeds of *Trifolium subterraneum* germinated was 0.6, 0.8 and 1.2 MPa on sand, loam and clay substrates, respectively [15]. In our studies, though maximum germination occurred at 0.05 MPa but with decreasing matric potential at 0.1 and 0.4 MPa in sandy loam soil, germination did occur in studied genotypes of chickpea.

The maximum root and shoot growth occurred at 0.05 MPa. However, by seed soaking there was a significant improvement in these parameters as there was an initial stimulation in germination. Genotype BG 267, had maximum root and shoot length and that of dry weight at 0.10 MPa followed by 0.05 and 0.40 MPa. Genotype JG 62 recorded maximum root and shoot dry weight at 0.05 MPa and pre-soaked seeds had an added advantage over control. The leaf area and leaf weight also responded similar to root and shoot growth. However, there was negligible variation in these parameters over SMPs and treatments. Total dry weight (TDW) was also maximum in JG 62 at 0.05 MPa followed by BG 261 and BG 267 (Table 1). In BG 267 total dry weight was again maximum at 0.10 MPa unlike JG 62 and BG 261. TDW was however, more in pre-soaked seeds than in control in all the SMPs. The interactive effects of all the factors (treatments) had a considerable influence on seedling emergence 20 days after germination.

The survival of plants per unit area (i.e. crop stand) is because of good germination followed by root and shoot growth leading to seedling establishment [3], but in our study SMP of 0.02 MPa, had hardly any emergence as compared to maximum occurrence at 0.05 MPa was because of the fact that at 0.02 MPa, it is near field capacity and causes depletion of air and that reduced air around the seeds at 0.02 MPa would have led to poor germination and seedling establishment and such results for seeds of several natural populations have been reported earlier [3, 11, 12, 16-20].

As revealed that BG 267 had maximum germination at 0.05 MPa but seedling growth was maximum at 0.10 MPa followed by 0.05 MPa is suggestive that BG 267 having larger sized seeds as compared to small sized JG 62 seeds had initial maximum imbibition followed by maximum

Table 1. Effect of seed soaking on root, shoot and leaf growth of chickpea genotypes at different levels of soil matric potentials (MPa)

Genotypes/ treatments (MPa)	Root length (cm (seedling <sup>-1</sup> ))	Shoot length (cm (seedling <sup>-1</sup> ))	Root dry wt. (mg (seedling <sup>-1</sup> ))	Shoot dry wt. (mg (seedling <sup>-1</sup> ))	Leaf area (cm <sup>2</sup> (seedling <sup>-1</sup> ))	Leaf dry wt. (mg (seedling <sup>-1</sup> ))	Total dry wt. (mg (seedling <sup>-1</sup> ))	Germi- nation (%)
<b>JG 62 Control</b>								
0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.05	23.0	15.0	21.1	15.0	26.7	22.8	58.9	60.7
0.10	20.7	12.0	19.7	10.5	17.2	15.4	45.6	58.8
0.40	15.2	10.2	8.5	9.2	16.4	11.3	29.0	55.4
Mean	14.7	9.3	12.3	8.7	15.1	12.4	33.4	43.7
<b>Soaked</b>								
0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
0.05	29.5	11.0	25.3	17.6	29.7	23.8	66.7	81.8
0.10	28.7	8.3	24.9	13.2	18.8	15.0	53.1	79.8
0.40	18.3	6.2	15.2	10.1	16.8	12.1	37.4	76.7
Mean	19.1	6.4	16.3	10.2	16.3	12.7	39.2	59.7
<b>BG 261 Control</b>								
0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.05	17.5	11.0	13.7	14.2	17.8	16.3	44.2	58.8
0.10	16.3	8.3	9.9	11.2	14.2	11.3	32.4	55.2
0.40	8.4	6.2	7.6	6.2	2.7	2.8	16.6	52.2
Mean	10.6	6.4	7.8	7.9	8.7	7.6	23.3	41.5
<b>Soaked</b>								
0.02	1.0	1.4	0.8	0.7	0.0	0.0	1.5	0.5
0.05	18.7	11.6	15.1	16.3	18.1	16.7	48.1	70.2
0.10	16.7	9.2	10.0	11.8	14.6	14.7	36.5	60.1
0.40	8.0	5.8	9.3	7.3	4.9	6.5	23.1	58.9
Mean	11.1	7.0	8.8	9.0	9.4	9.5	27.3	47.4
<b>BG 267 Control</b>								
0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.05	5.0	5.6	13.2	16.1	13.2	12.6	41.9	45.2
0.10	10.7	8.2	24.7	19.2	22.8	17.0	60.9	50.0
0.40	6.0	6.8	10.8	11.6	9.1	9.0	31.4	43.1
Mean	5.4	5.2	12.2	11.7	11.3	9.6	33.5	34.6
<b>Soaked</b>								
0.02	0.0	0.7	0.0	0.8	0.0	0.0	0.8	0.3
0.05	9.0	8.0	18.3	17.7	21.3	16.2	52.2	68.8
0.10	10.3	8.8	24.0	21.2	18.8	15.4	60.6	54.2
0.40	6.3	7.7	12.5	17.5	10.4	10.7	40.6	50.1
Mean	6.4	6.3	13.7	14.3	12.6	10.6	38.6	43.3
<b>CD (0.05)</b>								
Variety(V)	2.47	0.58	1.49	1.13	1.56	1.12	3.89	4.62
SMP(M)	2.05	0.97	1.65	2.30	2.10	1.88	3.56	4.25
Treatment(T)	0.88	0.55	0.83	0.64	NS	NS	2.12	3.39
VxM	3.36	1.49	2.61	3.50	3.26	2.88	1.45	4.25
MxT	1.89	NS	1.64	NS	NS	NS	2.10	2.35
VxT	NS	NS	NS	NS	NS	NS	3.30	3.36
VxMxT	NS	1.89	NS	NS	NS	NS	1.69	2.58

germination at 0.05 MPa. Consequently, growth at 0.10 MPa with comparatively less moisture than 0.05 MPa was enough for growth per unit area and time, but subsequently growth picked up at 0.05 MPa. That means whatever little water plant had been getting after germination at 0.10 MPa was enough to cause better growth with little chance of aeration. Probably at particular time of growth after germination, moisture at 0.10 MPa was at optimal level in BG 267 and moisture at 0.05 MPa at supra-optimal level which was not the case for JG 62. With growth and all other physio-biochemical processes started taking place, growth also picked up at 0.05 MPa.

Thus it could be concluded that seed soaking prior to sowing had a direct influence on better germination by stimulating the process and subsequently seedling growth particularly in a crop like chickpea where germination and initial seedling emergence is a problem [3, 11, 12]. Any impedance due to hard or impermeable seed coat initially on imbibition and germination could be overcome by pre-seed soaking to realize full potential of germinability of chickpea cultivars. Also, substantial growth could be effected at SMP of 0.05 MPa and with optimum availability of water, ensured growth by activating the radicle to elongate and pushing the plumule to an extent where reasonably good crop stand could be expected at successful seedling establishment. Initial water uptake by pre-soaking had advantage over seed coat by stimulating germination followed by better seedling growth.

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