EFFECT OF LAND CONFIGURATIONS AND PONGAMIA MULCH ON SOIL MOISTURE CONTENT AND YIELD OF YELLOW PERICARP SORGUM DURING *KHARIF*

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ABSTRACT

The field experiment was conducted during *kharif*, 2018-19 at College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad to study the effect of land configurations and pongamia mulch on soil moisture content and yield of yellow pericarp sorghum during *kharif*'. The treatments included land configurations (Flat bed, Ridge and furrow, Broad bed and furrow, Flat bed + Mulch, Ridge and Furrow + Mulch, Broad bed and furrow + Mulch.) and yellow sorghum genotypes (PYPS 101, PYPS 102, PYPS 103 and PYPS 104). Mulch used in the present investigation was Pongamia leaf mulch applied @ 6 t ha^{-1} uniformly at 20 DAS. Soil moisture played an vital role in increasing crop yields in the rainfed regions of semi-arid tropics. The effect of land configuration practices on soil moisture content and yield of yellow sorghum were evaluated during *kharif* 2018 on sandy clay loam soils of Hyderabad. The availability of soil water during most crop growth stages was increased by Broad bed and furrow + mulch, resulting in increased grain yield by 37 % (1701 kg ha^{-1}) of yellow sorghum over flatbed. Ridge and furrow + mulch was found to be the next best treatment, with a grain yield of 1590 kg ha^{-1}. Mulched treatments of flat bed, ridge and furrow and broad bed and furrow increased the grain yield by 20%, 28% and 37% respectively compared to flatbed without mulch. The purpose of this research is to determine the role of organic mulching on soil moisture conservation and yellow pericarp sorghum productivity.

Key words: Yellow pericarp sorghum, Genotypes, Land configurations, Soil moisture, Pongamia mulch

INTRODUCTION:

Sorghum is one of the main staple food for the world's poorest people across the semi-arid tropics. It is one among the five major cereals in the country and contributes to about 16% of the world's sorghum production. The crop is being cultivated over an area of 5.65 million hectares with a production of 4.41 million tonnes and a productivity of 780 kg ha^{-1} (Agricultural Statistics at a Glance, 2016). In Telangana, it is cultivated in 80,000 ha with production of 70,000 tonnes and productivity of 1051 kg ha^{-1}. Out of the total cultivated area under sorghum in Telangana, 60 % accounted to 48,000 ha is under rainfed conditions. However, area under sorghum is declining every year all across India (from 18 million ha in 1960 to 5.65 million ha in 2015-16). This decline in area is mainly due to competing crops such as rice, wheat, maize, cotton, sugarcane, chilli, soybean and groundnut. Besides, low market prices of *kharif* sorghum due to grain mold. Hence, an alternate use of sorghum is the need of the hour to improve socio-economic conditions of the farmers.

One of the unique features of sorghum is its variation in grain colour. The colour of the grain can vary from red, lemon-yellow, white to black. Yellow pericarp sorghums are generally raised in patches in tribal areas of Telangana during *kharif* for subsistence with minimum management practices resulting in low yields and susceptibility to pests and diseases. However, due to high nutritional, good roti-making and keeping qualities of yellow sorghum, it has created a demand for an increase in its area and production with improved cultures.

Yellow sorghums are typically tall statured as against the white sorghum and are susceptible to lodging, when raised under improved management practices during *rabi* and summer. Hence, they are invariably cultivated during *kharif* season in Telangana.

Moisture conservation under rainfed conditions can be accomplished by proper land management which plays a major role in minimising soil erosion and improving water use efficiency of field crops (Singh *et al.,* 2015). Land configurations *viz.,* ridge and furrow and bed systems have been known to be more feasible and practicable proposition to conserve soil moisture and dispose additional rainwater (runoff) in rainfed regions (Jinger *et al.,* 2017). Mulch, on the other hand has a great role in soil moisture conservation through modification of microclimatic soil conditions. It helps to prevent weed growth, reduce evaporation and increase infiltration of rainwater during growing season (Sarolia and Bhardwaj, 2012). Different types of organic mulches have been used to obtain good crop growth and yield in crops like groundnut, soybean, sesame, sunflower etc.

MATERIALS AND METHODS

A field experiment was conducted at the College of Agriculture, PJTSAU, Rajendranagar, Hyderabad during *kharif.* The perusal of the data revealed that the soil was sandy clay loam in texture, neutral in reaction (6.83), low (0.46 %) in organic carbon, low (224 kg ha^{-1}) in available nitrogen, medium (37.2 kg ha^{-1}) in available phosphorus and high (467.6 kg ha^{-1}) in available potassium. The bulk density of 0-15 cm and 15-30 cm was 1.48 g c.c^{-1} and 1.58 g c.c^{-1} respectively. The soil moisture content in 0-15 cm and 15-30 cm depth at field capacity was 19.2 and 17.8% respectively and at a permanent wilting point were 8.7 and 7.5% respectively. The total rainfall received during the growth period was 333.8 mm in 21 rainy days.

The experiment was laid out in strip plot design with six (6) land configurations as main plots and four (4) yellow pericarp genotypes in sub plots. The main plot treatments included were M_1- Flat bed, M_2 – Ridge and furrow, M_3 – Broad bed and furrow, M_4 – Flat bed + Mulch, M_5 – Ridge and Furrow + Mulch, M_6 – Broad bed and furrow + Mulch. Mulch applied is pongamia leaf @ 6 t ha^{-1}. The sub plots treatments were PYPS 101, PYPS 102, PYPS 103 and PYPS 104. The net plot area was 4.05 x 4.2 m. The spacing adopted for sowing was 45 cm × 15 cm. Green leaf of Pongamia, used as mulch @ 6 t ha^{-1} was spread between the crop rows in uniform thickness at 20 DAS. The crop was planted on 5.07.2018 and harvested on 22.10.2018. Broad beds and furrows were laid with a bed width of 135 cm and 15 cm deep furrow. Similarly, for ridges and furrows a depth of 15 cm was maintained.

Proper care was taken to maintain the same number of crop rows (12 rows) and total number of plants in each configuration. Urea, Di ammonium phosphate and muriate of potash were used as sources at recommended dosages of 60:40:30 kg N: P_2O_5: K_2O ha^{-1}. Recommended dose of nitrogen @ 60 kg ha^{-1} was applied as a uniform dose in two splits, one as basal and the other at 30 DAS. The entire recommended phosphorus (40 kg ha^{-1}) and potash (30 kg ha^{-1}) were applied as basal at the time of sowing uniformly to all the plots. Soil moisture was estimated from two soil depths *viz.,* 0-15 and15-30 cm by gravimetric method.

RESULTS AND DISCUSSION

The data revealed that land configurations significantly (P=0.05) influenced the soil moisture of yellow sorghum. But, the effect of genotypes was found to be non -significant. Whereas, yield of yellow sorghum differed significantly due to land configurations and genotypes. The interaction effect was found to be non-significant (P=0.05) in both the cases.

Soil moisture content

The soil moisture contents varied according to the rainfall occurred during the crop growth period. Weekly total rainfall of ≥ 5 cm occurred during 1st, 3rd and 5th Weeks after sowing. Correspondingly, the moisture contents observed during those weeks were maximum ranging from 9.76 to 11.74% in 0-15 cm soil depth. The soil moisture content of 0-15 cm soil depth was found equivalent both in ridges and furrows with mulch (M_5) and broad beds and furrows (M_6) with mulch whenever there is a rain event during any week. However, during the weeks when there is no rain, the soil moisture contents were highest under broad beds and furrows with mulch (M_6). Gnanasoundari and Balusamy (2015) at Coimbatore, Tamil nadu and Ankita Negi *et al.* (2018) at Pantnagar, Uttarakhand recorded similar results for broad beds and furrows and ridges and furrows, respectively. However, during the weeks where there is no rain, the soil moisture contents were highest under broad beds and furrows with mulch (M_6). Intermittent and well disturbed showers starting from sowing to soft dough stage were tapped well under broad beds and furrows with mulch (M6) and ridges and furrows with mulch (M5). But from there on, with the receding of rains, the soil moisture depleted gradually towards harvest. During this period broad bed and furrows with mulch (M_6) alone were found superior in maintaining higher soil moisture regime in 0-15 cm soil depth. At any sampling week, irrespective of the rain events, the soil moisture contents in the surface layer (0-15 cm soil depth) were maintained low (Fig 2b) in flatbeds without mulch (M_1) and ridges and furrows without mulch (M_2)

A similar trend of soil moisture contents was noticed in 15 – 30 cm soil depth. During the weeks when there are rain events, the soil moisture contents were low in the sub surface layer (15-30 cm) as compared to the surface (0-15 cm) layer. Also, moisture contents were higher under broad beds and furrows with mulch (M_6) and ridges and furrows with mulch (M_5). However, the sub surface layer (15-30 cm soil depth) maintained slightly higher moisture contents than the surface layer (0-15 cm) during the weeks where there was no rain. However, genotypes remained indifferent concerning soil moisture content.

Grain yield

Higher plant height, leaf area, dry matter production and yield attributes has contributed to highest yield (1700 kg ha^{-1}) under broad beds and furrows with mulch. Halli and Angadi (2018) reported that the optimum soil moisture may promote crop to express its full potential by utilizing soil moisture as well as aerial environment. Srivatsava and

Jangawad (1998) also reported higher yields with broad bed and furrow method of planting in soybean which might have helped in *in-situ* moisture conservation and improved root growth and nutrient access to the crop and thus increasing yield attributes and yield. Further, the leaf mulch has benefitted from increased infiltration rate, improved fertilizer availability and hence increased crop yield (Dushouyu *et al.,* 1995). Distinctively lowest grain yield of 1239 kg ha^{-1} was observed under flat bed with no mulch (M_1). Ridges and furrows with no mulch (M_2) also was found comparable to M_1 with equivalently lower yield of 1312 kg ha^{-1}.

PYPS 102 (1585 kg ha^{-1}) and PYPS 103 (1508 kg ha^{-1}) faired equivalently well to register higher grain yield among the genotypes. PYPS 104 and PYPS 101 together were least with correspondingly lower grain yields (PYPS 104 - 1413 kg ha^{-1} and PYPS 102 - 1320 kg ha^{-1}).

Stover yield

A perusal of the data indicated that stover yields were comparable and higher (12403 and 11965 kg ha^{-1}, respectively) under broad beds and furrows with mulch (M_6) and ridges and furrows with mulch (M_5). The counterpart treatments of M_4, M_5 and M_6 i.e., flatbed (M_1) and ridges and furrows (M_2) and broad beds and furrows (M_6) without mulch registered stover yields of 10178, 10319 and 10583 kg ha^{-1}, respectively and were found least among the treatments. This attribute is might be due to better improvement in moisture content in different soil depths (0-15 cm and 15-30 cm) at different growth stages of the crop. These results were in accordance with findings of Jnanesha *et al.*, (2016) and Halli and Angadi (2018).

Among the genotypes PYPS 102, with significantly highest stover yield of 12085 kg ha^{-1} outperformed the other genotypes. Whereas, PYPS 101 was noted to be the least (10151 kg ha^{-1}) with regarding to stover yield.

Conclusion

The soil moisture contents varied according to the rainfall occurred during the crop growth period. The soil moisture content of 0-15 cm soil depth was found equivalent both in ridges and furrows with mulch (M_5) and broad beds and furrows (M_6) with mulch whenever there is a rain event during any week. However, during the weeks when there is no rain, the soil moisture contents were highest under broad beds and furrows with mulch (M_6).

Similar trend of soil moisture contents was noticed in 15-30 cm soil depth. During the weeks when there are rain events, the soil moisture contents were low in the sub surface layer (15-30 cm) as compared to surface (0-15 cm) layer. Also, moisture contents were higher under broad beds and furrows with mulch (M_6) and ridges and furrows with mulch (M_5). However, sub surface layer (15-30 cm soil depth) maintained slightly higher moisture contents than surface layer (0-15 cm) during the weeks where there is no rain. However, genotypes remained indifferent with respect to soil moisture content. The interaction of genotypes with land configurations also was found insignificant.

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Table 1. Grain yield (kg ha^{-1}) and Stover yield (kg ha^{-1}) of yellow sorghum as influenced by land configuration, mulching and genotypes

Treatments	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
Main plots		
M_1 -Flatbed (FB)	1239^{e}	10178^{c}
M_2 -Ridge and furrow (RF)	1312de	10319^{c}
M_3 -Broad Bed and Furrow (BBF)	1406^{cd}	10583^{c}
M_4 -FB + M	1491^{bc}	11576^{b}
M_5 -RF + M	1590^{b}	11965^{ab}
M_6 -BBF + M	1701^{a}	12403^{a}
SEm ±	47	219
CD (P=0.05)	105	487
Sub plots		
S_1 – PYPS 101	1320^{c}	10151^{d}
S_2 – PYPS 102	1585^{a}	12085^{a}
S_3 – PYPS 103	1507^{ab}	11579^{b}
S_4 – PYPS 104	1413^{bc}	10869^{c}
SEm ±	45	144
CD (P=0.05)	109	353
Interaction (Main x Sub)		
SEm ±	47	348
CD (P=0.05)	NS	NS
Interaction (Sub x Main)		
SEm ±	63	373
CD (P=0.05)	NS	NS

Fig. 1a. Soil moisture content (%) at 0-15 cm soil depth under different land configurations in relation to rainfall

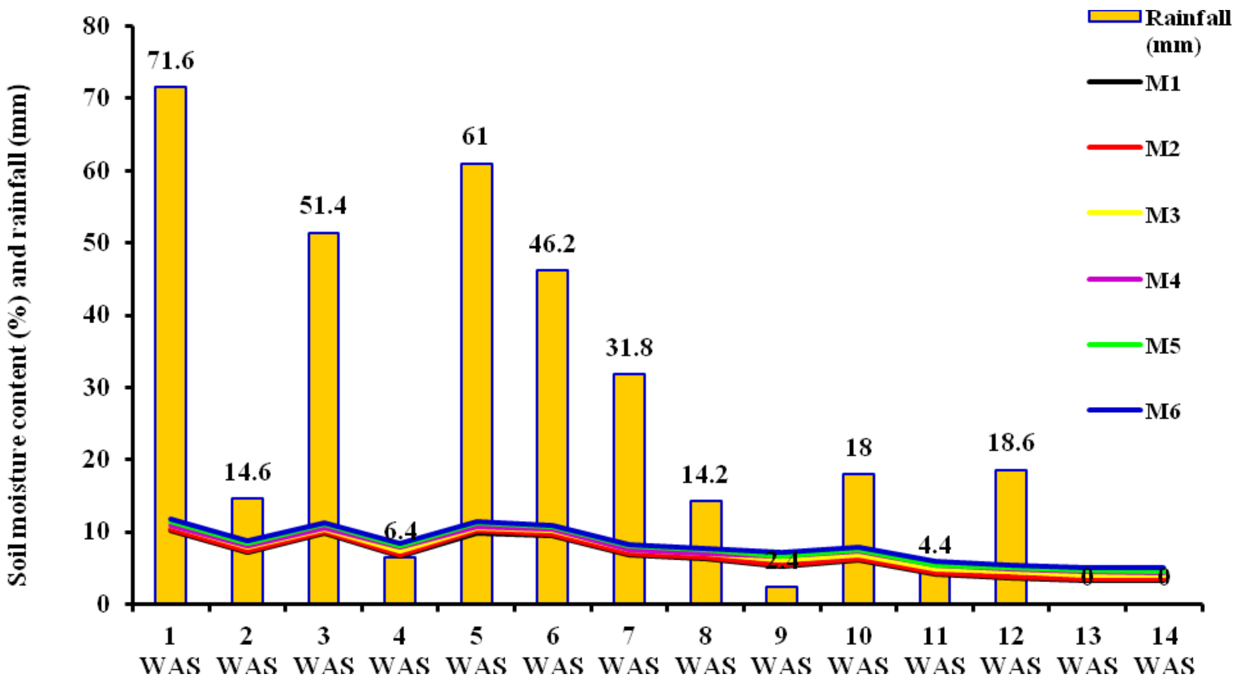
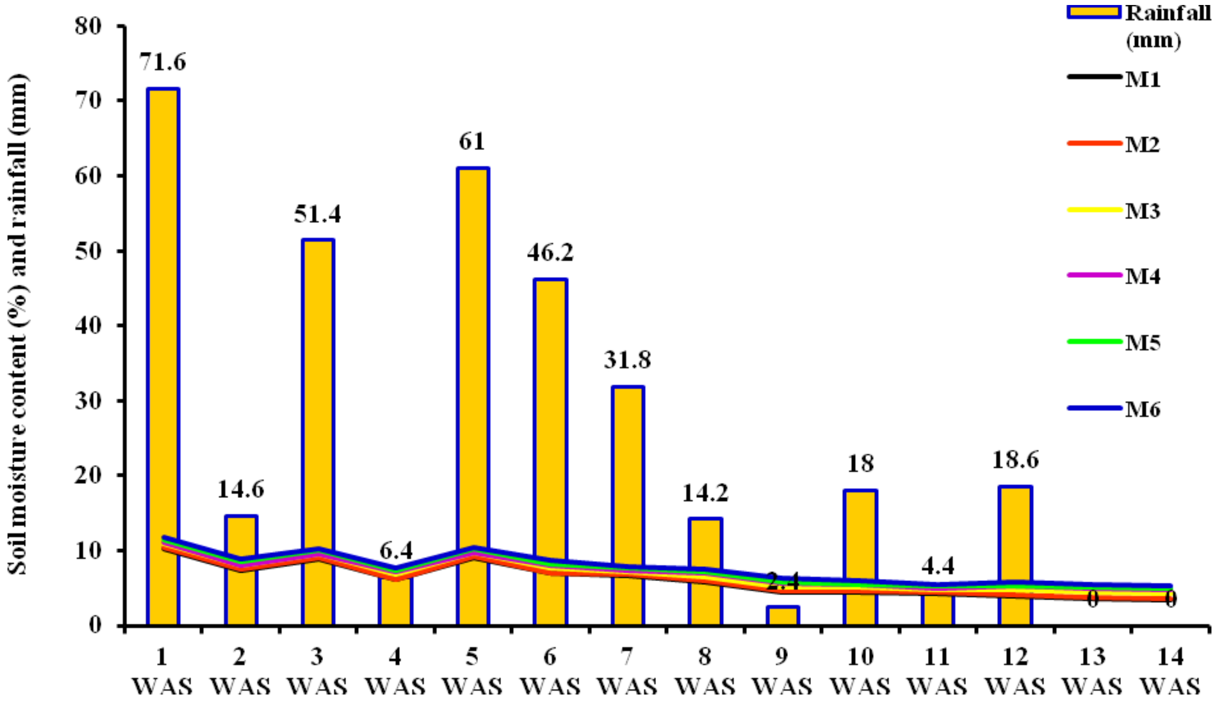
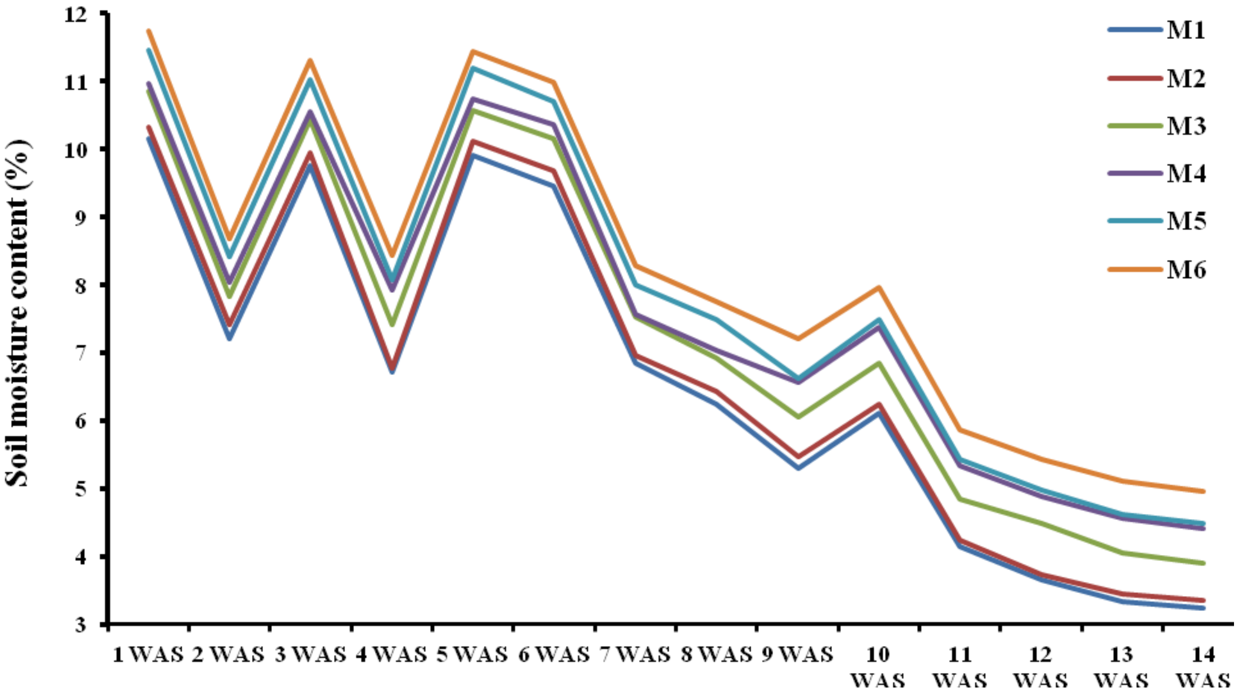


Fig. 1b. Soil moisture content (%) at 15-30 cm soil depth under different land configurations in relation to rainfall



2a. Soil moisture content (%) at 0-15 cm depth under different land configurations



2b. Soil moisture content (%) at 15-30 cm depth under different land configurations

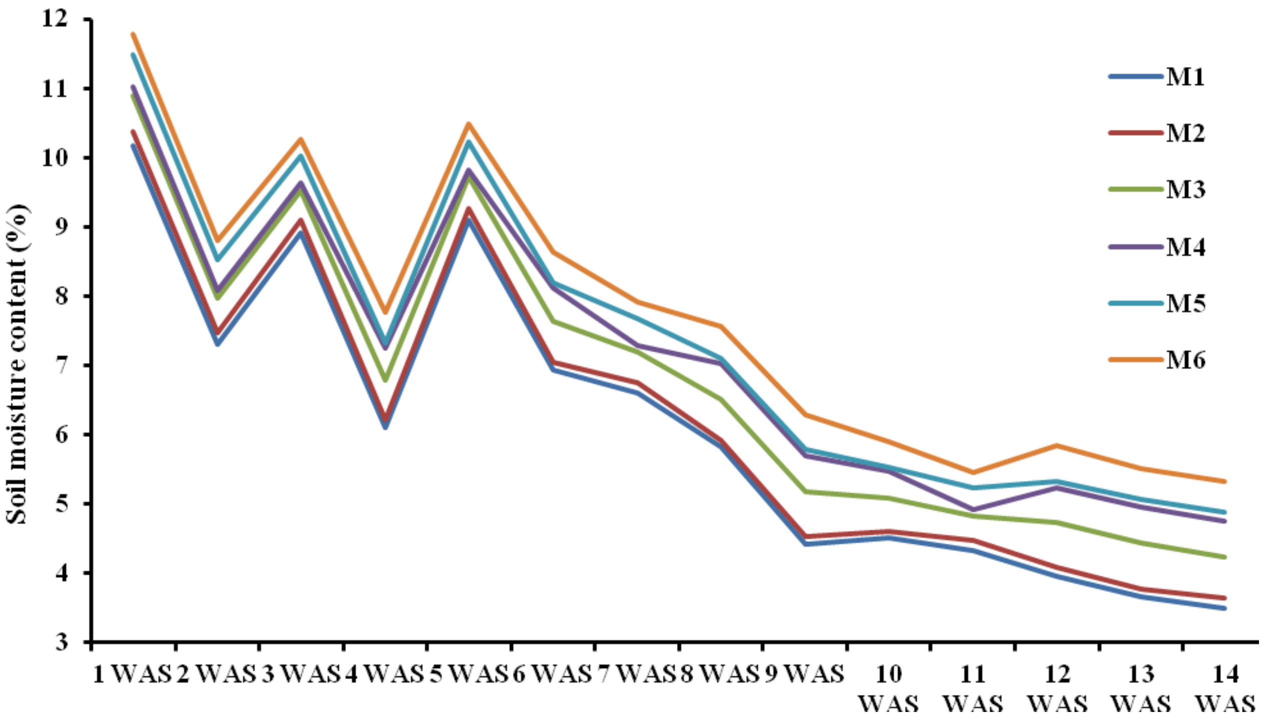


Fig.3a. Soil moisture content (%) in 0-15 cm soil depth at critical growth stages of yellow sorghum under different land configurations

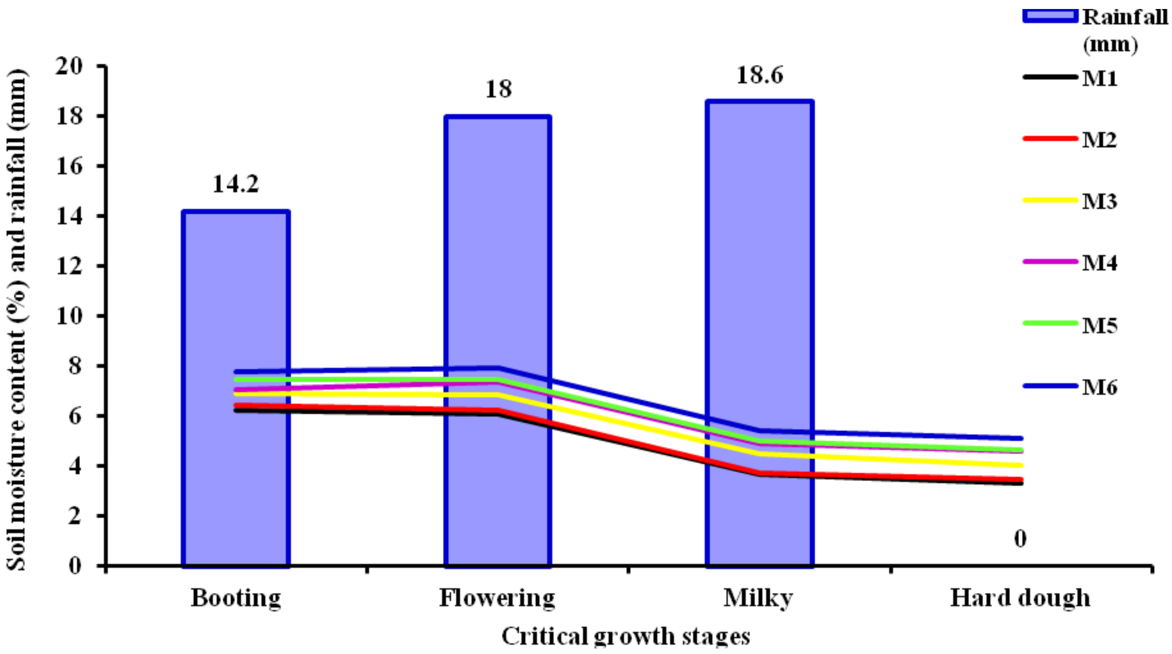


Fig.3b. Soil moisture content (%) in 15-30 cm soil depth at critical growth stages of yellow sorghum under different land configurations