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Verification of Conservation Agriculture for Maize on Dry Areas of Silte Zone, Ethiopia

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Abstract
One year verification trail on conservation agriculture practices were conducted in lanfuro woreda, Grinzila Shafode kebele, Silte Zone, SNNPR, Ethiopia. The objective of this study is to verify three tillage practices namely No tillage, Two times tillage with tide ridge and Conventional tillage on maize yield, soil moisture and infiltration rate in Andosols. Treatments were arranged in randomized complete block design with three replication. Data collected from this research were analyzed using SAS software, and LSD and DUNCANS was used for multiple comparison tests for the differences among the treatment means. Result reveals that conservation tillage increased the soil moisture retention and improved soil infiltration rate as compared to the conventional tillage method. Conservation tillage also reduced maize grain yield as compared with the conventional tillage methods however, difference between the maize yields obtained from different tillage methods was not significant.
Keywords: Conservation Agriculture, Soil moisture content, infiltration rate, Grinzila Shafode, Maize yield

1. INTRODUCTION

Conservation tillage is one of a tillage method leaving at least 30% of crop residues on soil surface. These residues on the soil surface can change different properties of soil like chemical, biological, and physical. Soil temperature, water content, bulk density, porosity penetration resistance and aggregate distribution are one of soil physical properties affected by tillage system (Hemmat and Eskandari, 2004). Pandey et al. (2008) observed that the soil organic carbon decreased with soil depth increased. Higher soil organic carbon was recorded in zero tillage than conventional tillage. Bilalis et al. (2010) observed that the soil organic matter and total nitrogen were higher in soils subjected to conservation tillage systems (minimum and no tillage) than under conventional tillage. Seed yield was also higher under minimum tillage than conventional tillage.

Conservation agriculture improve water use efficiency and grain yield of a crop but majorly depends on the rainfall probability, soil type, crop requirements, and soil water-storage capacity (Hemmat and Eskandari, 2004). It also increases stored soil water by increasing infiltration and reducing evaporation, but depending on the soil type and climatic conditions, this leads to higher, equal or even lower yields than conventional tillage systems (Lampurlanés et al., 2001). Fabrizzi et al. (2005) evaluated the effect of conservation tillage on the soil temperature, compaction, water content, and crop yield and reported that soil in no-till method had the higher water retention during the critical growth stage of corn. Thus, to improve moisture in the soil, a more attention should be focused on conservation tillage involving soil management practices that minimize the disruption of soil structure (Samarajeewa et al., 2006).

The aim of this study was to verify the influence of three tillage practices on soil moisture content (SMC), infiltration rate as well as their influence on maize yield under andosols in selected dry land areas of Silte Zone.

3. MATERIALS AND METHODS

3.1. Study Area Description -Grinzila shafode is one of the kebeles located in lanfuro Woreda of silte zone Southern Nation Nationalities and people's Region (SNNPR). It is located 65 km from worabe town, capital of silte zone. It is geographically located between 38^0 19' 30'' E - 38^0 23' 00'' E longitude and 7^0 42' 30'' - 7^0 45' 0'' N latitude. It covers an area of 1662.2ha. The kebele has parts of six villages, namely Gezecho Wolate, Koyo Negoro, Urgo Gezicho, Shedeger Kero, Urgo Gola, and Gezicho Zofo

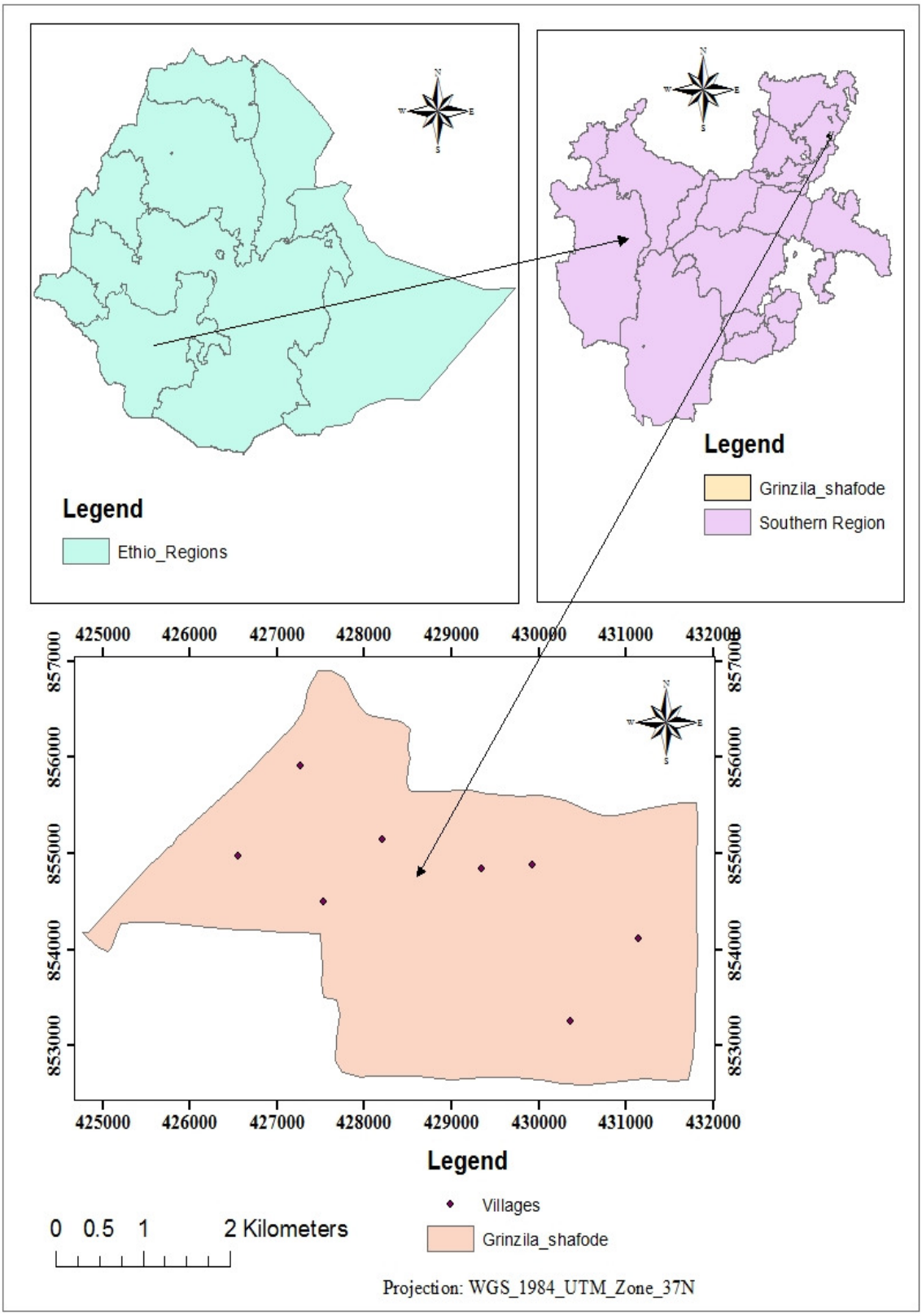


Figure 1. Location map of the study area

According to FAO soil classification (2012) and visual interpretation of the area, grinzila Shafode kebele is covered by three major soil types which are *Cambisols*, Andosols and Phaeozems. The elevation range of the area is 1805 to 1865 m.a.s.l and the slope of the study area is gentle which 3%.

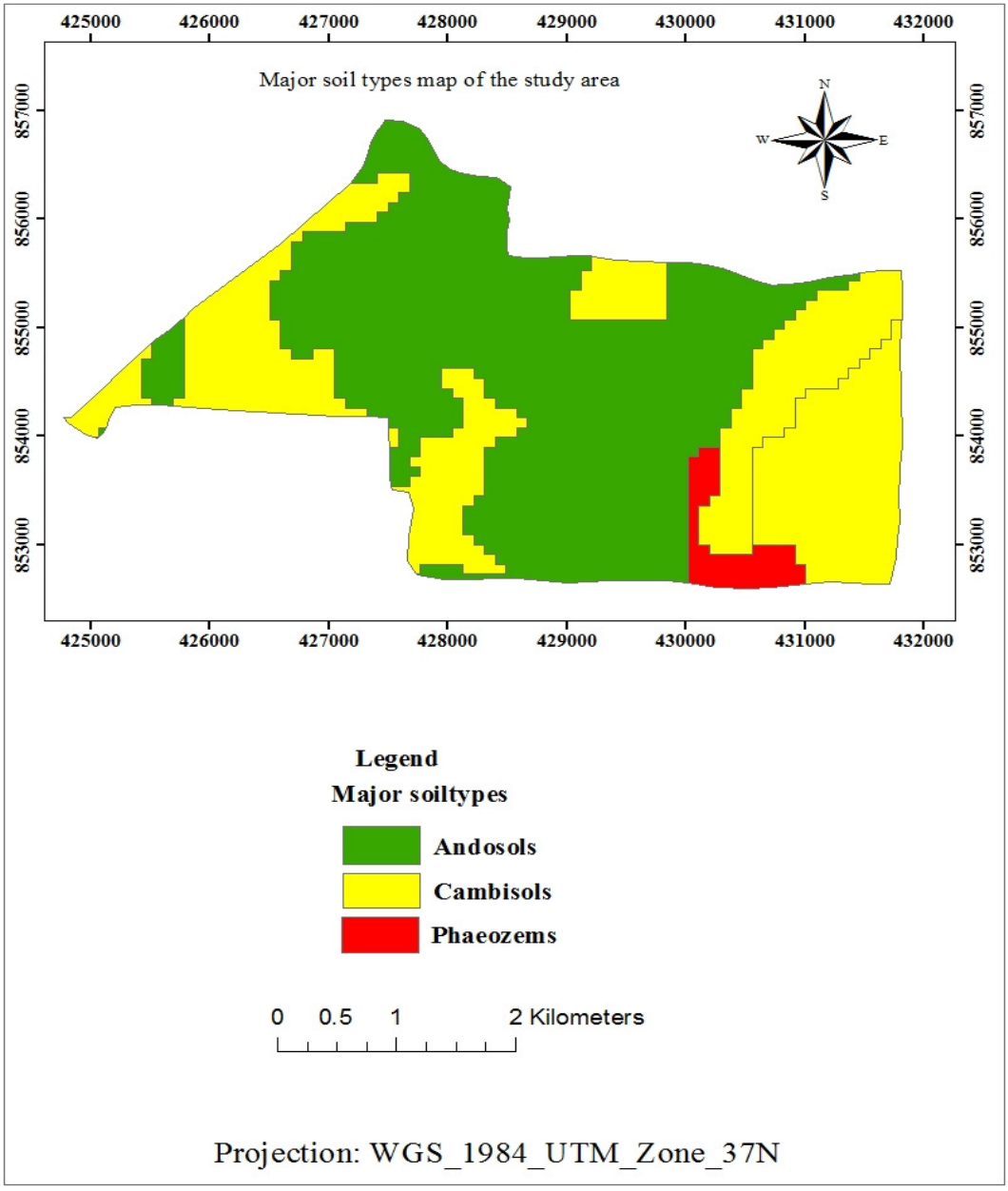


Figure 2. Major soil types map of the study area

3.2. Experimental layout- The CA trail was carried out in Grinzila Shafode kebele of silte zone. Data were collected from one year verification trail under maize production. The experiments were established on 2006 on andosols. The trail was laid out in randomized complete block design (RCBD) using three tillage practices (Conventional tillage, Two times tillage with tide ridge and No tillage) replicated three times on FTC (farmers training center). The plot sizes for each treatment were 10 m by 10 m. Two times tillage tide at 5m interval and 15 cm height of ties were established. Weed seed on no tillage and two times tillage with tide ridge was managed by applying 3 liter per hectare round up chemical herbicide before 15 days planting maize crop. Full recommended fertilizer dose urea(100kg/ha) and dap (100kg/ha) were applied on each treatments by applying full dose of dap fertilizer during planting and split application of urea 45 days after planting. 75 cm spacing between row and 25 cm between plants were used to sow maize seed.

3.3. Data collection techniques- Various maize productivity parameters (yield, Biomass and plant height, soil moisture content and infiltration rate) were collected. Yield and biomass, data were collected from 3m x3m sample pilot where as plant height data, were collected from 5 plants/sample plot and average values were taken. Soil infiltration rate were measured using double ring infiltiro meter ring. Double infilitrometer ring is pushed into the soil and Water is poured into the ring, and the rate at which the water soaks into the soil is

measured as shown in the figure 3 below whereas Soil moisture content (% volume) was determined using gravimetric method (RNAM, 1995). Representative composite soil samples from 0-20 cm depth from each plot were taken before and after verification trail, following the standard soil sampling procedure to evaluate physico-chemical analysis. The sample was oven-dried at 105 0 C and the moisture content was determined using the following equation.

$$MC = \frac{Ww - Wd}{Wd} x100 \quad [1]$$

Where; MC = Moisture content (%), Ww = Weight of wet soil (g) and Wd = Weight of dry soil (g)

3.4. Statistical data analysis-

The treatments were laid in a randomized complete block design with three replication in FTC. SAS PROC MIXED (SAS Institute, 2006) was used to determine the effect of different tillage practices on maize yield, yield component such as Biomass and plant height. Soil moisture content and infiltration rate after crop harvest were additionally collected. Soil moisture contents were measured by gravimetric methods and infiltration rate using double ring infiltrometer ring. Multiple comparison tests for the differences among the treatment means were identified using LSD and DUNCANS .The probability levels of 0.01and 0.05 were used to determine levels of significance between treatment means.

3.5. Materials used for the study- Double ring infiltro meter, Watch, 3 people, Reader, paper, pencil.

4. Results and Discussions

4.1. Effect of conservation agriculture on maize yield, yield component, soil moisture and infiltration rate

4.1.1. Effect of conservation agriculture on maize yield and yield components

Result of three tillage methods on maize grain yield, Biomass and plant height are shown in the table 1 below. The first year verification trail result showed that there was no significant difference between the treatments for maize yield, Biomass production and plant height ($p>0.05$). Although there is none significant difference among tillage treatments, more biomass yield advantage in CT and NT. Two times tillage with tide ridge have the lowest biomass production as compared to CT and TTT with tide ridge cultivation

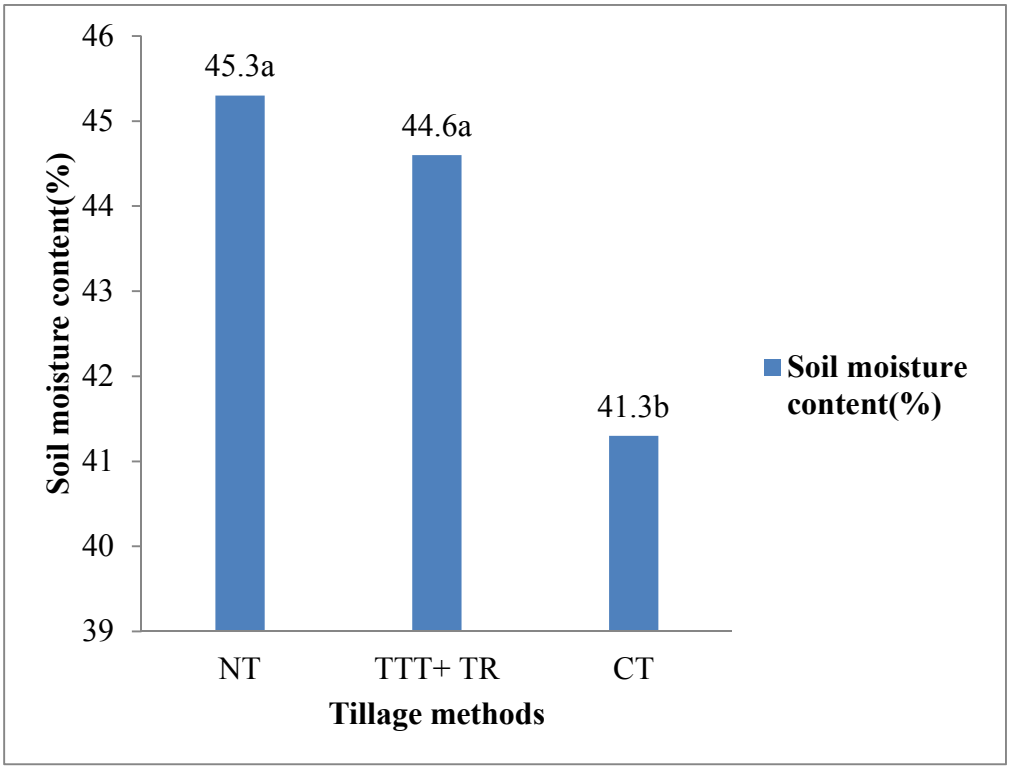
Table 3. Effect of conservation agriculture on maize yield and yield components

Treatments	Yield-Kg/ha	BMS-Tone/ha	Pht-cm/5pt
No tillage(NT)	30.83a	8.3a	2.3ab
Two times tillage with tide ridge(TTT+ TR)	26.3a	7.6a	2.2ab
Conventional Tillage(CT)	36a	9.2a	2.3ab
CV %	12.75	13.6	6.8
LSD(0.05)	NS	NS	NS

Averages with different letters were statistically different at the confidence level of 95%.

4.1.2. Effect of conservation agriculture on soil moisture and infiltration rate

The result also reveals that soil moisture content in the top 20 cm soil depth between tillage methods was vary as shown in the (Fig. 1) below. No till method and Two times till with tide ridge increased moisture retention in the soil for 9.7% and 7.9% as compared to the conventional tillage method respectively whereas, difference between No tillage and two times tillage with tide ridge was not significant from the moisture retention point of view. The main reason of high soil moisture retention in no till plot could be due to crop residue on soil surface. According to Rockwood and Lal (1974), a thin layer of dead crop residue 1-2 cm thick on the soil surface of no-till plots improves soil moisture conditions, prevent water evaporation from the soil surface and biological activity (earthworm) was stimulated by more favorable water regimes in no-tillage plots than in conventionally tilled plots. Increased population of earthworms, insects and greater root development contribute to better soil aeration, and SOM distribution in the soil profile through biological macro pores. Similarly Osunbitan et al.,(2004) reported that, conservation tillage influence soil physical properties like bulk density, infiltration and water retention.



NT-No tillage; TTT+ TR- Two times tillage with tide ridge and CT- Conventional tillage
Averages with different letters were statistically different at the confidence level of 95%.
Figure 3. Soil moisture retention in different tillage methods

Results of soil infiltration rate in different tillage methods are presented in the figure 4. The result reveals that, the highest infiltration rate was measured from no tillage then follows two times tillage and conventional tillage. The highest infiltration of rainwater in to the soil increases water availability to plants, reduces surface runoff and improves ground water recharge (Lipiec et al., 2005).

PLATES 1.Double ring infiltro-metre installation in the field

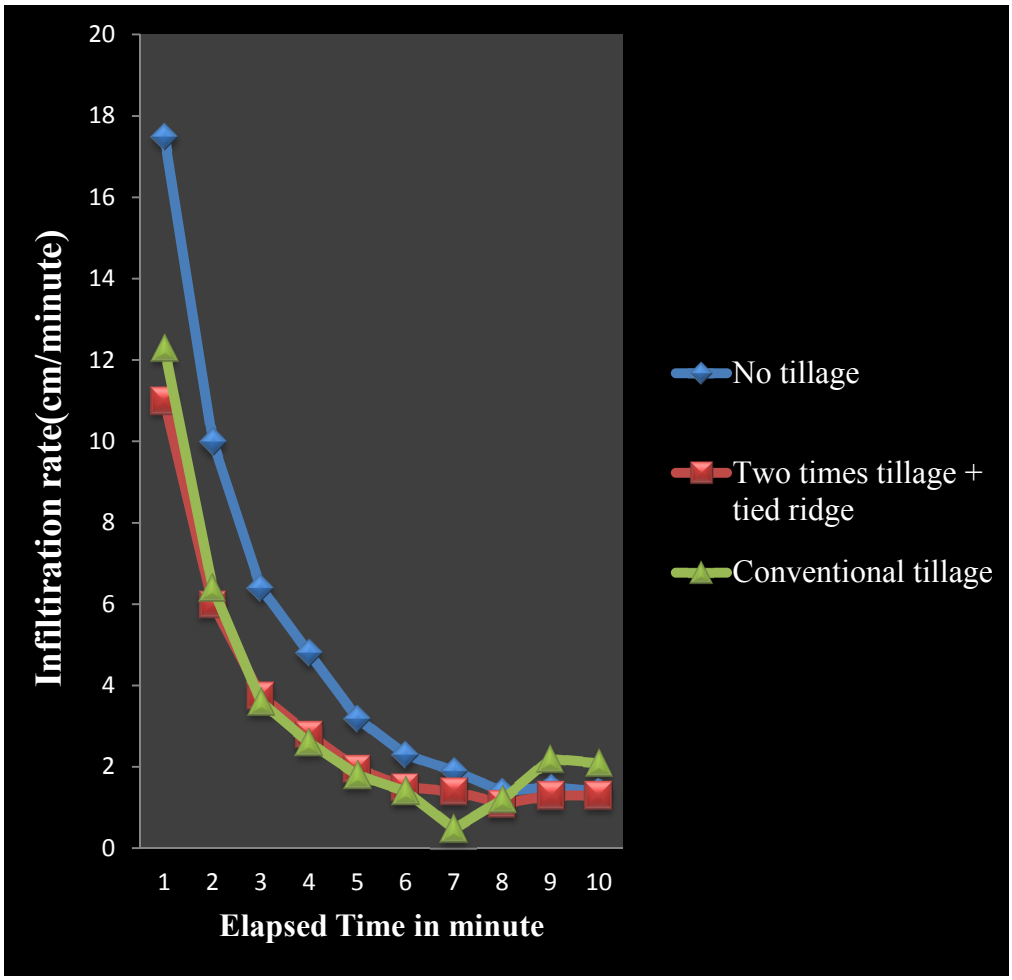


Figure 4. Infiltration Vs time graph

5. Summary and Conclusion

The objective of this study is to verify conservation agriculture practices namely No tillage, Two times tillage with tide ridge and Conventional tillage on maize yield, soil moisture retention and infiltration rate in Grinzila shafode kebele dry land areas of silte zone. No till method and Two times till with tide ridge increased moisture retention in the soil for 9.7% and 7.9% as compared to the conventional tillage method respectively whereas, difference between No tillage and two times tillage with tide ridge was not significant from the moisture retention point of view.

No till method decreased maize yield for 14.4% and Two times tillage with tide ridge decreased maize yield for 26.9% as compared to the conventional tillage method however, difference between the maize yield obtained from different tillage methods was not significant.

It is important to mark that, soil sample before and after planting test crop for selected physic-chemical analysis like Bulk density, soil organic matter should be collected and analyzed. Additionally, Economic analysis for each tillage methods should be analyzed to select cost effective tillage methods.

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