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Effect of rainfall on soil moisture content in pearl millet crop

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Abstract
In the pearl millet crop, soil moisture observation was taken by gravimetric method at 3 days interval. Soil samples were collected using a soil auger from the plot. Weight of the sample was measured by weighing machine before placing in oven for 24 hrs. at 105 °C. Annual normal rainfall of Anand is 860 mm of which 90 percent is received during June to September period in southwest monsoon. Monsoon prevails from 3rd week of June to the 2nd week of the September at Anand. The soil of experimental plot is representative of the region and is popularly known as *Goradu* soil. It is of alluvial origin and the texture of the soil is sandy loam. The field had a good drainage as well as fair moisture retentive capacity. During the course of investigation, soil moisture ranged between 13.6% to 18.5%. Soil moisture variation in observations with time is markedly high after rainfall. High soil moisture values (>18.5%) indicates less time between irrigation applied or rainfall.

Keywords: Soil moisture, gravitational method, rainfall

Introduction
The composition of the soil affects microclimates primarily through how much water it retains or evaporates from it. A soil that has a large ratio of clay retains more moisture than one that is mainly sand. The degree to which a soil retains moisture affects the humidity and temperature of the air above. After heavy rains, the soil can contain a lot of water and modify microclimates of plant. Also, the mineral composition of the soil, the degree of coverage. It affects temperature and moisture evaporation. Bare soils reflect more heat and light than those covered by plants or mulch. Soil in minimum tillage practice stored soil water more efficiently than conventional tillage practice. The plant growth is directly affected by deficit of water in plant and indirectly by soil water deficit and atmospheric stress (Shivakumar and shows, 1978) [17]. The optimum rainfall requirement of pearl millet ranges between 35 cm to 50 cm. But pearl millet can be grown in areas, which receive less than 35 cm of annual rainfall. Prolonged spells of warm, rainless weather may be detrimental and may lead to reduced crop yields. At harvest time, dry warm weather is most suitable. Although pearl millet can respond to good moisture supplies during its growth, it is nevertheless one of the toughest, drought tolerant crops available.

Method and Materials
The present investigation was carried out during 2018 in kharif season at the Agronomy Farm of B.A. College of Agriculture, Anand Agricultural University, Anand. Anand is located at 22° 35' N latitude and 72°55' E longitudes and at 45.1 m above the mean sea level. The experimental research farm falls under middle Gujarat Agro-climatic zone-III. The climate of this zone has been classified as semi-arid tropical. Annual normal rainfall of Anand is 860 mm of which 90 percent is received during June to September period in southwest monsoon. Monsoon prevails from 3rd week of June to the 2nd week of the September at Anand. The weather remains dry during October to May. Summer is hot and sometimes mercury crosses 45.5 ˚C in the month of May while winter is cool and dry and temperature drops up to 5.0 ˚C during January. On an average minimum temperature in winter months is about 11.0 ˚C. Pearl millet cultivar GHB-732 was selected as it is recommended for *kharif* and summer cultivation in Gujarat by Main Millet Research Station, Jamnagar.

Table 1: Soil properties

Particulars	Values
A. Physical properties (International pipette method, Piper, 1966)	
Sand (%)	47.4
Silt (%)	32.6
Clay (%)	19.6
B.Soil physical constants	
Soil moisture	**Value (%)**
Field capacity (Actual field method, Dastane, 1972)	18.0
Permanent wilting point (Sunflower method, Dastane, 1972)	5.0
Bulk density (g cm^{-3})	1.5
Maximum water holding capacity	33.0

(**Source:** Lunagaria, 2014)

Experimental field was prepared by removing the stubbles of the previous crop and was subsequently ploughed with tractor drawn mouldboard plough followed by breaking of clods by a cultivator. The layout of the experimental field was in accordance with the RBD design. The experimental research farm falls under middle Gujarat Agro-climatic zone-III. The plots were levelled using hand drawn plank after the laid out spacing marker at 30 cm and 45 cm for rows. On these rows planting marked using 10 and 15 cm marker. Sowing was done at a depth of about 5 cm by dibbling method. The crop was harvested at maturity. Harvesting was done with help of sickles. Initially all border rows from each gross plot were harvested separately and thereafter remaining plots were harvested as net plot. The crop harvested from each net plot was sundried and weighed separately. After threshing seed were cleaned in the open field by winnowing. Followed by seed drying under sunlight for two to three days to obtain uniform and constant moisture level. The dry sample was reweighted to calculate the soil moisture content by following equation:

$$\text{Soil moisture (\%)} = \frac{\text{Weight of moist soil-Weight of dry soil}}{\text{Weight of dry soil}} \times 100$$

Results

Soil water status monitoring is essential for evaluating soil water dynamics for scheduling irrigation events and for supporting optimum plant growth and yields. Soil moisture and its availability to support plant growth is a primary factor in farm productivity. Too little moisture can result in yield loss and plant death. Too much causes root disease and waste of water. In Figure 1 seasonal soil moisture content in pearl millet field is presented. It indicates variation of soil moisture as affected by evapotranspiration loss condition and irrigation. During the course of investigation soil moisture ranged from 13.6% to 18.5%. Soil moisture shows high values (>18.5%) during rainfall events. Irrigations were applied on 08-08-2018 and 19-09-2018 for gap filling and life saving purposes, respectively. The weekly rainfall along with normal during crop season is presented in Figure 2. There were fluctuations in rainfall pattern. Rainfall receipt during June was only 95 mm. The onset of monsoon was on 24th June during 25 SMW, proved good for the pearl millet sown on 27th June. There were heavy rainfall events during 29th SMW.

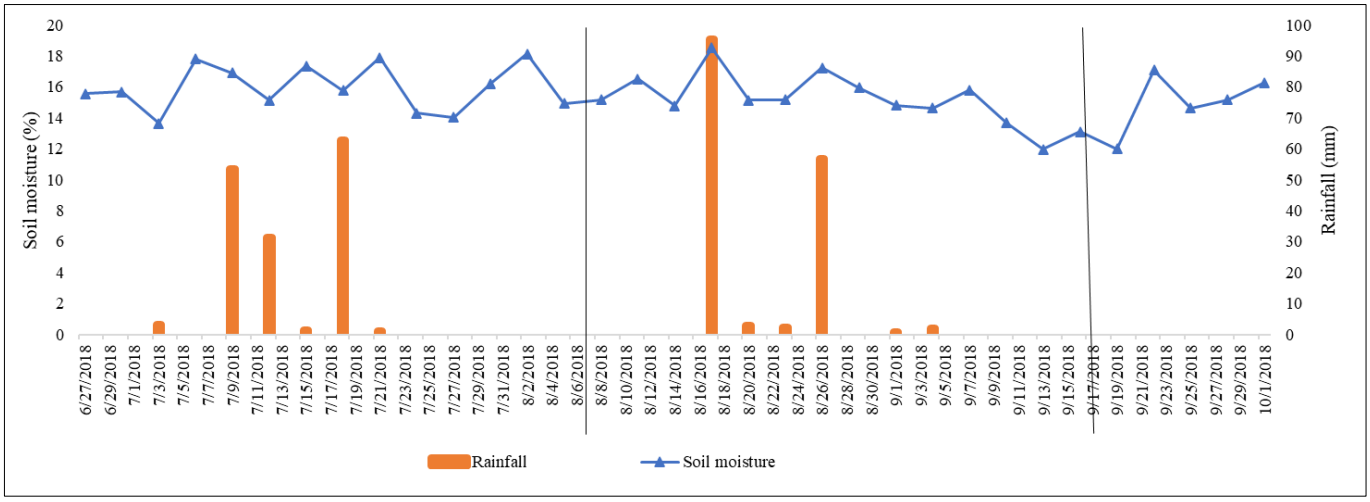

Fig 1: Soil moisture (%) during crop growing season (June – October, 2018). Irrigations are given as vertical lines.

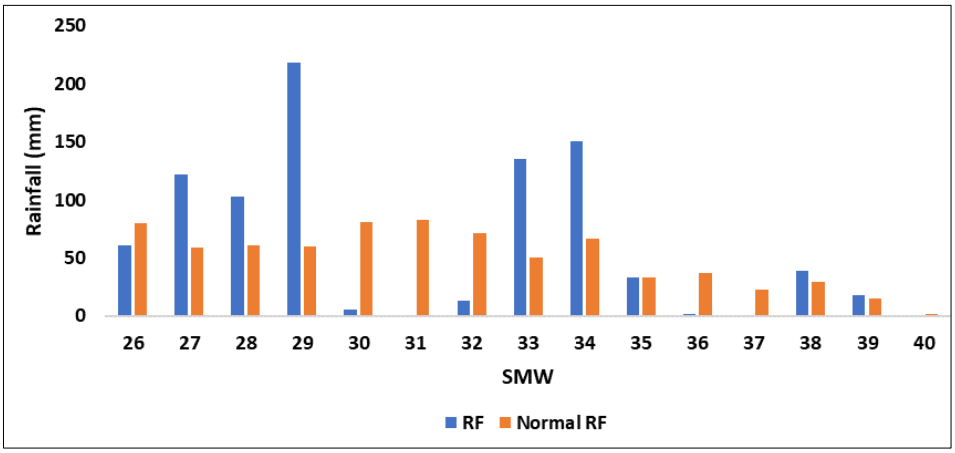

Fig 2: Rainfall (mm) during crop growing season (June - October, 2018)

Discussion

The effect of different weather variables that prevailed during the crop growing seasons were studied in detail. The onset of monsoon was on 24th June during 25 SMW, proved good for the pearl millet sown on 27th June. There were heavy rainfall events during 29th SMW. Evaporation was low during most weeks of June to October than the normal values except during 31st week. The crop was irrigated before onset of monsoon and during dry period (31st SMW). The rainfall fluctuated along the normal in most part of the crop season. However, during 30th week to 32 week, it was below the normal and in 37th week there was no rainfall. Monsoon was withdrawn during 40th SMW. Hence crop was to be irrigated thereafter, as and when required till its maturity. It also mainly effect to the soil moisture retention.

Conclusions

This study showed that during the course of investigation, soil moisture ranged from 13.6% to 18.5%. Soil moisture variation in observations with time is markedly high through rainfall. High soil moisture values (>18.5%) indicates less time between irrigation applied or rainfall and soil sample collected**.**

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