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Effect of Sowing Dates and Two Chickpea Cultivars on Some Growth Parameters and Yield

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ABSTRACT

A field study was conducted at Grdarasha Research Station of the College of Agriculture/ Salahaddin University– Erbil, during the growing season of 2017, to study the effect of sowing date on some growth parameters and yield of chickpea. A factorial experiment based on randomized complete block design (RCBD), with three replicates was used, sowing dates (January 20, February 9, March 1, and March 21), and two cultivars of chickpea (Rafidain and Gab) were implemented. Sowing at January, 20 produced the highest plant height (43.0 cm), leaf area (797.83 cm^2), leaf area index (2.66), dry matter (38.06 g m^{-2}), crop growth rate (7.90 g m^{-2} day^{-1}), number of primary branches $plant^{-1}$ (3.55), number of pod $plant^{-1}$ (21.60) and seed yield (2.160 t ha^{-1}). On the contrary sowing at March, 21 recorded the lowest of all above studied characteristics, also Gab cultivar surpassed the Rafidain cultivar in all characteristics studied except no. of seeds $plant^{-1}$ and 100-seed weight. From interaction sowing date with cultivars recorded the highest of all characteristics studied at sowing date January, 20 with Gab cultivars as well as Rafidain cultivar recorded the lowest of all studied characteristics at sowing date March, 21. There was positive highly significant correlation(r= 0.869) between seed yield and their components; no. of pods plant-1, no. of seeds pod-1 and 100-seed weight (r= 0.869, r= 0,810 and r= 0.706) respectively.

1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) belongs to the family fabaceae, an annual and one of important pulls crop. Chickpea is an important source of protein for millions of people in the developing countries, in addition to having high protein content (20-22%), rich in fiber and minerals. Chickpea the fourth largest grain legume crops in the world, with a total production of 10.9 million tons from an area of 12.0 million with a productivity of 0.91 ha^{-1}. Major producing countries include India, Pakistan and Iran (FAO, 2016). Chickpea being a leguminous crop improves soil fertility by fixing atmospheric nitrogen up to 99 kg/ ha in available from (NH_3 and NH_4) in the root through the phenomena of symbiosis (Schwenke *et al.*, 1998). Among the various agronomic practices, sowing time is the single most important factor influencing the yield of chickpea. Optimum sowing time of chickpea may vary from one variety to another and also from one region to another due to variation of agro-ecological conditions. Different sowing

dates subject the vegetative and reproductive stages of the plant to various temperature, solar radiation and day length (Yadav *et al.*, 1999).The exposure of crop to low temperatures during germination and seedling establishment and to high temperature during flowering and seed formation phases under delay-sown chickpea results in drastic reduction in yield (Turner *et al.*,2001). Yield loss in chickpea can vary between 30% and 60% depending on genotype, sowing time, location, and climatic conditions during sowing season. Some chickpea genotypes have capacity to tolerate drought and in that case sowing time can be delayed. However, earlier or late sowing caused drastic reduction in yield and net profit compared with timely sowing (Dixit *et al.,* 1993). The different genotype growth response varies to different environment and their relative ranking usually differ (Eberhort and Russel, 1966) and ultimately decides the selection of genotypes for a particular or different sowing dates for stabilized higher yields (Perkins and Jinks, 1968). The chickpea genotypes differ in their yielding ability, this calls for a need to generate more information on the response of chickpea genotypes to the dates of sowing for greater yields in a given agro-climatic conditions. Hence, there is a need to identify appropriate sowing time, suitable variety and their interaction with respect to growth, development and yield performance. Yadav *et al*. (1999) reported that vegetative growth of forty chickpea genotypes belonging to the kabuli and desi types, continued into the reproductive stage for longer under normal than late sowing. Mahse et al. (2006) at Rahuri (Maharashtra) found that late sowing of chickpea resulted into 36.6% reduction in number of pod plant^{-1}. Virk *et al*. (2005) found that chickpea sown on November, 5 resulted in significantly higher seed yield (2039 kg ha^{-1}) followed by sowing on October, 25 (1837 kg ha^{-1}) and November, 25 (1826 kg ha^{-1}). Fallah (2008) at Khorram-Abad (Iran) showed that delay in sowing from March, 6 to April, 5 significantly reduced the number of grains pod^{-1}. Malik *et al*. (1995) reported that the two chickpea cultivars sown at the end of September and end of October gave mean seed yield of 972 and 836 kg ha^{-1}, respectively. Reddy and Ahlawat (1998) reported that desi variety BG 261 recorded significantly higher number of pods plant-1 than kabuli variety ICCC-32. Stieller et al. (1994) reported from New Zealand that the highest seed yield among desi chickpea cultivars was produced by ICCV-93801 (26.8 g plant-1) and among kabuli chickpea cultivars by ICCV-92338 (20.3 g plant^{-1}). Yadav *et al*. (1998) in New Delhi reported that delayed sowing beyond November decreased seed yield in both desi and kabuli chickpea. However reduction in kabuli chickpea was on the higher side than desi chickpea. Ku March et al. (2013) in Hisar (Haryana) reported that chickpea cv. HK 98-155 produced higher seed yield as compared to cvs. HK-1and HK 00-290.The present study was carried out to investigate some growth parameters and yield of two cultivars at different sowing dates.

2. MATERIALS AND METHODS

A field study was conducted at Grdarasha Research Station of the College of Agriculture/ Salahaddin University-Erbil (Latitude 36° 4' N and Longitude 44°2' E) 415 meters above sea level having annual rainfall (250-600 mm) during the season of 2017 to study the sowing date on some growth parameters and yield of two chickpea cultivars. A factorial experiment based on randomized complete block design (RCBD), with three replicates was applied. The first factor represents four sowing dates (January 20, February 9, March 1, and March 21), and the second factor represents two cultivars

of chickpea (Rafidain and Gab). Representative soil samples were taken from various locations of the field at depth of (0-30 cm) after tillage. These samples were air dried then sieved by using 2 mm sieve, then packed for analysis.

Experimental unit size was (2m×2 m) consisting of 5 rows of 180 cm length and 30cm a part. Sowing was done manually, two seeds were placed in each hole of 10 cm a part and sowing depth of 3 cm. Five plants were selected randomly from each experimental unit to study the plant height (cm), leaf area (LA)(cm2) and leaf area index (LAI): was calculated by viticanopy program application, Dry matter (gm^{-2}): Which represent the dry mass of total green parts of plant after drying at 80°C for (48-52) hours, then weight was converted to g m-2.Crop growth rate (CGR) g m^{-2} day^{-1}: It was calculated by dividing dry matter yield (gm^{-2}) at flowering stage by number of days from sowing to the flowering stage.

$$\text{LAI} = \frac{\text{Plant total leaf area per plant}}{\text{Average land area occupied by plant}}$$

$$\text{Crop Growth Rate (CGR)} = \frac{1}{GA} \times \frac{W_2 - W_1}{T_2 - T_1}$$

Number of primary branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1} and the 100-seed weight (g) were calculated. All middle-line plants of each experimental unit were harvested to calculated yield (kg ha^{-1}). The data was analyzed statistically for all studied traits according to analyses of variance using the Statistical Analysis System (SAS Institute, 2005). Duncan's multiple range test (DMR) at 5% level was used to the determine among means (Steel and Torrie, 1997). Simple correlation coefficient was calculated between the seed yield and other traits, and among the traits themselves.

Table (1): Metrological record for Grdarasha field during the rainfall season of (2017).

Parameter Year 2017	Air Temperature in (°C)		Monthly total rainfalls (mm)	Relative Humidity (R.H%)
January	**Maximum**	**Minimum**		
1-8	13.49	2.40	21.1	63.7
9-16	14.10	2.78		
17-24	14.77	3.77		
25-31	10.33	2.99		
February				
1-7	8.75	-0.35	6.4	54.7
8-15	14.66	5.61		
16-23	11.89	1.29		
24-28	19.19	5.72		
March				
1-8	21.02	11.37	28.8	50.6
9-16	19.83	9.72		
17-24	20.29	10.09		
25-31	23.62	9.93		
April				
1-8	19.45	4.55	11.7	42.4
9-16	23.52	12.13		
17-24	26.50	13.04		
25-30	29.27	15.37		
May				
1-8	30.72	17.40	3.3	24.8
9-16	35.48	19.72		
17-24	33.63	19.69		
25-31	36.64	19.85		
June				
1-8	37.42	21.44	0.0	17.0
9-16	39.97	23.82		
17-24	37.77	23.40		
25-31	43.95	26.09		

3. RESULTS AND DISCUSSION

Plant height (cm)

The data presented in table (2) confirms the existence of significant differences among all the factors studied the highest plant height (43.00 cm) when planted at January, 1 compared with sowing date on March, 21 that recorded (28.16 cm) because of the variations of temperature degrees at different sowing dates (Table 1). Among different varieties, plant height was also differed significantly up to maturity, plant height was recorded (37.75 cm) in Gab cultivar but Rafidain cultivar recorded (34.25 cm). However the interaction between sowing date and cultivars has significantly, the highest plant height (44.33 cm) when planted Gab cultivar at January, 1 compared with sowing date at March, 21 with Rafidain cultivar (27.33 cm). This result is in agreement with Mahse *et al.* (2006) in Rahuri (Maharashtra) noticed that plant height was decreased by 14.5% under late sown condition as compared to normal sown condition. Also, Chaitanya and Chandrika (2006) observed that chickpea cultivars sown on November, 1 exhibited significantly greater plant height (32.9 cm) as compared to November, 15, and December, 1 sown crops.

Leaf area (cm^2)

The data pertaining to leaf area as influenced by sowing dates varieties and their interaction (Table 2). Among different sowing dates January, 20 exhibited significantly higher leaf area (797.66 cm^2) as compared to March, 21 this increase in early sowing (January, 20) was due to the suitable temperature degrees for vegetative growth, hence increase in leaf area (Table 1). Among the different cultivars, Gab exhibited significantly higher leave area followed by Rafidain cultivars. The highest leaf area (851.33 cm^2) for Gab cultivar when planted at January, 1 compared with Rafidain cultivar when planted at March, 21 with that recorded lowest (522.33 cm^2). This result is in agreement with Mansur *et al.* (2010) observed that sown on first October exhibited significantly greater leaf area as compared to November, 15.

Leaf area index (LAI)

The results shown in table (2) shows significant differences of leaf area index among sowing dates, cultivars and their interaction the heights leaf area index was recorded at sowing date January, 20 (2.66) but the lowest has recorded in sowing on March, 21 (1.66). Among the different cultivars, Gab has significantly showed higher leaf area index followed by Rafidain cultivars. The highest leaf area index Gab cultivar (2.48) when was planted at January, 20 compared with Rafidain cultivar planted on March, 21 that recorded the lowest (1.48). This result is in agreement with of Haloi and Baldev (1986) who reported that leaf area index gradually decreased with delay in sowing of chickpea crop.

Dry matter (g m^{-2})

The results of the analysis of variance in the table (2) showed significant differences for all the studied factors, plants cultivated at January, 20 produced higher yields of dry matter (38.80g m^{-2}), while the plants cultivated on March, 21 gave the dry matter (12.27g m^{-2}) due to rise in temperature degrees at late sowing dates (Table 1) which resulted in decrease in leaf area and plant height (Table 2) and then lowering in dry matter for these dates, the highest dry matter has recorded at January, 20 sowing date with Gab cultivar (38.47g m^{-2}) as compared with sowing on March, 21 with Rafidain cultivar (12.48g m^{-2}). This result is in agreement with the results of Mansur *et al.* (2010) who observed that chickpea cultivars sown on first October exhibited significantly greater dry matter as compared to November, 15.

Crop Growth Rate (g m^{-2} day^{-1})

The results of analysis of variance in table (2) showed significant differences among all studied factors and their interaction .The cultivated plants at January, 20 gave the highest rate of crop growth reached (7.9g m^{-2} day^{-1}), while on March, 21 gave the lowest rate for this trait (5.23 g m^{-2} day^{-1}). Almost the plant cultivated at January, 20 with Gab cultivar gave highest crop growth rate (8.33g m^{-2} day^{-1}), while Rafidain cultivar produced the lowest for this trait (5.06 g m^{-2} day^{-1}) when planted onMarch,21. From the data of table (4), it was noticed that there was a high significant correlation relationship between crop growth rate with leave area reached (r = 0.987).

No. of primary branches $plant^{-1}$

Table (3) shows the effect of sowing date, cultivars and their interaction on this trait components analysis of chickpea. The maximum among the sowing dates was January, 20 which was one of four sowing dates; whereas the minimum was for March, 1 and March, 21which was (2.95 and 2.88), respectively. However, the different cultivars, Gab cultivar obtained significantly higher no. of primary branches followed by Rafidain cultivar. The highest was on January, 20 (3.66) with Gab cultivar, but the least value was recorded for Rafidain cultivar on March, 21 (2.70). Also Rehman *et al.*(2015) showed number of branches per plant at October, 15 was significantly higher over other sowing dates and cultivars had non-significant number of branches per plant.

No. of pods $plant^{-1}$

The results of no. of pods$plant^{-1}$are displayed in table (3). A wide variation was observed between no. of pods/ $plant^{-1}$, the highest number of no. of pods $plant^{-1}$ was on January, 20 which was (21.60), while the lowest number was recorded on March, 21 which was (6.06). The maximum was for Gab cultivar (18.22); whereas the minimum was for Rafidain cultivar (14.38). Referring back to table (3), there was coincidence in the results of Gab cultivar at January, 20which also give highest number (23.32), but the lowest was (7.88) from Rafidain cultivars at March, 21.The obtained results in the study indicated that the response of chickpea cultivars to sowing times were different. Therefore, to determine suitable sowing date in chickpea different cultivars should be studied (Kaya*et al.*, 2010).

No. of seeds pod^{-1}

The of no. of seeds $pod^{-1}$are displayed in table (3) shows that the highest was recorded for the sample collected on January, 20 (1.60), which was near to the sample on February, 9 (1.08), followed by (1.07) at March, 1 which all other samples were similar statistically. Whereas the minimum was on March, 21 (0.56). However the cultivars that the optimum results for Gab cultivar (1.13). Considering the interaction between sowing date and cultivars, the highest was (1.27) for Gab at January, 20 but the lowest value was recorded from Rafidain cultivar at March, 21 (1.00). However, delay in sowing resulted in adverse effect of climate which, resulted in poor crop stand and short time to complete their life cycle, especially after November, 15 (O'Toole *et al.*,2001).

100-seed weight (g)

Table (3) shows100-seed weight the highest for the sample collected on January, 20 (26.44 g), which was similar to sample February, 9, March, 1, and March, 21 which were(26.40, 24.90, and 24.78 g) respectively that all samples were similar. The highest interaction were recorded for the sample collected from Gab at January, 20 (28.69 g), but the least was (21.01g) for Rafidain cultivar at March, 21. The lowest number of 100-seed

weight and seed yield in early and late autumn sowing dates were due to encounter of flowering and fertilization stages with high and low temperatures respectively (Chaitanya *et al.*,2006).

Seed yield (kg ha^{-1})

Seed yield displayed in table (3) shows that the highest at January, 20 (2159.55kg ha^{-1}), while the lowest were at March, 1 (1579.94kg ha^{-1}). The highest cultivars were also for Gab (1725.50 kg ha^{-1}) but the lowest value was recorded for Rafidain (1590.75 kg ha^{-1}) the increase of yield on January, 20 led to increase in all yield components for this sowing date (Table 3). These variations in numbers, in the samples confirm that the interaction between sowing date and cultivars are different. The optimum value was on January, 20 for Gab (2274.36kg ha^{-1}), whereas the minimum was on March, 21 for Rafidain (959.33kg ha^{-1}). The results are in general agreement with the published results that in 2012-13 growing season, sowing date and cultivars interaction significantly influenced the chickpea seed yield per hectare (Rehman *et al.*,2015). The result showed that different sowing date and chickpea cultivars had individually significant effect on yield and yield component (Yucel *et al.*, 2008). From the data of table (4) it was noticed that there was a highly significant correlation relationship between seed yield with no. of primary branches per plant^{-1}, no. of pods per plant, no. of seeds per pod and 100-seed weight which were (r = 0.882, r =0.869, r =0.810, and 0.706) respectively.

Table 2: Effect of sowing date on some growth parameters of two chickpea cultivars.

Sowing date		Plant height (cm)	Leaf area (cm^2)	Leaf area index	Dry matter (g/m^2)	Crop Growth Rate (g/m^2/day)
January, 20		43.0 a	797.83 a	2.66 a	38.06 a	7.90 a
February, 9		38.16 ab	673.66 b	2.24 b	30.09 ab	6.78 b
March, 1		36.16 b	593.83 c	1.98 c	24.63 b	5.95 c
March, 21		28.16 c	499.33 b	1.66 d	12.47 c	5.32 d
Cultivars		**Plant height (cm)**	**Leaf area (cm^2)**	**Leaf area index**	**Dry matter (g/m^2)**	**Crop Growth Rate (g/m^2/day)**
Rafidain		34.25 b	595.8 b	2.01 ab	25.4 b	6.16 ab
Gab		37.75 a	676.6 a	2.25 a	27.6 a	6.82 a
Sowing date × Cultivars		**Plant height (cm)**	**Leaf area (cm^2)**	**Leaf area index**	**Dry matter (g/m^2)**	**Crop Growth Rate (g/m^2/day)**
January, 20	Rafidain	41.66 ab	744.33 b	2.48 b	38.01 a	7.48 b
	Gab	44.33 a	851.33 a	2.84 a	38.12 a	8.33 a
February, 9	Rafidain	34.66 bcd	640.33 d	2.13 d	28.24 abc	6.51 d
	Gab	41.66 ab	707.00 c	2.35 c	33.55 ab	7.22 c
March, 1	Rafidain	35.00 abc	522.33 e	1.87 e	22.52 bc	5.76 f
	Gab	37.00 abc	626.00 d	2.08 d	26.74 bcd	6.15 e
March, 21	Rafidain	27.33 d	476.66 g	1.58 g	15.48 cd	5.06 g
	Gab	29.00 cd	522.33 f	1.74 f	12.48 d	5.58 f

Table 3: Effect of sowing date on yield a yield component of two chickpea cultivars.

Sowing date		No. of primary branches/ plant	No .of pods/plant	No. of seeds/pod	100 seed weight (g)	seed yield (kg/ha)
January, 20		3.55 a	21.60 a	1.60 a	26.44	2159.55 a
February, 9		3.16 ab	18.88 ab	1.08 a	26.40	1898.68 b
March, 1		2.95 b	12.27 b	1.07 a	24.90	1579.94 c
March, 21		2.88 b	6.06 c	0.56 c	24.78	991.17 d
Cultivars		No. of primary branches	No. of pods/plant	No. of seeds/pod	100 seed weight (g)	seed yield (kg/ha)
Rafidain		3.00 ab	14.38 b	1.08 ab	25.14	1590.75 b
Gab		3.20 a	18.22 a	1.13 a	26.11	1725.50 a
Sowing date × Cultivars		No. of primary branches	No. of pods/plant	No. of seeds/pod	100 seed weight (g)	seed yield (kg/ha)
January, 20	Rafidain	3.22 ab	19.88 ab	1.19 a	28.65 a	2044.73 b
	Gab	3.66 a	23.32 a	1.27 a	28.69 a	2274.36 a
February, 9	Rafidain	3.16 b	17.11 bc	1.07 ab	26.70 ab	1845.00 d
	Gab	3.21 ab	19.8 ab	1.12 a	27.59 abc	1952.37 c
March, 1	Rafidain	2.88 b	12.66 c	1.05 b	24.22 bcd	1515.33 f
	Gab	3.11 ab	17.88 bc	1.09 ab	25.21 abc	1644.48 e
March, 21	Rafidain	2.70 b	7.88 e	1.00 b	21.01 b	959.33 h
	Gab	2.85 b	11.88 d	1.02 b	22.86 bc	1023.00 g

Table 4: Correlation coefficient analysis among the traits of chickpea cultivars

	Plant height	Leaf area	Leaf area index	Dry matter	Crop Growth Rate	No. of primary branches/ plant	No. of pods/plant	No. of seeds/pod	100-seed weight	Seed Yield
Plant height	1.000									
Leaf area	0.785 **	1.000								
Leaf area index	0.786 **	1.000 **	1.000							
Dry matter	0.827 **	0.779 **	0.779 **	1.000						
Crop Growth Rate	0.780 **	0.987 **	0.987 **	0.745 **	1.000					
No. of primary branches/plant	0.567**	0.518 *	0.518 *	0.804 **	0.360 *	1.000				
No .of pods/plant	0.768 **	0.795 **	0.794 **	0.919 **	0.791 **	0.826 **	1.000			
No. of seeds/pod	0.631 **	0.524 **	0.658 **	0.820 **	0.605 **	0.301 *	0.788 **	1.000		
100-seed weight	0. 222	0.951 **	0.135	0.438 *	0.137	0.021	0.144	0.026	1.00 **	
Seed Yield	0.792 **	0.951 **	0.950 **	0.820 **	0.938 **	0.882 **	0.869 **	0.810 **	0.706 **	1.00 **

*and ** significant at level 0.05 and 0.01 respectively

4. CONCLUSIONS

It is concluded that early sowing date on January, 20 excelled the other sowing date (February 9, March 1, and March 21) for all characters studied, also Gab cultivar surpassed Rafidain cultivar for all characteristics except 100-seed weight, the highest seed yield (2.160 t ha^{-1}) and other yield components were recorded at sowing date January, 20, while the lowest were at March, 1 (1.580 t ha^{-1}). From interactions the highest seed yield (2.274 t ha^{-1}) recorded from Gab cultivar with sowing date at January, 20, while the minimum was recorded for Rafidain cultivar at March, 21 (0.959 t ha^{-1}).

REFERENCES

Chaitanya, S. K and Chandrika (2006). Response of chickpea genotype to different date of sowing in alligols of chittor district. Andhra Pradesh, India. Int. chickpea and pigeonpea Newsletter, 10: 8-9.

De Bei R,; Fuentes S,; Gilliham M,; Tyerman S,; Edwards E,; Bianchini N.; Smith J and Collins C. (2016) . VitiCanopy: a free computer app to estimate canopy vigor and porosity for grapevine. Sensors 2016, 16, 585.

Dixit, J. P., P. V. A. Pillai and K. N. Namdeo (1993).Response of chickpea (*Cicer arietinum* L.) to sowing date and irrigation schedule. Indian J. Agron., 38 (1): 121-123.

Eberhort, S. A. and W. A. Russel (1966).Stability parameters for comparing varieties. Crop Sci., 6: 36-40.

Fallah, S. (2008).Effects of sowing date and density on yield and its components in chickpea (*Cicer arietinum* L.) genotypes under dryland conditions of Khorram-Abad. Persian J. Sci. Tech. Agric. Natural Resources. 12 (45): 123-136.

Haloi, B and B. Baldev (1986). Effect of irrigation on growth attributes in chickpea, when grown under different dates of sowing and population pressure. Indian J. Pl. Physiol., 29 (1): 14-27.

Kaya, H., Arif, S. and Muhammet, T. (2010). Effect of sowing dates and seed treatments on yield, some yield parameters and protein content of chickpea (*Cicer arietinum* L.) African J. of Biotechnology, 9(25): 3833-3839.

Kumar, Sunil ; R. K. Pannu, A. K. Dhaka; B, Singh and K. D. Sharma (2013). Effect of irrigation levels on growth and yield of Kabuli chickpea (*Cicer arietinum* L.) genotypes. Ann. Agric. Bio. Res.,18(1): 29-31.

Mahse, L. B., D. V. Beshmukh and B. M. Jamadagni (2006). Varietal improvement of chickpea for rainfed and late sown conditions. Ann. Pl. Physiol., 20 (2) : 177-180.

Malik, S. P., H. L. Ghadge and A. S. Jadhav (1995).Contribution of production parameters to yield of chickpea under dryland condition. Indian J. Agron., 40 (1): 111-113.

Mansur, C. P., Y. B. Palled, S. I. Halikatti, M. B. Chetti and P. M. Salimath (2010). Pattern of leaf area, canopy width and dry matter production in chickpea as influenced by dates of sowing and irrigation levels. Karnataka J. Agric. Sci., 23 (4): (635-637).

O'Toole N.F.L.; Stoddard O'Brien, L. (2001). Screening of chickpea for adaptation to autumn sowing. J. Agron. Crop Sci., 186(3):193-207.

Perkins, J. M. and J. L. Jinks (1968).Environmental and genotype environmental components of variability. Heredity 23: 339-356.

Reddy, N. R. N. and I. P. S. Ahlawat (1998).Response of chickpea genotypes to irrigation and fertilizer under late sown conditions. Indian J. Agron., 43 (1): 95-101.

Rehman, H.; Rafi Q.; Atique, R.; Farhan, A.;Jamshaid, Q.; Muhammad, S. and Shah, N. (2015). Effect of Different Sowing Dates on Growth and Grain Yield of Chickpea (*Cicer arietinum* L.)Cultivars under Agro-environment of Taluka Dokri Sindh, Pakistan. American Journal of E. A., 8(1): 46-53.

SAS (2005).Statistical Analysis System. SAS institute Inc., NC, USA. Release 82.

Schwenke, G. D.; M. B. Peoples; G. L.Turner and D. F. Herridge. (1998). Doses nitrogen fixation of commercial, dryland chickpea and faba bean crops in north-west New south wales maintain or enhance soil nitrogen. Aust, J. Ex, Agric., 38: 61-70.

Steel R.G.H.; Torrie J. H.;Dicky D.A. (1997). Principles and procedures of statistics.A biometrical approach. 3rd Ed. McGraw Hill, Inc. Book Co. N.Y.,352-358.

Stieller, R. M.; G. D. Hill and B. A. Kenzieb. (1994).Evaluating new chickpea genotypes in Cantebury. Proceedings of Annual Conference - Agron Society of New Zealand, 24: 63-66.

Turner, N.C. Wright, G.C. and Siddique, K.H.M. (2001). Adaptation of grain legumes (pulses) to water-limited environments, Adv. Agron, 71: 193-231.

Virk, H. K. Guriqbal, Singh and H. S. Sekhon (2005). Effect of time of sowing on the productivity of chickpea (*Cicer arietinum* L.) varieties, J. Res., PAU, 42(2): 148-149.

Yadav, V. S.; S. S. Yadav; J. D. S. Singh and D. Panwar. (1999). Morpho-physiological basis of yield varieties in chickpea under late sowing conditions, Ann. Agric. Res., 20 (2): 227-230.Yadav, V. S., S. S. Yadav, J. KuMarch and D.

YucelD, Anlarsal AE. (2008). Performance of some winter chickpea (*Cicer arietinum* L.) genotypes in Mediterranean conditions. Notulae Botanicae Horti Agrobotanici Cluj- Napoca.,36(2):35-41.