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Original Research Article

Effect of in-situ Moisture Conservation Practices on Soil Moisture Content of Rainfed Groundnut (*Arachis hypogaea*)

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Keywords

Kharif, Groundnut, Soil moisture content, Rainfed.

A B S T R A C T

India ranks among top three producers of groundnut in the world and stood 2nd in the world groundnut production scenario with an annual groundnut seed production of 5.9 million tonnes and annual groundnut oil production of 1.5 million tonnes. However, there has been a consistent fluctuation in the area and production over the years and across the states due to insufficient soil moisture. Hence, a field experiment was conducted during *kharif*, 2016-17 at Agricultural College Farm, Tirupati to study the effects of *in-situ* moisture conservation techniques on soil moisture content of rainfed groundnut *(Arachis hypogaea)*. Vertical tillage with subsoiler and deep ploughing effective in conserving the soil moisture content by providing better environment for rainfed groundnut.

Introduction

Groundnut is the principle vegetable oil crop in India and occupies the top slot in terms of area as well as production of total oilseeds in the country. However about 85 per cent area under groundnut remains rainfed of which nearly 80 per cent comes under dryland where irrigation facilities do not exist at all. By 2020 AD, the demand for oilseed in India will double and requirement of groundnut will reach at least 14 million tonnes only. To bridge this gap, the productivity of groundnut has to be enhanced at a rate of 2.2 percent per annum. This growth has to come mainly from the increase in productivity. The main constraint for groundnut development in dry regions is lack of suitable technology for soil and water management under varied rainfall conditions. In many areas, the total precipitation is sufficient for one and in some cases for two good crops per year. Rain dependent moisture conservation practices have been and may continue to be the mainstay of the future of groundnut agriculture in India. Not more than 20 per cent of the total groundnut area is expected to be under irrigation by 2020 AD, from the existing 17 per cent. Keeping in view, the importance of groundnut crop, which is predominantly grown during *kharif* season in Chittoor district of Andhra Pradesh, the present experiment was carried on the soil moisture content of rainfed groundnut (*Arachis hypogaea*) as influenced by different moisture conservation practices.

Materials and Methods

The field experiment was conducted in field No.138 of S.V. Agricultural College

Dryland Farm, Tirupati campus of Acharya N.G. Ranga Agricultural University, which is geographically situated at 13.5^0 N latitude and 79.5^0 E longitude, with an altitude of 182.9m above the mean sea level in the Southern Agro-Climatic Zone of Andhra Pradesh. According to Trolls classification, it is under Semi-Arid Tropics (SAT). The experimental soil was sandy loam, neutral in reaction (7.5), low in organic carbon (0.38 %) and available nitrogen (149.8 kg ha^{-1}), medium in available phosphorous (11.8 kg ha^{-1}) and available potassium (161.3 kg ha^{-1}). The experiment was laid out in randomized block design with eight soil moisture conservation treatments replicated thrice. The treatments consisted of conventional tillage (T_1), vertical tillage with subsoiler upto a depth of 60 cm at an interval of 1.0 m followed by secondary tillage (T_2), deep ploughing with mould board plough upto a depth of 40 cm followed by secondary tillage (T_3), conservation furrow after every row (T_4), conservation furrow after every four rows (T_5), broad bed and furrows (90/30 cm) (T_6), straw mulch @ 5 tonnes ha^{-1} (T_7) and soil mulch (frequent intercultivation) (T_8).

Soil moisture at 0 - 30 and 30 - 60 cm soil depth during period of crop growth was measured gravimetrically to assess the influence of these treatments on the growth and development of groundnut. Moisture sampling was done at 25 days interval for all the treatments. The soil moisture content was expressed as percentage.

Results and Discussion

Soil moisture at 0-30 cm soil depth

The soil moisture content (%) for the crop period upto 30 cm depth was estimated and presented in Table 1 and depicted in figure 1.

Soil moisture content at 25 DAS

The Soil moisture content at 25 DAS was the highest in vertical tillage with subsoiler (T_2) followed by deep ploughing (T_3) and broad bed and furrows (T_6).

The later treatment, straw mulch (T_7) also maintained consistently higher soil moisture content which was significantly superior to conservation furrow after every row (T_4), conservation furrow after every four rows (T_5) and soil mulch (T_8). In conventional tillage (T_1) the moisture status was low as compared to rest of the treatments.

Soil moisture content at 50 DAS

Moisture data indicated that among the different moisture conservation practices, vertical tillage with subsoiler (T_2) maintained higher soil moisture content which was however on par with deep ploughing (T_3), broad bed and furrows (T_6) and significantly superior to straw mulch (T_7). The treatment, conservation furrow after every row (T_4) recorded higher soil moisture content which was on par with conservation furrow after every four rows (T_5) which in turn was comparable with soil mulch (T_7). The soil moisture content was the least in conventional tillage (T_1).

Soil moisture content at 75 DAS

The data on soil moisture content at 75 DAS upto 0-30 cm depth indicated that the highest soil moisture content was recorded in vertical tillage with subsoiler (T_2) which was significantly superior to rest of the treatments. There was no significant difference between the treatments, conservation furrow after every four rows (T_5) and soil mulch (T_8). The lowest soil moisture content was registered with conventional tillage (T_1).

Soil moisture content at harvest

The Soil moisture content decreased as the crop reached the stage of harvest. However, vertical tillage with subsoiler (T_2) recorded significantly higher soil moisture content followed by deep ploughing (T_3). Broad bed and furrows (T_6) recorded higher soil moisture content which was however on par with straw mulch (T_7) and significantly superior to conservation furrow after every row (T_4), conservation furrow after every four rows (T_5) and soil mulch (T_7). Conventional tillage (T_1) recorded the least soil moisture content as compared to rest of the treatments

Soil moisture at 30-60 cm soil depth

The data on soil moisture content in 30-60 cm soil depth at different crop stages as influenced by *in-situ* moisture conservation practices are presented in Table 2 and depicted in figure 2.

Soil moisture content at 25 DAS

At 25 DAS, maximum soil moisture content was recorded under vertical tillage with subsoiler (T_2) which was however on par with deep ploughing (T_3) but superior to broad bed and furrows (T_6) and straw mulch (T_7). The treatment, conservation furrow after every row (T_4) was on par with conservation furrow after every four rows (T_5) which in turn was comparable with soil mulch (T_8) where as conventional tillage (T_1) recorded the least soil moisture content.

Soil moisture content at 50 DAS

Among the moisture conservation practices tested, the highest soil moisture content was in vertical tillage with subsoiler (T_2) which was similar to that in deep ploughing (T_3) and broad bed and furrows (T_6) and significantly superior to straw mulch (T_7), conservation furrow after every row (T_4), conservation furrow after every four rows (T_5). The soil moisture content was reduced and was found to be minimum with soil mulch (T_8) which was however on par with conventional tillage (T_1).

Soil moisture content at 75 DAS

The soil moisture content was the highest in vertical tillage with subsoiler (T_2) which was comparable with deep ploughing (T_3) and broad bed and furrows (T_6).

The treatment, straw mulch (T_7) recorded a soil moisture content of 13.2% and was found to be significantly superior to conservation furrow after every row (T_4), conservation furrow after every four rows (T_5), soil mulch (T_8) and conventional tillage (T_1).

Soil moisture content at harvest

Vertical tillage with subsoiler (T_2) recorded the highest soil moisture content but was on par with deep ploughing (T_3) and broad bed and furrows (T_6). This was followed by straw mulch (T_7), conservation furrow after every row (T_4), conservation furrow after every four rows (T_5) and soil mulch (T_7). The least moisture content was observed in conventional tillage (T_1).

Vertical tillage might have retained more moisture available to plants to put a better growth. Vertical tillage had favorable influence on soil moisture content which resulted in better growth of the plants.

The higher soil moisture content in vertical tillage might be due to favorable soil physical conditions which play an important role in root extension and absorption of moisture and nutrients.

Table.1 Soil moisture content (%) at 0 - 30 cm depth at different growth stages as influenced by different moisture conservation practices

Treatments	Soil moisture content (%)			
	25 DAS	**50 DAS**	**75 DAS**	**At harvest**
T_1: Conventional Tillage	10.9	6.1	8.3	6.0
T_2: Vertical tillage with subsoiler upto a depth of 60 cm at an interval of 1.0 m followed by secondary tillage	19.2	9.4	13.6	10.3
T_3: Deep ploughing with mouldboard plough upto a depth of 40 cm followed by secondary tillage	16.8	9.3	10.9	8.5
T_4: Conservation furrow after every row	13.6	8.0	9.2	7.7
T_5: Conservation furrow after every four rows	12.3	7.8	8.7	7.4
T_6: Broad bed and furrow (90/30 cm)	15.4	9.2	10.1	8.3
T_7: Straw mulch @ 5 tonnes ha^{-1}	14.9	8.4	9.6	8.2
T_8: Soil mulch (frequent intercultivation)	11.8	7.4	8.7	6.7
SEm±	0.38	0.21	0.26	0.20
CD (P=0.05)	1.1	0.6	0.7	0.6

Table.2 Soil moisture content (%) at 30 - 60 cm depth as influenced by different moisture conservation practices

Treatments	Soil moisture content (%)			
	25 DAS	**50 DAS**	**75 DAS**	**At harvest**
T_1: Conventional Tillage	9.1	6.5	10.6	7.3
T_2: Vertical tillage with subsoiler upto a depth of 60 cm at an interval of 1.0 m followed by secondary tillage	21.0	10.0	14.3	10.8
T_3: Deep ploughing with mouldboard plough upto a depth of 40 cm followed by secondary tillage	20.1	9.9	13.8	10.8
T_4: Conservation furrow after every row	12.3	7.7	12.5	8.6
T_5: Conservation furrow after every four rows	11.4	7.0	11.8	8.3
T_6: Broad bed and furrow (90/30 cm)	14.7	9.6	13.8	10.4
T_7: Straw mulch @ 5 tonnes ha^{-1}	14.2	8.8	13.2	9.1
T_8: Soil mulch (frequent intercultivation)	11.0	6.2	11.5	8.1
SEm±	0.41	0.22	0.32	0.23
CD (P=0.05)	1.2	0.6	0.9	0.6

Fig.1 Graphical representation of soil moisture content (%) at 0-30 cm depth as influenced by different moisture conservation practices

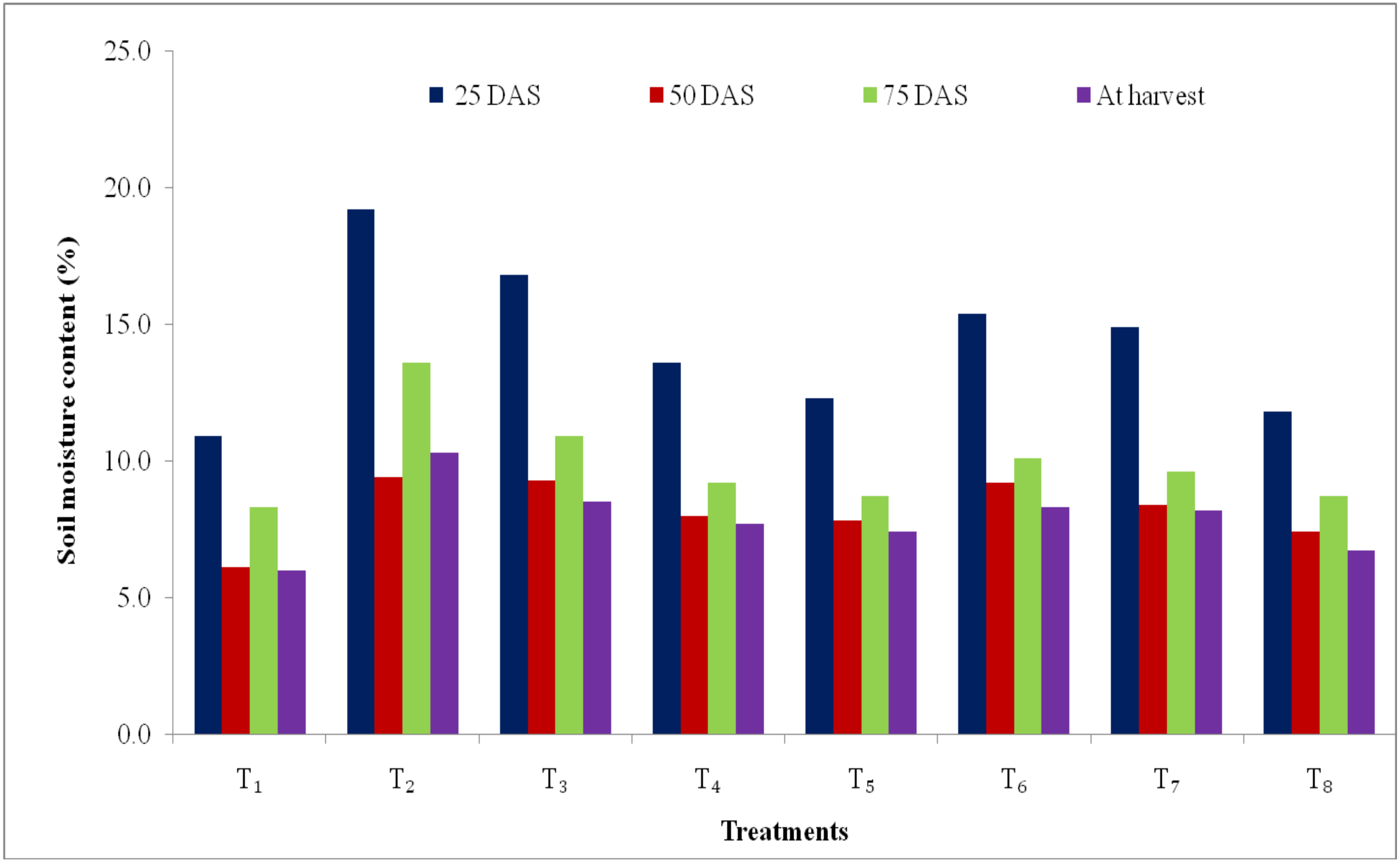
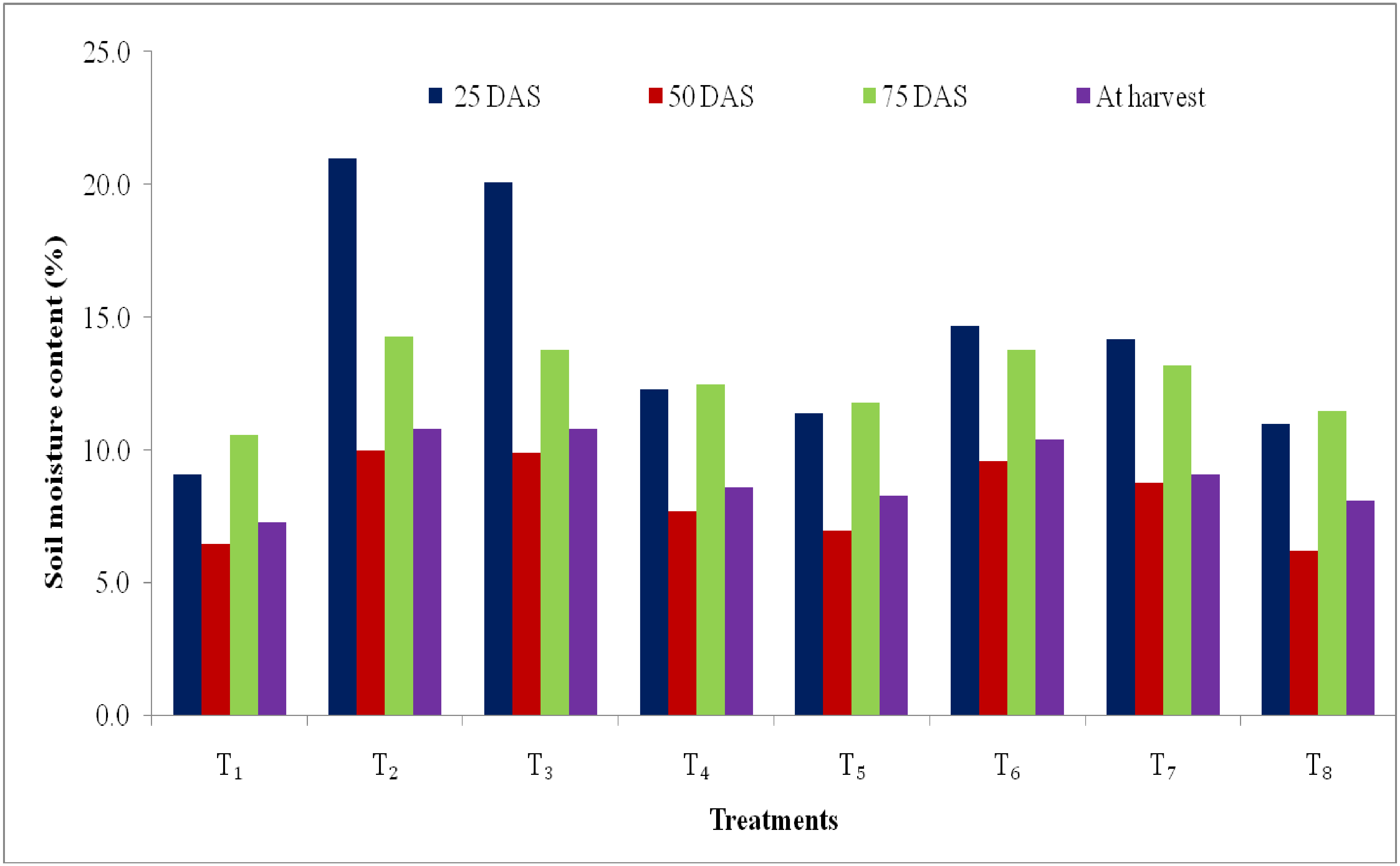


Fig.2 Graphical representation of soil moisture content (%) at 30-60 cm depth as influenced by different moisture conservation practices



Conservation furrows after every row (T_4) and every four rows (T_5) may be effective on Vertisols with low infiltration rate and high moisture retentive capacity. Soil mulch also did not yield better in conserving soil moisture in alfisols. This was due to the fact that there was no difference in moisture conservation treatment between conventional tillage and soil mulch except that soil mulch was done during 20 days interval. Hence there was no appreciable difference in soil moisture content due to these 2 treatments. In view of the above drawbacks with conservation furrows, soil mulch and conventional tillage methods, vertical tillage with subsoiler, deep ploughing and broad bed and furrow methods of moisture conservation resulted in high soil moisture content all through the crop periods.

Mathukia *et al.,* 2015 reported that deep tillage was found efficient in moisture conservation by recording significantly the highest soil moisture content at 60 DAS in pigeonpea, followed by the row subsoiling. Similar findings with soil mulch were reported by Reddy (1986).

Devi *et al.,* (1991) concluded from an experiment conducted during *kharif* season in shallow red soils at Hyderabad that higher soil moisture content was obtained with broad bed and furrows during the entire crop growth period of castor which was however closely followed by dead furrows.

Mulching with groundnut shells in black soils recorded higher percentage of soil moisture as compared to straw mulch, shallow furrowing, stubble mulch and no mulch (Subbaiah *et al.,* 1979).

From the results, it is evident that broad bed and furrows, vertical tillage and deep ploughing methods of moisture conservation practices are effective for conserving rain water leading to higher productivity of rainfed groundnut on sandy-loam soil.

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