Research Note

Andhra Pradesh J Agril. Sci : 7(2): 188-192, 2021

EFFECT OF RAINWATER MANAGEMENT PRACTICES ON SOIL PHYSICO-CHEMICAL PROPERTIES IN DRYLAND GROUNDNUT (*Arachis hypogaea* L.)

A. MALLISWARA REDDY*, A. PRATAP KUMAR REDDY, B. RAVINDRANATHA REDDY, M.V.S. NAIDU, P. SUDHAKAR AND B. SAHADEVA REDDY

Agricultural Research Station, ANGRAU, Ananthapuramu-515 001.

Date of Receipt: 28-12-2020 Date of Acceptance: 01-07-2021

Two thirds of India's agricultural land is vulnerable to moisture stress of various intensities and the probability of occurrence of a moisture stress is over 35 per cent (Bhandari *et al*., 2017). In India, 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). The rainfall in dryland areas is not only scanty but also highly erratic and ill distributed. Due to erratic rainfall coupled with prolonged dryspells during crop growth period, crop yields are generally low and unstable under rainfed conditions. Inadequate implementation of moisture conservation practices is a major constraint in agricultural production. Hence, the adoption of improved conservation practices is need to be sustained. Rainfed areas can be made productive and profitable by adopting improved technologies for rainwater conservation. In the semi-arid tropics 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 sub normal rainfall or drought years through farm ponds (Venkateswarlu *et al.,* 2016).

Groundnut is an important leguminous oilseed crop in dryland tracts of scarce rainfall zone of Andhra Pradesh. In India, Andhra Pradesh is the second largest state in cultivating rainfed groundnut with an area of 5.68 lakh hectares with production of 6.22 lakh tonnes and productivity of 1095 kg ha^{-1} (DES, 2019). Due to erratic rainfall coupled with prolonged dryspells during critical phenophases of groundnut lead to reduced and unstable yields under rainfed conditions. Rainfall is the most significant climatic variable affecting groundnut production, because 70 per cent of the groundnut area is under semi-arid tropical conditions, which are characterized by low and erratic rainfall. Adequate moisture is essential during key developmental stages of groundnut crop like flowering and pod filling and even short periods of moisture stress during these stages can cause significant loss in yield of groundnut crop (Shinde *et al*., 2010). Efficient management of dryspells with a suitable rainwater management practice is desired for increasing productivity in groundnut under dryland agriculture. The conservation furrow is a simple and low (or) no cost *in situ* rain water conservation practice adopted in *alfisols* in rainfed areas with moderate slope varying from 1 to 4 per cent. Supplemental irrigation in rainfed agriculture through rainwater harvesting not only reduces the risk of total crop failure due to dryspells, but also substantially improves the crop and water productivity (Biazin *et al*., 2011).

Mulching is the process of covering the cultivated field with unused, inorganic material, sand, pebbles and soil with a little additional investment. Surface mulches are used to prevent soil from blowing and beating action of rainfall, reduce run-off, increase infiltration, improves water holding capacity, reduce evaporation, keep down weeds, improve soil structure and thereby increase the yield. Shales is a category of sedimentary rock known for its role as a source rock for most of the petroleum basins. Shales are used as surface mulch in parts of Ananthapuramu and YSR Kadapa districts of Andhra Pradesh, to conserve the sporadic and limited rainfall received in dryland areas for soil moisture conservation and reliable crop production. The locally available shales in these districts are called as *Beluku*, which is fine grained, laminated or fissile clastic sedimentary rocks with predominance of clay and silt as the detrital components. In recent years, shales are used as mulch to conserve the rainwater and to maximize the crop productivity in rainfed

*Corresponding author, E-mail: malliagronomy@gmil.com

groundnut directly by addressing temporal discontinuity between the availability of rainfall and crop water demand. Shale mulch serves as a surface barrier to reduce evaporation and thereby conserve soil moisture. Shale mulched treatments increased the infiltration, reduced the impact of raindrop on soil and increased the opportunity time for entry of water in to the soil profile. Expanded shale is believed to be beneficial to modify the soil properties by enhancing overall aeration, improving water and nutrient holding and releasing capacities, respectively and thereby promoting the optimum plant growth (Dunnett and Kingsbury, 2008). Zeolite increased the soil pH and exchangeable potassium (Filcheva and Tsadilas, 2002). Application of tank silt (an indigenous natural resource) to the soil improved clay content in the plough layer resulting in improvement of the available soil water content, organic carbon content and available P_2O_5 and K_2O (Bhanavase *et al.*, 2011). Keeping these points in view, present investigation was conducted to study the physico-chemical properties due to different rainwater management practices.

The field experiment was conducted during *kharif*, 2017 and 2018 at dryland farm of Agricultural Research Station, Ananthapuramu of Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The present experiment consists of nine treatments each replicated thrice in a randomized block design. The treatments include T_1 : Dryland groundnut (without *in-situ* and *ex-situ* rainwater management), T_2 : Formation of conservation furrows at every 1.2 m width at sowing , T_3 : T_2 + one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50% flowering , T_4 : T_2 + two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50 % flowering , T_5 : Shales (*Beluku* in Telugu) application 300 t ha^{-1} as surface mulch (first year application only), T_6 : T_5 + one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50% flowering , T_7 : T_5 + two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering , T_8 : Only one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50% flowering and T_9 : Two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering. Groundnut variety, *Dharani* was used in the present study. As per treatments, shales 300 t ha^{-1} was applied during first year of experimentation (*kharif*, 2017) only as its efficiency as a mulch on the surface of soil will continue up to five years. The manually operated rainout shelters are used for imposing drought stress in respective treatments. Conservation furrows were formed at the time of sowing. Supplemental irrigation was given from harvested rainwater stored in the farm pond, which is nearer to experimental field. A composite soil sample was collected at random from 0-30 cm soil depth and analysed for physico-chemical properties, before sowing and after harvest of the crop in field experiment. The soil was red sandy loam in texture, near neutral in reaction (6.02), low in organic carbon (0.37 %) and available nitrogen (138 kg ha^{-1}), medium in available phosphorus (52 kg ha^{-1}) and potassium (202 kg ha^{-1}), prior to start of the experiment during 2017. The pH of the soil was determined in 1 : 2 soil-water suspension using pH meter with a glass electrode as described by Jackson (1973). The electrical conductivity (EC) of the soil was determined by conductometry method as described by Jackson (1973) and expressed in dSm^{-1}. The organic carbon content of the soil was determined by wet digestion method (Walkley and Black, 1934) and expressed in per centage. The data was analysed statistically for test of significance following the Fishers method of analysis of variance as outlined by Gomez and Gomez (1984).

The data on soil pH after harvest of the groundnut crop as influenced by different rainwater management practices during 2017 and 2018 is presented in Table 1. During 2017, different rainwater management practices did not differ the soil pH values significantly but slightly higher soil pH was registered with shale amended treatments (T_7, T_6 and T_5). Soil pH ranged from 6.02 to 6.45 in different tested treatments. The higher soil pH value was recorded with application of shales 300 t ha^{-1} combined with two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50 % flowering (T_7) and lower soil pH value was recorded with dryland groundnut (T_1) during 2017. During 2018, Soil pH values are slightly higher compared to 2017 in different rainwater management practices. Soil pH values ranged from 6.03 to 6.47 during 2018 in different treatments. The higher soil pH value (6.47) was recorded with application of shales 300 t ha^{-1} combined with two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50 % flowering (T_7) and lower soil pH value (6.03) was recorded with dryland groundnut (T_1), but there is no significant difference among different rainwater management practices during 2018. Higher soil pH values were registered with shale amended treatments during both the years of study might be due to shales acted as

Table 1. Post-harvest soil pH, soil electrical conductivity (dS m^{-1}) and soil organic carbon (%) of groundnut as influenced by rainwater management practices during *kharif*, 2017 and 2018

Treatments	Soil pH		Soil EC (d S m^{-1})		Soil organic carbon (%)	
	2017	2018	2017	2018	2017	2018
T_1 : Dryland groundnut (Without in-situ and ex-situ rainwater management)	6.02	6.03	0.14	0.13	0.37	0.37
T_2 : Formation of conservation furrows at every 1.2 m width at sowing	6.14	6.17	0.18	0.17	0.37	0.37
T_3 : T_2 + one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50% flowering	6.17	6.19	0.16	0.14	0.37	0.38
T_4 : T_2 + two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering	6.26	6.32	0.18	0.16	0.38	0.39
T_5 : Shales (*Beluku* in Telugu) application @ 300 t ha^{-1} as surface mulch (first year application only)	6.37	6.40	0.21	0.17	0.38	0.39
T_6 : T_5 + one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50% flowering	6.40	6.42	0.20	0.16	0.39	0.40
T_7 : T_5 + two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering	6.45	6.47	0.20	0.18	0.39	0.40
T_8 : Only one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50% flowering	6.19	6.21	0.17	0.15	0.37	0.37
T_9 : Two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering	6.23	6.27	0.19	0.17	0.37	0.38
SEm±	0.219	0.139	0.015	0.014	0.019	0.021
CD(P=0.05)	NS	NS	NS	NS	NS	NS
Initial value	6.02		0.14		0.37	

buffering agent to stabilize the soil pH. Similar results reported earlier with zeolite amended soil by Filcheva and Tsadilas (2002).

The data on electrical conductivity after harvest of the groundnut crop as influenced by different rainwater management practices during 2017 and 2018 is presented in Table 1. During 2017, different rainwater management practices did not differ the electrical conductivity values significantly. During 2017, EC values ranged from 0.14 dSm^{-1} to 0.21 dSm^{-1}, where as in 2018, EC values ranged from 0.13 dSm^{-1} to 0.18 dSm^{-1} in different rainwater management practices. During both the years of experimentation, slightly higher soil electrical conductivity was recorded with application of shales 300 t ha^{-1} combined with two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50 % flowering (T_7) followed by shales application 300 t ha^{-1} as surface mulch (T_5). This might be due to increased soil moisture in the soil profile, which might have increased the solubility of salts and there by increased the electrical conductivity in shale applied treatments. The rest of the rainwater management practices like formation of conservation furrows and supplemental irrigation did not influence the soil physico-chemical properties. Similar results were also reported by Simsek *et al*. (2017).

Organic carbon of soil was found to be non-significant due to various rainwater management practices statistically during both the years of experimental study (Table 1). During 2017, soil organic carbon values ranged from 0.37 to 0.39 per cent, whereas, in 2018, soil organic carbon values ranged from 0.37 to 0.40 per cent in different rainwater management practices. Slightly higher soil organic carbon was recorded with application of shales 300 t ha^{-1} combined with two supplemental irrigations of 10 mm each when dryspell of 10 days occurs after 50% flowering (T_7) followed by application of shales 300 t ha^{-1} combined with one supplemental irrigation of 10 mm when dryspell of 10 days occurs after 50% flowering (T_6) and shales application 300 t ha^{-1} as surface mulch (T_5) during both the years of study. This might be due to improved soil physical environment particularly water holding capacity, which in turn increased the soil biota led to enhanced decomposition of organic material rapidly and thereby increased the soil organic carbon. Bhanavase *et al*. (2011) also reported that application of tank silt significantly improved the soil organic carbon in the plough layer apart from increased clay content. Dryland groundnut (T_1) cultivation recorded lower soil organic carbon due to poor water holding capacity, which resulted in decreased soil microbial load and thereby reduced the soil organic carbon in the soil.

LITERATURE CITED

Bhanavase, D.B., Thorve, S.B., Upadhye, S.K., Kadam, J.R and Osman, M. 2011. Effect of tank silt application on productivity of rabi sorghum and soil physico-chemical properties. *Indian Journal of Dryland Agricultural Research and Development*. 26(2): 82-85.

Bhandari, H., Pandey, S., Sharan, R., Naik, D., Hirway, I., Taunk, S.K and Sastri, A.S.R.A.S. 2017. Economic costs of drought and rice farmers' drought-coping mechanisms in eastern India. *In: Pandey, S., Bhandari, H., Hardy, B (Eds). Economic Costs of Drought and Rice Farmers' Coping Mechanisms: A Cross-country Comparative Analysis*: 43-112.

Biazin, B., Sterk, G., Temesgen, M., Abdulkedir, A and Stroonsnijder, L. 2011. Rainwater harvesting and management in rainfed agricultural systems in sub-saharan Africa- A review. *Physics and Chemistry of the Earth*. 47-48: 139-150.

DES, 2019. *Directorate of Economics and Statistics*. Planning Department, Andhra Pradesh.

Dunnett, N and Kingsbury, N. 2008. *Planting green roofs and living walls*. Timber Press Inc. Portland, O.R. 112.

Filcheva, E. G and Tsadilas, C. D. 2002. Influence of clinoptilolite and compost on soil properties. *Communications in Soil Science and Plant Analysis*. 33 (3-4) : 595-607.

Gomez, K.A and Gomez, A.A. 1984. *Statistical Procedures for Agricultural Research*. International Rice Research Institute, Manila, Philippines.

Jackson, M.L. 1973. *Soil Chemical Analysis*. Prentice-Hall of India Pvt. Ltd., New Delhi. 134-204.

Shinde, B.M., Limaye, A.S., Deore, G.B and Laware, S.L. 2010. Physiological responses of groundnut (*Arachis hypogaea L.*) varieties to drought stress. *Asian Journal of Experimental Biological Science. Special issue*: 65-68.

Simsek, U., Erdel, E and Barik, K. 2017. Effect of mulching on soil moisture and some soil characteristics. *Fresenius Environmental Bulletin*. 26(12): 7437-7443.

Sunitha, V., Vanaja, M., Sowmya, P., Razak, S.K.A., Kumar, G.V., Anitha, Y and Lakshmi, N.J. 2015. Variability in response of groundnut (*Arachis hypogaea* L.) genotypes to moisture stress and stress release. *International Journal of Bio-resource and Stress Management*. 6(2): 240-249.

Venkateswarlu, B., Chary, G.R., Singh, G and Shivay, Y.S. 2016. *Climate Resilient Agronomy.* The Indian Society of Agronomy, New Delhi. 120-142.

Walkley, A and Black, C.A. 1934. Estimation of organic carbon by chromic acid titration method. *Indian Journal of Soil Science*: 37(1): 29-34.