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Effect of Soil Moisture Content on Seedling Emergence and Early Growth of Some Chickpea (*Cicer arietinum* L.) Genotypes

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ABSTRACT

At the crop level, the drought stress accounts for most variations in yield. A controlled glasshouse investigation at day/night temperatures of 22/15°C based at Perth City, Western Australia was performed (in 2006) to assess the influence of different soil moisture contents (field capacity percentage basis) on emergence as well as early plant growth in twenty chickpea genotypes. The experiment was laid out in split plot design with soil moisture content as the main treatment and genotype as sub-treatment. Significant differences (P < 0.001) as regards plant emergence and early growth were observed among different soil moisture contents (from 100 to 50, then to 25% field capacity). This brought about a quadratic reduction in mean emergence percentage, delayed the first day to emergence and suppressed the early growth in all the chickpea genotypes. Highly significant differences were also noticed among the genotypes for mean emergence percentage, first day to emergence, plant height, leaf area, total above-ground biomass (plant size) as well as specific leaf area. Significant interaction effect of soil moisture contents and genotypes were observed only for some of the characteristics. Inverse relationship between first day to emergence with plant height (r= - 0.87) and above-ground biomass (r= -0.84**) were observed, indicating that the chickpea genotypes which emerged sooner produced greater plant size. Seed size and density were found to have no relationship with plant size. Although the Kabuli types on average germinated faster and produced larger plants as opposed to the Desi types under the limited soil moisture content, but there was no consistency observed among the chickpea genotypes. Susceptibility of the genotypes to limited soil moisture condition was shown through relatively longer delays in time to emergence (lower germination rate) and reduction in seedling parameters as compared to the resistant genotypes. Final average above-ground biomass (plant size) and plant height under the limited soil moisture content, as opposed to adequate moisture level (F. C. 25% vs. 100%), were reduced 79-85% in Kabuli and 77-79% in Desi types, respectively.**

Keywords: Chickpea genotypes, Early seedling growth, Emergence percentage, First day to emergence, Soil moisture content.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is planted under varying soil moisture conditions, from the subtropics to Mediterranean-climatic regions. In subtropical areas it is sown after the summer monsoon rains and in Mediterranean-regions it is grown in autumn during the cool wet months of winter or spring (Siddique *et al.*, 1999). Soil moisture supply is an important environmental factor controlling germination and seedling establishment (Tylor *et al.*, 1982). High seed emergence and seedling establishment contribute directly to the crop yield (Maiti and Moreno-Limon,

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2001). Rapid seed emergence along with fast plant growth and early maturity substantially contribute to high chickpea yield under drought conditions (Gupta, 1985). Lack of adequate soil moisture in the seedbed is a major hindrance to the establishment of chickpea crop. This is because inadequate soil moisture can reduce seed germination, slow down seedling growth and diminish yield in rainfed crops (Sharma, 1985).

Preliminary field and laboratory studies at ICRISAT (Saxena *et al*., 1983) showed that chickpea cultivars differed in their ability to germinate under limited seedbed moisture conditions. Furthermore, chickpea has a putatively higher moisture requirement for seed germination than such other pulses as field pea, lentil and faba bean (Hadas and Stibbe, 1973). The present study was undertaken to collect information on the effects of soil moisture content on emergence rate and early seedling growth (up to 600 degree days of growth) in some chickpea genotypes.

MATERIALS AND METHODS

Plant Material

Twenty genotypes of chickpea (*Cicer arietinum* L.) with a diversity in origin and seed size were examined (Table 1) under different soil moisture contents. Soil used was from the A-horizon of a reddish brown sandy clay loam (USDA, Calcic Haploxeralf, pH 7.0 in $CaCl_2$) from a field site at Merredin, Western Australia. Polyvinyl chloride pots, 13 cm in diameter and in height, filled to a depth of 12 cm with soil were utilized for chickpea planting. Each pot contained about 2.0 kg of soil with an average bulk density of 1.44 g cm^{-3}. Then 1.4 g powder of an amended (with Cu, Zn, and Mo) super phosphate was incorporated (Davies, 1999) into the top 6-7 cm depth of the soil in each pot. The seeds were inoculated with commercial *rhizobium* before seeding. At sowing time on 5 May 2006, five to ten seeds from each geno-

Table 1. Chickpea genotypes and their seed characteristics.

Genotype	Type	Origin	100 seed weight (g)	Seed density (g cc^{-1})
Almaz	Kabuli	CLIMA	43.05	0.7487
BG 372	Desi	India	14.52	0.7153
Bumper	Kabuli	Australia	36.44	0.7753
Dooen	Desi	Azerbaijan	16.51	0.7275
Garnet	Kabuli	Turkey	24.07	0.7643
ICC 10415	Desi	India	16.24	0.7063
ICC 4958	Desi	India	24.56	0.7675
ICCC 33	Kabuli	India	21.00	0.7243
ICCV 00307	Kabuli	India	22.19	0.7158
ICCV 97301	Kabuli	India	34.67	0.7538
K 850	Desi	India	27.03	0.7508
Kaniva	Kabuli	South-west Asia	29.51	0.7665
Kimberley Large	Kabuli	CLIMA	68.65	0.7503
Lasseter	Desi	Iran	22.58	0.7527
Moti	Desi	India	21.93	0.6748
Nafice	Kabuli	CLIMA	43.94	0.6975
Norwin	Desi	Australia	16.05	0.6980
Rupali	Desi	Australia	13.51	0.7506
Sona	Desi	India	16.91	0.6902
Tyson	Desi	India	13.68	0.7200

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type, based on their viability rate in a standardized laboratory seed testing, were planted at 4-5 cm depth in the middle of each pot.

The experiment was conducted in an evaporatively cooled glasshouse at Floreat Park, Perth, WA, with day/night temperatures of 22/15°C, natural light and decreasing photoperiodism from 11.0 to 10.5 hours. Pots were arranged in 4 replicates in a randomized complete block-split plot design with four soil moisture treatments (25%, 50%, 75%, and 100% field capacity on dry weight basis) as main plots and genotypes as subplots. The pots were watered every three cardinal days according to treatments, and seedlings thinned to one per pot two weeks past sowing.

Soil Moisture Treatments

The different soil moisture treatments were determined through volumetric water content measurement in each pot, using the gravimetric water content (%) and bulk density (Kamara and Haque, 1988). Bulk density was calculated by weight (gram) of dry soil divided by pot volume (g per cubic cm), and gravimetric water content calculated by the amount of water added per gram of dry soil (g g^{-1}). Finally, the volume of water in four treatments applied during the experiment were as follows:

1. 0.2710 cm^3 cm^{-3} considered as 100% field capacity (control treatment).
2. 0.2032 cm^3 cm^{-3} considered as 75% field capacity.
3. 0.1358 cm^3 cm^{-3} considered as 50% field capacity.
4. 0.0674 cm^3 cm^{-3} considered as 25% field capacity.

The drying pots were monitored, using a digital balance at 3 day intervals during the development of water deficits. Then, the amount of missing water from each pot was replaced through hand irrigation close to the percent required field capacity according to the soil moisture treatments.

Measurements

The standard germination test (ISTA, 1985), 100-seed weight and seed density (g cc^{-1}) (Dahiya *et al.*, 1997) were assessed in the laboratory prior to running the trials, (Table 1). In the glasshouse experiment, emergence percentage was recorded daily until the seedling emergence completed. Emergence percentage was calculated by dividing the number of emerged seedlings by the total seeds sown. From these observations the time to first day of emergence was recorded (and analysed through ANOVA) for each genotype and replicate. Then, peak emergence rate was determined by regressing emergence percentage against days after sowing during the linear phase (i.e. after initial emergence and before rates tailed off after 11 days). Other parameters such as plant height, branch numbers, leaf area, total above-ground biomass (plant size) and specific leaf area were determined at 600 growing degree days (°C d) after sowing. For leaf area, the harvested plant was placed in a plastic bag and immediately transported to the laboratory where leaf area was measured, using a portable area meter (Licor Model). Subsequently, the plant material was separated into leaf and stem, oven-dried at 65°C for 72 hours, and weighed.

Statistical Analysis

Split-plot ANOVA as well as regression were performed, using Genstat (Version 8). The effects of seed type (Kabuli versus Desi), soil moisture content and seed size were compared, using polynomial contrast.

RESULTS

Emergence Percentage

The glasshouse investigation of the effect of soil moisture content on mean germination percentage showed a decline (P< 0.001)

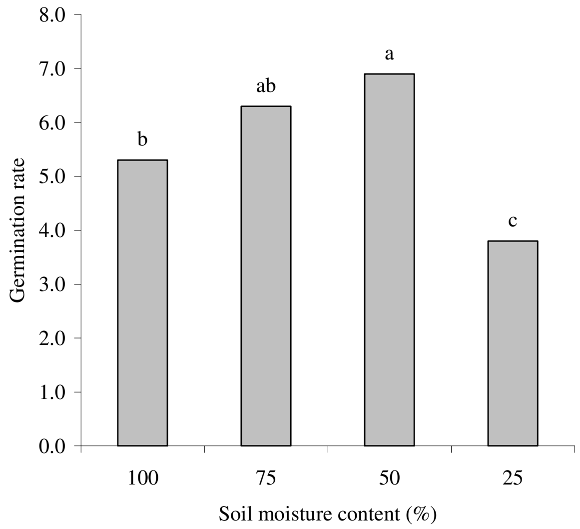

Figure 1 . Effect of soil moisture content (% field capacity basis) on germination rate (averged over replications and genotypes)

at 25 % field capacity (Table 2). Chickpea genotypes also showed significant differences (Table 3); nevertheless, no significant interaction effect (P> 0.05) was observed (between the impact of soil moisture content and genotypes) on mean germination percentage.

Although, the relationships between seedling emergence percentage, seed size (r= 0.18**) and seed density (r= 0.38**) were significant, but the differences in emergence percentage due to chickpea types were not significant (P> 0.05). Rupali, the small seed size genotype (135 mg seed^{-1}), scored a similar seed emergence rate (Table 3) with those of large seed size genotypes (Kimberley Large and Nafice).

Table 2. Mean soil moisture effects on chickpea genotypes characteristics (averaged over genotypes and replications).

Treatments (% field capacity basis)	Emergence percentage	Time to first emergence	Plant height (cm)	Branch numbers per plant.	Leaf area(cm^2)	Above-ground biomass (g plant^{-1})	Specific leaf area (cm^2 g^{-1})
100%	78.4	3.8	20.2	4.5	102.6	0.98	178.0
75%	86.4	6.2	19.0	4.4	81.8	0.83	164.8
50%	83.7	7.9	14.4	3.5	41.6	0.54	131.3
25%	56.5	13.9	3.7	1.0	2.5	0.21	37.3
L.S.D. (p= 0.05)	10.8	1.06	2.3	0.4	23.3	0.2	11.4

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Time to First Day of Emergence

Time taken to emergence, as a parameter of seedling vigour, was remarkably prolonged with a decline of soil moisture content from 100% field capacity (Table 2). The reduced moisture levels at 25% and 50% F. C. postponed the first day to emergence by 9.5 to 6.5 days, respectively, as compared to 75–100% field capacity. In other words, it has been noted that on leaving the sown seeds for a considerable period at low soil moisture content, the time to emergence becomes maximally prolonged. Similar to emergence rate, no significant interaction effect (P> 0.05) was observed between the impact of soil moisture content and genotypes on the first day to emergence.

The chickpea genotypes being exposed to 25% and 50% F.C. (a stressful seedbed) emerged at a rate of about 2.4 to 1.4 times lower, respectively as compared to 100% F. C. (control treatment). The time to emergence in Desi type chickpea was shorter than that for the Kabuli genotype (P< 0.001). On an average the germination rate was higher in large seed genotypes than that in the small seed ones. The genotypes Norwin, Dooen (Desi types), and ICCV 00307, Kimberley Large, Nafice (Kabuli types) had the highest germination rate (Table 3). The relationship between emergence percentage and germination rate among the chickpea types (r= 0.70**) was indicative of a positive and significant association between these two parameters.

Table 3. Chickpea genotypes emergence per cent and early seedling growth characteristics until 600° Cd.

Genotype	Emergence percentage	Time to emergence	Germination rate	Plant height (cm)	Branch numbers Per plant	Leaf area (cm^2 $plant^{-1}$)	Above-ground biomass (g plant-1)	Specific leaf area (cm2 g^{-1})
Almaz	75.9	8.3	6.6	14.3	3.3	59.6	0.78	133.5
BG 372	64.8	8.9	5.9	10.3	3.1	35.0	0.47	131.8
Bumper	55.0	9.8	4.6	15.7	3.7	58.5	0.74	131.0
Dooen	72.3	8.0	11.5	14.4	3.4	44.1	0.61	130.0
Garnet	71.9	9.6	7.3	14.7	3.7	53.8	0.63	132.7
ICC 10415	72.5	8.4	5.8	12.6	3.3	42.9	0.58	126.8
ICC 4958	76.3	7.9	6.7	15.6	3.9	52.2	0.69	130.6
ICCC 33	82.5	9.7	8.0	9.9	3.3	34.4	0.52	121.2
ICCV 00307	83.8	7.5	9.8	15.0	3.1	55.5	0.72	129.9
ICCV 97301	88.4	8.1	7.2	14.3	3.4	60.9	0.76	134.6
K 850	63.8	8.9	6.2	11.5	3.6	52.1	0.67	135.0
Kaniva	63.8	8.6	5.8	17.2	3.7	57.2	0.75	127.1
Kimberley Large	87.5	10.1	9.7	17.9	2.9	28.5	0.59	90.0
Lasseter	69.6	7.9	6.4	16.5	3.3	40.6	0.56	134.9
Moti	84.8	8.1	6.4	15.2	3.2	54.4	0.73	133.4
Nafice	95.0	8.1	9.6	13.4	3.2	42.8	0.67	114.2
Norwin	84.4	6.9	12.3	14.0	3.2	46.1	0.63	142.3
Rupali	83.3	7.4	7.8	15.7	3.1	39.0	0.54	136.2
Sona	73.8	7.7	5.8	17.4	3.5	43.6	0.64	124.2
Tyson	76.0	8.9	6.8	10.8	3.2	34.0	0.52	117.6
L. S. D. (P= 0.05)	16.3	1.3	5.4	1.9	n.s.	8.4	0.08	18.1

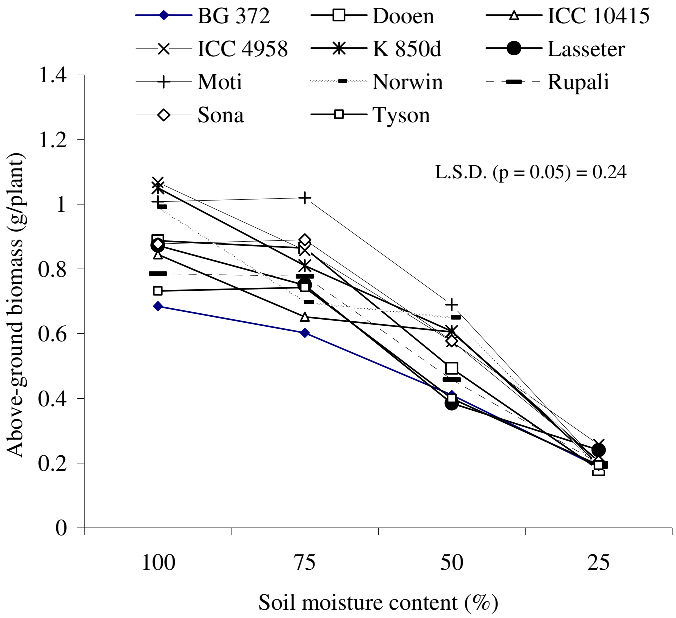

Figure 2a. Relationship between soil moisture content (% field capacity basis) and above-ground biomass at 600 °Cd for kabuli chickpea genotypes

Seedling growth studies

The seedling growth was affected (P< 0.05) by soil moisture (Table 2) and also in all chickpea genotypes (Table 3). The chickpea genotypes varied significantly in plant stature, leaf area and above-ground biomass. Plant height significantly differed (P< 0.05) between Kabuli and Desi types (Table 3). Average plant heights under the limited soil moisture content (F. C. 25% vs. 100%) were only was 2.9 cm in Dooen (Desi type), and 1.45 cm in ICCC 33 (Kabuli type) as compared to mean plant height (14.3 cm), that means the plant stature, being shortened for about 80-90% (data not shown).

Branch numbers per plant was significantly reduced (P< 0.001) with limited soil moisture content treatments (Table 2). The difference between soil moisture treatments as for branches per plant was significant (R^2 = 0.997), however in most of the genotypes no significant differences were observed (Table 3). Similarly, no significant interaction effects were observed for this trait.

The effect of soil moisture content on leaf area per plant (Table 2) showed a decline (quadratic slope with R^2= 0.99) indicating that chickpea genotypes were facing leaf growth repression under moisture stress (P< 0.001). Under the limited soil moisture content (F. C. 25% vs. 100%) the average leaf area in all genotypes got reduced by 97.5% (Table 2). The chickpea genotypes also exhibited substantial variations for leaf area (81.3%). The leaf variation gradient in Kabuli types (b= - 0.002) was more than that in Desi types (b= -0.001), meaning that there was a lesser decrease of leaf area in the latter chickpea genotypes.

Each and every one of the reduced soil moisture contents from 100% field capacity downwards severely (P< 0.001) depressed the final above-ground biomass (Table 2). Total biomass of a 33 day-old plant (at 600 °C d) showed an 81% reduction, when exposed to stress condition (F. C. 25% vs. 100%). This reduction in total biomass

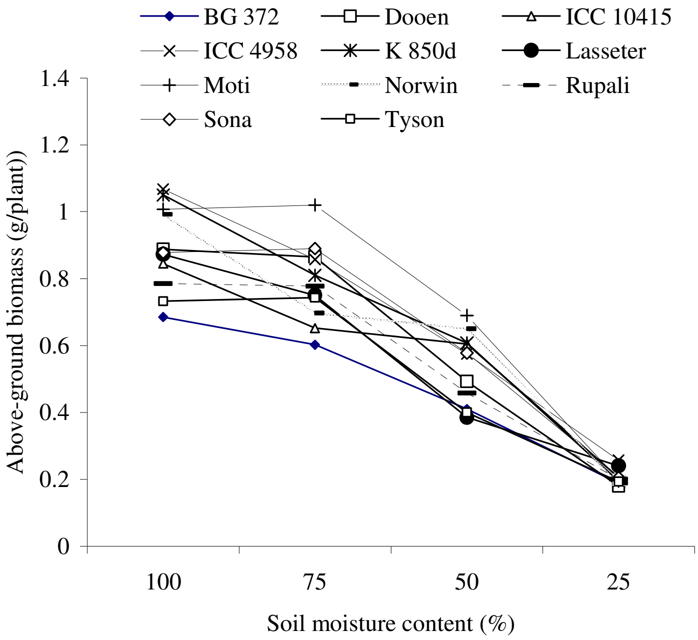

Figure 2b. Relationship between soil moisture content (% field capacity basis) and above-ground biomass at 600 °Cd for desi chickpea genotypes

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ranged from 0.19 g for Garnet (Kabuli type) and Dooen (Desi type), as compared to 1.07-1.24 g for ICC 4958 (Desi type) and ICCV 00307 (Kabuli type), respectively under the moisture stress (F. C. 25% vs. 100%) (Figures 2a and 2b). Above-ground biomass significantly ($P< 0.001$) differed in Kabuli (Figure 2a) vs. Desi types of chickpea (Figure 2b). The adverse effects of water stress even at 50% and 75% field capacity caused a reduction of 15-45% in above-ground biomass, respectively (Table 2). The genotypes Almaz, Kaniva (Figure 2a) and Moti, ICC 4958 (Figure 2b) produced the maximum biomass; whereas the genotypes ICCV 33, Kimberley Large (Kabuli types); and Dooen, Norwin (Desi types) produced the minimum dry weights. Regression analysis for soil moisture contents vs. genotypes revealed that 66.3% of variances for above-ground biomass ($P< 0.001$), which is due to chickpea genotypic differences.

There were positive significant associations observed between plant height (r= 0.79**), branch numbers (r= 0.76**), leaf area (r= 0.93**), and specific leaf area (r= 0.61**) with total biomass. The emergence percentage (r= 0.49**) and seedling vigour parameters such as the first day to emergence (r= - 0.84**) showed significant relationships with total biomass per plant; indicating that the genotypes (ICCV 00307, ICC 4958) which emerged or were established at an earlier stage at a lower soil moisture content produced larger plants.

Total specific leaf area (SLA) of stressed plant (F. C. 25% vs. 100%) was lower than in that of the control soil moisture treatment (Table 2). Mean SLA value for stressed plants (F. C. 25% vs. 100%) was 37.3 and that of the control treatment 178.0 3 cm^2 g^{-1}. The average SLA for all the genotypes under limited soil moisture content was reduced by 91%. Significant differences between Kabuli and Desi chickpea genotypes for SLA were observed (Table 3). The genotypes Kimberley Large, Nafice (Kabuli types); and Tyson, Sona (Desi types) produced the lowest SLA, while the genotypes ICCV 97301, Almaz (Kabuli types) and Norwin, Rupali (Desi types) produced the highest SLA. Plant height (r= 0.81**), branch number (r= 0.77**) and leaf area (r= 0.76**) were positively and significantly correlated with specific leaf area.

DISCUSSION

For most of the chickpea genotype characteristics studied here, significant interactions (Soil moisture contents×Genotypes) were observed which were not well explained by either seed size or seed type. Although seed size (r= 0.18**) and seed density (r= 0.38**) showed some relationship with emergence rate, but no significant differences ($P > 0.05$) were recorded between Kabuli (78.2%) and Desi types (74.7%) for this trait under different soil moisture contents. Nevertheless, some researchers have reported that the macrosperma cultivars of chickpea (Singh and Afria, 1985) as well as of lentil (Singh and Singh, 1982) are more sensitive to moisture stress than are microsperma cultivars. Among all chickpea genotypes the small seed size Rupali (135 mg $seed^{-1}$) scored similar mean emergence percentage (Table 3) to those of large seed size genotypes (e.g. Kimberley Large and Nafice). These results were in agreement with report of Verma *et al.* (2005) who showed that seed size can affect in glasshouse percentage emergence of pigeon pea. Mean germination rate was higher in such small seed size genotypes as Norwin, Dooen (Desi types), as compared to such large seed Kabuli types as ICCV 00307, Kimberley Large, and Nafice (Table 3). These foregoing observations indicated that seed weight and density did not favourably affect the mean emergence percentage, first day to emergence and germination rate among chickpea genotypes. It may be concluded that these tests (i.e. seed test weight and seed density) are not adequately enough to determine the overall seedling establishment in field conditions for chickpea genotypes.

The relationships between time to emergence and above-ground biomass were negative (r= -0.84**). In other words, the penalty of a late emerged seedling is slower growth and smaller plant size (biomass), which indicates the important role of chickpea genotypes on germination rate. Hereditary differences in germination rate between the normal and slow germinating chickpea genotypes have been reported (Dahiya *et al.*, 1997). In our research, the seedling growth was also shown to be adversely affected by soil moisture reduction, and that the chickpea genotypes varied significantly in production of branches, leaf area and above-ground biomass. Rapid seedling growth has been found to be associated with well established seedling and subsequent early growth in chickpea (Gupta, 1985), which in turn contributes favourably to high yield under drought conditions.

Plant height ($P < 0.05$) and the number of branches ($P < 0.001$) were significantly decreased (Table 2) with more severe soil moisture deficits (F. C. 25% vs. 100%). These results well agreed with the report by Lutfor Rahman and Mesbah Uddin (2000). A substantial reduction in soybean plant height as a result of a short period of water stress has been reported by Momen *et al.*, (1979). Positive relationships between plant height and other seedling traits have also been observed. There was a positive association reported ($P < 0.05$) between the final plant height and bean yield (White *et al.*, 1992). Insufficient leaf area development was the most sensitive reaction to the limited soil moisture (Table 2). There is enough evidence in literature that reduced soil moisture during the early seedling stage diminishes leaf growth which in turn would result in a reduction of both dry matter and yield (Constable and Hern, 1978).

The chickpea genotypes also exhibited substantial variation for leaf area (81.3%). A linear and strong relationship between leaf

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area and above-ground biomass (r= 0.97**) among the chickpea genotypes under different soil moisture contents was observed ($P< 0.01$). An important role of leaf area in determining the drought tolerance in common bean has been reported by Wright and Redden (1998). Similarly, such other characteristics as germination percentage (r= 0.54**), the first day to emergence (r= -0.91**), plant height (r= 0.92**) and number of branches (r= 0.94**), etc. showed significant associations with leaf area. Leaf area and other morphological characteristics have been found to be positively correlated with yield in some crops like cowpea (Dhanasekar and Pandey, 2005). Here, it can be inferred that the plant height and branch numbers per plant had a strong effect on leaf area, which in turn conformed the findings in cowpea (Dhanasekar and Pandey, 2005).

As a whole, the experimental data revealed significant differences between soil moisture contents (F. C. 25% vs. 100%) for emergence percentage rate and seedling growth up to 600°C d (GDD). Two conclusions may be drawn here: (a) mean emergence percentage was diminished, and (b) time to emergence was progressively delayed with the initial soil moisture content being decreased. The rate of germination has been shown to decline in response to increasing moisture stress in soybean cultivars (Srivastava and Ahulwalia, 1978).

In the present study, the chickpea genotypes exhibited large inconsistency in emergence rate as well as in early growth, which offer a great opportunity in selecting drought tolerant genotypes. Singh and Singh (1982) have reported that seed germination and seedling growth of macrosperma subspecies of lentils were more sensitive to soil moisture effects than the microsperma. At 25% F. C. (stressed condition), the Kabuli types emerged faster and produced larger plants, and the first day to emergence occurred to be sooner in the latter genotypes, as compared to Desi types, due to their superiority in seed size and density (Table 1).

In conclusion, among the twenty chickpea genotypes evaluated, it was found that Almaz, Bumper, ICCV 00307, ICCC 97301, Kaniva (Kabuli types); and ICC 4958, K 850, Moti, Norwin (Desi types) were comparatively resistant to water stress, rendering them suitable for being used in breeding programs. The chickpea genotypes ICC 4958 and ICCV 00307 were identified as drought tolerant, had the fastest emergence, early growth, higher leaf area and biomass accumulation coupled with more plant height and branch numbers.

Significant differences were noticed between genotypes×soil moisture contents interaction and some the chickpea traits. The fast emerged seedlings were taller, produced more branches, developed larger leaf areas and accumulated more above-ground biomass as well as specific leaf area than the slow emerging genotypes. Yadav *et al*. (2005) also reported that soil water stress is a major constraint limiting productivity of chickpea varieties/genotypes and that they vary in their tolerance to water stress, which supports the results of our study.

The genotypes ICC 4958 and Almaz were the superior ones under 25% and 100% soil moisture contents, respectively. The negative correlation of the first day to emergence with above-ground biomass, plant height, branch numbers, leaf area, specific leaf area (data not presented) suggested that the first day to emergence could be a reliable and efficient trait that can be employed in screening soil moisture stress tolerant chickpea genotypes; even though one vigour indicating parameter will not be enough to judge the overall seedling emergence potential and early plant growth in the field.

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اثرمحتوای رطوبت خاک بر جوانه زدن و رشد رویشی ژنوتیپ های نخود (*Cicer arietinum* L.)

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چکیده

اغلب تغییرات عملکرد گیاهان زراعی ناشی از تنش خشکی می باشد. لذا به منظور ارزیابی اثر میزان مختلف رطوبت خاک (بر اساس در صد ظرفیت مزرعه) بر جوانه زدن و رشد رویشی ژنوتیپ های نخود تحقیق حاضر در شرایط کنترل شده در دمای روز - شب ۲۲/۱۵ درجه سانتیگراد در یک ایستگاه تحقیقاتی واقع در غرب استرالیا (شهر پرث) به سال ۲۰۰۶ انجام گرفت. طرح بلوک های تصادفی در قالب کرتهای خرد شده با میزان مختلف رطوبت خاک (۴ سطح) در کرت اصلی و واریته های نخود (۲۰ ژنوتیپ) در کرت های فرعی با ۴ تکرار اجراء گردید. نتایج نشان داد که با کاهش رطوبت خاک از ۱۰۰در صد به ۵۰ یا ۲۵ ٪ میانگین در صد جوانه زدن روندی نزولی (تابع درجه دوم) داشت و موجب تاخیر روز های کاشت تا جوانه زنی بذور گردید. ژنوتیپ نخود در صد جوانه زدن، زمان جوانه زنی، ارتفاع بوته، تعداد شاخه، سطح برگ، کل ماده خشک و سطح ویژه برگ متفاوت و معنی‌داری ($p < 0.01$) داشتند. برهمکنش رطوبت خاک و ژنوتیپ ها نیز برای برخی صفات معنی دار بود. روابط منفی بین اولین روز جوانه زنی با ارتفاع بوته ($r = -0.87^{**}$) و ماده خشک ($r = -0.84^{**}$) بیان داشت که ژنوتیپ هائی که زودتر سبز شدند دارای بوته های بزرگتری نیز بودند. اندازه و تراکم بذر با اندازه بوته ارتباطی نشان نداد اگر چه ارقام کابلی متوسط جوانه زنی سریعتر و اندازه بوته بزرگتری نسبت به ارقام دسی در شرایط محدودیت رطوبتی داشتند ولیکن بین ژنوتیپ ها تغییرات چشمگیری وجود نداشت. حساسیت ژنوتیپ ها به محدودیت رطوبتی با تاخیر نسبتا زیاد در زمان جوانه زنی (سرعت پائین جوانه زنی) و کاهش رشد رویشی گیاهچه ها در مقایسه با ارقام متحمل قابل مشاهده بود. از میزان ماده خشک و ارتفاع بوته به ترتیب ۸۵-۷۹٪ در ارقام نخود کابلی در مقایسه با ارقام نخود دسی به میزان ۷۹-۷۷٪ در شرایط تنش رطوبتی نسبت به شرایط مطلوب رطوبت خاک کاسته شد.

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