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RESEARCH ARTICLE

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Response of summer clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] to irrigation scheduling and integrated nutrient management

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ABSTRACT

An experiment was conducted in summer seasons during 2004 and 2005 at ECFP Farm (Now, Regional Research Station), Anand Agricultural University, Anand to study the response of summer clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] to irrigation scheduling and integrated nutrient management under middle Gujarat conditions. Plant height at harvest was found significantly higher under 0.7 IW:CPE ratio whereas, dry weight of root nodules per plant at 45 DAS as well as number of branches and pods per plant at harvest were significantly higher under irrigation scheduling at 0.5 IW:CPE ratio. Irrigating the crop 0.5 IW: CPE ratio recorded significantly higher seed yield (1319 kg ha^{-1}) and registered the highest net realization (Rs. 13,822 ha^{-1}) and CBR (2.83). Application of 100 % RDF or 75 % RDF along with 10 t FYM ha^{-1} or 75 % RDF plus seed inoculated with *Rhizobium* + PSB recorded higher plant height, number of branches and number of pods per plant as well as significantly higher seed and straw yields and higher water user efficiency than control. While, application of *Rhizobium* + PSB inoculation along with 10 t FYM ha^{-1} recorded maximum number and dry weight of root nodules per plant at 45 DAS as compared to control and 100 % RDF. Application of 75 % RDF along with seed inoculation with *Rhizobium* + PSB recorded maximum net returns of Rs. 14,740 ha^{-1}, the highest CBR of 3.61 and save 25 % of chemical fertilizers.

KEY WORDS : Clusterbean, Integrated nutrient management, Irrigation scheduling, *Rhizobium*

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INTRODUCTION

Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] is an important drought resistant leguminous crop of India grown in Rajasthan, Gujarat, Haryana, Utter Pradesh and Punjab. The cultivated area of clusterbean in the country during 2007-08 was 25.2 lack hectares with production of 7.5 lack tones. It is used for human consumption, cattle feed, green manuring, medicinal and industrial purposes as well as for soil improvement. Clusterbean has recently assumed significant role because of its gum (galactomannan) content (35-40 %). India is a leading exporter of guar gum and earns about Rs 731 crores annually. Clusterbean meal, the by-product of guar industries is used as concentrate for animals, which contains 42 per cent protein. Clusterbean is a short duration crop and could be grown in the summer season with assured irrigation facilities. Nutrient management is one of the important cost effective agronomic factors to augment the crop production. To compensate the short supply of inorganic fertilizers and due to recent price hike in it, the use integrated nutrient practices should be advocated.

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MATERIALS AND METHODS

Twenty-four treatments comprising of all possible combinations of three irrigation scheduling (I_1: irrigation at branching, flowering and pod development stages, I_2: irrigation at 0.5 IW:CPE ratio and I_3: irrigation at 0.7 IW:CPE ratio) with eight integrated nutrient management practices (N_1: control, N_2: 100 % RDF *i.e.* 20:40:0 NPK ha^{-1}, N_3: FYM @ 10 t ha^{-1} + 50 % RDF, N_4: FYM @ 10 t ha^{-1} + 75 % RDF, N_5: *Rhizobium* + PSB + 50 % RDF, N_6: *Rhizobium* + PSB + 75 % RDF, N_7: *Rhizobium* + PSB, N_8: FYM @ 10 t ha^{-1} +*Rhizobium* + PSB) were tested in a split plot design with four replications. The soil of the experimental field was loamy sand in texture having good drainage capacity. It was low in organic carbon and available nitrogen, medium in available phosphorus and high in available potassium. Gujarat Guar-1 variety was

selected for sowing at distance of 30 x 10 cm during the last week of February.

RESULTS AND DISCUSSION

The results obtained from the present study have been presented under following heads :

Growth attributes:

Plant height at harvest, number of branches per plant and dry weight of root nodules per plant were found significantly highest under the irrigation scheduling treatment I_3 over the treatment I_1 (Table 1). The increase in all growth attributes under the treatment I_3 might be due to additional moisture supply due to application of frequent irrigation helps in promoted the cell division and cell multiplication activities, better availability of nutrients enhance the vegetative growth and early infection and establishments of effective rhizobium host symbiosis, this leads to increase in dry weight of root nodules. Similar results were obtained by Kavitha and Wahab (2001) and Bhadoria and Bhadoria (2002).

Integrated nutrient management treatments did not significantly alter plant height at harvest during both the years. Significantly higher number of branches per plant (7.19) was registered under the treatment N_2 over the treatments N_1, N_3, N_5 and N_7. Dry weight of root nodules was observed significantly the highest with the N8 treatment over rest of integrated nutrient management treatments, except the treatment N6 during both the years. Over all improvement in growth attributes might be due to combined effect of organic manures and chemical fertilizers. It helps in improved the soil condition might have favourably increase the root and shoot growth, which ultimately resulted in more area for nodule formation and number of branches per plant. The present finding is in close agreements with Tarafdar and Rao (2001).

Yield attributes:

Significantly the highest number of pods per plant was recorded with the treatment I_3 during 2004 and the treatments I_2 during 2005 as compared to treatments I_1 (Table 1). This is because of irrigation applied at shorter interval avoids moisture stress and provide favourable condition for moisture and nutrient availability to the crops. Bhadoria and Bhadoria (2002) also found similar types of results. Irrigation scheduling failed to show significant effect on the test weight of clusterbean during both the year.

Difference due to integrated nutrient management treatments with respect to number of pods per plant was found to be significant during 2004 only, while during 2005,

Table 1 : Growth and yield attributes of clusterbean as affected by irrigation scheduling and integrated nutrient management

Treatments	Plant height at harvest (cm)		Branches per plant at harvest		Dry weight of root nodules/plant (mg)		Pods per plant at harvest		Test weight (g)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Irrigation schedule										
I_1	79.2	73.6	6.16	6.05	46.06	50.29	39.3	41.9	31.24	31.62
I_2	84.5	84.0	7.19	7.30	55.46	59.94	54.8	59.3	31.43	31.33
I_3	96.7	95.1	7.13	7.26	55.54	59.83	55.5	57.5	30.34	30.32
S.E. ±	3.69	2.24	0.13	0.13	1.18	1.68	1.61	1.12	0.49	0.87
C.D. (P=0.05)	12.77	7.74	0.47	0.46	4.10	5.83	5.58	3.88	NS	NS
C.V. %	24.04	15.02	11.33	11.04	12.80	16.81	18.30	12.01	8.95	15.87
Integrated nutrient management										
N_1	84.7	80.1	6.31	6.48	38.22	39.37	44.5	50.3	30.92	30.90
N_2	84.4	84.7	7.00	7.19	40.18	44.51	50.7	57.2	31.32	31.36
N_3	89.4	84.2	6.85	6.74	46.34	50.77	47.5	51.1	30.98	30.93
N_4	91.6	85.3	7.03	7.06	50.35	53.84	49.9	53.1	30.68	30.90
N_5	83.3	82.4	6.62	6.51	58.09	62.49	54.4	51.5	31.25	31.19
N_6	85.7	88.3	7.03	7.18	64.21	68.54	52.9	55.6	31.53	31.83
N_7	85.8	83.5	6.71	6.72	54.55	58.88	47.4	50.7	31.08	31.24
N_8	89.7	85.5	7.06	7.05	67.79	72.12	52.6	53.4	30.25	30.38
S.E. ±	2.66	2.58	0.20	0.15	1.80	1.83	2.21	2.31	0.92	0.91
C.D. (P=0.05)	NS	NS	NS	0.44	5.08	5.16	6.21	NS	NS	NS
Interaction (IxN)	--	--	--	--	--	--	SIG	--	--	--
C.V. %	10.62	10.59	10.19	7.89	11.94	11.20	15.32	15.13	10.23	10.18

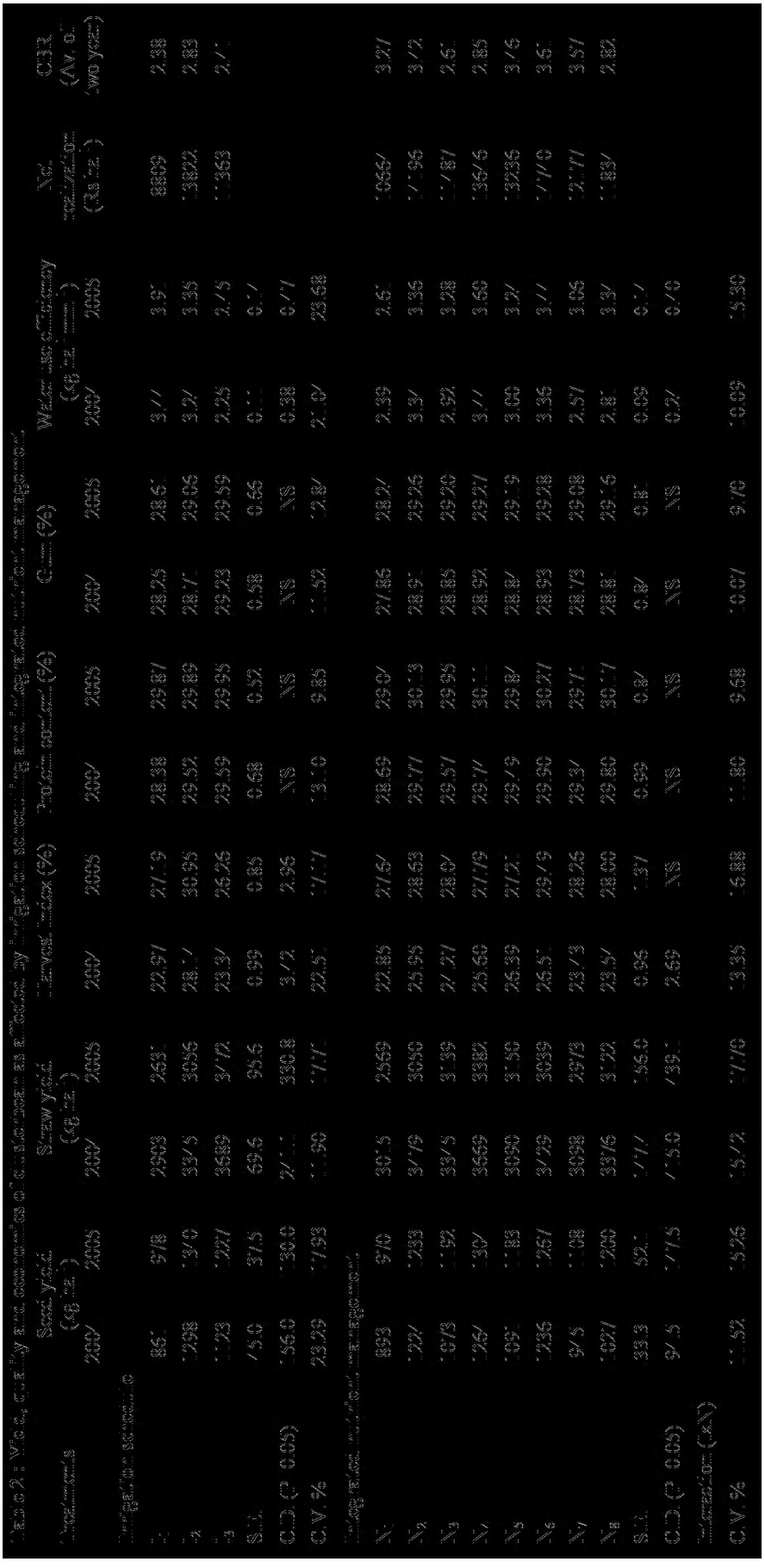
NS=Non-significant

they were non significant. Treatment N_5 recorded significantly higher number of pods per plant (54.4) over treatments N_1, N_3 and N_7. It might be due to optimum supply of nutrients particularly nitrogen and phosphorus through out the life period of crop plant enhance the root and shoot developments and induce the flowering resulting in improvement in number of pods per plants. Similar findings reported by Dadhich and Gupta (2001) and Meena and Meena (2003).

Yield and harvest index:

Seed and straw yield of clusterbean was significantly influenced due to irrigation scheduling (Table 2). Treatment I_2 (0.5 IW: CPE ratio) recorded significantly higher grain yield of 1298 and 1340 kg ha^{-1} over all other treatments during the years 2004 and 2005, respectively, except the treatments I3 during the year 2005. The increase in seed yield under the treatment I2 over I1 and I3 was 30.25 and 13.79 per cent, respectively. This was eventually due to cumulative effect of improvement in growth and yield attributes such as plant height, number of branches per plant and number of pods per plant. Straw yield of clusterbean was significantly highest with the I_3. It increased to the tune of 29.39 and 11.84 per cent under I_3 treatments over I_1 and I_2 treatments, respectively. Increase in straw yield with increase in irrigation frequency was due to the profound increase in growth attributes such as plant height and number of branches per plant. This results is in close conformity by Shubhra *et. al*. (2003). Significantly lowest grain and straw yield of clusterbean was registered under the irrigation treatment I_1 during both the years.

Different integrated nutrient management treatments showed their remarkable effect on seed and straw yield of clusterbean. The treatment N_4 (10 t FYM ha^{-1} + 75 % RDF) produced significantly higher seed yield than other



treatments except treatments N_6 and N_2 during 2004. However, treatment N_4 was found significantly superior over treatments N_1 and N_7 only during the year 2005. Straw yield of clusterbean was recorded significantly highest with the treatment N_4 over the treatment N_1 during both the year, except the treatments N_5 and N_7 during the year 2004.

Significantly highest value of harvest index was noticed under treatment I_2 over treatment I_1 and I_3. Harvest index remarkably not affected by different integrated nutrient management practices during the year 2005. However, during the year 2004, it was significantly affected. The treatment N_6 recorded significantly higher harvest index (26.51 %) over the treatments N_1, N_7 and N_8.

Quality parameter:

The higher values of protein and gum content were recorded under the I_3 irrigation treatment and integrated nutrient management treatment N_6 during both the years (Table 2).

Water use efficiency:

The magnitude of increase in water use efficiency was 52.89 and 59.59 per cent by treatments I_1 and 44.00 and 36.73 per cent by treatment I_2 over treatment I_3 during 2004 and 2005, respectively (Table 2). Reduction in water use efficiency under frequent irrigation could be due to higher moisture regime make more moisture lost through evaporation, transpiration and deep percolation rather than water used for crop production. Similar type of results was observed by Tank *et al.* (1992) and Bhadoria and Bhadoria (2002). Treatment N_4 observed significantly highest water use efficiency over the treatments N_1, N_3, N_5, N_7 and N_8 during the year 2004 and treatments N_1 and N_7 during year 2005. The magnitude of increase in WUE by the treatments N_4 was 43.93 and 37.93 per cent over treatment N_1 during the year 2004 and 2005, respectively.

Economics:

Among different irrigation treatments, I_2 recorded maximum net realization (Rs 13,822 ha^{-1}) and CBR (2.83) (Table 2). While in case of integrated nutrient management treatments, the highest net realization (Rs 14,740 ha^{-1}) was obtained under treatment N_6 with maximum CBR (3.61) and it closely followed by treatment N_2 with net realization (Rs 14,196 ha^{-1}) and CBR of 3.42

It is, therefore, concluded that irrigating the clusterbean crop with 0.5 IW: CPE ratio obtained highest seed yield, net realization and CBR as well as fertilized the crop with 75 % RDF along with 10 t FYM ha^{-1} or 75 % RDF plus seed inoculated with *Rhizobium* + PSB obtained highest seed yield, net returns, CBR and save 25 % of chemical fertilizers.

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