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Land and rainwater management of sunflower (*Helianthus annuus*) cultivation in saline Vertisols*

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Salt-affected soils forms sizable area in India. An area of 6.73 million ha of salt-affected soils was estimated for the entire country (Sharma *et al.* 2004). Salt-affected soils are widely distributed in arid and semi–arid regions, where the annual evapotranspiration exceeds the annual precipitation. Crops such as sunflower (*Helianthus annuus* L.) is gaining popular among farmers in Karnataka and it also known to be salt tolerant. Sunflower cultivatoin under saline Vertisols offers more challenges due to germination failure, poor growth and low yield. However, to increase the productivity of sunflower in salt-affected soils under rainfed conditions, salts needs to be leached out of root zone and more moisture is to be conserved for which effective land layouts for rain water harvesting are very important. Hence, a study was conducted to evaluate different land layouts and rainwater harvesting techniques for their efficacy on moisture conservation, salt leaching and performance of sunflower.

A field experiment was conducted to evaluate the effect of different *in-situ* rain water harvesting practices and land layouts at Agricultural Research Station Gangavathi, Karnataka. The treatments comprised of compartment bunding, deep ploughing, bedding, ridges and furrows and tied ridges and furrows were compared with traditional land layout of flatbed as control. Different *in-situ* rain water harvesting practices and land layouts were made during the beginning of monsoon (June) and were allowed to harvest sufficient rain water to facilitate conservation of moisture and leaching of salts. The sunflower crop was sown September 2003–06. The experiment was laid out in randomized block design with 4 replications. The soil was saline with field capacity of 40%. The crop was fertilized 60 : 33 : 50 kg NPK/ha. The moisture content of the soil was measured by gravimetric method. Soil samples were collected to a depth of 0–60 cm and analyzed for EC (1: 2.5 soil water suspensions). and expressed as ECe after multiplying with appropriate correction factor (2.66) derived for the soil.

At germination stage 14.8, 11.6, 7.4, 5.5, 4.5% more moisture (Table 1) as compared to control was observed in the tied ridges and furrows, ridges and furrows, bedding, compartment bunding and deep ploughing land layouts, respectively during 2003–04. Similar trend was observed during 2004–05 and 2005–06. At seed setting stage 15.3% more moisture was recorded in tied ridges and furrows as compared to control, followed by ridges and furrows (14.3%), compartment bunding (4.9%), deep ploughing (4.5%) and bedding (1.8%) during 2003–04. Similarly, during 2004–05, 37.4, 29.7, 25.3, 24.9, and 8.2% more moisture as compared to control was observed in tied ridges and furrows, ridges and furrows, bedding, compartment budding and deep ploughing, respectively. Similar trend was observed during 2005–06.

The initial soil salinity was reduced at germination stage (Table 1) due to leaching of salts by rain water in all the land layouts. The highest per cent reduction of soil salinity to the extent of 27.6, 32.6 and 43.3% was observed during 2003–04, 2004–05 and 2005–06, respectively, in tied ridges and furrows. The soil salinity observed at germination stage however was increased at harvest stage of the crop in all the land layouts. The per cent increase in soil salinity was more in control than the other land layouts. The soil salinity at harvest was less in tied ridges and furrows as compared to initial soil salinity during all the years, which was not observed in the other land layouts.

Germination percentage, plant height and head diameter were significantly influenced by the different *in-situ* moisture harvesting practices and land layouts (Table 2) during all the years. Highest germination percentage was observed in bedding method followed by ridges and furrows, tied ridges

*Short note

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Table 1 Effect of different in-situ rain water harvesting practices on moisture content and soil salinity

Year	Treatment	Moisture content (%)		Soil salinity (dS/m)		
		At germination	At seed setting	Initial	At germination	At harvest
2003–04	Compartment bunding	32.8	23.4	7.4	5.8	7.8
	Deep ploughing	32.5	23.3	6.7	5.4	8.2
	Bedding	33.4	22.7	6.6	5.1	6.7
	Ridges and furrows	34.7	25.5	7.6	5.8	6.3
	Tied ridges and furrows	35.7	25.7	7.6	5.5	5.8
	Control	31.1	22.3	7.2	6.6	9.7
2004–05	Compartment bunding	32.6	22.6	8.2	6.1	8.8
	Deep ploughing	29.6	19.7	9.0	7.6	9.9
	Bedding	33.4	22.8	8.1	5.8	8.6
	Ridges and furrows	34.1	23.6	7.7	5.5	8.0
	Tied ridges and furrows	35.5	25.0	7.9	5.0	7.1
	Control	27.5	18.2	9.2	8.5	10.9
2005–06	Compartment bunding	32.9	22.2	7.9	5.2	7.4
	Deep ploughing	31.9	21.6	8.5	6.7	8.7
	Bedding	33.6	23.0	8.3	5.1	7.9
	Ridges and furrows	34.7	24.2	8.2	5.0	6.9
	Tied ridges and furrows	35.3	25.1	8.3	4.7	6.5
	Control	29.4	17.8	9.5	7.8	9.3

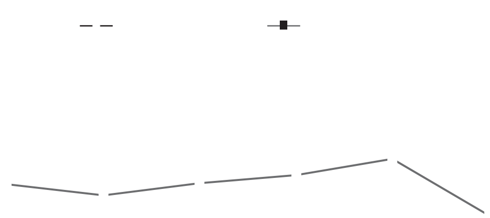

Fig 1 Effect of different *in-situ* moisture harvesting practices on mean moisture content (mean of 3 years)

Fig 2 Effect of different *in-situ* moisture harvesting practices on mean salinity (mean of 3 years)

and furrows, compartment bunding, deep ploughing and was least in control. Significantly higher plant height and head diameter was recorded in tied ridges and furrows, followed by ridges and furrows, bedding, compartment bunding, deep ploughing and least in control. However, the test weight (100 seeds) remained non-significant.

The seed yield was significantly influenced by the rainwater harvesting practices and land layouts (Table 3). Highest pooled seed yield (0.97 tonnes/ha) was obtained in the tied ridges and furrows, followed by ridges and furrows (0.93 tonnes /ha), bedding (0.90 tonnes /ha), compartment budding (0.77 tonnes /ha), deep ploughing (0.75 tonnes /ha) and least (0.53 tonnes /ha) in control. The highest yield in tied ridges and furrows is attributed to higher soil moisture and lower salinity that resulted in increased plant height and production of bigger ear heads that in turn lead to increased yield. The results are in agreement with the findings of Manjunath Habbara *et.al* (2005)

The gross returns, net returns and B: C was significantly influenced by different *in-situ* rain water harvesting practices

Table 2 Effect of different *in-situ* rain water harvesting practices on germination and yield parameters

Treatment	Germination (%)			
	2003–04	2004–05	2005–06	Pooled
Compartment bunding	84.5	83.5	84.0	84.7
Deep ploughing	82.5	81.5	81.7	81.3
Bedding	94.7	94.5	94.2	94.5
Ridges and furrows	91.0	90.2	88.5	89.9
Tied ridges and furrows	93.0	91.7	90.7	89.3
Control	72.5	74.0	73.7	73.4
CD (P = 0.05)	7.69	7.5	6.8	4.8
Plant height (cm)				
Compartment bunding	124.2	120.5	164.9	136.5
Deep ploughing	123.1	117.0	162.4	134.2
Bedding	127.0	124.1	168.2	139.8
Ridges and furrows	132.1	127.6	170.2	143.3
Tied ridges and furrows	135.4	130.4	172.0	145.9
Control	118.4	113.7	149.0	127.9
CD (P = 0.05)	10.24	9.4	9.08	7.09
Ear head diameter (cm)				
Compartment bunding	13.1	12.2	13.0	12.8
Deep ploughing	13.0	12.0	12.7	12.5
Bedding	14.4	13.4	13.3	13.7
Ridges and furrows	14.6	13.6	13.4	13.9
Tied ridges and furrows	14.8	13.7	13.8	14.1
Control	11.4	10.6	9.10	10.4
CD (P = 0.05)	1.06	0.95	1.10	0.71
100 -seed weight (g)				
Compartment bunding	5.5	4.2	5.1	5.0
Deep ploughing	5.4	4.2	5.0	4.9
Bedding	5.2	4.1	5.0	4.7
Ridges and furrows	5.7	4.2	5.2	5.1
Tied ridges and furrows	5.7	4.5	5.5	5.2
Control	5.4	4.1	4.9	4.8
CD (P = 0.05))	NS	NS	NS	NS

Table 3 Effect of different *in-situ* rain water harvesting practices on sunflower yield and economics

Treatment	Yield (tonnes/ha)			
	2003–04	2004–05	2005–06	Pooled
Compartment bunding	0.71	0.71	0.90	0.77
Deep ploughing	0.70	0.69	0.86	0.75
Bedding	0.86	0.81	1.03	0.90
Ridges and furrows	0.90	0.83	1.05	0.93
Tied ridges and furrows	0.94	0.87	1.10	0.97
Control	0.53	0.51	0.56	0.53
CD (P = 0.05)	0.10	0.08	0.08	0.06
Gross returns (Rs/ha)				
Compartment bunding	14247.5	15807.0	21522.0	17392.2
Deep ploughing	13932.5	15257.0	20694.0	16701.8
Bedding	17370.0	17869.5	24894.0	20120.5
Ridges and furrows	18120.0	18282.0	25344.0	21006.0
Tied ridges and furrows	18937.5	19178.5	26316.0	21303.3
Control	10620.0	11335.5	13644.0	11740.5
CD (P = 0.05)	2041.8	1958.8	2021.9	1539.1
Net returns (Rs/ha)				
Compartment bunding	5097.5	6507.0	12022.0	7875.5
Deep ploughing	4832.5	5957.0	11194.0	7327.8
Bedding	8210.0	8569.5	15394.0	10724.5
Ridges and furrows	8620.0	8582.0	15344.0	10841.2
Tied ridges and furrows	9337.5	9378.5	16216.0	11644.0
Control	4585.0	2535.5	4644.0	3066.5
CD (P = 0.05)	3441.9	1958.8	2022.0	1502.0
Benefit: cost ratio				
Compartment bunding	1.56	1.70	2.26	1.84
Deep ploughing	1.53	1.64	2.18	1.77
Bedding	1.91	1.92	2.61	2.14
Ridges and furrows	1.97	1.88	2.53	2.15
Tied ridges and furrows	1.97	1.97	2.60	2.18
Control	1.23	1.29	1.51	1.34
CD (P = 0.05)	0.22	0.20	0.22	0.18

and land layouts (Table 3). Highest pooled gross returns (Rs 21 303/ha), net returns (Rs 11 644/ha) and benefit : cost ratio (2.18) was observed in tied ridges and furrows, followed by ridges and furrow, bedding, compartment bunding, deep ploughing and least in control.

SUMMARY

A field experiment was carried out for three years during 2003–06, to evaluate the effect of different *in-situ* rain water harvesting practices and land layouts on sunflower crop performance, moisture conservation and soil salinity under the saline soils at Agricultural Research Station Gangavathi, Karnataka. Pooled data of 3 years revealed significantly higher sunflower yield (0.97 tonnes/ha) in tied ridges and furrows (followed by ridges and furrows (0.93 tonnes /ha). Highest gross returns (Rs 21 303/ha), net returns (Rs 11 644/ha) and benefit : cost ratio (2.18) was recorded in tied ridges and furrows. Highest moisture content of 35.7, 35.5 and 35.3% was observed at the germination stage in tied ridges and furrows in all the 3 years. Maximum decrease in soil salinity to the extent of 27.6, 32.6 and 43.3% compared to initial was observed in tied ridges at germination stage due to leaching of salts by the harvested rainwater

REFERENCES

Manjunath Hebbara, Raja Kumar, G.R, Ravishankar G, Salimath SB, and. Raghavaiah CV. 2005. Enhancing sunflower productivity in saline soils. *Karnataka Journal of Agricultural Sciences* **18**(2): 282–4.

Sharma R C, B R M Rao and Saxena R K. 2009. Salt affected soils in India-current assessment. (*in*) *Advances in Sodic Land Reclamation. International Conference on Sustainable Management of Sodic Lands*, Lucknow.