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Impact of tillage and fertility management on Lixisol hydraulic characteristics

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Abstract

Water and soil fertility are the most limiting factors to crop production in semi-arid zones. In Burkina Faso soil and water conservation techniques were developed and promoted in the Saharan zone where the annual rainfall is less than 600 mm. This study was conducted in Nadion located in the South Sudan zone of Burkina Faso to assess the impact of no-till, tied ridging; ripping and conventional tillage combined with soil fertility management options (control, compost, NPK + Urea, crop residues, and Compost+ NPK + Urea) on soil hydraulic characteristics. Infiltration tests were performed in the second year of the study, after harvesting (December) using a tension disc infiltrometer. The results showed that ripping improved soil steady state infiltration rate compared to the other tillage practices. The Tied-ridging improved soil saturated hydraulic conductivity and the hydraulically functioning pores size which may lead to an improvement in soil moisture storage. The mulching practice increased the field saturated hydraulic conductivity compared to the zero mulching. The improving tendency value of hydraulic conductivity in zero tillage practice on Lixisol soils suggests that Zero tillage has the potential for reducing runoff and soil erosion in the South Sudan Zone of Burkina Faso.

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Introduction

Infiltrability is one of the most important soil physical properties, which affects soil water availability for plant use and groundwater recharge, and is related to soil erosion and water runoff (Lipiec *et al.*, 2006). Soil macropores play an important role in the rapid conduction of water (Hendrix *et al.*, 2007), and greatly influence soil water infiltration, which contributes to lower the runoff and reduce soil erosion (Perkins *et al.*, 2012).

Infiltrated water amount can be assessed by in situ measurements using pressure infiltrometers (Reynolds and Elrick, 1990) or tension infiltrometers (Wahl *et al.*, 2004).

According to Kemper *et al.* (2012), tillage practices greatly affect soil macroporosity and infiltration characteristics, which consequently affect water runoff and soil erosion. These influences varied with many factors such as soil type, location and fertility management options. Kay and Vanden Bygaart (2002) reported that the adoption no-tillage (NT) generally lead to an increase of the volume fraction of > 500 μm bio-pores and 100–500 μm macro-pores and the decrease of the volume fraction of 30–100 μm macro-pores. Wahl *et al.* (2004) have also reported an increase in the continuity and the connectivity of the macropore system under reduced tillage practice and a higher infiltration rate compared with conventional tillage practice (Roper *et al.*, 2013). However, Capowiez *et al.* (2009) studies showed that conservation tillage did not improve soil macroporosity or infiltrability compared with conventional tillage.

Other studies even revealed higher infiltration rate under conventional tillage compared to zero tillage practices (Melero *et al.*, 2011). Tillage practices inducing changes in soil infiltration characteristics, have been a major focus in soil erosion studies (Govaerts *et al.,* 2007). In Burkina Faso, several water harvesting technologies such as tillage, stone rows, hedgerows, earth bunds and mulching practices have been used to improve soil water infiltration and storage (Nicou and Charreau, 1985; Zougmoré *et al.*, 2003; Ouattara *et al.*, 2007). However, little information is available on Lixisol in the south Sudan zone of Burkina Faso. It has been reported that zero tillage management and ripping can help to restore organic matter level and reduce soil degradation on Luvisol in Burkina (Ouattara, 2007). Conservation tillage practices, especially zero tillage, are just starting in the study area. Farmers have been practicing tied ridging technique. Little is known about how zero tillage and tied ridging practices affect soil hydraulic characteristics.

Tied ridging practice and the application of compost and sorghum straw may improve soil hydraulic characteristics. Accordingly, the objective of this study is to evaluate the influence of four tillage options (zero tillage, ripping, tied ridging and conventional tillage) and five fertility management options on soil hydraulic characteristics. The results can be helpful to propose strategies for erosion control in the context of agricultural sustainability this area and other areas with similar soil degradation problems.

Materials and methods

Experimental site

The experiment was conducted at Nadion (11°7'60"North and 2°13'0"East), located at about 175 km south of Ouagadougou. Nadion is in the south Sudan zone of Burkina Faso where the annual rainfall is more than 1000 mm. In general, the rainfall is irregular and poorly distributed in the entire region.

This situation is not very favourable for the achievement of high agricultural productivity. The main soil in this area is Lixisol with 66.4% of sand, 26.9% of silt and 6.8 of clay. Table 1 shows the physic-chemical characteristics of the research site.

Experimental design

The experiment design was a randomized complete block with a split plot treatment arrangement and in three replications.

The main plots were water conservation practices with four options: 1. No-till (direct planting); 2. Minimum till (ripping); 3. Tied ridging; the ridges were tied one month after sowing; 4. Conventional tillage (plowing using animal traction with soil inversion to 15 cm depth).

The sub plots were amendment practices with five options: 1. Control –no fertilizer, no compost and no crop residues; 2. 2.5 tons per ha of compost every year; 3. (37-23-14) kg ha^{-1} applied in the form 100 kg ha^{-1} of NPK (14-23-14) and 50 kg ha^{-1} of Urea (46%N); 4. Total crop residues retained (for the first year 2 tons ha-1 of crop residues was applied); 5. 2.5 tons per ha of compost x 100 kg ha^{-1} of NPK (14-23-14) and 50 kg ha^{-1} of Urea (46%N).

Measurement of infiltration

Infiltration tests were performed in the second year of the study, after harvesting (December). In each plot, infiltration measurements were carried out *in situ* using a tension disc infiltrometer. In tied ridging plots, the infiltration measurement was done on the ridges while for the ripping plots it was done between the ripping lines. The tensions, h = -10 cm, -5 cm, and h = 0 cm water; were applied at the soil - disc interface, at the same place for the three pressure heads. Two measurements were performed per plot. For sorptivity determination, a reading was taken at h = 0 cm.

Determination of hydraulic conductivity

The hydraulic conductivity was determined from the infiltration measurements using the expression (Wooding, 1968):

$$Q = K\left[1 + \frac{4}{\pi r \alpha}\right] \quad (1)$$

where, r (cm) is the disk radius, Q (cm h^{-1}) is the constant infiltration rate, K (cm h^{-1}) is the hydraulic conductivity, and α is a constant dependent on soil porosity as used by Ouattara (2007).

Assuming an exponential correlation between conductivity and the pressure head gives (Gardner, 1958):

$$K(h) = Ks\exp(\alpha h) \quad (2)$$

Where, K_s is the field saturated hydraulic conductivity, K(h) - the hydraulic conductivity at a given pressure and h is the applied pressure head. To be able to derive K_s, two pressure heads are used. For two heads pressure h1 and h2,

$$Q(h1) = Ks\, e^{(\alpha h1)}\left[1 + \frac{4}{\pi r \alpha}\right] \quad (3)$$

$$Q(h2) = Ks\, e^{(\alpha h2)}\left[1 + \frac{4}{\pi r \alpha}\right] \quad (4)$$

From equations (3) and (4), α is calculated as,

$$\alpha = \frac{\ln(\frac{Q1}{Q2})}{(h1 - h2)} \quad (5)$$

From α, h_1 and h_2 fixed and Q measured it was possible to calculate Ks using equations (3) and (4).

$$Ks = \frac{\alpha}{r}\exp(-\alpha h1)\frac{Q(h1)}{Q} \quad (6)$$

Sorptivity determination

Soil sorptivity (S) is a term defined by Philip (1975) as soil hydraulic property which describes the movement of water in the soil at early stages of infiltration by capillary action. The infiltration is governed by equation (7). The first term of the equation is the gravity free absorption of water into the soil due to capillary and adhesive forces. The second term of the equation represents the infiltration due to the gravity when the soil wets up. At early stage of infiltration, the second term is null and the equation is reduced to equation (8). The sorptivity was determined from equation (9).

$$I = St^{1/2} + At \quad (7)$$

$$I = St^{1/2} \quad (8)$$

$$S = \frac{I}{\sqrt{t}} \quad (9)$$

$$S = \frac{I}{\sqrt{t}} \qquad (10)$$

Where I is the cumulative infiltration (mm), S the sorptivity (mm/s$^{1/2}$), t is the time (s) and A is the empirical constant of the soil related to unsaturated hydraulic conductivity.

Determination of hydraulically functioning pore size (λm)

The hydraulically functioning pores are the spores that conduct water during its transmission throughout the soil profile. Angulo - Jaramillo *et al.* (2000) defined the hydraulically functioning pore size, λm for given infiltration parameter as:

$$\lambda m = \frac{\sigma\alpha}{\rho g} \qquad (11)$$

where α is a constant dependent on soil porosity, **σ** is (8) the surface tension of water (7.2 x 10^{-2} N.s.m^{-2}), ρ the density of water (1000 kg m^{-3}) and g the gravitational constant (9.81 m s^{-1})

Statistical Analyses

Mixed model analysis was conducted using pro Genstat package (version 9.2). When statistically significant effect was detected, the standard error of difference (sed) was used for mean separations. Statistical significance was determined at the $p < 0.05$.

Results

Mixed model analysis (Tables 2 and 3) showed tillage and soil amendments to significantly influence infiltration rate and saturated hydraulic conduction. Sorptivity was significantly affected by soil amendments but not tillage.

Table 1. Physico - chemical characteristics of the soil at the research site.

Soil depth (cm)	0-10	10-20
Organic carbon (%)	1.06	0.89
pH (1 :2.5 H_2O)	6.00	5.70
Total nitrogen (%)	0.06	0.04
Total phosphorus (mg/kg)	312.17	246.67
Total potassium (mg/kg)	665.17	911.03
Exchangleable bases (cmol/kg)		
Calcium (Ca^{2+})	4.59	3.03
Magnesium (Mg^{2+})	0.96	0.75
Potassium (K^+)	0.15	0.13
Sodium (Na^+)	0.10	0.09
Cation Exchange Capacity (CEC) (cmol/kg)	6.24	7.60
Sum of Anions (S) (cmol/kg)	5.80	4.00
Saturation rate (S/CEC) (%)	92.67	56.33
Bulk density (cm^3/g)	1.64	1.62
Sand (%)	66.30	65.00
Silt (%)	26.90	26.10
Clay (%)	6.80	8.90

Infiltration rate (Table 2) varied between 0.83 and 1.15 cm h^{-1} in the order of Ripping > Conventional tillage > Tied ridging > Zero tillage. Apart from the difference in infiltration rate between Ripping and conventional tillage, which was not significant, all other differences among the tillage treatments were significant with the Zero recording the least rate of infiltration. Although all tillage beyond Zero recorded infiltration rates > 1 cm h^{-1}, infiltration under all tillage practices fell within the moderately slow category (0.5 – 2. cm h^{-1}) by Landon's (1991) guidelines.

The impact of tillage on field saturated hydraulic conductivity (Ks) showed that Ks range from 7.8 to

37.8 cm h^{-1} in a decreasing order of Tied ridging > Zero tillage > Conventional tillage > Ripping (Table 2). Ks varied from moderately rapid (6-8 cm h^{-1}) under ripping, through rapid (8 – 12 cm h^{-1}) under Conventional, to very rapid (>12 cm h^{-1}) under Zero and Tied ridging. In all cases, the differences in Ks among the treatments were significant except that between Conventional tillage and Tied ridging.

Table 2. Soil hydraulic characteristics as affected by tillage practices.

Parameters	Tillage practices					
	Zero tillage	Ripping	Tied Ridging	Conventional tillage	Chi^2 probability	SED
i (cm/h)	0.828	1.152	1.008	1.116	0.01	0.108
λm (mm)	0.034	0.006	0.105	0.012	0.04	0.037
Ks (cm/h)	19.40	7.80	37.80	11.30	0.009	9.60
S $mm/s^{1/2}$	0.610	0.669	0.631	0.650	0.20	0.07

λm = hydraulically functioning pore size; SED = standard error of difference of means, i = infiltration rate, Ks = saturated hydraulic conductivity, S = Sorptivity.

The sorptivity (Table 2) ranged from 0.610 to 0.669 mm $S^{1/2}$ for the Zero tillage and Ripping respectively with no significant differences between the tillage practices. All the tillage treatments recorded greater sorptivity than the Zero tillage with the percentage increment being 3, 7 and 10 under Tied ridging, Conventional and Ripping respectively.

Tillage practices also significantly influenced hydraulically functioning pores, designated as λm (μm). The pore sizes varied from 6 to 105 μm (0.006 to 0.105 mm) under Tied ridging and Ripping respectively with a trend of Tied ridging > Zero tillage > Conventional tillage > Ripping. The difference in the magnitude of pore size of the latter two tillage treatments was not significant. All other differences among the remaining tillage treatments were significant. The pore diameter categorization (Landon, 1991) of tillage practices were coarse (macro) pores (> 100 μm) for Tied-ridging, medium (meso) pores (30 – 100 μm) for Zero tillage, fine (micro) pore (< 30 μm) for Ripping and Conventional tillage. These pores have significant implications for water movement, storage and aeration.

Table 3. Soil hydraulic characteristics as affected by fertility management options.

Parameters	Fertility management options						
	Control	Compost	NPK + Urea	Mulch	Compost + NPK + Urea	Chi^2 pr	SED
i (cm/h)	1.142	1.097	1.163	0.843	0.842	0.02	0.134
λm (mm)	0.008	0.014	0.030	0.063	0.082	0.35	0.043
Ks (cm/h)	6.80	10.9	19.9	40.40	17.50	0.02	10.7
S $mm/s^{1/2}$	0.758	0.781	0.637	0.535	0.614	0.008	0.08

λm = hydraulically functioning pore size; sed = standard error of difference of means, i = infiltration rate, Ks = saturated hydraulic conductivity, S = sorptivity.

The mean infiltration rate, as influenced by soil amendments, ranged from 0.842 to 1.163 cm h^{-1} under compost + NPK + urea and NPK + urea respectively (Table 3). Infiltration rate was moderately slow under all the soil amendments. Infiltration rate was in the order of NPK + urea > Control > Compost > Mulch > Compost + NPK + urea. Neither differences among the three latter nor the former two amendments were significant. However, between these two groups, the differences were significant. The addition of compost to NPK + Urea decreased infiltration rate of the latter amendment by 28% but it still remained moderately slow.

The saturated hydraulic conductivity (Table 3) varied between 6.8 and 40.4 cm h^{-1} under control and mulch respectively in the order of mulch > NPK + Urea > compost + NPK + urea > compost > control. Saturated hydraulic conductivity was moderately rapid under control, rapid under compost and very rapid under mulch, NPK + urea and compost + NPK + urea. The differences in the magnitude of hydraulic conductivity between control and compost as well as those of the compost, NPK + urea and compost + NPK + urea were not significant. All other differences were significant with mulch recording the highest Ks. Sorptivity (Table 3) under the amendments was in a decreasing order of compost > control > NPK + urea > compost + NPK + urea > Mulch with values ranging from 0.535 to 0.781 mm $S^{1/2}$ for mulch and compost respectively. All the soil amendments recorded significantly greater sorptivity than the mulch. The differences between the control and compost and those between NPK + urea and compost + NPK +urea were not significant. The sorptivity under compost was significantly greater than all the other amendments.

The hydraulically functioning pores recorded under the various soil amendments ranged from 0.008 mm to 0.082 mm in an increasing order of control < compost < NPK + Urea < mulch < compost + NPK + Urea (Table 3). The differences were, however not significant ($P<0.05$). The pore sizes were micro under control and compost and medium (meso) under NPK + Urea, mulch and compost + NPK + Urea.

The interaction between tillage practices and fertility management options did not significantly affect the measured parameters.

There was a positive relationship between hydraulically functioning pore diameter and soil hydraulic conductivity values with a R^2 value of 0.77 % (Fig. 1).

Discussion

In the Sahelian zone of Burkina Faso, where adequate water availability for plant growth is and continues to be a major constraint to crop production, there is an urgent need to make full use of the soil as a water reservoir and conductor to sustain crop growth and yield. This is even more so in the ongoing climate variability and change, the adverse impacts of which are extending to hitherto favourable agro-ecological zones, such as the south Sudan of Burkina Faso.

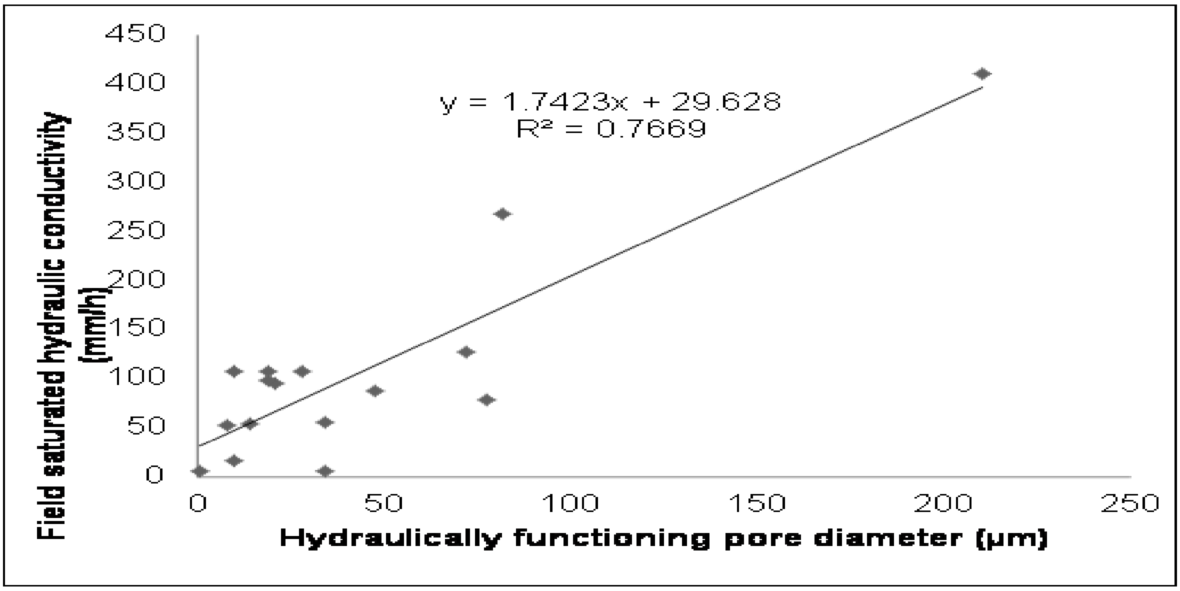

Fig. 1. Relationship between hydraulically functioning pore diameter and field saturated hydraulic conductivity.

Available strategies to achieve this include managing the soil to take up as much water as possible for storage and insuring that the water stored is optimally used by plants for photosynthate production through transpiration. This requires reducing the non - productive evaporation from bare soil surfaces and weeds. These goals can be achieved by enhancing the soil's infiltrability (infiltration control) whilst reducing evaporation (evaporation control) through the respective use of tillage and crop residue management, particularly mulching (Palese *et al.*, 2014).

The major physical properties of the soil affecting it water intake, storage, recharge of groundwater, onset of overland flow and deep percolation are sorptivity, infiltrability, hydraulic conductivity and porosity especially pore size distribution and pore continuity (Turner, 2006; Ouattara, 2007). These properties measured in this study respond variably to different tillage, residue management and soil amendments. These responses, which have hitherto not received much attention, particularly in the south Sudan zone of Burkina Faso, are discussed separately but integratively to show how they act individually and together to achieve the goal of water intake and storage in the soil and their implications for water conservation.

Sorptivity

Sorptivity is a measure of the capacity of the soil to absorb or desorb water by capillarity without gravitational impact (Philip, 1957). It is embodies in a single parameter the influence of matrix suction and conductivity on the transient related to changes in surface wetness or suction. Sorptivity values depend on initial water content and diminish as initial moisture increases (Philip, 1957). These values therefore have meaning only in relation to initial and final moisture content (Hillel, 1998). According to Bonsu (1993) and Raut *et al* (2014), sorptivity is an important soil characteristic which governs the early stage of infiltration with significant impact on time – to-incipient ponding, defined as the transition between predonding and ponding during infiltration into unsaturated soil. The latter influences the overland flow production potential of the soil and the commencement of the sediment transport by overland flow in the erosion process.

The results of the study showed that the magnitude of sorptivity, measured at an initial soil moisture range of 0.05 – 0.10 m^3 m^{-3}, did not vary significantly among the tillage practices, except that between Ripping and Zero tillage ($P<0.05$). However, all tillage practices beyond Zero resulted in higher sorptivity with percentage increment being 3, 7 and 10 under Tied-ridging, Conventional tillage and Ripping respectively. This could be the loosening of the soil under the latter three practices which resulted in a greater total porosity than the relatively compact Zero-tilled soil (1.66 Mg ^{3}).

It is worthy to note, however that whilst total porosity is an important consideration in soil water processes such as sorptivity, infiltration, hydraulic conductivity and water storage, pore size, distribution and continuity exert the most significant impact. Yet most studies on these processes lay emphasis on total porosity to the neglect of the size determination, presumably because of the ease of measurement of the former.

The results further showed a tendency of sorptivity to decrease with increasing pore size. Thus sorpitivity of the tillage practices (Zero, Ripping and Conventional) which recorded hydraulically functioning pore sizes within the capillary pore size range (micro and meso pores) were higher than Tied-ridging which had non capillary pores (macro pores). This may be due to the greater dependence of sorptivity on matrix suction resulting from the physical affinity between water and the matrix of soil, including both the soil particle surfaces and the capillary pores than gravitational force (Hillel, 1998). Indeed this accord with Hallett's (2008) assertion that soil with larger (non-capillary) pores has lower sorptivity than that with smaller (capillary) pores. Even in the latter range, sorptivity decreased with increasing pore size micro (Ripping and Conventional) to meso (Zero) pores. The magnitude of sorptivity has important implications for time-to-incipient ponding. Higher sorptivity increases time-to-incipient ponding and delays the onset of overland flow production through affording the soil a greater contact time for water intake and storage. This decreases runoff volume and energy for sediment transport and erosion is thereby reduced. The higher sorptivity recorded under Ripping than Zero tillage implies a greater cumulative infiltration and less potential risk to runoff and erosion. This is reasonable considering that, apart from having similar residue-covered surface condition as the Zero plots, Ripping produced shallow slits with micro bunds along the edges on the contour to serve as in-situ water harvesting and conservation zones.

Sorptivity was also influenced by soil amendments. At the base value of the control plots, sorptivity was increased but not significantly by compost. However, it was significantly reduced by all the other soil amendments, and more so by mulching. The underlying reason may be due to the impact of the amendments on pore size. Whilst the compost maintained the microporosity of the control, the other amendments, especially mulching and compost + NPK + Urea increased the micro to mesopores with a consequent reduction in sorptivity as pointed out earlier. Studies of the impact of soil amendments on sorptivity are scare in the literature and would require in depth research attention to facilitate a better understanding and management of soil amendments of enhanced soil water relationships and productivity.

Infiltration

The implication of the preceding discussion is that, in rainfed agriculture, the farmers' insurance for available water for sustainable crop growth and yield is what is stored in the soil. Soil infiltrability plays a major role in this by enhancing in-situ rain water harvesting and conservation, recharging groundwater and reducing runoff and erosion (Ouattara, 2007; Hati *et al.*, 2015).

Infiltration, being the process of water entry into the soil, generally downward flow through all or part of the soil surface (Hillel, 1998), is influenced by the characteristics of the soil, especially its sorptivity and hydraulic conductivity. Other factors include rainfall intensity, temperature, vegetation cover, and distribution of soil moisture and availability of water at the surface (Fujita, 2014).

As an initial entry of water into the soil, infiltration is affected by mechanical loosening of the soil and residues management (Ouattara *et al.,* 2007). Consequently, the results of the study showed tillage and soil amendments to significantly influence infiltration. All tillage practices beyond Zero significantly enhanced infiltration with Ripping and Conventional tillage recording the highest values. As observed by Ehlers *et al.* (1987) all tillage methods which increase the looseness and openness of the top soil are of benefit to soil infiltrability. In a loose soil, the voids temporarily store water and the rapidly draining pores conduct the water into deeper layers. In an open soil, the voids and macrospores remain accessible and thus play a major role in infiltration and drainage. However, on many structurally unstable loams, such as sandy loam in this study, the open structure is rapidly lost as a result of surface slaking and sealing by raindrop impact. In these circumstances the infiltrability declines rapidly.

According to Hillel (1998) and Ladon (2014), the infiltration process can be viewed as a function of the intrinsic permeability of the soil and the fluidity of the penetrating liquid. The former includes sorptivity and hydraulic conductivity and the latter, density and viscosity.

The results showed infiltration to follow the same trend as sorptivity which tended to decrease with increasing hydraulically functioning pore size. This is contrary to expectation whereby infiltration increases with increasing pore size. The underlying reasons lies with the distinction between the infiltration process under saturated and unsaturated soil and non-ponding and ponding conditions. The major difference is in the hydraulic conductivity of the soil under saturated and unsaturated flow conditions.

In this study, infiltration was measured under unsaturated conditions at the tension head (h) of 0, -5 and -10 cm. In such circumstances, large pores (macropores) as recorded under Tied-ridging quickly empty and become no-conductive as the suction develops and thereby steeply decrease the initially high conductivity. On the other hand, the small pores (micro and meso pores) as recorded under Ripping, Conventional and Zero tillage, retain and conduct water even at appreciable suction, so that hydraulic conductivity does not decrease as steeply, and may even exceed that of the large pores subjected to the same suction such as that of the Tied-ridging. This presumably accounts for why the infiltration values followed the trend of Ripping > Conventional > Zero > Tied-ridging. However, as pointed out by Hillel (1998), the very opposite is often the case when saturated conditions prevail. When the soil is saturated, all the pores are water-filled and conducting. The water phase is continuous and the conductivity is maximal. Under such conditions, the most conductive soils are those in which large and continuous pores, such as that of Tied-ridging, constitute most of the pore volume, whereas the least conductive are the soils in which the pore volume consists of numerous micropores, such as those of Ripping and Conventional tillage. It is in accord with this that saturated sandy soil conducts water more rapidly than a poorly aggregated or dispersed soil (Hillel, 1998).

Field saturated hydraulic conductivity

The latter flow conditions under saturated soil relative to pore size account for reported increased in hydraulic conductivity with increasing hydraulically functioning pore size (λm) in this study which was in the order of Tied-ridging > Zero > Conventional > Ripping. This trend shows that hydraulic conductivity was highest under the tillage treatment with macroporosity followed by that with mesoporosity and the lowest with microporosity. Similar observation has been reported by Ouattara *et al.* (2007) and Teixeira *et al.* (2014). Mulching also significantly enhanced hydraulic conductivity by several orders of magnitude up to about five times of that under the other amendments. The activities of ants and the other burrowing organisms in creating biopores under mulching are implicated in the increase in hydraulic conductivity as observed by Zougmore *et al.* (2004) and Siczek *et al.* (2015). Such pores facilitate preferential flow with consequent increase in saturated hydraulic conductivity.

Conclusion

The results showed that tied ridging practice notably improved soil hydraulic conductivity and soil hydraulically functioning pores sizes diameter compared with the pervasive conventional tillage, ripping and zero tillage practices. The improving tendency value of hydraulic conductivity in zero tillage practice on Lixisol soils suggests that Zero tillage has the potential for reducing runoff and soil erosion in the South Sudan Zone of Burkina Faso. Organic matter application improved filed saturated hydraulic conductivity. The result suggests that soil fertility management option should integrate the used of compost or other organic matter sources in addition to mineral fertilizer to improve soil hydraulic characteristics.

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