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Influence of dates of sowing and irrigation scheduling (IW: CPE ratio) on yield attributes and yield of summer moth bean

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Abstract
A field experiment was conducted during summer season of the year 2010 at Anand Agricultural University, Anand, Gujarat. To study the influence of dates of sowing and irrigation scheduling (IW:CPE ratio) on Yield attributes and yield of summer moth bean. The results indicated that Sowing at 30th January recorded the significantly higher yield attributes *viz.*, average number of pods per plant (37.81), average pod length (3.78 cm) and average number of seeds per pod (5.66). Date of sowing had significant effect on seed yield of moth bean. Significantly the highest seed (460 kg/ha) was recorded under treatment D_2 (sowing at 30th January). Whereas, significantly lower seed (368 kg/ha) was under treatment D_1 (sowing at 20th January). Treatment D_2 (sowing at 30th January) increase seed yield to the tune of 18.26%, 19.78% and 20% over the treatments D_3 (sowing at 9th February), D_4 (sowing at 19th February) and D_1 (sowing at 20th January), respectively. Among the different levels of irrigation scheduling, average length of pod (3.78 cm), average pods per plant (37.53) and average number of seeds per pod (5.66).Treatment I_2 (0.7 IW:CPE ratio) secured significantly the highest seed (472 kg/ha), whereas, significantly the lowest seed (319 kg/ha) was observed under treatment I_0 (control, irrigation at critical growth stages). Result revealed that treatment combination of (D_2I_2), 30th January date of sowing of moth bean with irrigation scheduling based on IW:CPE ratio 0.7 (8+1 irrigation) recorded significantly the highest seed yield (651 kg/ha). For securing higher seed yield and net realization from summer moth bean it is advisable that crop should be sown at 30th January with nine irrigations, each of 50 mm depth scheduled at an IW:CPE ratio of 0.7.

Keywords: Date of sowing, Irrigation scheduling, yield attributes and summer Mothbean

Introduction
Moth bean (*Vignana contifolia* (Jacq.) Marechal) originated in the semi-arid regions of India, most probably in the State of Rajasthan (Fageria, 1992) [1]. It is cultivated in the states of Rajasthan, Haryana, Utter Pradesh, Punjab, Maharashtra, and Gujarat. The most common sowing practice was through broadcast. In Punjab, it was cultivated with black and green grams as a mixed crop, more often in the unfertile soils. It is a ground-hugging plant and only about a one foot high. The crop is generally grown in the north Western deserts regions of India and Pakistan, especially in area where moong bean greatly suffers from drought. Production of moth bean varies in the India, and all production is consumed within the country. The lower productivity of this crop is attributed to several factors such as growing under moisture stress conditions, marginal lands with very low inputs and without pest and disease management, non avaibility of high yielding varieties and late sowing. Moreover, the yield of local cultivars of moth been is much less as compared to other pulse crops. Hence, there is need to enhance the production potential of this crop through use of organic manures, biofertilizers. Chemical fertilizers play an important role to meet the nutrient requirement of the crop but continuous use of these on lands will have deleterious effects on physical chemical and biological properties of soil, which in turn reflects on yield (Sarkar *et al.*, 1992) [2].

Date of Sowing has been recognized as the most important non-monetary input affecting yield of *summer* moth bean as late sowing coincides with high temperature during the initial crop growth stage and pre- monsoon shower at reproductive stage. On the other hand, early sown crop faces moderate temperature during initial growth stage, particularly in middle Gujarat region, which adversely affect the crop growth and finally the yield. Late sowing does not provide enough time to prepare land for *kharif* crop, which delays *kharif* sowing. Therefore, it is imperative to determine the optimum time of sowing of moth bean crop for obtaining higher economic yield. Water is well known essential constituent of living organism for their growth and development. Both excess or deficit use of water, reduces the crop yield drastically. Water

stress during the active crop growth phase results into cessation of growth as it influences the photosynthesis and other physiochemical processes and or death, by desiccation. The excess water leads to the problems of raising water table, soil salinity. Hence, water management studies have become an important aspect of research for irrigated crops. Irrigation is mainly given to crop for achieving maximum yield with batter quality of produce. The ideal scheduling of irrigation depends upon the soil, climate and plant characteristics. Keeping all these factors in view, the present research work entitled "Influence of date of sowing and irrigation scheduling (IW:CPE ratios) on growth, yield attributes and yield of summer moth bean under middle Gujarat conditions.

Materials and Methods

The present experiment was conducted at Agronomy Farm of Anand Agricultural University, Anand, (Gujarat) during summer season of the year 2010. The climate of this region is semi-arid and sub-tropical with an average rainfall of 870 mm received entirely from the south west monsoon current. Winter is severe and sets in the month of November and continued till the end of January. Summer is hot and dry, covers the month of April-May. The mean minimum temperature ranged from 12.2 ºC to 23.7 ºC and mean maximum temperature ranged from 30.3 ºC to 41.7 ºC during the crop season of the year 2010. The soil is representative of the soils of the region and is particularly known as 'Goralu soil' which alluvial in origin and belongs to the Entisols. It responds well to manuring and is suitable to variety of crop of tropical region. The soil is very deep and moisture retentive. The soil was low in nitrogen, medium in available phosphorus and high in available potash. The soil is free from any kind of salinity and sodicity. The detail of experimental techniques employed for the investigation was stripe plot consisted four date of sowing i.e. D_1 = 20th January, D_2 = 30th January, D_3= 9th February and D_4=19th February as first stripe and four irrigation scheduling levels i.e. I_0 – critical growth stages @ Branching, at flowering, at pod formation, at grain formation. (Control), I_1 – 0.5 IW: CPE ratio, I_2 - 0.7 IW: CPE ratio and I_3 - 0.9 IW: CPE ratio.

The experimental field was thoroughly prepared by tractor cultivator followed by harrowing and at last planking for leveled the soil. The seeds of Moth bean were used for sowing. As per the date of sowing treatments, first, second, third, and four sowing was done manually on 20th January, 30th January, 9th February and 19th February 2010, respectively. First treated seed with Rhizobium culture 'pv movable' @ 400gm/20kg seeds and then dry sowing was done at 60 cm row to row and 10 cm plant to plant distance. The crop was fertilized with 20 kg N and 40 kg P_2O_5 per hectare from DAP and urea as basal application i.e. before sowing in opened furrow as common application. Thinning, weeding and plant protection measures were taken as and when required. Plant protection measures were adopted as and when required. Pods were harvested manually when they turned brown to dark brown. The pods from border lines were harvested first and kept separately. Then, the pods from net plot were manually picked and allowed to sun dry for four days in cotton bags. The seed weight of each net plot was done by pan balance and recorded for each net plot separately. Five randomly selected and tagged plants from each plot were used for recording observation on yield attributes. The data generated on yield, quality and various characterized were subjected to statistical analysis using "Analysis of variance technique". The value of table 'F at 5% level of significance, where the treatment differences were found significant the value of CD and C.V. %were also worked out to compare the treatment mean (Snedecor and Cochran, 1967) [3].

Result and Discussion

Effect of date of sowing and irrigation scheduling on yield attributes

Sowing at 30th January (D_2) recorded significantly higher average length of pod (3.78 cm), which was remained at par with treatments D_3 (sowing at 9th February) and treatment D_4 (sowing at 19th February), respectively (Table 1). While lower average length of pod (3.57 cm) was observed under treatment D_1 (sowing at 20th January), being at par with treatment D_4 (sowing at 19th February). Treatment I_2 (0.7 IW:CPE ratio) recorded significantly higher (3.94 cm) average length of pod, which was remained at par with treatments I_1 (0.5 IW:CPE ratio, 3.76 cm) and I_3 (0.9 IW:CPE ratio, 3.66 cm.), respectively.

Table 1: Effect of date of sowing and irrigation scheduling on yield attributes

Treatments	Length of pod	Pods per plant	Seeds per pod
A Vertical strip (Date of sowing) (D)			
D_1 : 20th January	3.57	32.75	5.08
D_2 : 30th January	3.78	37.81	5.66
D_3 : 9th February	3.74	36.43	5.37
D_4 : 19th February	3.67	35.81	5.34
S.Em. ±	0.04	0.47	0.09
C.D. at 5%	0.14	1.49	0.29
B Horizontal strip (Irrigation IW:CPE ratios) (I)			
I_0 : Control	3.39	34.57	5.20
I_1 : 0.5 IW:CPE ratio	3.76	35.29	5.34
I_2 : 0.7 IW:CPE ratio	3.94	37.53	5.66
I_3 : 0.9 IW:CPE ratio	3.66	35.12	5.25
S.Em. ±	0.09	0.57	0.07
C.D. at 5%	0.30	1.84	0.23

Significantly higher average number of pods (37.81) per plant was recorded under treatment D_2 (sowing at 30th January) and it was remained at par with treatment D_3 (sowing at 9th February). Whereas, the lowest number of pods per plant (32.75) was observed under treatment D_1 (sowing at 20th January). Treatments D_3 (sowing at 9th February) and D_4 (sowing at 19th February) was remained at par with each other. Treatment I_2 (0.7 IW:CPE ratio) recorded significantly the highest average pods per plant (37.53), while lower average number of pods (34.57) was recorded under treatment I_0 (control, irrigation at critical growth stages). Treatment I_1 (0.5 IW:CPE ratio), being at par with treatment I_3 (0.9 IW:CPE ratio). Treatment D_2 (sowing at 30th January) recorded higher average number of seeds per pod (5.66), which was remained at par with treatment D_3 (sowing at 9th February, 5.37). Significantly lower average number of seeds per pod was recorded under treatment D_1 (sowing at 20th January), being at par with treatment D_4 (sowing at 19th February). Also, treatments D_3 (sowing at 9th February) and D_4 (sowing at 19th February) remained at par with each other. Significantly the highest average number of seeds per pod (5.66) was observed under treatment I_2(0.7IW:CPE ratio), while the lower average number of seeds per pod (5.20) recorded under treatment I_0 (control, irrigation at critical growth stages), which was remained at par with treatments I_1 (0.5 IW:CPE ratio) and I_3(0.9 IW:CPE ratio).The probable reason might be due to favourable temperature and bright sun shine hours resulted in to better growth parameters of the plants. The increase in temperature usually increases the

photosynthesis and increases the photosynthates from source to sink, ultimately higher growth parameters. Treatment I_2 (0.7 IW:CPE ratio) assured shorter intervals between two irrigation as well as higher quantity of water application which did not permit moisture stress and created favourable conditions for the development of yield attributing characters of plant in respect to water and nutrient availability. Similar findings have been also reported by Tank *et al.* (1992) [4], Trivedi *et al.* (1994) [5] in green gram.

Effect of date of sowing and irrigation scheduling on seed yield

Date of sowing had significant effect on seed yield of moth bean (Table 2). Significantly the highest seed yield (460 kg/ha) was recorded under treatment D_2 (sowing at 30th January). Whereas, significantly lower seed yield (368 kg/ha) was under treatment D_1 (sowing at 20th January), being at par with treatments D_4 (sowing at 19th February), D_3 (sowing at 9th February), respectively. Treatment D_3 (sowing at 9th February) and Treatment D_4 (sowing at 19th February) were remained at par with each other. Treatment D_2 (sowing at 30th January) recorded higher seed yield to the tune of 18.26%, 19.78% and 20% over the treatments D_3 (sowing at 9th February), D_4 (sowing at 19th February) and D_1 (sowing at 20th January), respectively. Significantly the highest seed yield (472 kg/ha) was observed under treatment I_2 (0.7 IW:CPE ratio), whereas significantly the lowest seed yield (319 kg/ha) was observed by treatment I_0 (control, irrigation at critical growth stages). Treatment I_1 (0.5 IW:CPE ratio) was remained at par with treatment I_3 (0.9 IW:CPE ratio). Treatment I_2 (0.7 IW:CPE ratio) recorded higher seed yield at the extant of 16.73%, 17.58%, and 32.41% over the treatments I_1 (0.5 IW:CPE ratio), I_3 (0.9 IW:CPE ratio) and I_0 (control, irrigation at critical growth stages), respectively.

Table 2: Effect of date of sowing and irrigation scheduling on seed yield

Treatments	Seed yield (Kg ha^{-1})
A Vertical strip (Date of sowing) (D)	
D_1 : 20th January	368
D_2 : 30th January	460
D_3 : 9th February	376
D_4 : 19th February	369
S.Em. ±	8.00
C.D. at 5%	25
B Horizontal strip (Irrigation IW:CPE ratios) (I)	
I0 : Control	319
I1 : 0.5 IW:CPE ratio	393
I2 : 0.7 IW:CPE ratio	472
I3 : 0.9 IW:CPE ratio	389
S.Em. ±	13
C.D. at 5%	41

Interaction effect of date of sowing and irrigation scheduling on seed yield

Interaction effect between date of sowing and irrigation scheduling (IW:CPE ratios) was significant (Table 3), treatment combinations (D_2I_2), 30th January date of sowing of moth bean with irrigation scheduling based on IW:CPE ratio 0.7 (9 irrigation) recorded significantly the highest seed yield (651 kg/ha). Treatment combination (D_2I_3), 30th January date of sowing with irrigation scheduling based on IW:CPE ratio 0.9 (11 irrigation) and (D_3I_2), 9th February date of sowing of moth bean with irrigation scheduling based on IW:CPE ratio 0.7 (9 irrigation) again (D_2I_1), 30th January date of sowing of moth bean with irrigation scheduling based on IW:CPE ratio 0.5 (7 irrigation) and D_1I_2, 20th January date of sowing of moth bean with irrigation scheduling based on IW:CPE ratio 0.7 (9 irrigation), D_4I_2 19th February date of sowing with irrigation scheduling based on IW:CPE ratio 0.7 (9 irrigation) were remained at par with each other. Significantly lower seed yield (303 kg/ha) was obtained under treatment combinations D_2I_0, 30th January date of sowing of moth bean with irrigation scheduling based on critical growth stages being at par with treatment combination D_3I_0, (sowing at 9th February and control, irrigation at critical growth stages), D_4I_0 (sowing at 19th February and control, irrigation at critical growth stages), D_1I_0 (sowing at 20th January and control, irrigation at critical growth stages) were remained at par with each other. It is concluded that second date of sowing (D_2: 30th January) and irrigation I_2 (0.7 IW:CPE ratio, 9 irrigation) was found beneficial and conducive for the highest seed yield of summer season cultivation of moth bean. The probable reason might be prevailing of optimum maximum and minimum temperature which have resulted in to higher rate of photosynthesis as well as higher translocation of photosynthates. Plant in the earlier and late sowing gave poor yield due to poor vegetative as well as reproductive growth. The increase in seed yield might be due to the increase irrigation frequency and consumptive use on account of increased ratio. Thus, there was progressive increased in seed yield due to favourable moisture condition and better availability of soil moisture at higher frequency of irrigation throughout the crop growth period which remarkably stimulated the yield.

Table 3: Interaction effect between date of sowing and irrigation sch eduling on seed yield

Treatment	Seed yield (Kg ha^{-1})			
Date/Irrigation	I_0	I_1	I_2	I_3
D_1 : 20th January	330	376	406	360
D_2 : 30th January	303	421	651	467
D_3 : 9th February	319	389	430	364
D_4 : 19thFebruary	325	389	400	363
S.Em. ±	19.00			
CD at 5%	55.14			

Conclusion

For securing higher seed yield and net realization from summer moth bean crop Cv. RMO-225 raised on loamy sand soil of middle Gujarat, it is advisable that crop should be sown at 30th January with nine irrigations, each of 50 mm depth scheduled at an IW:CPE ratio of 0.7. The common irrigation should be applied immediately after dry sowing; first irrigation at fourteen days after common irrigation and second at also fourteen days after first irrigation and remaining six irrigations should be applied at an interval of seven to ten days.

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