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Influence of *in situ* Moisture Conservation Practices on the Performance of Dryland Cluster Bean

T. B. ALLOLLI, U. K. HULIHALLI AND S. I. ATHANI

Department of Horticulture
University of Agricultural Sciences, Dharwad - 580 005, Karnataka, India
E-mail : ukhulihalli_uasd@rediffmail.com

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Abstract: Cultivation of vegetable crops in particular and horticulture crops in general under dry land / rain fed agro-ecosystem is not so popular like conventional food grain crops. In this regard concerted efforts have been made by Department of Horticulture, Regional Agricultural Research Station, Raichur through National Agriculture Technology Project (NATP). Research programme was under taken as "On Farm Adaptive Research (OFAR) trials on culsterbean with different moisture conservation practices, across 20 farmer's field spread over 8 villages; as management of rain water under dry land situation is of paramount importance from the point of view of increasing the productivity of crops in these lands. Different moisture conservation practices viz., ridges and furrows, ridges and furrows + mulch and farmers practice (Flat bed method) were followed. Ridge and furrows along with mulch enhanced the vigour of the crop as manifested in higher plant height, leaf area and dry matter production. Further moisture conservation practices (ridges and furrow + mulch) helped to promote the productivity of cluster bean as evident in significantly higher yield per unit area. The pooled data indicated the higher yield (30.41 q/ha) due to ridges and furrows + mulch followed by ridges and furrows as compared to flat bed method (24.63 q/ha) of cultivation. The results of individual years followed the similar trend. The economic indicators like net returns per ha (Rs. 14701/ha) and B: C ratio (2.53) was found maximum with ridges and furrows + mulch. Further, ridges and furrows + mulch resulted in higher moisture retention in the soil as compared to flat bed method of cultivation.

Key words : *In situ* moisture conservation practices, dry land, cluster bean, ridges and furrows, vegetables, rainfed agro ecosystems

Introduction

It is a common perception that vegetables cannot be grown under rain fed situation in arid and semiarid regions; which are other wise dominated by cereals, pulses and other field crops. This was very much evident from diagnostic survey undertaken before the initiation of this project. Majority of the farmers were ignorant and non-confidant of growing vegetables on dry lands. The share of horticultural crops like vegetables and fruits in arid and semiarid regions either in respect of area or production or even consumption is very negligible. Mono cropping of cereals and other field crops since centuries, have made, these dry lands deprived of crop diversity with horticultural components. Crop diversification is a need of hour to address various socio-economic and environmental issues haunting different agro-ecosystems across the country. For instance cereals dominated rain fed agro-ecosystems are not only monotonous in their cropping system but also failed to address nutritional requirement of the poor farmers and are less potential economically. Perhaps this might be the fact that, policy makers inclined to give thought on introduction of horticulture (vegetable) crops into the cereals dominated rain fed agro-ecosystems through National Agriculture Technology Project (NATP) bearing project number RNPS-22, so as to introduce the element of diversity into the land use system, besides, meeting nutritional requirement like vitamins and minerals etc; as vegetable crops are rich in vitamins, minerals and other nutritional components. Several vegetables viz., culsterbean, okra, onion and chilli are more economically potential than many of the cereals; hence part of the land can be covered with vegetables, so as to accomplish diversity in land use system. Moisture being the most limiting for growth and development in these lands needs to be conserved to the best advantage of crop plants. Surkod and Itnal (1998) have observed higher soil moisture content due to compartment bunding, while Selvaraju *et al.* (1999) reported similar views due to adoption of tied ridges and furrows and compartment bunding as compared to flat bed method. Conservation of *in-situ* moisture still holds more relevance in vegetables, which are less resistant to moisture deficit environment than traditional drought resistant agricultural crops. Hence, successful attempt was made to grow vegetables exclusively under dry lands with moisture conservation practices.

Material and Methods

The project area consisting of Raichur and Deodurg Talukas in Raichur District, lies in the North Eastern Dry Zone of Karnataka. The zone is characterized by high to medium aridity and low humidity. The average rainfall of the area is 680 mm; of which 90 per cent is received during the months from July to September. The range of rainfall during the study period was 430.5 mm as minimum and 670.50 mm as maximum during 2002 and 2003 respectively. The potential evapo-transpiration exceeds precipitation in all the months except in September. Less water deficit of 27 mm and 36 mm is observed in July and August months respectively. Mean monthly maximum temperature of the area varies between 28.22^{o} C to 44.70^{o} C and 16.59^{o} C to 31.33^{o} C during May and December respectively. Experiments

were laid out in randomized design with plot size of 10 m x 10 m across 20 farmer's fields, considering each farmer as replication. The soil of the experimental fields was black cotton soil, which is inherently known to hold moisture for longer time. In all OFAR fields, treatments consisting of ridges and furrow, ridges and furrows + mulch and flat bed methods were imposed for this purpose. Ridges were prepared at the distance of 45 cm apart during June. Local mulch material consisting of dried leaves of sapota guava and mango were used as 15 cm thick cover which was approximately 150 kg per plot. Seeds of culsterbean were dibbled all along one side of ridges according to recommended spacing i.e., 45 cm. Fertilizer dose consisting of 25:75:62 kg N, P_2O_5 and K_2O/ha was applied through urea, single super phosphate and muriate of potash. Observations were recorded on vegetative parameters, dry matter production, pod length, pod weight, pod girth and yield per hectare. Economic evaluation was also carried out to find out net returns and B: C ratio. Analysis of variance for individual characters was done by the procedures suggested by Panse and Sukhatme (1967). Moisture retention in the soil after rains due to different treatments at the interval of two days up to ten days period was worked out.

Results and Discussion

Vegetative parameters : The pooled, 2002 and 2003 data indicated the significant difference with respect to vegetative parameters due to moisture conservation practices (Table 1). The pooled data revealed significantly the highest plant height (111.30 cm), number of branches (16.30), number of leaves (36.25), leaf area (9.43 dm^2), leaf area index (1.043) and stem girth (1.19 cm) with ridges and furrows + mulch treatment. Similar trends were observed during 2002 and 2003 too at different growth stages. On the contrary, the performance of cluster bean grown on flat bed (as farmer practices) was comparatively poor as evident from considerable reduction in all growth parameters (Table 1). The positive effects of moisture conservation practices like ridges and furrows; in enhancing the plant height and yield attributes of sorghum, cowpea, bengalgram and sunflower have been reported by Somasundaram, *et. al.* (2000).

Dry matter production : The pooled data indicated that significantly higher production of dry matter (22.95 g/plant) was observed with ridges and furrows + mulch followed by cluster bean grown with ridges and furrows method (18.02 g/plant), as compared to flat bed method of cultivation (16.33 g/plant). Similar trend was observed during both the years of experimentation (Table-2).

Yield and yield attributing parameters : Significantly the highest yield due to moisture conservation practice was evident in dry land cluster bean as indicated by data of pooled as well as individual years (Table 2). The pooled data indicated that pod yield was significantly higher (30.41 q/ha) with ridges and furrows + mulch. On the contrary the yield obtained in flat bed method was reduced to nearly 19 per cent (24.63 q/ha) as compared to ridges and furrows + mulch. These results are in conformity with Das and Maliwal (1996) who reported that the moisture conservation practices like application of organic mulch @ 10 t/ha recorded significantly higher seed cotton yield as compared to no mulch. The similar trends were observed with respect to yield attributing characters. Pod length (9.43 cm), pod weight (9.04 gm) and pod girth (0.80 cm) were higher with ridges and furrows + mulch (pooled data) compared to values observed with flat bed (7.90 cm, 7.35 g and 0.73 cm respectively). Similar trends were observed during individual years (Table-2). The variation in yield due to *in-situ* moisture conservation practices might have been caused due to the better expression of growth and yield components. Better performance of dry land cluster bean may be further attributed to beneficial effects imparted by *in situ* moisture conservation practices. To know the beneficial effects of different *in situ* moisture conservation practices, moisture content in soil profile was analysed from 2 DAR (days after rains) to 10 DAR at 0-15 and 16-30 cm soil depth. Maximum moisture content was observed in the soil profile due to ridges and furrows +mulch (Table 3). The moisture content in the soil profile at second DAR due to ridges and furrows + mulch was 57.90 per cent and 59.08 per cent at 0-15 and 16-30 cm soil depth respectively. The corresponding values due to flat bed method were 53.52 and 55.08 per cent. The moisture content at 10^{th} DAR due to ridges and follows + mulch were 24.20 and 25.10 per cent as against 21.42 and 22.13 per cent due to flat bed method at 0-15 and 16-30 soil depth respectively. Pendke *et al.* (2000) revealed the advantage of adoption of moisture conservation practices like deep tillage with broad bed and furrow before sowing; in enhancing seed cotton yield over deep tillage with one directional hoeing. Hulihalli and Patil (2006) reported that compartment bunding, tied ridges and furrows, broad bed and furrow gave significantly higher seed cotton yield compared to flat bed sowing.

Monitory returns:Economic analysis of different moisture conservation practices in cluster bean obviously reflects the superiority of ridges and furrows + mulch; as evident in higher net returns (Rs. 14701/ha) and B:C ratio (2.53) in pooled data. The similar trend was observed during both the years. The corresponding values in cluster bean raised in flat bed method were Rs. 10577/ha and 1.86 (Table-4). Higher net return and B:C ratio due to *in situ* moisture conservation practices by adopting ridges and furrows + mulch, might be due to higher yield, that was responsible for increased gross returns. Sagare *et al.* (2001) reported that opening furrow after each row and after two rows of cotton resulted in higher benefit: cost ratio (2.22 and 2.88 respectively) over control (1.69).

It was concluded that *in situ* moisture conservation practice viz., ridges and furrows + mulch, imparted beneficial effect on cluster bean for getting good growth and higher yields; which subsequently led to higher net returns and B: C ratio. Further, the findings also suggested to use cluster bean as the best alternative dryland crop for arid and semiarid region, where rainfall ranges from 450-600 mm. It is also advantageous for farmers to include such crops in the their land use systems, as the income obtained due to frequent harvests one month after planting will supplement day today economic needs of the farmers.

Table 1. Influence of water conservation practices on growth parameters of dry land cluster bean

Treatments	Plant height (cm)			Number of branches per plant			Nos. of leaves per plant			Leaf area (dm^2)			Leaf area index			Stem girth (cm)		
	2002	2003	Pooled	2002	2003	Pooled	2002	2003	Pooled	2002	2003	Pooled	2002	2003	Pooled	2002	2003	Pooled
T_1	108.00	107.23	107.60	16.83	12.81	14.20	36.39	28.27	32.33	9.92	7.34	8.63	1.089	0.810	0.949	0.91	1.01	0.96
T_2	111.40	111.16	111.30	17.70	14.81	16.30	41.50	31.00	36.25	10.76	8.09	9.43	1.195	0.890	1.043	0.91	1.46	1.19
T_3	101.60	101.21	101.40	14.26	13.21	13.70	33.95	29.00	31.48	9.21	6.59	7.90	1.030	0.720	0.875	0.830	1.09	0.97
S.Em ±	1.19	2.31	1.23	0.50	0.40	0.43	1.15	1.20	1.17	0.27	0.16	0.19	0.028	0.010	0.016	0.019	0.020	0.06
CD at 5%	3.56	6.88	3.28	1.49	1.19	1.14	3.43	NS	3.09	0.81	0.48	0.22	0.084	0.050	0.059	0.060	NS	0.14

T1- Ridges and furrows, T2- Ridges and furrows + mulch, T3 – Farmers practices (Flat bed method)

Table 2. Influence of water conservation practises on dry matter production, yield, yield attributing characters and economics of dry land cluster bean

Treatments	Dry matter prdn. (g/plant)			Pod length (cm)			Pod weight (g)			Pod girths (cm)			Yield (q/ha)		
	2002	2003	Pooled	2002	2003	Pooled	2002	2003	Pooled	2002	2003	Pooled	2002	2003	Pooled
T_1	18.53	17.50	18.02	18.2	8.18	8.35	7.77	7.50	7.64	0.81	0.71	0.67	27.51	25.90	26.72
T_2	21.90	24.0	22.95	9.41	9.36	9.43	8.90	9.17	9.04	0.83	0.76	0.80	31.19	29.63	30.41
T_3	16.43	16.23	16.33	7.39	8.08	7.90	7.25	7.44	7.35	0.78	0.67	0.73	23.84	25.42	24.63
S.Em ±	0.63	0.62	0.59	0.34	0.29	0.19	0.28	0.16	0.19	0.02	0.01	0.02	0.79	0.67	0.76
CD at 5%	1.88	1.80	1.74	1.02	0.72	0.72	0.84	0.48	0.64	NS	0.05	0.00	2.34	1.99	2.21

T1- Ridges and furrows, T2- Ridges and furrows + mulch, T3 – Farmers practices (Flat bed method)

Table 3. Per cent water content in soil profile as influenced by different moisture conservation in dry land cluster bean

Treatments	2nd DAR		4th DAR		6th DAR		8th DAR		10th DAR	
	0-15 cm	16-30 cm	0-15 cm	16-30 cm	0-15 cm	16-30 cm	0-15 cm	16-30 cm	0-15 cm	16-30 cm
T_1	55.23	58.10	51.61	54.28	44.60	40.20	30.28	26.28	22.10	23.10
T_2	57.90	59.08	53.60	55.09	48.10	42.70	33.98	28.10	24.20	25.10
T_3	53.52	55.08	50.32	52.96	41.98	39.41	29.12	24.31	21.42	22.13

T1- Ridges and furrows, T2- Ridges and furrows + mulch, T3 – Farmers practices (Flat bed method)

Table 4. Influence of water moisture conservation practise on economics of dry land cluster bean

Treatments	Gross returns (Rs.ha)			Cost of cultivation (Rs.ha)			Net return (Rs.ha)			B:C ratio		
	2002	2003	Pooled	2002	2003	Pooled	2002	2003	Pooled	2002	2003	Pooled
T_1	22008	20720	21866	9402	9402	9402	12606	12318	12462	2.34	2.46	2.38
T_2	24952	23704	24353	9652	9602	9627	15300	14102	14701	2.58	2.46	2.53
T_3	19072	20336	19624	9052	9202	9227	10020	11134	10577	2.11	2.20	1.86

T1- Ridges and furrows, T2- Ridges and furrows + mulch, T3 – Farmers practices (Flat bed method)

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