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RESEARCH ARTICLE

Growth of multipurpose tree species (MPTS) as influenced by various soil moisture conservation techniques under rainfed conditions

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ABSTRACT : The present experiment was conducted on medium deep silty loam soil to study the effect of rain water conservation techniques on growth of multipurpose tree species (MPTS) in terms of height and collar diameter. The experiment was conducted during the year 2012-2014 on AEEC Farm, Dr. Panjabrao Deshmukh Agriculture University, Akola with five treatments *viz.*, half-moon terracing (T_1), mulching with locally available grasses @ 10 kg/ plant (T_2), compartment bunding with bund height of 0.15 m (T_3), use of soybean as cover crop (T_4) and control (T_5) and four replications in Randomized Block Design. The results revealed that plant height and collar diameter of tree species were found significantly highest in half moon terracing (T_1) followed by mulching with locally available grasses @ 10 kg/ plant (T_2) as compared to other treatments. Soil moisture content of Karanj, Sitaphal and Bel at different soil depths was also found highest in half-moon terracing (T_1) and mulching with locally available grasses @ 10 kg/ plant (T_2).

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Key Words :
Growth, Biomass, Moisture conservation techniques

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A significant cause of low crop production and crop failure in rainfed agriculture in the tropics is low and erratic rainfall. However, in many areas crop and land management do not optimise water flow along the rooting zone of the crop. Thus, poor yields are related to an insufficiency of soil moisture rather than to an insufficiency of rainfall. Tropical and sub-tropical rainfed agriculture depends on an adequate supply of water in the rooting zone of the soil. It has been estimated that soil water limits crop production in approximately three-quarters of the world's arable soils and is the main factor responsible for low yields in the seasonally dry and semi-arid tropics and sub-tropics (Calegari *et al.,* 1998).

Moisture is the constraint in commercial cultivation of arid horticultural crops. Hence, the need of the hours is to develop technologies which not only require low water input but also have high water use efficiency. Moisture being a rare commodity in arid ecosystem, the first and foremost requirement is to conserve the available soil or rain water. For conservation of rain water both *in situ* and *ex situ* technologies have been developed. Scarcity of irrigation water at critical periods of crop growth is a limiting factor for successful cultivation of the crop in the arid and semi-arid regions. Therefore, soil moisture conservation will definitely help in augmenting

production. *In situ* moisture conservation techniques and mulching influences the soil moisture, soil temperature, suppress weed growth and maintain soil fertility (Polara *et al*., 2013). The present investigation was therefore, undertaken to study the effect of soil conservation techniques on growth of tree species in terms of height and collar diameter.

In rainfed agricultural lands efforts should therefore be concentrated on increasing the proportion of water that enters the soil (infiltration), minimizing the moisture loss through runoff and evaporation and improving soil water availability and water use efficiency through improved soil management.

EXPERIMENTAL METHODOLOGY

The present study was conducted for most suitable moisture conservation techniques and locally available mulching materials in 2 years old Karanj, Sitaphal and Bel planted at 4 m × 4 m on AEEC Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in Randomized Block Design during 2012-2013 to 2013-14. Treatments were applied before rainy season. The treatments consisting of half-moon terracing (T_1), mulching with locally available grasses @ 10 kg/ plant (T_2), compartment bunding with bund height of 0.15 m (T_3), use of soybean as cover crop (T_4) and control (T_5). Observation on growth parameters *viz.*, plant height and collar diameter and soil moisture content at different soil depths in the year was carried out and analysed statistically.

Statistical analysis :

The obtained data was analyzed by statistical significant at $P<0.05$ level, S.E. and C.D. at 5 per cent level by the procedure given by (Gomez and Gomez, 1984).

EXPERIMENTAL FINDINGS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Trees performance :

Data pertaining to the growth of Karanj, Sitaphal and Bel are given in Table 1 which indicates the favourable effect of soil and water conservation techniques on the growth of tree species.

Karanj (Pongamia pinnata) :

Growth :

The maximum pooled mean plant height was observed in T_1 (37.73 cm) followed by T_2 (34.55 cm), T_3 (31.28 cm), T_4 (28.83 cm) and minimum in T_5 (25.10 cm). Similarly the higher pooled collar diameter was observed in T_1 (2.54 cm) followed by T_2 (2.41cm), T_3 (2.34 cm), T_4 (2.28 cm) and minimum in T_5 (2.08 cm). T_1 was found significantly superior to enhance the plant height and collar diameter followed by T_2, T_3, T_4 over T_5. The maximum increase in plant height was observed in T_1 (49.63 %) followed by T_2 (37.09 %), T_3 (24.06 %) and T_4 (14.94 %) over T_5. Similarly the higher increase in collar diameter was observed in T_1 (22.65 %), followed by T_2 (16.29 %), T_3 (12.99 %) and T_4 (9.94 %) over T_5.

Soil moisture :

The maximum soil moisture content (Table 2) upto the depth of 15-60 cm was observed 10.12 to 14.12 per cent in T_1 followed by T_2 (9.54 to 13.54 %), T_3 (9.08 to 13.08 %), T_4 (8.34 to 12.76 %) and minimum in T_5 (7.54 to 12.08 %). The maximum increase in soil moisture content was observed 13.34 to 34.22 per cent as in T_1 followed by T_2 (12.09 to 26.53 %), T_3 (5.98 to 20.42%), T_4 (3.64 to 10.61%) over T_5.

Sitaphal (*Annona squamosa*) :

Growth :

It was observed from Table 1 that the maximum pooled mean plant height was observed in T_1 (37.55 cm) followed by T_2 (32.48 cm), T_3 (29.53 cm), T_4 (27.18 cm) and minimum in T_5 (23.85 cm). Similarly the higher pooled collar diameter was observed in T_1 (2.74 cm) followed by T_2 (2.61 cm), T_3 (2.43 cm), T_4 (2.31 cm) and minimum in T_5 (2.16 cm). T_1 was found significantly superior to enhance the height and collar diameter followed by T_2, T_3 and T_4 over T_5. The maximum increase in plant height was observed in T_1 (57.62 %) followed by T_2 (36.25 %), T_3 (23.64 %), T_4 (13.97 %) over T_5. Similarly the higher increase in collar diameter was observed in T_1 (28.06 %), followed by T_2 (21.56 %), T_3 (12.73 %), T_4 (7.02 %) over T_5. Similar results was obtained by Polara *et al.* (2013), Gupta (1995), Mandal and Chattopadhyay (1994) and Keskar *et al.* (1986).

Polara *et al*. (2013) reported that the different *in situ* water harvesting techniques and mulching with locally available materials were found significant for influencing

Table 1 : Effect of soil conservation techniques on growth of dry land trees species

Sr. No.	Tree species	Treatments	Growth (cm)						Increase over T_5 (%)					
			Height (cm) 2012-13	Height (cm) 2013-14	Pooled mean	Collar dia. (cm) 2012-13	Collar dia. (cm) 2013-14	Pooled mean	Height 2012-13	Height 2013-14	Pooled mean	Collar dia. (cm) 2012-13	Collar dia. (cm) 2013-14	Pooled mean
1.	Karanj	T_1	30.95	44.5	37.73	2.49	2.59	2.54	42.29	56.42	49.63	27.04	18.26	22.65
		T_2	28.9	40.2	34.55	2.33	2.49	2.41	32.87	41.30	37.09	18.88	13.70	16.29
		T_3	26.1	36.45	31.28	2.29	2.39	2.34	20.00	28.12	24.06	16.84	9.13	12.99
		T_4	25.15	32.5	28.83	2.26	2.29	2.28	15.63	14.24	14.94	15.31	4.57	9.94
		T_5	21.75	28.45	25.10	1.96	2.19	2.08	-	-	-	-	-	-
		F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	-	-	-	-	-	-
		S.E. ±	0.64	0.35	0.43	0.052	0.011	0.025	-	-	-	-	-	-
		C.D. (P=0.05)	1.79	1.06	1.96	0.145	0.033	0.12	-	-	-	-	-	-
2.	Sitaphal	T_1	31.5	43.6	37.55	2.69	2.79	2.74	53.69	56.55	57.62	29.38	16.74	28.05
		T_2	27.15	37.8	32.48	2.52	2.69	2.61	35.77	35.73	36.25	20.57	12.55	21.55
		T_3	24.35	34.7	29.53	2.26	2.59	2.43	22.67	24.60	23.64	17.09	8.37	12.73
		T_4	22.65	31.7	27.18	2.12	2.49	2.31	14.11	13.82	13.97	9.85	4.18	7.02
		T_5	19.85	27.85	23.85	1.93	2.39	2.16	-	-	-	-	-	-
		F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	-	-	-	-	-	-
		S.E. ±	0.52	0.32	0.29	0.044	0.00079	0.017	-	-	-	-	-	-
		C.D. (P=0.05)	1.46	0.96	1.32	0.124	0.0025	0.077	-	-	-	-	-	-
3.	Bel	T_1	25.8	35.6	30.70	2.44	2.54	2.49	29.33	49.89	39.61	31.18	18.69	24.94
		T_2	23.4	32.25	27.83	2.31	2.44	2.38	17.29	35.79	26.54	24.19	14.02	19.11
		T_3	21.85	29.3	25.58	2.12	2.34	2.23	9.52	23.37	16.45	13.97	9.35	11.65
		T_4	20.9	25.6	23.75	2.00	2.24	2.12	4.76	12.00	8.38	7.53	4.67	6.10
		T_5	19.95	23.75	21.85	1.86	2.14	2.00	-	-	-	-	-	-
		F Test	Sig.	Sig.	-	Sig.	Sig.	Sig.	-	-	-	-	-	-
		S.E. ±	0.34	0.19	0.20	0.032	0.012	0.016	-	-	-	-	-	-
		C.D. (P=0.05)	0.94	0.59	0.92	0.087	0.034	0.073	-	-	-	-	-	-

Table 2: Effect of conservation techniques on soil moisture content

Treatments	Soil moisture				Increase in moisture over T_5 (%)			
	15 cm	30 cm	45 cm	60 cm	15 cm	30 cm	45 cm	60 cm
Karanj (*Pongamia pinnata*)								
T_1	10.12	11.72	13.08	14.12	34.22	28.51	13.34	16.89
T_2	9.54	10.78	12.96	13.54	26.53	18.20	12.31	12.09
T_3	9.08	10.08	12.23	13.08	20.42	10.53	5.98	8.28
T_4	8.34	9.74	11.96	12.76	10.61	6.80	3.64	5.63
T_5	7.54	9.12	11.54	12.08	-	-	-	-
Sitaphal (*Annona squamosa*)								
T_1	10.17	11.23	13.23	14.08	33.12	22.46	14.94	16.94
T_2	9.74	10.54	12.98	13.23	27.49	14.94	12.77	9.88
T_3	9.12	10.08	12.23	12.97	19.37	9.92	6.26	7.72
T_4	8.42	9.54	11.96	12.48	10.21	4.03	3.91	3.65
T_5	7.64	9.17	11.51	12.04	-	-	-	-
Bel (*Aegle marmelos*)								
T_1	10.23	13.64	14.17	14.08	32.17	49.40	23.97	15.69
T_2	9.91	12.08	13.76	13.48	28.04	32.31	20.38	10.76
T_3	9.17	11.74	13.08	12.96	18.48	28.59	14.44	6.49
T_4	8.47	10.54	12.64	12.48	9.43	15.44	10.59	2.55
T_5	7.74	9.13	11.43	12.17	-	-	-	-

the vegetative parameters of custard apple in three year pooled analysis data except stem girth. Treatment of circular basin with 5 per cent slope and mulching with locally available materials produced maximum height (3.27 m) which was at par with treatment crescent bunding (3.14 cm).

Soil moisture :

The maximum soil moisture content up to the depth of 15-60 cm was observed 10.17 to 14.08 per cent in T_1 followed T_2 (9.74 to 13.23), T_3 (9.12 to 12.97), T_4 (8.42 to 12.48) and minimum in T_5 (7.64 to 12.04). The maximum increase in soil moisture content was observed 14.94 to 33.12 per cent as in T_1 followed by T_2 (9.88 to 27.49 %), T_3 (6.26 to 19.37 %), T_4 (3.65 to 10.21 %) over T_5 (Table 2).

Bel (Aegle marmelos) :

Growth :

The maximum pooled mean plant height was observed in T_1 (30.70 cm) followed by T_2 (27.83 cm), T_3 (25.58 cm), T_4 (23.75 cm) and minimum in T_5 (21.85 cm). Similarly the higher pooled collar diameter was observed in T_1 (2.49 cm) followed by T_2 (2.38 cm), T_3 (2.23 cm), T_4 (2.12 cm) and minimum in T_5 (2.00 cm). T_1 was found significantly superior to enhance the height and collar diameter followed by T_2, T_3 and T_4 over T_5. The maximum increase in plant height was observed in T_1 (39.61 %) followed by T_2 (26.54 %), T_3 (16.45 %), T_4 (8.38 %) over T_5. Similarly the higher increase in collar diameter was observed in T_1 (24.49 %), followed by T_2 (19.11 %), T_3 (11.66 %), T_4 (6.10 %) over T_5 (Table 1).

Soil moisture :

The maximum soil moisture content up to the depth of 15-60 cm was observed 10.23 to 14.17 per cent in T_1 followed T_2 (9.91 to 13.76 %), T_3 (9.17 to 13.08 %), T_4 (8.47 to 12.64 %) and minimum in T_5 (7.74 to 12.17 %). The maximum increase in soil moisture content was observed 15.69 to 49.40 per cent in T_1 followed by T_2 (10.76 to 32.31 %), T_3 (6.49 to 28.59 %), T_4 (2.55 to 15.44 %) over T_5 (Table 2).

Conclusion :

From the results it was concluded that half-moon terracing (T_1) and mulching with locally available grasses @ 10 kg/ plant (T_2) produced significantly increase in height, collar diameter and moisture content at different depths. Rain water conservation technique *viz.*, half-moon terracing and mulching resulted in better moisture retention and caused improvement in plant microclimate

resulting in better vegetative growth as compared to other treatments.

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