

Effect of Different Rainwater Management Practices on Growth Attributes and Yield of Dryland Groundnut

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ABSTRACT

A field experiment was conducted during two consecutive kharif seasons of 2017 and 2018 at Agricultural Research Station, Ananthapuramu of Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The experiment was laid out in a randomized block design with three replications. There were 9 treatments consisting of dryland groundnut (Without in-situ and ex-situ rainwater management), Formation of conservation furrows at every 1.2 m width at sowing, T₂ + one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50 % flowering, T₂ + two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering, Shales (Beluku in Telugu) application @ 300 t ha⁻¹ as surface mulch (first year application only), T₅ + one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50% flowering, T₅+ two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering, only one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50% flowering and two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering. Significantly higher plant height, leaf area index at all growth stages and pod and haulm yield were recorded with application of shales shales @300 t/ha combined with two supplemental irrigations of 10 mm each when dry spell of 10 days occurs after 50% flowering (T₇), which was statistically comparable with application of shales @300 t/ha combined with one supplemental irrigation of 10 mm each when dry spell of 10 days occurs (T₆) during both years of study. Where as, lower plant height, leaf area index, pod and haulm yield were recorded with dryland groundnut (without in-situ and ex-situ rainwater management) (T₁).

Keywords: Groundnut, Rainwater management, Growth parameters, Yield.

INTRODUCTION

In India, drylands receive a mean annual rainfall of less than 750 mm. Low rainfall in drylands makes the crop production dependent entirely on the onset, quantity, frequency and

distribution of rainfall. Rainwater and soil losses in drylands are also more due to run-off and erosion, respectively because of the favourable physical and chemical properties of soils.

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Moisture stress is a recurring chronic problem, which has a sizeable proportion of area falling in arid and semi-arid tropics (Sunitha et al., 2015). Groundnut is an one of the important oilseed cash crop in India. Andhra Pradesh is second largest state in the country in cultivating groundnut. Among different production constraints in drylands, moisture stress is one of the most important factors, which can limit the productivity of groundnut. Efficient management of dryspells with appropriate rainwater management practices is desired for groundnut under rainfed agriculture. Surface mulches are used to reduce run-off, increase infiltration, improves water holding capacity improve soil structure and lead to increase the yield. Shales (locally called *beluku*) is used as surface mulches in some parts of Ananthapuramu and YSR Kadapa districts of Andhra Pradesh, to conserve the rainwater effectively in dryland areas. Expanded shale functioned as an effective slow-release source of fertilizer and acted as a water reservoir in soil (Sloan et al., 2011). The conservation furrow is a simple and low cost *in situ* rainwater conservation practice adopted in *alfisols*. These furrows harvest the local runoff water and improve soil moisture in the adjoining crop rows, particularly during the period of water stress. In the semi-arid regions of South India, nearly 10 to 40 per cent of rainfall goes as runoff from the fields depending on the land slope. Of this runoff, nearly 10 per cent can be harvested and recycled as protective irrigation, especially during drought years through farm ponds (Venkateswarlu et al., 2016). Recycling of farm pond water reduces moisture stress especially in groundnut at moisture sensitive stages stabilizes crop yields during drought years. Keeping in view, the present experiment was conducted to find out the best rainwater management practices for dryland groundnut cultivation during *kharif* on red sandy loam soils.

MATERIALS AND METHODS

A field experiment was conducted at Agricultural Research Station, Ananthapuramu of Acharya N.G. Ranga Agricultural University,

Andhra Pradesh, which is geographically situated in between 14° 41' 104" N latitudes and 77° 40' 281" E longitudes and at an altitude of 350 m. above mean sea level, which falls under Semi-Arid tropics (SAT) according to Trolls classification and comes under the Scarce Rainfall Zone of Andhra Pradesh. The soil was red sandy loam in texture, near neutral in reaction, low in organic carbon and available nitrogen and medium in available phosphorus and potassium prior to start of the experiment. The experiment consists of 9 treatments laid out in a randomized block design with three replications. The treatments were: Dryland groundnut (without *in-situ* and *ex-situ* rainwater management) (T₁), formation of conservation furrows at every 1.2 m width at sowing(T₂), T₂ + one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50 % flowering (T₃), T₂ + two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering (T₄), Shales (*Beluku* in Telugu) application @ 300 t ha⁻¹ as surface mulch (first year application only) (T₅), T₅ + one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50% flowering (T₆), T₅+ two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering (T₇), only one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50% flowering(T₈) and two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering (T₉). The groundnut crop of variety '*Dharani*' was sown on 22nd June during *kharif*, 2017 and on 30th July during *kharif*, 2018. The experimental field ploughed twice with a tractor drawn cultivator. Shales (*Beluku*) was applied as surface mulch @ 300t/ha to the respective treatments *viz.*, T₅, T₆ and T₇. Similarly, conservation furrows were formed at sowing time itself with an innovative technique of attaching shovels to the seed covering blade in the treatments of T₂, T₃, T₄. Supplemental irrigation was given with harvested rainwater from farm pond to the concerned treatments *i.e.*, T₃, T₄, T₆, T₇, T₈, T₉. All the agronomic management practices were followed as per

the university recommendations for raising the crop. Soil physico-chemical parameters were recorded before sowing and at harvest of groundnut crop. The rainfall received during crop growing period was 537.2 mm within 34.0 rainy days during *kharif*, 2017 and 226 mm within 11 rainy days during *kharif*, 2018. Five plants were randomly selected per plot for determination of growth parameters. The growth parameters assessed included plant height (cm) and leaf area index (LAI). At harvest, pods and haulm were harvested and weighed separately. The data collected for all the parameters were subjected to statistical scrutiny by the method of analysis of variance for randomized block design. Statistical significance was tested with 'F' test at 5 per cent level of probability and compared the treatmental means with critical difference.

RESULTS AND DISCUSSION

Plant height

Among the various rainwater management practices tried, the highest plant height of groundnut was produced with application of shales combined with two supplemental irrigations of 10 mm each when dry spell of 10 days occurs after 50% flowering (T_7), however, which was statistically comparable with application of shales@300 t/ha combined with one supplemental irrigation of 10 mm each when dry spell of 10 days occurs (T_6) at 30, 60, 90 DAS and at harvest during both the years of experimentation (Table-1). Plant height was increased with combination of surface mulch and supplemental irrigation was mainly attributed to increased cell division due to better availability of conserved soil moisture in soil profile and reduction of evaporation leading to higher soil moisture availability for long time in the root zone. These results were in accordance with the findings of Kumar et al. (2018) and Singh et al. (2019). Lower plant height in dryland groundnut plants might be due to moisture stress decreases rapid cell division, elongation and reduces internodal length due to low turgor lead to reduction in main axis and cotyledonary branches are shorter which might have ultimately lead to

the reduction in plant height. These results were in corroborated with the findings of Reddy et al. (2003).

Leaf Area Index

The leaf area index of groundnut gradually increased with increase in age of the crop up to 90 DAS and then declined towards harvest, due to senescence of older leaves (Table-2).

Significantly higher LAI was obtained with application of shales combined with two supplemental irrigations of 10 mm each when dry spell of 10 days occurs after 50% flowering (T_7), which was on par with application of shales combined with one supplemental irrigation of 10 mm each when dry spell of 10 days occurs (T_6) at 30, 60, 90 DAS and at harvest during both the years of investigation. Higher leaf area index recorded with integrated rainwater management treatment at all growth stages of groundnut might be due to sufficient soil moisture availability in root zone, which helps to maintenance of higher tissue water status by the plant due to congenial soil conditions that resulted in more extraction of moisture from the soil. Lower leaf area index was recorded with dryland groundnut might be due to, drought stress reduced leaf area index mainly due to reduction in leaf size, leaf expansion, closure of stomata, low turgor status and increase the canopy temperature. These results were in conformity with the findings of Ashkani et al. (2007).

Pod Yield (kg ha^{-1})

Among the different rainwater management practices tried, higher pod yield of groundnut was registered with application of shales combined with two supplemental irrigations of 10 mm each when dry spell of 10 days occurs after 50% flowering (T_7), which was at par with application of shales combined with one supplemental irrigation of 10 mm when dry spell of 10 days occurs (T_6) and significantly superior to rest of the treatments during both the years of investigation (Table-3). Surface mulch with shales recorded higher yield, it was attributed to reduced soil compaction, adequate moisture availability supply, which contributed to better root development and

large nutrient content in soil-shale mixture. Similar results were reported in alfalfa by Kempe and Rivard (1987) and Sankar et al. (2018) in soil mulch. Supplemental irrigation gave a significantly higher pod and haulm yield as compared to rainfed groundnut. These results were in agreement with the findings of Reddy et al. (2013) and Reddy and Sulochanamma, (2008). Lower pod yield was observed with dryland groundnut (Without in-situ and ex- situ rainwater) (T₁) might be due to, the shallow roots, poor root proliferation, lack of soil moisture in soil profile at different phenophases of groundnut resulting in lower moisture and nutrient uptake and a more rapid depletion of moisture in the rooting zone. These results were in agreement with the findings of Pervin et al. (2014).

Haulm Yield (kg ha⁻¹)

Among the different rainwater management practices tried, higher haulm yield of groundnut was recorded with application of shales combined with two supplemental irrigations of 10 mm each when dry spell of 10 days occurs after 50% flowering (T₇), which was on par with application of shales combined with one supplemental irrigation of 10 mm when dry spell of 10 days occurs (T₆) during 2017, 2018. Lower haulm yield was observed with dryland groundnut (Without *in-situ* and *ex-situ* rainwater) (T₁) might be due to deficit soil moisture in root zone at key developmental stages resulting heavy reduction in leaf area and dry matter in groundnut. These results were in agreement with the findings of Sunitha et al. (2015).

Table 1: Plant height (cm) of groundnut at different growth stages as influenced by rainwater management practices during *kharif*, 2017 and 2018

Treatments	30 DAS		60 DAS		90 DAS		Harvest	
	2017	2018	2017	2018	2017	2018	2017	2018
T ₁	12.0	10.9	21.1	19.4	30.0	25.2	42.0	29.8
T ₂	12.6	12.4	22.0	21.1	31.2	25.6	44.4	31.6
T ₃	12.3	12.3	23.1	22.2	33.3	28.6	46.2	33.3
T ₄	12.8	12.4	23.7	22.7	34.2	29.3	47.7	34.3
T ₅	14.3	13.5	24.4	23.8	34.7	30.2	48.1	35.5
T ₆	14.4	13.4	25.1	24.7	35.0	30.5	49.2	36.6
T ₇	14.6	13.8	26.0	25.7	36.1	32.0	49.8	37.0
T ₈	12.1	11.2	22.9	21.7	32.7	28.0	46.0	32.9
T ₉	12.2	11.0	23.5	22.4	34.1	28.9	46.5	34.0
SEm±	0.30	0.26	0.51	0.61	0.80	0.68	0.94	0.76
CD(P=0.05)	0.9	0.8	1.5	1.8	2.4	2.0	2.8	2.3

Table 2: Leaf area index of groundnut at different growth stages as influenced by rainwater management practices during *kharif*, 2017 and 2018

Treatments	30 DAS		60 DAS		90 DAS		Harvest	
	2017	2018	2017	2018	2017	2018	2017	2018
T ₁	0.33	0.49	1.50	1.52	3.30	2.18	3.06	2.06
T ₂	0.41	0.60	1.71	1.65	3.37	2.25	3.19	2.14
T ₃	0.40	0.62	2.02	1.87	3.55	2.42	3.29	2.27
T ₄	0.43	0.61	2.14	2.20	3.64	2.76	3.40	2.58
T ₅	0.49	0.75	2.17	2.15	3.78	2.75	3.56	2.61
T ₆	0.47	0.79	2.29	2.55	3.84	2.95	3.62	2.82
T ₇	0.50	0.77	2.34	2.60	3.90	3.03	3.68	2.90
T ₈	0.38	0.52	1.83	1.93	3.47	2.32	3.24	2.23
T ₉	0.38	0.51	1.97	1.98	3.58	2.51	3.35	2.39
SEm±	0.021	0.023	0.060	0.079	0.086	0.066	0.074	0.059
CD(P=0.05)	0.06	0.07	0.18	0.24	0.26	0.20	0.22	0.19

Table 3: Pod and haulm yield (kg ha⁻¹) of groundnut as influenced by rainwater management practices during kharif, 2017 and 2018

Treatments	Pod yield (kg ha ⁻¹)		Haulm yield (kg ha ⁻¹)	
	2017	2018	2017	2018
T1	1635	782	3503	2306
T2	1694	846	3750	2553
T3	1839	939	4015	2707
T4	1909	1001	4325	2774
T5	1989	1013	4459	2812
T6	2054	1065	4514	2917
T7	2238	1120	4603	3072
T8	1704	905	3810	2639
T9	1865	970	4112	2665
SEm±	63.1	29.9	120.1	76.7
CD(P=0.05)	189	90	360	230

CONCLUSION

The present investigation revealed that higher pod and haulm yield of groundnut was recorded with application of shales combined with two supplemental irrigations of 10 mm each when dry spell of 10 days occurs after 50% flowering (T₇), which was on par with application of shales combined with one supplemental irrigation of 10 mm when dry spell of 10 days occurs (T₆) on red sandy loam soils of Scarce Rainfall Zone of Andhra Pradesh.

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