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Effect of Different Dates of Sowing and Irrigation Levels on Growth and Yield of Chickpea (*Cicer Arietinum* L.)

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ABSTRACT

A field experiment was conducted to study the Effect of dates of sowing and irrigation levels on growth and yield of chickpea at Maddipadu Village, Prakasam district during the *rabi* seasons of 2015-16 and 2016-17. The field experiment comprised three dates of sowing and nine irrigation levels replicated three times in strip plot design. Highest dry matter accumulation was recorded with crop sown during 1st Fortnight of November followed by 2nd fortnight of November at 90 DAS and at maturity. Significantly highest drymatter accumulation was recorded with I_9 treatment which was superior to other treatments. Pod numbers plant^{-1} increased significantly in crop sown during 1st Fortnight of November and superior to other two dates. Significantly higher seed yield of 2463 and 2128 kg ha^{-1} was recorded with crop sown during 1st fortnight of November in first and second years, respectively which were superior to other dates of sowing. Irrigation as aerial water spray at the rate of 10, 000 to 20, 000 L ha^{-1} at pod filling stage and 15, 000 to 20, 000 L ha^{-1} in two intervals at maximum vegetative and pod filling stage was recorded higher seed yield consistently during both the years of study and significantly superior to the rest of the treatments.

Key words: *Chickpea, Dates of sowing, Drymatter accumulation, Irrigation levels, Number of pods, Seed yield.*

Chickpea (*Cicer arietinum* L.) is an old world pulse and one of the seven Neolithic founder crops in the Fertile Crescent of the Near East (Lev Yadun *et al*., 2000). Chickpea is the third most important pulse crop in the world after dry bean and peas, whereas in India chickpea is first most important pulse crop cultivated over an area of 8.35 m ha producing 7.17 Mt with an average productivity of 859 kg ha^{-1}. Andhra Pradesh is one of the major chickpea producing states in India. In terms of area and production chickpea occupies 5th position, whereas productivity of the crops is 1062 kg ha^{-1}, which is far above the national average (859 kg ha^{-1}). Still there is a scope for enhancement of chickpea yields (Anonymous 2016).

In sub-tropical region like India, the climate is temperate with winter rainfall. Chickpea is conventionally grown on residual soil moisture conditions on deep soils. Therefore, the crop faces high temperature and water stress towards maturity, which result in low and variable yields. Both temperature and moisture supply during the growing period had a strong influence on chickpea. The most vital step towards enhancing yield of chickpea is to ensure that the phenology of the crop is well in line to resources and constraints of the crop growth and development (Summerfield *et al*., 1990). Grain yield is significantly sensitive to water stress during the pod setting to grain development periods irrespective of soil texture (Jalota *et al*., 2006). As the season progress, the crop is exposed to increasing temperatures and soil moisture deficit resulting in low yields. Chickpea growing areas of Andhra Pradesh are characterized by low surface and ground water resources thus, supplemental irrigation in conventional methods of irrigation is not possible in addition to this chickpea crop is efficient in harvesting moisture during early morning hours in the form of dew. In view of this, the present study was conducted by application of irrigation water through foliar spray at different dosages on crop growth, yield attributes and yield are taken in to consideration to test the possibility of stabilizing yields.

MATERIAL AND METHODS

Field experimentation was conducted at farmer's field, Maddipadu Village, Prakasam district during the *rabi* seasons of 2015-16 and 2016-17. The experiment was conducted in strip plot design replicated thrice in with three sowing windows as main plots viz., D_1: 2nd Fortnight of October, D_2: 1st Fortnight of November and D_3: 2nd Fortnight of November and eight irrigation levels of water with one control i.e I_1= No irrigation, I_2= Irrigation with aerial water spray at pod filling stage (70-75 DAS) @ 5,000 L ha^{-1}, I_3= Irrigation with aerial water spray at pod filling stage (70-75 DAS) @ 10, 000 L ha^{-1}, I_4= Irrigation with aerial water spray at pod filling stage (70-75 DAS) @ 15, 000 L ha^{-1}, I_5= Irrigation with aerial water spray at pod filling stage (70-75 DAS) @ 20, 000 L ha^{-1}, I_6= Irrigation with aerial water spray at maximum vegetative stage (30-35 DAS) followed by pod filling stage (70-75 DAS) @ 5, 000 L ha^{-1}, I_7= Irrigation with aerial water spray at maximum vegetative stage (30-35 DAS) followed by pod filling stage (70-75 DAS) @ 10, 000 L ha^{-1}, I_8= Irrigation with aerial water spray at maximum vegetative stage (30-35 DAS) followed by pod filling stage (70-75 DAS) @ 15, 000 L ha^{-1}, I_9= Irrigation with aerial water spray at maximum vegetative stage (30-35 DAS) followed by pod filling stage (70-75 DAS) @ 20, 000 L ha^{-1}. The experimental soil was clay having a pH of 8.1 and EC 0.22 dS m^{-1}, high in available nitrogen (201 kg N ha^{-1}) high in phosphorous (96 kg P_2O_5 ha^{-1}) and low in potassium (86 kg K_2O ha^{-1}). Nitrogen, phosphorus and potassium were applied throug urea, single super phosphate and murate of potash, respectively. All other agronomic practices were followed as per recommendation. The data were collected on five randomly seleced plants in each plot and the data were subjected for stastical analysis.

RESULTS AND DISCUSSION

Drymatter accumulation of chickpea (kg ha^{-1}) as influenced by dates of sowing and irrigation levels at different growth stages of crop growth during *rabi* 2015-16 and 2016-17 is presented in Table 1. The results showed that, dates of sowing and irrigation levels significantly influenced drymatter accumulation. However, the interaction between the dates and irrigation levels was found non-significant. During both the years of study, the dates of sowing consistently influenced drymatter accumulation at all the growth stages except at 30 days after sowing. Highest dry matter accumulation was recorded with crop sown during 2nd Fortnight of November followed by 1st fortnight of November. Thereafter crop sown during 1st fortnight of November recorded highest drymatter accumulation at rest of the growth stages followed by crop sown during 2nd fortnight of October. Crop accumulated highest drymatter of 7193 kg ha^{-1} followed by 5930 kg ha^{-1} at 90 days after sowing with second date of sowing and first date of sowing, respectively.

The results showed the influence of irrigation as aerial water spray at different levels. The drymatter accumulation increased with increase in levels of aerial water spray at different stages of growth during both the years of study. Highest dry matter accumulation was recorded with I_8 and I_9 treatments at 60, 90 days after sowing and at harvest during both years of study. At 30 days after sowing irrigation levels did not show vivid variation among different irrigation levels. At 60 days after sowing, the treatment I_9 recorded highest drymatter accumulation, which was on par with I_8 during first year of study and with I_6, I_7 and I_8 during second year of study. Similar trend observed at 90 days after sowing during first year. However, during the second year of study, significantly highest drymatter accumulation recorded with I_9 treatment, which was on par with I_4, I_5, I_7 and I_8 treatments and superior to other treatments. Drymatter accumulation at harvest showed a consistent trend at harvest due to levels of irrigation. Highest dry matter accumulation recorded with I_9 treatment, which was on par with I_4, I_5 and I_8 treatments.

It was revealed from the present investigation that, application of irrigation through aerial water spray @ 15, 000 to 20, 000 L ha^{-1} at pod filling stage (I_4 and I_5 treatments) enhanced drymatter accumulation. However, application of same quantity of water at two equal splits at maximum vegetative and pod filling stage has numerically increased drymatter accumulation. This might be due to net gain of drymatter in vegetative structures after flowering is much higher with irrigation through aerial water spray @ 15, 000 to 20, 000 L ha^{-1} at pod filling stage. These results were in agreement with Razzak *et al*., (2017).

Dates of sowing differ significantly in influencing the number of pods plant^{-1} during both the years of study (Table-2). Significantly, higher number of pods plant^{-1} recorded with second date of sowing during both the years of study, which was superior to first and third date of sowing. The first and third dates are op par during first year only. Irrigation levels did not influence pod number during first year, however during second year highest number of pods recorded with I_9 treatment followed by I_8 treatment, which in turn was on par with I_7 treatment and superior to rest of the treatments. Interactions between dates of sowing and irrigation levels were not significant during both the years of study. Variation in sowing time beyond optimum was found to decrease the number of pods per plant. The second date of sowing falls under favourable moisture regimes than other two dates and gradual depletion of soil moisture influenced significant reduction in pods plant^{-1}. These findings were in agreement with Fazlul *et al*., (2009) and Dixit *et al.,* (1993). The terminal moisture stress due to controlled progressive soil drying from early podding at which application of irrigation significantly enhanced pods plant$^{-1.}$ These findings were in agreement with Pacucci *et al*., (2006).

The dates of sowing and irrigation levels significantly influenced seed yield of chickpea during both the years of study (Table 3). Significantly higher seed yield of 2463 and 2128 kg ha^{-1} was recorded with crop sown during 1st fortnight of November in first and second years, respectively which were superior to other dates of sowing. The improvement in yield in

Table 1. Drymatter accumulation of chickpea (kg ha^{-1}) as influenced by different dates of sowing and irrigations levels at different stages of crop growth during *Rabi* 2015-16 and 2016-17.

Treatment	2015-16				2016-17			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
Dates of sowing								
2nd Fortnight of October	160	2383	6702	5428	106	1899	5930	4844
1st Fortnight of November	204	2618	8049	6494	154	2312	7193	5863
2nd Fortnight of November	223	2209	5873	4642	129	1587	4986	4062
SE m ±	3.3	62	186.6	100	5.1	62.3	139.4	125.9
CD (P=0.05)	12.9	243.4	732.7	392.6	19.5	244.7	547.4	494.1
CV (%)	8.7	13.3	14.1	9.4	19.9	16.6	12	13.3
Irrigation as aerial water spray levels (L ha^{-1})								
I_1= No irrigation	196	2271	6178	4946	129	1808	5330	4350
I_2= Irrigation at 75 DAS @ 5,000	195	2272	6443	5157	130	1805	5567	4539
I_3= Irrigation at 75 DAS @ 10, 000	195	2263	6728	5385	131	1810	5863	4793
I_4= Irrigation at 75 DAS @ 15, 000	196	2275	7051	5644	128	1813	6211	5086
I_5= Irrigation at 75 DAS @ 20, 000	196	2274	7469	5976	130	1724	6686	5440
I_6= Irrigation at 35 and 75 DAS @ 5, 000	195	2303	6427	5153	129	1904	5579	4546
I_7= Irrigation at 35 and 75 DAS @ 10, 000	195	2477	6748	5423	131	2020	5885	4794
I_8= Irrigation at 35 and 75 DAS @ 15, 000	197	2659	7168	5797	130	2167	6340	5167
I_9= Irrigation at 35 and 75 DAS @ 20, 000	196	2836	7658	6212	129	2343	6866	5591
SE m ±	1.2	71.2	258.1	247.5	4.8	117.9	306.7	250
CD (P=0.05)	NS	213.6	773.8	741.9	14.5	353.5	919.4	749.7
CV (%)	11.8	8.8	14.1	13.4	11.2	18.2	15.2	15.2
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Number of pods plant^{-1} of chickpea as influenced by different dates of sowing and irrigations levels during *rabi* 2015-16 and 2016-17.

Parameters	2015-16	2016-17
Dates of sowing		
2nd Fortnight of October	45.9	37.1
1st Fortnight of November	57.9	45
2nd Fortnight of November	40.7	32.8
SE m ±	1.3	0.1
CD (P=0.05)	5.2	0.6
CV (%)	14.3	8.7
Irrigation as aerial water spray levels (L ha^{-1})		
I_1= No irrigation	46.5	37.2
I_2= Irrigation at 75 DAS @ 5,000	46.7	37.4
I_3= Irrigation at 75 DAS @ 10, 000	47.0	37.7
I_4= Irrigation at 75 DAS @ 15, 000	47.3	38.0
I_5= Irrigation at 75 DAS @ 20, 000	47.3	38.0
I_6= Irrigation at 35 and 75 DAS @ 5, 000	47.1	37.6
I_7= Irrigation at 35 and 75 DAS @ 10, 000	48.7	38.1
I_8= Irrigation at 35 and 75 DAS @ 15, 000	50.5	39.4
I_9= Irrigation at 35 and 75 DAS @ 20, 000	52.1	41.1
SE m ±	1.9	0.4
CD (P=0.05)	NS	1.3
CV (%)	11.5	14.8
Interaction	NS	NS

Table 3. Seed yield of chickpea (kg ha^{-1}) as influenced by different dates of sowing and irrigations levels during *Rabi* 2015-16 and 2016-17.

Parameters	2015-16	2016-17	Pooled
Dates of sowing			
2nd Fortnight of October	2168	1924	2046
1st Fortnight of November	2463	2128	2295
2nd Fortnight of November	1994	1784	1889
SE m ±	64.2	50.1	54.2
CD (P=0.05)	252	184.5	212.7
CV (%)	15.1	12.4	13.5
Irrigation as aerial water spray levels (L ha^{-1})			
I_1= No irrigation	2070	1835	1952
I_2= Irrigation at 75 DAS @ 5,000	2124	1890	2007
I_3= Irrigation at 75 DAS @ 10, 000	2199	1955	2077
I_4= Irrigation at 75 DAS @ 15, 000	2276	2008	2142
I_5= Irrigation at 75 DAS @ 20, 000	2391	2128	2259
I_6= Irrigation at 35 and 75 DAS @ 5, 000	2107	1850	1978
I_7= Irrigation at 35 and 75 DAS @ 10, 000	2159	1879	2019
I_8= Irrigation at 35 and 75 DAS @ 15, 000	2235	1960	2098
I_9= Irrigation at 35 and 75 DAS @ 20, 000	2323	2004	2163
SE m ±	64.2	64.9	65.4
CD (P=0.05)	192.4	194.6	196
CV (%)	8.7	9.9	9.4
Interaction	NS	NS	NS

second date of sowing over other dates of sowing was because of better availability of moisture and congenial temperature at the time of germination and seedling establishment have contributes better growth, development of yield attributes and thus higher yields. Similar response of irrigation as aerial water spray at the rate of 10, 000 to 20, 000 L ha^{-1} at pod filling stage and 15, 000 to 20, 000 L ha^{-1} in two intervals at maximum vegetative and pod filling stage was recorded consistently during both the years of study and significantly superior to the rest of the treatments. When rainfall fails to provide sufficient moisture for normal plant growth, addition of small amount of water would improve and stabilize yields of rainfed crops (Oweis and Hachum, 2003). Further, limited supplemental irrigation can however plays a major role in boosting and stabilizing the productivity of winter-sown chickpea (Zhang *et al*., 2000). Pooled analysis of seed yield also indicated significant differences in dates of sowing and irrigation levels as in case of individual years data. The pooled yield of 2295 kg ha^{-1} was recorded with crop sown during 1st fortnight of November followed by that of 2nd fortnight of October and 2nd fortnight of November. The response to irrigation levels also followed similar trend as in case of individual years. The interaction between dates of sowing and irrigation as aerial water spray levels was not significant during both the years.

Adverse effects of the low surface soil moisture, high soil and air temperatures during seedling establishment period in case of first date of sowing and at pod filling stage in case of third date of sowing was responsible for lower yields in comparison to second date of sowing, where adequate soil moisture and congenial ambient and edaphic temperatures contributed for higher yield. The results of present investigation infer that reproductive stage (pod filling) is most critical period for moisture sensitivity. These findings are in agreement with those of Nayyar *et al*., (2006) and Rinaldi *et al*., (2008). Therefore, the response to this climate resilience agronomic practices due to which chickpea was most important rainfed crop with assured yields even if north east monsoon fails. These findings were in agreement with Saini and Faroda (1997) who opined deficit irrigation has profound effect on stabilization crop yields especially at pod filling stage by increased test weight and reducing plant moisture stress, where full scale of irrigation cannot be practiced due to low surface and ground water resources.

CONCLUSION

Chickpea sown in 1st fortnight of November recorded higher drymatter accumulation, pods per plant and seed yield.

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