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Rwanda, popularly known as the land of thousands hills, is a small (26,338 km²) land-locked country lying in tropical region having two dry and two rainy seasons. Annual rainfall amount in Rwanda is mostly distributed during two rainy seasons. Super optimal temperature, rapid evaporation and increased transpiration demand after the cessation of rainy season dry the surface layer rapidly, causing an increase in mechanical impedance and reduced crop yield during the two dry seasons. In addition to this Rwandan farmers are still using primitive tool like hand hoe for both primary and secondary tillage operations. Therefore, deep tillage practice is very important to remove this compacted layer. So far the physics of tillage has made no progress in Rwanda. Hence, a study has been taken up on improvement of soil moisture by engaging tractor drawn tillage machinery during dry seasons at Kigali, Rwanda.

In order to identify suitable tillage machinery, a field experiment was conducted in the research and production farm of Higher Institute of Agriculture and Animal Husbandry at Rubilizi which is in the outskirt of Kigali city of Rwanda. Tractor drawn machineries namely seven tyne cultivator, tow bottom disk plough and two gangs disk harrow and hand hoe were selected for carrying out tillage operations, since these machineries are found available in the study area. Two dry seasons were selected for the study namely short dry season (Mid Dec 2008 to Feb 2009) and long dry season (Mid May 2009 to Aug 2009). All the weather parameters pertain to the study period collected from Kanombe Meteorological Observatory. Soil moisture content in the field was measured by using gravimetric method.

Three factors split plot design was used in the study. Eight different combination of tillage treatments were taken as first factor. Second factor considered as depth of ploughing namely 10cm, 20cm and 30 cm. Soil moisture content present in the experimental plots observed at different depth of ploughing at every week interval for the period of dry season, was taken as third factor. Agricultural research package (AGRES) was used to analyze the data which was collected for short and long dry seasons. Disk ploughing followed by two passes of disk harrowing identified as best tillage treatment to retain higher moisture content at 30cm depth of ploughing for short and long dry seasons, when compared with other treatments.
Ill the mean time, multiple linear regression analysis also was carried out for the eight tillage treatments with respect to soil moisture (dependent factor) and weather parameters like ambient temperature, evaporation rate and relative humidity (independent factors) for long dry season (Mid May 2009 to Aug.2009). The value of $r^2$ in the multiple regression equations found in the range of 52.7 ± 3.2%. This showed soil moisture variation occurred not only due to the environmental factors considered have but also varies according to other factors namely solar radiation intensity, duration of the day light hour, wind velocity and soil physical properties.

In order to confirm the results obtained by previous experiments, crop performance studies were conducted in the experimental site for both dry seasons. In the experimental site four sample plots of 16m x 12m each were taken up. Two plots were prepared by using disk plough for 30cm depth followed by two passes of disk harrowing. Another two plots were conventionally prepared with hand hoe. All the four plots were chosen side by side. The ruling varieties of maize (Pool,9) and beans (PK 10) crops were selected and raised in tilled and conventionally prepared plots separately for comparison. During short dry season (Mid Dec 2009 to Feb 2010) in tillage operations, 89% and 92%; sowing, 16.4% and 19.4% and weeding operations, 18.3% and 18.6%> of man-hour saved for maize and beans crops respectively under tilled plot when compared with conventional plot. Similarly in case of yield, 5484 kg/ha and 4765 lcg/ha obtained in tilled plot for maize and beans crop respectively when compared with conventional plot. The same trend was observed during long dry season (15th may 2010 - Aug 2010).

Further to understand the soil moisture migration pattern in the experimental site, Water was allowed to flow through three different drippers having sizes of 1.5mm, 1.75mm and 2mm and kept it on top of the soil filled in three transparent boxes. The water allowed wetting the soil present in each box by a dripper with a fixed flow rate. Each time the wetting pattern was marked in the transparent side of the box with the help of a marker pen and was mapped in graph sheets in (x,y) side and (x,z) sides. The data set for (x,y) and (x,z) for different flow rates were analyzed with computer aided packages for arriving the equations to simulate the curve of soil moisture migration. The conclusion from the study revealed the fact that drip irrigation would have been adopted with 2 mm drippers, which caused more wetting area for irrigating the crop in dry season of the Rubirizi experimental plot which will improve the crop productivity further.