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# Effect of Time of Sowing, Row Spacing and Variety on Summer Cluster Bean (*Cymopsis tetragonoloba* (L.)Taub.) Under Middle Gujarat Conditions

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**A field experiment was carried out at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat during the summer season of the year 2015 to study the effect of time of sowing, row spacing and variety on summer cluster bean under middle Gujarat conditions, in loamy sand soil. Eighteen treatment combinations comprised of three dates of sowing *viz*., $D_1$: (21st January); $D_2$: (1st February) and $D_3$: (11th February) as main plot treatments and combination of three different row spacing viz., $S_1$: 30 cm; $S_2$: 45 cm; and $S_3$: 60 cm along with two varieties $V_1$ (GG 1) and $V_2$ (GG 2) as sub plot treatments, were laid out in Split Plot Design with three replications. Results revealed that treatment combination $D_3S_1V_2$ (sowing on 11th February with 30 cm row spacing with variety GG 2) recorded significantly higher seed yield (1476 kg ha$^{-1}$) which was found at par with treatment combination $D_2S_3V_2$ (sowing on 1st February with 60 cm row spacing with variety GG 2). However, maximum net realization (Rs.50667 ha$^{-1}$) and BCR (4.53) were obtained under treatment combination $D_2S_3V_2$, followed by $D_3S_1V_2$ with net realization of Rs.48511 ha$^{-1}$ and BCR of 4.24.**

**Keywords**: Time of sowing, row spacing, variety, cluster bean**.**

Cluster bean (*Cymopsis tetragonoloba* (L.)Taub.) is an important self pollinated, multipurpose, drought resistant leguminous crop,cultivated in arid and semi-arid areas of about 23.30 mollion hectare in India producing 1.22 million tone of cluster bean with productivity of 584 kg ha$^{-1}$(Anon.,2014). Rajasthan is the largest Cluster bean producing states in the world as it dominates the Indian production scenario contributing to around 4.2 lakh tons *i.e.* over 70% of the total production in India. It is cultivated in 3.18 lakh hectares in Gujarat with 1.91 lakh tone production with productivity of 602 kg ha$^{-1}$ (Anon., 2015). Its cultivation mainly confines the districts of Banaskantha, Sabarkantha, Kutch, Mehsana, Gandhinagar, Patan and Kheda. However, its productivity during *kharif* season is low due to uneven and erratic distribution of rainfall in these areas as well as incidence of pests and diseases. For exploiting yield potential of cluster bean its cultivation is shifted to summer season. Among the various management factors contributing to growth and development of cluster bean, non-monetary inputs like time of sowing, row spacing and selection of variety play vital role in summer season. The cardinal range for cluster bean being 15-35 °C, early or late sowing may impact its germination and growth. The late sowing in summer may face the risk of rainfall during ensuing monsoon season at maturity. High or low density sowing may have lead to poor yield performances. Varieties of cluster bean viz. Gujarat Guar 1 (GG

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1) and Gujarat Guar 2 (GG 2) have been released by G.A.U., S.K. Nagar, which have been found suitable for cultivation during summer season in north Gujarat conditions. But the performance of cluster bean varieties at varied time of sowing and row spacing have not been evaluated for middle Gujarat conditions in summer season. Therefore, this experiment was conducted.

## MATERIALS AND METHOD

A field experiment was carried out at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat during the summer season of the year 2015 to study the effect of time of sowing, row spacing and variety on summer cluster bean under middle Gujarat conditions, in loamy sand soil, low in organic carbon (0.35%), medium in available phosphorous (43.28 kg $P_2O_5$ $ha^{-1}$) and high in available potash (388.17 kg $K_2O$ $ha^{-1}$). Eighteen treatment combinations comprised of three dates of sowing *viz*., $D_1$: (21st January); $D_2$: (1st February) and $D_3$: (11th February) as main plot treatments and combination of three different row spacing viz., $S_1$: 30 cm; $S_2$: 45 cm; and $S_3$: 60 cm along with two varieties $V_1$ (GG 1) and $V_2$ (GG 2) as sub plot treatments, were laid out in Split Plot Design with three replications.

## RESULTS AND DISCUSSION

### Effect of time of sowing

A perusal of data presented in table-1 revealed that sowing on 1st February ($D_2$) being at par with sowing on 11th February ($D_3$) gave significantly higher plant height at 30 (32.31 cm), 60 DAS (56.47cm) and at harvest (82.97cm) and for test weight (38.90 g) of cluster bean over sowing on 21st January ($D_1$). Conversely, crop sown on 11th February ($D_3$) produced significantly the highest branches $plant^{-1}$ (6.01), pods $plant^{-1}$(43.92), seeds $pod^{-1}$ (7.96) and pod length (9.11 cm) over early sowing on 1st February ($D_2$) and 21st January ($D_1$). Better growth of plant in terms of plant height under late sowing on 1st February ($D_2$) and 11th February ($D_3$) reflected into better development of yield attributes. Moreover, congenial climatic conditions especially at reproductive phase also played vital role in development of yield attributes due to positive sink to source ratio wherein assimilates translocation to reproductive components. These

**Table 1.** Effect of time of sowing, row spacing and variety on various growth and yield attributes of Cluster bean

| Treatments | Plant height (cm) | | | Number of branches $plant^{-1}$ | Number of pods $plant^{-1}$ | Pod length (cm) | Number of seeds $pod^{-1}$ | Test weight (g) |
|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | At Harvest | | | | | |
| Time of sowing (D) | | | | | | | | |
| $D_1$ : 21st January | 27.29 | 51.44 | 75.26 | 5.42 | 32.96 | 6.51 | 5.47 | 35.54 |
| $D_2$ : 1st February | 32.31 | 56.47 | 82.97 | 5.47 | 34.86 | 7.97 | 6.73 | 38.90 |
| D3: 11th February | 31.99 | 55.08 | 81.24 | 6.01 | 43.92 | 9.11 | 7.96 | 38.79 |
| S.Em ± | 0.61 | 0.92 | 1.49 | 0.10 | 0.95 | 0.26 | 0.30 | 0.61 |
| C.D. at 5% | 2.40 | 3.63 | 5.87 | 0.41 | 3.73 | 1.04 | 1.18 | 2.41 |
| C.V. % | 8.50 | 7.21 | 7.95 | 7.78 | 10.83 | 14.28 | 18.93 | 6.90 |
| Row spacing (S) | | | | | | | | |
| $S_1$ : 30 cm | 30.03 | 55.96 | 82.04 | 5.52 | 36.88 | 7.54 | 6.40 | 38.23 |
| $S_2$ : 45 cm | 30.76 | 53.47 | 78.63 | 5.66 | 37.14 | 7.80 | 6.62 | 37.32 |
| $S_3$ : 60 cm | 30.81 | 53.57 | 78.79 | 5.72 | 37.72 | 8.24 | 7.13 | 37.68 |
| S.Em ± | 0.61 | 0.69 | 1.04 | 0.10 | 0.70 | 0.18 | 0.18 | 0.60 |
| C.D. at 5% | NS | 2.01 | 2.99 | NS | NS | 0.52 | 0.52 | NS |
| Variety (V) | | | | | | | | |
| $V_1$ : GG 1 | 34.38 | 60.12 | 88.39 | 5.13 | 33.60 | 6.44 | 5.37 | 33.63 |
| $V_2$ : GG 2 | 26.69 | 48.54 | 71.25 | 6.13 | 40.89 | 9.28 | 8.07 | 41.86 |
| S.Em ± | 0.50 | 0.57 | 0.85 | 0.08 | 0.57 | 0.15 | 0.15 | 0.49 |
| C.D. at 5% | 1.44 | 1.64 | 2.45 | 0.24 | 1.65 | 0.43 | 0.43 | 1.42 |
| C. V. % | 8.49 | 5.43 | 5.51 | 7.59 | 7.98 | 9.76 | 11.43 | 6.76 |

findings are substantiated with those reported by Patel *et al*., (2004) and Vishal et al., (2014).

Similar trend was observed for seed and stalk yield. The impact of different time of sowing on seed and stalk yield of cluster bean reported in table 2 indicated that 1st February sowing ($D_2$), being at par with 11th February sowing ($D_3$) produced significantly higher seed (1027 kg ha$^{-1}$) as well as stalk (5043 kg ha$^{-1}$) yield which were 21.12 % and 27.87 % higher over 21stJanuary sowing ($D_1$), respectively. Higher seed and stalk yield under treatments $D_2$ (1st February) and $D_3$ (11th February) over $D_1$ (21st January) might be attributed to enhanced yield attributes in later sowing over early sowing under favorable weather conditions which might induced photosynthetic activity and translocation of assimilates which was reflected in augmentinggermination, plant height and ultimately had complimentaryimpact on number of branches plant$^{-1}$, pod development and seed formation (Kalyani ,2012).

Harvest index (Table 2) was found unchanged due to different time of sowing. However, maximum harvest index (19.56 %) was reported under sowing on 11th February ($D_3$).

**Effect of row spacing**

Results given in table-1 and table-2 revealed that significantly the highest plant height at 60 DAS (55.96 cm) and at harvest (82.04 cm) and stalk yield (4859 kg ha$^{-1}$) were obtained when crop sown at 30 cm spacing ($S_1$) over rest of the treatments. Nevertheless, crop sown at 60 cm spacing ($S_3$) being at par with 45 cm spacing ($S_2$) produced significantly higher pod length (8.24 cm) and seeds pod$^{-1}$ (7.13) over 30 cm spacing ($S_1$). Plant height at 30 DAS, branches plant$^{-1}$, pods plant$^{-1}$, test weight (g), seed yield (kg ha$^{-1}$) and harvest index (%) were found statistically at par due to different row spacing.Under wider spacing some of the yield components might have been increased on individual plant basis but would have been decreased on per unit area basis, while under narrow spacing though number of plants per unit area might have been increased, but the yield components might have been declined on individual basis and eventually the biological yield was reduced. A similar result was obtained by Machado *et al*., (2003).

**Effect of variety**

In the present experiment different varieties showed imperial impact on all the growth

**Table 2.** Effect of time of sowing, row spacing and variety on seed and stalk yield and harvest index of Cluster bean

| Treatments | Seed yield (kg ha$^{-1}$) | Stalk yield (kg ha$^{-1}$) | Harvest index (%) |
|---|---|---|---|
| Time of sowing (D) | | | |
| $D_1$ : 21st January | 848 | 3944 | 19.50 |
| $D_2$ : 1st February | 1027 | 5043 | 17.34 |
| D3: 11th February | 979 | 4450 | 19.56 |
| S.Em ± | 33 | 176 | 0.58 |
| C.D. at 5% | 131 | 692 | NS |
| C.V. % | 14.87 | 16.69 | 13.00 |
| Row spacing (S) | | | |
| $S_1$ : 30 cm | 996 | 4859 | 18.76 |
| $S_2$ : 45 cm | 916 | 4178 | 18.41 |
| $S_3$ : 60 cm | 942 | 4400 | 19.22 |
| S.Em ± | 23 | 126 | 0.55 |
| C.D. at 5% | NS | 364 | NS |
| Variety (V) | | | |
| $V_1$ : GG 1 | 658 | 5392 | 11.00 |
| $V_2$ : GG 2 | 1245 | 3566 | 26.59 |
| S.Em ± | 18 | 103 | 0.45 |
| C.D. at 5% | 53 | 298 | 1.30 |
| C. V. % | 10.07 | 11.95 | 12.44 |

parameters, yield attributing characters and yield (Table 1 and Table-2). Variety GG 2 ($V_2$) proved statistically superior over variety GG1 ($V_1$) in all the aspects barring periodical plant height and stalk yield. Significantly maximum branches plant$^{-1}$ (6.13), pods plant$^{-1}$ (40.89), pod length (9.28 cm), number of seeds pod$^{-1}$ (8.07),test weight (41.86 g), seed yield (1245 kg ha$^{-1}$) and harvest index (26.59 %) were recorded under variety GG 2 ($V_2$) over GG 1 ($V_1$) . On the other hand, variety GG 1 ($V_1$) exhibited higher plant height at 30 DAS (34.38 cm), 60 DAS (60.12 cm) and at harvest (88.39 cm) and produced higher stalk yield (5392 kg ha $^{1}$) over variety GG 2 ($V_1$). Variety GG 2($V_2$) produced 89 % higher seed yield over variety GG 1($V_1$). This can be attributed to higher biomass accumulation coupled with effective translocation and distribution of photosynthesis from source to sink (Patel *et al*., 2010).

**Interaction effect**

Interaction effect between D X V was found significant (Table 3(a)) for plant height at 30 DAS, pod length, seeds pod$^{-1}$, stalk yield and harvest index. Treatment combination $D_3V_1$ (sowing on 11$^{th}$ February with GG 1) being at par with treatment combination $D_2V_1$ (sowing on 1$^{st}$ January with GG 1) reported significantly higher plant height (37.17 cm) as well as stalk yield (5589 kg ha$^{-1}$). However, in case of pod length and number of seeds pod$^{-1}$, treatment combination $D_3V_2$ (sowing on 11$^{th}$ February with GG 2) out right produced highest pod length (10.95 cm) and number of seeds pod$^{-1}$(9.84). Significantly higher harvest index (28.96) was reported under treatment combination $D_1V_2$, which remained at par with $D_3V_2$.

Interaction between D X S (Table 3(b)) were found significant for seed yield as well as harvest index, wherein treatment combination $D_3S_2$ (sowing on 11$^{th}$ February at 30 cm row spacing) gave significantly higher seed yield (1085 kg ha$^{-1}$) and harvest index (22.05 %). Nevertheless, it remained at with $D_2S_2$ and $D_2S_3$ for seed yield and with $D_1S_3$ and $D_1S_1$ for harvest index.

Number of pod plant$^{-1}$, seed yield as well as harvest index were found significantly influenced due to interaction between S X V (Table 3 (c)) and treatment combination $S_3V_2$ gave appreciably higher Number of pod plant$^{-1}$(42.51), seed yield (1245 kg ha$^{-1}$) and harvest index (28.02 %).

**Table 3 (a).** Interaction effect of time of sowing and variety on various growth and yield attributes of Cluster bean

| Time of sowing (D) | Plant height (cm)30 DAS | | Pod length (cm) | | Number of seeds pod$^{-1}$ Variety (V) | | Stalk yield (kg ha$^{-1}$) | | Harvest index (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $V_1$:GG1 | $V_2$:GG2 | $V_1$:GG1 | $V_2$:GG2 | $V_1$:GG1 | $V_2$:GG2 | $V_1$:GG1 | $V_2$: GG2 | $V_1$:GG1 | $V_2$:GG2 |
| $D_1$ : 21$^{st}$ January | 28.84 | 25.74 | 5.65 | 7.36 | 4.71 | 6.22 | 5066 | 2823 | 10.03 | 28.96 |
| $D_2$ : 1$^{st}$ February | 37.13 | 27.49 | 6.40 | 9.54 | 5.33 | 8.13 | 5520 | 4565 | 12.28 | 22.39 |
| $D_3$:11$^{th}$ February | 37.17 | 26.82 | 7.28 | 10.95 | 6.07 | 9.84 | 5589 | 3310 | 10.70 | 28.42 |
| S. Em ± | 1.06 | | 0.31 | | 0.31 | | 178 | | 0.78 | |
| C.D. at 5% | 3.06 | | 0.90 | | 0.91 | | 515 | | 2.25 | |

The perusal of result given in table 3(d) revealed that treatment combination $D_3S_1V_2$ (cluster bean variety GG 2 sown on 11th February with 30 cm row spacing ), being at par with $D_2S_3V_2$(cluster bean variety GG 2 sown on 1st February with 60 cm row spacing) produced significantly higher seed yield (1476 kg ha-1) over rest of the treatment combinations.This could be also attributed to higher biomass accumulation coupled with effective translocation and distribution of photosynthates from source to sink. The result was also supported by Sonani*et al*. (2016).

**Economics**

Data pertaining to economics (Table-4) clearly indicated that the highest net realization Rs. 50667 $ha^{-1}$ and BCR (4.53) were obtained under treatment combination $D_2S_3V_2$, i.e. cluster bean variety GG 2 sown on 1st February with 60 cm

**Table 3 (b).** Interaction effect of time of sowing and row spacing on seed yield and harvest index of Cluster bean

| Time of sowing (D) | Seed yield kg $ha^{-1}$ | | | Harvest index (%) | | |
|---|---|---|---|---|---|---|
| | Row spacing (S) | | | | | |
| | $S_1$ : 30 cm | $S_2$ : 45 cm | $S_3$ : 60 cm | $S_1$ : 30 cm | $S_2$ : 45 cm | $S_3$ : 60 cm |
| $D_1$ : 21st January | 943 | 798 | 804 | 19.29 | 18.98 | 20.22 |
| $D_2$ : 1st February | 961 | 1056 | 1063 | 14.93 | 18.73 | 18.35 |
| $D_3$:11th February | 1085 | 894 | 958 | 22.05 | 17.52 | 19.10 |
| S. Em ± | 32 | | | 0.95 | | |
| C.D. at 5% | 92 | | | 2.76 | | |

**Table 3 (c).** Interaction effect of row spacing and variety on number of pod $plant^{-1}$, seed yield and harvest index of Cluster bean

| Row spacing (S) | Number of pod $plant^{-1}$ | | Seed yield kg $ha^{-1}$ | | Harvest index (%) | |
|---|---|---|---|---|---|---|
| | | | Variety (V) | | | |
| | $V_1$ :GG1 | $V_2$:GG2 | $V_1$ GG1 | $V_2$:GG2 | $V_1$ :GG1 | $V_2$ :GG2 |
| $S_1$ : 30 cm | 35.14 | 38.61 | 665 | 1327 | 9.99 | 27.52 |
| $S_2$ : 45 cm | 32.73 | 41.54 | 670 | 1162 | 12.60 | 24.23 |
| $S_3$ : 60 cm | 32.93 | 42.51 | 639 | 1245 | 10.42 | 28.02 |
| S. Em ± | 0.99 | | 32 | | 0.78 | |
| C.D. at 5% | 2.86 | | 92 | | 2.25 | |

**Table 3 (d).** Interaction effect of time of sowing, row spacing and variety on seed yield of cluster bean

| Time of sowing (D) | Row spacing (S) | (Seed yield kg $ha^{-1}$) Variety (V) | |
|---|---|---|---|
| | | $V_1$ : GG 1 | $V_2$ :GG 2 |
| $D_1$21st January | $S_1$ : 30 cm | 624 | 1261 |
| | $S_2$ : 45 cm | 556 | 1040 |
| | $S_3$ : 60 cm | 505 | 1103 |
| $D_2$1st February | $S_1$ : 30 cm | 678 | 1245 |
| | $S_2$ : 45 cm | 895 | 1217 |
| | $S_3$ : 60 cm | 665 | 1461 |
| $D_3$11th February | $S_1$ : 30 cm | 694 | 1476 |
| | $S_2$ : 45 cm | 558 | 1231 |
| | $S_3$ : 60 cm | 746 | 1170 |
| S. Em ± | 55 | | |
| C.D. at 5% | 160 | | |

**Table 4.** Economics of cluster bean as influenced by time of sowing, spacing and variety

| Treatments | Seed yield (kg ha$^{-1}$) | Stalk yield (kg ha$^{-1}$) | Gross Income (Rs. ha$^{-1}$) | Total cost of cultivation (Rs. ha$^{-1}$) | Net realization (Rs.ha$^{-1}$) | BCR |
|---|---|---|---|---|---|---|
| $D_1S_1V_1$ | 624 | 5521 | 33242 | 14957 | 18285 | 2.22 |
| $D_1S_1V_2$ | 1261 | 3194 | 55231 | 14957 | 40274 | 3.69 |
| $D_1S_2V_1$ | 556 | 4537 | 29046 | 14657 | 14389 | 1.98 |
| $D_1S_2V_2$ | 1040 | 2809 | 45814 | 14657 | 31157 | 3.13 |
| $D_1S_3V_1$ | 505 | 5139 | 27909 | 14357 | 13552 | 1.94 |
| $D_1S_3V_2$ | 1103 | 2465 | 47818 | 14357 | 33461 | 3.33 |
| $D_2S_1V_1$ | 678 | 6688 | 37152 | 14957 | 22195 | 2.48 |
| $D_2S_1V_2$ | 1245 | 4820 | 57030 | 14957 | 42073 | 3.81 |
| $D_2S_2V_1$ | 895 | 4808 | 43012 | 14657 | 28355 | 2.93 |
| $D_2S_2V_2$ | 1217 | 4486 | 55409 | 14657 | 40752 | 3.78 |
| $D_2S_3V_1$ | 665 | 5065 | 34198 | 14357 | 19841 | 2.38 |
| $D_2S_3V_2$ | 1461 | 4389 | 65024 | 14357 | 50667 | 4.53 |
| $D_3S_1V_1$ | 694 | 5979 | 36729 | 14957 | 21772 | 2.46 |
| $D_3S_1V_2$ | 1476 | 2952 | 63468 | 14957 | 48511 | 4.24 |
| $D_3S_2V_1$ | 558 | 4537 | 29126 | 14657 | 14469 | 1.99 |
| $D_3S_2V_2$ | 1231 | 3889 | 55074 | 14657 | 40417 | 3.76 |
| $D_3S_3V_1$ | 746 | 6250 | 39215 | 14357 | 24858 | 2.73 |
| $D_3S_3V_2$ | 1170 | 3090 | 51435 | 14357 | 37078 | 3.58 |

Selling Price: Seed – Rs. 40 kg$^{-1}$, Stalk – Rs. 1.5kg$^{-1}$

row spacing; followed by treatment combination $D_3S_1V_2$i.e. cluster bean variety GG 2 sown on 11$^{th}$ February with 30 cm row spacing, with net realization of Rs. 47511 ha$^{-1}$ and BCR of 4.24.

## CONCLUSION

In light of the above results it can be concluded that summer cluster bean variety GG-2 should be sown on 1$^{st}$ February with wider row spacing of 60 cm for getting higher yield and monetary return. In case, sowing is delayed, variety GG-2 should be sown on 11$^{th}$ February at narrow spacing of 30 cm.

## REFERENCES


1. Anonymous (2014).www.indianstatistics.com
2. Anonymous (2015).www.guargumcultivation.com
3. Kalyani D. (2012).Performance of cluster bean genotypes under varied time of sowing. *Legume Res.,* **35**(2):154-158Machado *et al*., (2003).
4. Machado, S., C. Humphreys, B. Tuck, T. Darnell and M. Corp (2003) Variety, seeding date, spacing and seeding rate effects on grain yield and grain size of chickpea in Eastern Ortegon. Agric. Exper. Station Oregon State Univ. Special Report. 1047. Patel *et al*., (2004)
5. Patel, I. C., Patel M. M., Patel A. G., and Tikka, S. B. S. Response of summer cluster bean varieties to time of sowing and row spacing on yield under north Gujarat agro climatic condition. *J. of Arid Legumes,* 2004; **1**(1): 24-26
6. Patel, M.M.; Patel I.C.; Patel P.H.; Vaghela, S.G.; Patel R.I. and Acharya S. Effect of sowing time, row spacing and seed rate on yield and yield attributes of moth bean (V. aconitifolia) under rain fed conditions. *Journal of Arid Legumes,* 2010; **7**(2): 112-114.
7. Sonani, V. V., Gurjar, R., Parmar, H. C. and Patel, R. R. Effects of sowing dates and spacing on summer greengram. *Green Farming,* 2016; **7**(1):194-196.
8. Vishal D, Arvadia M. K., and Swapnil D. Ideal sowing dates for summer cluster bean in South Gujarat. *Trends in Biosciences,* 2014; **7**(23): 3792-3794.