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Effects of Sowing Time and Spacing on Growth and Yield of Chickpea for Green Pod

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ABSTRACT

To study the "Effects of sowing time and spacing on growth and yield of chick pea for green pod in Middle Gujarat Agro-Climatic Condition" was conducted at Agricultural Research Station, Anand Agricultural University, Derol during 2015-16 to 2017-18. The experiment was laid out in a Split Plot Design (SPD) with three replications, comprising date of sowing (6) as a main plot and Spacing (2) sub plot of chick pea total thirty six treatment combinations. The results showed that the 1st Oct. (40th Std. week) sowing recorded significantly higher green pod yield (1554, 1713, 1861 and 1709 kg/ha) was found in GG-2 variety during the all the year and pooled analysis. However, in case of spacing S_2 (45x10 cm) recorded higher green pod in yield (1144, 1486, 1568 and 1399 kg/ha) was found non-significant during first two year, while significant in third year and pooled analysis.

KEYWORD

Chick pea, green pod yield, date of sowing and spacing

INTRODUCTION

Pulses are considered as an important part of food crop occupying a unique position in agriculture and also an important component of food grain crops because of their high nutritive value (Singh *et al.*, 2015). Pulses also have inherent capacity to fix atmospheric nitrogen and adaptability to a wide range of agro-ecological, cropping system and management ability (Singh *et al.*, 2013). Pulses occupy 68.32 Mha area and contribute 57.51 MT to the world's food basket. India shares 35.2 per cent area and 27.65 percent of the global production. In India, the per cent contribution of pulses towards total food grain production has declined during the last three decades, while it has increased for rice and wheat (Chaturvedi and Masood Ali, 2002). Chickpea in India is grown on 7.58 Mha with 5.75 MT production and an average productivity of 793 kg/ha. Maharashtra is one the major chickpea growing state in the country. Gujarat shares 2.92, 3.65 and 0.25 per cent area, production and productivity, respectively of the nation under chickpea.

However, at present the average productivity in the state is high (1008 kg/ha) compared to national level (Anonymous, 2009). Chickpea is important crop of Middle Gujarat. Chickpea variety GG 2 is bold seeded variety and preferred as green pods. The information on sowing date of chickpea is lacking hence the experiment is proposed. Limited study has been made with regard to green chickpea production. Hence with this background an investigation entitled "Effects of sowing time and spacing on growth and yield of chick pea for green pod in Middle Gujarat Agro-climatic condition" during the years 2015-16 to 2017-18 was conducted with objective to find out the appropriate sowing time and spacing in Chickpea

MATERIALS AND METHODS

The experiment was carried out to study the "Effects of sowing time and spacing on growth and yield of chickpea for green pod in Middle Gujarat Agro-climatic condition" was conducted at Agricultural Research Station, Anand Agricultural University, Derol during 2015-16 to 2017-18. The experiment was laid out in a Split Plot Design (SPD) with Three replications and thirty six treatment combinations, comprising of main plot as date of sowing (D_1: 17th Sep. (38th Std. week), D_2: 24th Sep. (39th Std. week), D_3: 1st Oct. (40th Std. week), D_4: 8th Oct. (41st Std. week), D_5: 15th Oct. (42nd Std. week) and D_6: 22nd Oct. (43rd Std. week))and sub plot Spacing (S_1: 30 X 10 cm and S_2: 45 X 10 cm) of chickpea.

The soil of the experimental field was sandy loam in texture having medium in nitrogen, high in phosphorus and high in potassium. All the cultural practices including weeding, manuring and fertilization and plant protection measure were carried out as per recommended package of practice of chickpea. Data recorded were statistically analyzed using Analysis of Variance (ANOVA) technique (Panse and Sukhatme, 1985).

RESULT AND DISCUSSION

Plant height (cm)

The mean data pertaining to plant height at different date of sowing chickpea are given in Table 1. It indicated that among the treatments date of sowing and spacing showed non-significant at harvest stage for different year and pooled analysis. Data

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presented in Table 1 revealed that difference in plant height at harvest was found non-significant during the year 2015-16, 2016-17 and in pooled analysis but it was significantly affected in the year 2017-18. The maximum plant height at harvest was measured under application of D_6: 22nd Oct (43rd Std. week) date of sowing 42.2, D_2: 24thSept (39th Std. week) 50.9, 51.5and 46.1 cm) at harvest for different year of date of sowing and pooled analysis. While, the lower plant height was recorded during the year 2015-16, 2016-17, 2017-18 and pooled analysis 35.9, 46.5, 45.1 and 44.2 cm at harvest respectively. The present finding was supported by Yadav *et al.* (1999). An appraisal of data in Table 1 indicated that difference in plant height at harvest was found non-significant. The maximum plant height was recorded S_2 (45x10 cm) (39.9, 48.3, 48.8 and 45.7 cm) at harvest in different spacing for all the year and pooled analysis as compared to S_1 (30x10 cm) spacing treatment (Table 1).

Table 1: Plant height (cm) at harvest for effect of date of sowing and spacing of chickpea as influenced by different treatments

Treatment details	Plant height (cm) at harvest			
	2015-16	2016-17	2017-18	Pooled
Main plot (A) Date of sowing				
D_1: 17th Sep.	40.8	49.4	45.1	45.1
D_2: 24th Sep.	35.9	50.9	45.8	44.2
D_3: 1st Oct.	37.1	48.1	51.5	45.5
D_4: 8th Oct.	40.1	47.5	50.4	46.0
D_5: 15th Oct.	39.1	48.4	50.8	46.1
D_6: 22nd Oct.	42.2	46.5	49.3	45.9
SEm±	1.33	1.91	1.35	1.51
CD (P=0.05)	NS	NS	4.26	NS
Sub plot (B) Spacing				
S_1: 30x10 cm	38.5	48.7	48.7	45.3
S : 45x10 cm	39.9	48.3	48.8	45.7
S.Em.±	0.67	0.92	0.61	0.43
CD (P=0.05)	NS	NS	NS	NS
Interaction				
D x S	5.05	NS	NS	NS
SEm±	1.64	2.24	1.49	1.95
CD (P=0.05)	5.1	NS	NS	NS
Y x D	-	-	-	4.48
Y x S	-	-	-	NS
Y x D x S	-	-	-	5.18

Number of branches per plant

Data presented in Table 2 indicated that number of branches per plant was found non-significant due to different date of sowing in individual year, except number of branches per plant which was significant during 2015-16 as well as pooled analysis. Though, the result was found significant, while significantly higher number of branches per plant was recorded under D_3:1st Oct (40th Std. week) in pooled data but was at par with D_6: 22nd Oct (42nd Std. week) date of sowing and D_1:17th Sept. (38th Std. week) treatment. The above results were

Table 2: Number of branches per plant for effect of date of sowing and spacing of chickpea as influenced by different treatments

Treatment details	No. of branches per plant			
	2015-16	2016-17	2017-18	Pooled
Main plot (A) Date of sowing				
D_1: 17th Sep.	2.7	3.7	4.2	3.5
D_2: 24th Sep.	2.1	4.2	4.1	3.5
D_3: 1st Oct.	3.1	4.7	4.7	4.2
D_4: 8th Oct.	2.6	5.1	4.4	4.0
D_5: 15th Oct.	2.6	5.1	4.2	4.0
D_6: 22nd Oct.	2.8	4.5	4.0	3.8
SEm±	0.17	0.39	0.26	0.17
CD (P=0.05)	0.54	NS	NS	0.48
Sub plot(B) Spacing				
S_1: 30x10 cm	2.7	4.5	4.2	3.8
S_2: 45x10 cm	2.6	4.5	4.3	3.8
SEm±	0.09	0.32	0.15	0.07
CD (P=0.05)	NS	NS	NS	NS
Interaction				
D x S	NS	NS	NS	NS
SEm±	0.22	0.32	0.37	0.18
CD (P=0.05)	NS	NS	NS	NS
Y x D	-	-	-	NS
Y x S	-	-	-	NS
Y x D x S	-	-	-	NS

in consonance with those of Sharma *et al.* (1988) in chickpea var. GG -2.

They reported that the lowest number of number of branches per plant was obtained by late sowing of chickpea for green purpose due to various phonological stages of crop. Data presented in Table 2 revealed that number of branches per plant found to be non-significant due to different spacing during all the year of experimentation as well as in pooled analysis. The effects of all possible interactions of various treatments were found non-significant with respect to number of branches per plant due to different spacing during all the year of experimentation as well as in pooled analysis.

Number of green pods per plant

Further data reported in Table 3 revealed that number of green pods per plant was found significant during 2016-17 and 2017-18. Significantly higher number of pods per plant was recorder under D_3: 1st Oct (40th Std. week) as compared to rest of the treatments, except treatment D_4: 8th Oct (41stStd. week) and D_5:15th Oct (42nd Std. Week). Whereas, significantly lower number of green pods per plant was noticed under D_1:17thSept (38th Std. week) but was at par with D_2:24th Sep (39th Std. week) date of sowing. Thakur *et al.* (1998).

They observed that the significantly highest number of green pods per plant of chick pea was obtained in date of sowing 20th September. Sharma *et al.* (1988) reported that delayed sowing beyond 20th October i.e., sowing on 30th October, 9th November and 19th November decrease the number of pods plant. Data

Table 3: Numbers of green pods per plant for effect of date of sowing and spacing as influenced by different treatments.

Treatment details	No. of green pods per plant			
	2015-16	2016-17	2017-18	Pooled
Main plot (A) Date of sowing				
D_1: 17th Sep.	14.2	32.6	33.9	26.9
D_2: 24th Sep.	12.2	39.2	32.7	28.0
D_3: 1st Oct.	15.1	50.3	43.2	36.2
D_4: 8th Oct.	13.4	44.5	35.8	31.2
D_5: 15th Oct.	15.6	44.5	34.2	31.4
D_6: 22nd Oct.	14.7	41.8	29.8	28.8
SEm±	0.85	2.49	1.57	1.99
CD (P=0.05)	NS	7.86	4.95	NS
CV (%)	14.7	14.5	11.0	14.3
Sub plot (B) Spacing				
S_1: 30 x10 cm	14.5	55.8	33.8	29.4
S_2: 45 x10 cm	13.9	59.6	36.0	31.5
SEm±	0.41	0.85	0.86	1.14
CD (P=0.05)	NS	2.48	NS	NS
Interaction				
D x S	NS	NS	NS	NS
SEm±	1.00	2.18	2.09	1.06
CD (P=0.05)	NS	NS	NS	NS
CV (%)	12.2	8.9	10.4	10.5
Y x D	-	-	-	5.11
Y x S	-	-	-	2.14
Y x D x S	-	-	-	NS

on number of pods plant was significantly affected due to different spacing treatment only during the year 2016-17. Significantly higher number of pods per plant was recorded under S_2 (45x10 cm) spacing treatment as compared to S_1 (30x10 cm) spacing treatment (Table 3).

The interaction effect Y x D in first year D_5 are at par with all the treatment. Second and third year D_3 are highly significant compared to all treatment, while in case of pooled basis D_3 are at par with D_4 and D_5 (Table 3). Y x S interaction in first year S_1 at par with S_2, second year S_2 are significant but third year S_2 at par with S_1, while in pooled basis S_2 at par with S_1 on number of green pods per plant for pooled analysis (Table 3).

Number of seeds per pod

The results presented in Table 4 indicated that number of seeds per pod was found non-significant during the year 2015-16, 2016-17 and pooled analysis. An except in 2017-18 was found significant due to different date of sowing.

A perusal of the data Table 4 showed that number of seeds per pod found to be non-significant due to different spacing during both the year of experimentation as well as in pooled analysis. The interaction effect of Y x D for the first year date of sowing i.e. D_2, D_3 and D_4 was at par with D_5 and D_1 however

Table 4: Number of seeds per pod for effect of date of sowing and spacing as influenced by different treatments

Treatment details	Number of seeds per pod			
	2015-16	2016-17	2017-18	Pooled
Main plot (A) D ate of sowing				
D_1: 17th Sep.	2.7	2.4	2.3	2.4
D_2: 24th Sep.	2.9	2.6	2.3	2.6
D_3: 1st Oct.	2.9	2.3	2.8	2.7
D_4: 8th Oct.	2.9	2.6	2.6	2.7
D_5: 15th Oct.	2.8	2.4	2.5	2.5
D 22nd Oct.	2.6	2.6	2.5	2.6
SEm±	0.11	0.08	0.08	0.09
CD (P=0.05)	NS	NS	0.25	NS
CV (%)	9.3	8.2	7.8	8.5
Sub plot (B) Spacing				
S_1: 30x10 cm	2.8	2.5	2.5	2.6
S_2: 45x10 cm	2.8	2.4	2.5	2.6
SEm±	0.07	0.04	0.03	0.03
CD (P=0.05)	NS	NS	NS	NS
Interaction				
D x S	NS	NS	NS	NS
SEm±	0.16	0.10	0.08	0.07
CD (P=0.05)	NS	NS	NS	NS
CV (%)	9.8	7.1	5.5	7.9
Y x D			-	0.26
Y x S	--	-	-	NS
Y x D x S			-	NS

in case of Second year date of sowing i.e. D_2, D4 and D_6 at par with D_1 and D_5 and third year D_3 at par with D_4. While in case of pooled basis D_3 and D_4 at par with D_5, D2, D4and D_1. between date of sowing found significant with respect to number of seeds per pod (Table 4).

Days to Maturity

Days to maturity significantly affected due to different date of sowing during three the year of experimentation as well as in pooled analysis (Table 5). Treatment D_6: 22nd Oct (43rd Std. Week) took significantly higher days to reach at maturity level both in individual year as well as in pooled analysis, while minimum days was observed under D_3:1st Oct (40th Std. Week) date of sowing treatment. Results presented in Table 5 indicated that days to maturity significantly affected due to different spacing treatment only during 2016-17. Wherein, S_2 (45x10 cm) spacing treatment took minimum days (79) to reach at maturity as compared to S_1 (30x10 cm) spacing treatment.

Among different interactions, D x S interaction was found significant in second year D_6 date of sowing are significant compared to all treatment and spacing S_1 at par with S_2. (Table 5) While in case of Y x D interaction first and second year D_6 are significantly compared to other treatment, while in case of third year D_6 at par with D_2. Pooled basis D_6 is significant compared to other treatment (Table 5).

Table 5: Days to maturity for effect of date of sowing and spacing as influenced by different treatments.

Treatment details	Days to Maturity			
	2015-16	2016-17	2017-18	Pooled
Main plot (A) Date of sowing				
D_1: 17th Sep.	80	76	80	79
D_2: 24th Sep.	81	78	81	80
D_3: 1st Oct.	79	78	78	78
D_4: 8th Oct.	82	79	80	80
D_5: 15th Oct.	83	80	80	81
D_6: 22nd Oct.	86	81	81	83
SEm±	0.19	0.25	0.34	0.69
CD (P=0.05)	0.61	0.77	1.06	2.18
Sub plot (B) Spacing				
S_1: 30 x 10 cm	82	79	80	80
S_2: 45 x 10 cm	82	78	79	79
SEm±	0.25	0.15	0.20	0.12
CD (P=0.05)	NS	0.45	NS	NS
Interaction				
D x S	NS	S	NS	NS
SEm±	0.60	0.36	0.49	0.29
CD (P=0.05)	NS	1.11	NS	NS
Y x D			-	0.76
Y x S	--	-	-	NS
Y x D x S			-	NS

Green pod yield (kg/ha)

Green pod yield was significantly affected due to different date of sowing during individual year as well as in pooled analysis. Significantly higher green pod yield (1554 kg/ha) was recorded under D_3:1st Oct (40th Std. Week) date of sowing as compared to rest of the sowing dates during 2015-16, Significantly higher green pod yield (1713 kg/ha) was recorded under D_3:1st Oct (40th Std. Week) date of sowing as at par with D_6:22nd Oct (43th Std. Week)sowing dates during 2016-17 and Significantly higher green pod yield (1861 kg/ha) was recorded under D_3:1st Oct (40th Std. Week) date of sowing as at par with D_5:15th Oct (42nd Std. Week) and D_6:22nd Oct (43th Std. Week)sowing dates during 2017-18. Pooled of three year D_3:1st Oct (40th Std. Week) date of sowing recorded highly significant higher green pod yield (1709 kg/ha) as compared to other treatment (Table 6).

The current investigation was supported by Sandhu *et al.* (2002). They noted that the super early chickpea genotypes for vegetable purpose as a catch crop, for three sowing dates at Ludhiana. Among them three genotypes, ICCV-96029 produced the highest green pod yield of 3622 kg per ha and green seed yield of 3235 kg per ha in the second date of sowing (September, 30). The data green pod yield was significantly in pooled analysis, though it was not significant during first and second year and found significant in third year due to different spacing treatments. Significantly higher green pod yield (1399 kg/ha) was recorded under S_2 (45x10 cm) spacing as compared to S1 (30x10 cm) spacing treatment (Table 6). The interaction effect Y x D was found significant on green pod yield for pooled analysis. In case of first and third year D_3 are highly significantly compared to all other date of sowing, while in case of second year D_3 at par with D_6. Pooled basis also D_3 are highly significant compared to other treatment (Table 6).

Economics of developed technology

Results reported in Table 7 indicated that gross income as influenced by application of different date of sowing and spacing in all the year as well as pooled basis. Data presented in (Table 7) indicated that the maximum net profit of Rs. 47360 per hectare was obtained with D_3:1st Oct (40th Std. Week) date of sowing. The lowest net profit of Rs. 20520 per hactare was recorded with treatment D_1:17th Sept (38th Std. Week) date of sowing. Data presented in (Table 7) clearly indicated that the maximum net profit of Rs. 35560 per hactare was obtained with treatment S_2 (45x10 cm) spacing. The lowest net profit Rs. 31120 per hactare was recorded with treatment S_1 (30X10 cm) with BC Ratio values of 2.74 and 2.48 with treatments S_2 (45x10 cm) and S_1 (30x10 cm) treatments spacing. It was evident from the data presented from Table 7 showed that the highest net return worth Rs. 48200 was secured under treatment combination D_3S_2 followed by D_3S_1 (Rs. 47160) per hactare with regard to BCR values, the same treatment combination recorded maximum value 3.36 and 3.25 respectively.

Table 6: Green pod yield (kg/ha) for effect of date of sowing and spacing as influenced by different treatments

Treatment details	Green pod yield (kg/ha)			
	2015-16	2016-17	2017-18	Pooled
Main plot (A) Date of sowing				
D_1: 17th Sep.	698	1274	1143	1038
D_2: 24th Sep.	794	1271	1332	1132
D_3: 1st Oct.	1554	1713	1861	1709
D_4: 8th Oct.	1211	1476	1430	1372
D_5: 15th Oct.	1310	1435	1651	1465
D_6: 22nd Oct.	1015	1528	1624	1389
SEm±	59.4	66.5	87.5	64.8
CD (P=0.05)	187	210	276	204
Sub plot (B) Spacing				
S_1: 30 x 10 cm	1050	1414	1445	1303
S_2: 45 x 10 cm	1144	1486	1568	1399
SEm±	35.2	37.8	32.1	20.3
CD (P=0.05)	NS	NS	98	58
Interaction				
D x S	NS	NS	NS	NS
SEm±	86.1	92.6	78.7	49.6
CD (P=0.05)	NS	NS	NS	NS
Y x D	-	-	-	208
Y x S	-	-	-	NS
Y x D x S	-	-	-	NS

Table 7: Economics of green pod yield (kg/ha) of chickpea as influenced by date of sowing and spacing on different treatments

Treatment combinations	Green pod yield (kg/ha)	Gross income (Rs/ha)	Cost of cultivation (Rs/ha)	Net income (Rs/ha)	BC Ratio
D1S1	984	39360	21000	18360	1.87
D1S2	1092	43680	20400	23280	2.14
D2S1	1075	43000	21000	22000	2.05
D2S2	1189	47560	20400	27160	2.33
D3S1	1704	68160	21000	47160	3.25
D3S2	1715	68600	20400	48200	3.36
D4S1	1359	54360	21000	33360	2.59
D4S2	1385	55400	20400	35000	2.72
D5S1	1385	55400	21000	34400	2.64
D5S2	1545	61800	20400	41400	3.03
D6S1	1309	52360	21000	31360	2.49
D6S2	1469	58760	20400	38360	2.88

Note: Green pod Selling price: Rs.40 per kg

CONCLUSION

From the results of three years experimentation, it can be Concluded that to obtain higher profitable green pod yield of chickpea sowing dates of 1st October (40th Std. week) keepng treatment S_2 (45x10 cm) under middle Gujarat Agro-climatic condition.

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