Journal of Agriculture and Environmental Sciences
December 2015, Vol. 4, No. 2, pp. 104-112
ISSN: 2334-2404 (Print), 2334-2412 (Online)

Published by American Research Institute for Policy Development
DOI: 10.15640/jaes.v4n2a12
URL: http://dx.doi.org/10.15640/jaes.v4n2a12

Effect ofTwoTypes ofTillage andN-FertilizatioNoncotton Root Biomassin the WaterShed ofOuri-Yori(Municipality Of Materi)

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Abstract

Management of soil fertility in particular of the tropical degraded ferruginous soils is a key factor for attaining potential crop yield. An experiment was conducted to investigate the effect of different systems of tillage and nitrogen fertilizer on root biomass of cotton (*Gossypiumhirsutum*), plant height and leaf area index. The experiment was laid out in a split plot design with tillage systems [conventional tillage (CT) and reduced tillage (RT)], fertilizer rates (0; 60 and 120 Kg N/ha) and mulching [Crop mulching (M) and no mulching (NM)]. Our results showed that at 30, 60 and 120 days after sowing, tillage systems had a significant effect (P<0.001; P<0.01and P<0.05) on cotton root biomass at 0 - 10 cm; 10 - 20 cm and 30 - 40 cm depth. A significant effect of tillage system was also recorded on plant height at 21, 42 and 63 days after sowing. The highest average plant height (121 ±1.3 cm) was obtained with the conventional tillage. However, tillage system did not show a significant (P>0.05) effect on the leaf area index. The effect of nitrogen fertilizer was significant (P<0.01 and P<0.05) on root biomass at 90 and 120 days after sowing. The interaction between tillage system and nitrogen fertilization dose significantly (P<0.01 and P<0.001) affected the root biomass. However, the highest number of roots (15.453±3.23g/plant), plant height and leaf area index was recorded in the conventional tillage with the fertilizer rate of 120 kg N/ha. In addition, tillage system and nitrogen fertilization had a significant effect on the date of flowering of cotton plants.It can be concluded from the study that CT and nitrogen fertilizer boosted root growth, leaf area index and plant height of cotton.

Keywords: Soil tillage, nitrogen fertilizer, tropical ferruginous soil, cotton roots

Résumé

La gestion de la fertilité des sols est une nécessité dans l'atteinte des rendements potentiels des cultures. La présente étude a eu pour but la détermination de l'effet combiné des différents types de travail du sol, du paillage et de la fertilisation azotée sur la biomasse racinaire du coton (*Gossypiumhirsutum*), de l'indice de surface foliaireet de hauteur dans la perspective d'accroitre la productivité de la plante. Le dispositif expérimental est un split plot avec pour facteurs principal, lesystème de travail du sol[labour conventionnel (LC) et labour réduit (RT)], et pour facteurs secondaires: la fertilisation azotée à des doses de (0; 60 et 120 kg N/ha) et le paillage [paillage (P) et sanspaillage (SP)]. Nos résultats ont indiqué que les systèmes de labour ont été hautement significatifs (P<0,001 ; P<0,01 et P<0,05) sur la production de biomasse racinaire à 0-10; 10-20 et 30 – 40 cm de profondeur du sol ceci à 30; 60 et 120 jours après semis (JAS).

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La croissance en hauteur des plants a également été significativement (P<0,001 et P<0,01) influencée par les techniques de travail du sol (à 21 ; 42 et 63 JAS). La plus forte valeur moyenne de la hauteur des plantes (121,19±1,31 cm) est obtenue dans le traitement LC. Cependant, les techniques de travail du sol ont eu un effet non significatif (P>0,05) sur l'indice de la surface foliaire (ISF). L'effet de la fertilisation azotée a été significativement (P<0,01 et P<0,05) plus marqué sur la production de biomasse racinaire (à 0-10 ; 0 – 30 et 0 – 10 cm de profondeur du sol) ceci à 90 et 120 JAS, mais non significatif (P>0,05) à 30 et 60 JAS. L'effet significatif (P<0,01 et P<0,001) de l'interaction n'apparait sur la biomasse racinaire qu'à 90 et 120 JAS respectivement dans les profondeurs de prélèvement de 10 – 20 cm et 30 – 40 cm. En effet, le système de labour (LC) a produit significativement (P<0,05) plus de biomasse des racines (15,453±3,23g/plant) avec la dose 120 N kg/ha comparativement au système RT. Des effets similaires ont été observés sur la hauteur des plants et l'ISF. On peut conclure que le labour conventionnel et la fertilisation azotée améliorent la prolifération des racines et la hauteur des plants du cotonnier.

Mots clés : Fertilité du sol,fertilisation azoté, labour, biomasse racinaire, Coton, Bénin.

1. Introduction

Scenarios of climate change are of growing importance especially in agriculture. According to the predictions and the estimated effects developing nations are the most vulnerable to the manifestationsof climate change. Recently, several authors have focused on different simplified cultivation techniques (SCT) with respect to tillage to mitigate these harmful impacts (Mrabet, 1993; Mrabet, 2001 and FAO, 2010).

Tillage is an ancient practice which one of the first objectives is to create a favorable environment for plant growth and root development (Klute, 1982; Chopart and Nicou, 1976 and Köller, 2003). Certainly, various definitions are assigned to plowing. According to Lal (1979, 1983),it is defined as the physical, chemical or biological soil handling in order to optimize the conditions for germination, establishment of the bed of seedlings and plants growth. Soil preparation can significantly change the nutritional status and the changes can be manifestedby good or bad performance of crops.

Due to the degraded state of agricultural land in Benin, which extreme irregularities of climate added to,one of the problems that need to be solved for the operator would be the development of strategies that best contributedto promote their exploitation. Turning to these threats, many studies or research has been conducted in various soil and climatic conditions (Unger et al, 1991; Arshad, 1996; Gómez et al., 1999; Dercon et al., 2010a, 2010b). It was established positive correlations between total root weight and peanut yields, maize and sorghum (Chopart and Nicou 1989). Generally, the obtainingof optimal performance remains mixed regarding certain factors, such as land degradation, erratic rainfall and the adoption of new tillage practices.

To better understandthe impacts oftillagepatterns andnitrogen fertilizationon the developmentof cotton root system,this researchwas initiated, especially in anincreasinglyimportant climate change context .It essentiallyaims to:(1)determine the effectof two types oftillageonroot biomassproduction; (2)assess thelevels of nitrogeninthe amount ofproducedroot and then , (3) determine the effectof the types oftillage andN-fertilizationonthe height andleaf area index(LAI) of cottonplants .

Materials and Methods

Area of study

The experimentalsite is locatedin the northwestof Benin(10 °38'-11 ° 4 'North latitude and 0°48'-1 ° 10'East longitude). The average annualtemperature hovers around32.3°Cand average rainfall is1000 mm/year.The experimental plotswere installedduring the2013crop yearon aferruginoustropical soilleachedmoderatelydeep. The plotsweresown ofcotton(*Gossypiumhirsutum*) and coveredby maize cropresidues (Zea mays)from the previous year(2012).

Tillagesystem androotsamples

Twotillagetypes werecompared: Conventional Tillage (CT) and Reduced tillage (RT). Conventional tillagewas performedusinganimaltractionin the firstfortnight ofMay 2013andreduced tillagehas not undergone anyform of tillage before cottons owing (*Gossypiumhirsutum*) to June 26/2013. Theseplots (RT) were treated withthe herbicidetoa weekof the sowing.Subplots sizewas 10x 5m²and experiencewas organizedfollowingthesplit plot designofsix treatmentswith fourrepetitions.Four differentdepths ofsoil[0-10;10-20; 20-30; 30-40cm]were examined forthe evaluation of thetotal rootbiomass (NicouandChopart, 1976) at various stages ofplant development.

Nitrogenlevels andmulching

Three nitrogenlevelswere also tested. N1 andN2 treatmentsrepresentrespectivelytheaveragetreatment rates (N1= 60Kg/ha) and the highorN2 =120Kg/hafollowed by the witnesstreatment (N0 = 0 Kg/ ha).Maizecrop residuesof year2012were usedfor the mulchingof subplots.Thesinglemineral fertilizersused for fertilizationplotswerein the formof urea(46%N), triple superphosphate (46%P_2O_5) and potassium chloride (60% K_2O). Application ofnitrogenwas done intwo identicalfractions,the first fractionwas made20days after sowingas well as allofP and K, the second half ofnitrogenwas applied40 day's aftersowing.

Table1: Characteristics ofdifferentsappliedfertilizerformulas

Nitrogen level (kgN/ha)	Nutrientintake (kg / ha)			Amount		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
0	0	60	40	0 (0)	300 (650)	200 (330)
60	60	60	40	300 (652)	300 (650)	200 (330)
120	120	60	40	600(1304)	300 (650)	200 (330)

Values in parenthesis represent the amounts of urea, triple superphosphate and potassium chloride applied to each elementary field.

Statistical analysis

Data were subjected to ANOVA and mean values separated using Fisher's least significant difference test at $P < 0.05$. The multiple comparison test was carried out with Fisher's least significant difference (LSD).All statistical analyzes different variables were performedby SAS 9.2general linear model procedure.

Results and Discussion

Influenceof the type's oftillage systemson cottonplants growth data

Root Biomass: Theroot biomass of the cottonplantsfor each type oftillageis shownin Table 3.At the endof the study,the analysis of varianceshowedsignificant differencesinroot biomassat thedepth0 – 10to 30cmthis30DASand depths0 – 10cm; 10 – 20cm at 60DAS (Table 2)between the differenttillagetreatmentsexcept forthoseobtainedin periods of90 and 120days after sowing(DAS).

Indeed, the CT treatment has positively affected the root's production at 30 and 60DAS compared to RT treatment (Table3 and Table 2).Despite theinsignificant effect tillage types on root biomass90 and120DAS, CT treatment shows average values relatively greater than the RT process singonall examined depths. In particular,thedepthfrom 30 to 40cmis providedinroot biomassin the CTtreatmentand12%greater thantheRTprocessing one. This means that thecottonplants in theCTtreatment havea high capacitytotake waterand basement nutrientselementswhat make them lesssusceptibleto the vagaries ofrainfalland climate change.These results are similarto Chopart, (1993) who observedadequate growthof the root systeminthetilledplotsin comparison with the untilled landSenegal.Carman andal. (1997); Wright andal.(2008) have noticed that thereduced tillagehas leadto upper layerscompaction andtherebyreduces therootdevelopmentspeed.

According to Nelson(1974), inacertainloweredplowingcondition, counting of thesoil becomesdetrimentalto the proliferation ofroots.In addition,therootcotton productioniscloselyinfluenced bythe strength of thesoil.

Table 2: Analysis of Variance Table to three factors (F-value) of the root biomass considering tillage, nitrogen fertilization and mulching

Under Variation	dof	Fisher value – Root biomass (g / plant)												
		30 DAS	60 DAS			90 DAS				120 DAS				
		0 – 10 (	0 – 10 (	10–20	0 – 20 (	0 – 10	10–20	20–30	0 – 30	0 – 10	10–20	20–30	30 –4 0	0 – 40
Tillage	1	41,40**	14,56**	11,97*	15,27**	0,97**ns**	2,06**ns**	0,32**ns**	1,12**ns**	1,10**ns**	0,77**ns**	0,50**ns**	6,29*	1,34**ns**
Nitrogen	2	1,89**ns**	0,62**ns**	0,01**ns**	0,49**ns**	7,12**	2,83**ns**	0,04**ns**	7,86**	3,42*	0,95**ns**	1,57**ns**	0,29**ns**	2,97**ns**
Mulching	1	0,01**ns**	0,95**ns**	0,51**ns**	0,98**ns**	0,43**ns**	8,64**	0,48**ns**	0,84**ns**	0,05**ns**	0,69**ns**	3,00**ns**	13,48**	0,43**ns**
Tillage*Nitrogen	2	0,18**ns**	0,68**ns**	1,28**ns**	0,81**ns**	1,49**ns**	0,55**ns**	3,08**ns**	2,09**ns**	4,30*	5,23*	1,92**ns**	1,19**ns**	5,16*
Tillage*Mulching	1	0,70**ns**	0,05**ns**	0,07**ns**	0,02**ns**	6,49*	2,88**ns**	0,04**ns**	6,95*	0,04**ns**	0,00**ns**	1,02**ns**	6,66*	0,09**ns**
Nitrogen*Mulchi	2	0,79**ns**	0,06**ns**	0,22**ns**	0,05**ns**	0,14**ns**	1,32**ns**	0,71**ns**	0,03**ns**	0,57**ns**	0,96**ns**	0,98**ns**	0,18**ns**	0,70**ns**
Tillage*Nitrogen	2	0,03**ns**	1,01**ns**	0,76**ns**	1,08**ns**	1,09**ns**	0,24**ns**	1,27**ns**	0,91**ns**	1,18**ns**	0,05**ns**	1,18**ns**	1,29**ns**	0,78**ns**

dof : degree of freedom ; ns : P > 0,05 ; * : P < 0,05 ; ** : P < 0,01 ; *** : P< 0,001

Table3: Evolution of theproductionofcottonplantsrootbiomassbasedontillagetechniques

Root biomassplantcotton(g / plant Number ofdays after sowing (	**Depths (cm)**	**Conventional Tillage (CT)**	**Reduced Tillage (RT)**
30	0-10	0,05±0,00a	0,02 ±0,00b
60	0 - 10	0,81±0,07a	0,11±0,01a
	10-20	0,45±0,00b	0,05±0,00b
90	0-10	4,20±0,03a	3,85±0,23a
	10-20	0,38±0,04a	0,31±0,03a
	20-30	0,18±0,01a	0,16±0,04a
120	0-10	8,05±0,98a	6,95±0,58a
	10-20	2,09±0,36a	1,74±0,21a
	20-30	0,47±0,10a	0,39±0,04a
	30-40	0,31±0,04a	0,19±0,01b

Values followed bythe samealphabeticalletterof the same characterandthe same factorare not significantlydifferent (P> 0.05) according to theLSDtest.

Height: Figure 1 shows the results of the effect of different types of tillage on the growth of the cotton plant height. ANOVA showed significant effect of tillage techniques on plant height, this to 21; 42; and 63 days after sowing (Table 4). The highest average heights are obtained in the CT treatment (11.98 cm; 32.13 cm;67.89 cm) compared to treatment RT which indicated lower values (9.63 cm; 23.68 cm; 55 61 cm)

These results are similar to those of Kayode and Ademiluyi(2004) which observed low heights corn plants in the non-tilled plots compared with tilledplots in South -West of Nigeria. Khurshid et al. (2006) also achieved great heights of the plants in the conventional tillage system compared with tillage system reduces plots in Faisalabad in Pakistan. Aikins and Afuakwa (2010) also found the greatest heights of the Cowpea plants in tilled plots in comparison with non-tilled plots. Indeed, the combined effect of three factors (tillage types, soil mulching and nitrogen) was significant (P <0.05) only in the first measurement (Table 4). Thus, it is obvious that different tillage methods play a key role in the growth and development of the cotton plants.

Table 4: Analysis of Variance Table to three factors (F-value) of the root biomass considering tillage, nitrogen fertilization and mulching

Fisher Value Under variation	dof	Height				
		21 DAS	42 DAS	63 DAS	84 DAS	115 DAS
Tillage	1	66,27***	44,41***	11,64**	0,29ns	2,94ns
Nitrogen	2	1,28ns	1,71ns	2,93ns	7,84**	22,27***
Mulching	1	7,21*	5,91*	1,99ns	0,59ns	0,46ns
Tillage*Nitrogen	2	1,41ns	1,68ns	0,55ns	1,69ns	2,15ns
Tillage*Mulching	1	1,00ns	0,11ns	0,28ns	0,04ns	0,10ns
Nitrogen*Mulching	2	0,45ns	0,53ns	0,01ns	0,08ns	0,50ns
Tillage*Nitrogen*Mulching	2	4,23*	0,73ns	0,72ns	0,27ns	1,04ns

dof: degree of freedom ; ns : P > 0,05 ; * : P < 0,05 ; ** : P < 0,01 ; *** : P< 0,001

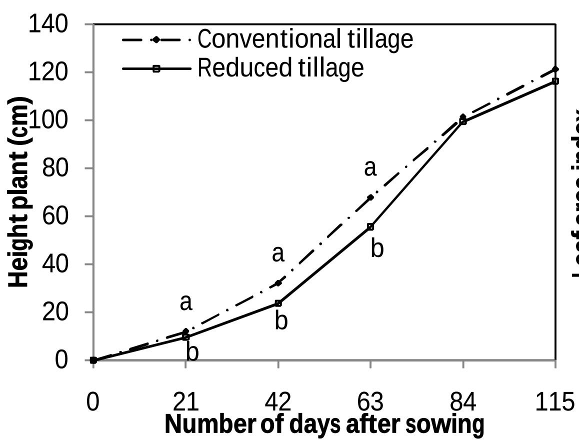
The leaf area index: The development of leaf area of cotton plants is important for photosynthesis and for yield. The photosynthetic capacity of crops is a function of leaf area. The role of leaf area is crucial for crops in the interception of light rays and thus has a large impact on crop yields (Dwyer and Stewart, 1986). Figure 2 shows effect of tillage systems on the evolution of the leaf area index (LAI) of cotton plants during the experiment. There is no significant effect of tillage systems on the LAI during the experimental period (Table 5). But the best LAI were observed in the tilled plots throughout the growing seasonin comparison with the RT. Thus, the RP treatment produced plants with reduced leaf area andthen did not allow a better development of the aerial biomass.

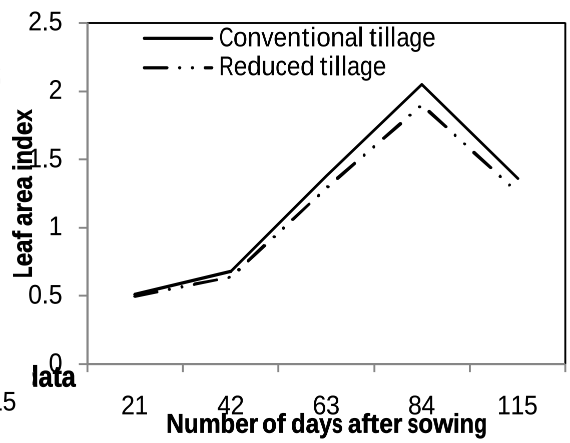
Table 5: Analysis of VarianceTableto three factors (F-value) of the leaf area indexregarding tillage, nitrogen fertilizationand mulching

Fishervalue Undervariation	dof	Leaf area index				
		21 DAS	42 DAS	63 DAS	84 DAS	115 DAS
Tillage	1	0,07ns	0,13ns	0,91ns	2,19ns	2,19ns
Nitrogen	2	0,55ns	0,54ns	0,22ns	5,50**	5,50**
Mulching	1	2,48ns	0,05ns	0,03ns	0,13ns	0,13ns
Tillage*Nitrogen	2	4,64*	0,02ns	0,27ns	0,40ns	0,40ns
Tillage*Mulching	1	2,22ns	0,29ns	0,01ns	0,02ns	0,02ns
Nitrogen*Mulching	2	0,11ns	0,99ns	0,02ns	0,48ns	0,48ns
Tillage*Nitrogen*Mulchin	2	2,23ns	0,41ns	3,02ns	1,44ns	1,44ns

dof : degree of freedom ; ns : P > 0,05 ; * : P < 0,05 ; ** : P < 0,01 ; *** : P< 0,001

As a matter of fact,the peakwas observed at12 weeks afterplantingin bothtillagetechniques (CT = 2.05) and (RT=1.90). Butdecreasesat the endof the growing season. This would be related toSenescenceandfalling leavesof the plants.





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Root biomass: The effectof nitrogen fertilizeron the production ofroot biomassisshown in Table6.The influence ofdifferent rates of nitrogenwas positivelysignificant (P <0.01) at samplingdepths0-10cmand0-30cmDAS90andsignificantly(P <0.05) toDAS120atthe samplingdepthof0 – 10cm (Table 2). The dose120 kgN /ha(8.68 ±1.24g/plant) produced the largestamountofroot biomasscomparedto other treatmentsto 120 days.Only the witness treatment induces low producing root (5.58 ± 0.58 g/plant). However, in the depth from 30 to 40 cm differences between the witness treatment and nitrogenrates are very low (Table 6). This shows that the nitrogen fertilizersratesnot contribute to an increase in root density in the basement andto abetter removal of the water and nutrients of lower layers.

The increase in root biomass by doses of nitrogen is only a reflection of the poor soil conditions of study area in nitrogen. These results emphasize the effectiveness of nitrogen and its role in the development of the whole plant (aerial and underground portion) than in the availability of other nutrients in favor of the plant. It has been demonstrated that the nitrogenous nutrition positively affects the proliferation and distribution of the roots and improves soil humidity(Asghar and Kanehiro, 1977). The efficient use of nitrogen not only depends on the rooting depth, but also on the adopted tillage technique.

Table 6: Effectofaddition ofnitrogenousfertilizeronroot biomassproductionof the plantsof cotton

Root biomassplantcotton(g/plant)				
		NutrientN-rates (kg / ha)		
Number ofdays after sowing (DAS)	**Depths Cm**	**0**	**60**	**120**
30	0-10	0,04±0,00a	0,04±0,04a	0,03±0,00a
60	0-10	0,56±0,06a	0,68±0,11a	0,65±0,08a
	10-20	0,08±0,01a	0,09±0,01a	0,08±0,01a
90	0-10	3,27±0,25b	4,89±0,39a	3,90±0,28b
	10-20	0,28±0,26b	0,42±0,06a	0,33±0,03ab
	20-30	0,16±0,06a	0,18±0,01a	0,17±0,02a
120	0-10	5,58±0,58b	8,24±0,89a	8,68±1,24a
	10-20	1,53±0,21a	2,18±0,27a	2,04±0,53a
	20-30	0,29±0,03a	0,49±0,06a	0,51±0,15a
	30-40	0,25±0,04a	0,27±0,04a	0,23±0,05a

Values followed by the same alphabetical letter of the same character and the same factor are not significantly different (P>0.05) according to the LSD test.

Plant Height: The height difference between the different applied doses of nitrogen was significant in the development stages of the plant (Table 3). The results show that the effect of nitrogenapplication is significant (P <0.05) during the growth periods from 63, 84 and 115 DAS (Figure 3). The cumulative effect of the CT and the different applied ratesof nitrogen appears significant (P <0.05) on plant height 21 and 84 (DAS).
On the contrary the effect of the interaction of RTtreatment and various nitrogen levels becomes significant (P <0.05) from 42 and 84 DAS. The favorable effect of nitrogen fertilization was noticed throughout the growth of plants.

In generalthe average values ofthe highestheightinthegrowthare observedat rates 60 and 120kgN /ha(124.675 ±3.05cmand126.806±2.23cm)comparedto the witnesstreatment (0 kg N/ ha)witha significantlylower value(104.837±2.50cm) at the end of the cycle (Figure 3).So, it is a proven fact thatthe application ofnitrogenboosts thegrowthand development ofplants.These results are inagreementwiththoseofRochester andal.(2001)who showedthat the height of the cottonplantsisrelated to the levelofnitrogenin the soil.

The leaf area index: The effect of nitrogen application on the evolution of the leaf area index (LAI) is shown in Figure 4. The analysis of variance showed the significantly effect of the nitrogen intake (P <0.01) on the evolution of the leaf area index (LAI) of cotton plants only 84 DAS (Table 4).

It was found that the index of leaf area of the plant increases gradually as the growth cycle increases before reaching its peak at 84 and decreases to 115 DAS reflecting thereby the leaf senescence and physiological maturity. Indeed, the evolution of the LAI in time depends on the soil and nitrogen fertilization. The dose 60 kg N/ha has exacerbated the LAI (2.28 ± 0.10) elucidating good development of aerial biomass. These results are due to the quality and quantity of nutrients in the fertilizer becauseMengel and Kirkby (1978) have shown that the nitrogen and phosphorus induce the growth of leaves and therefore increasesof the LAI in the most part of the plants.

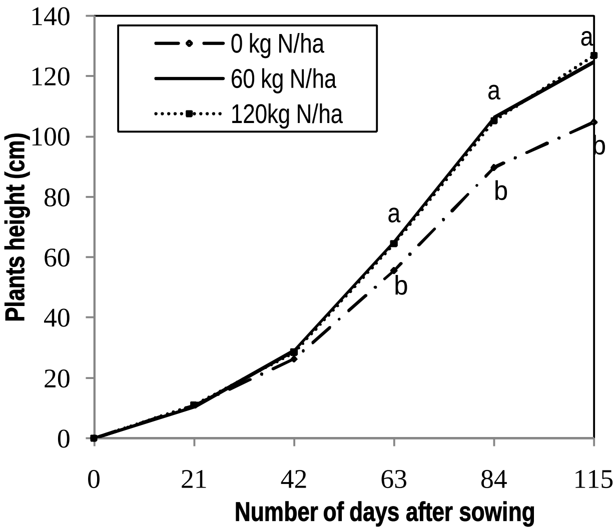

Fig3: Evolution ofplant heightas a function ofvarious dosesofnitrogen

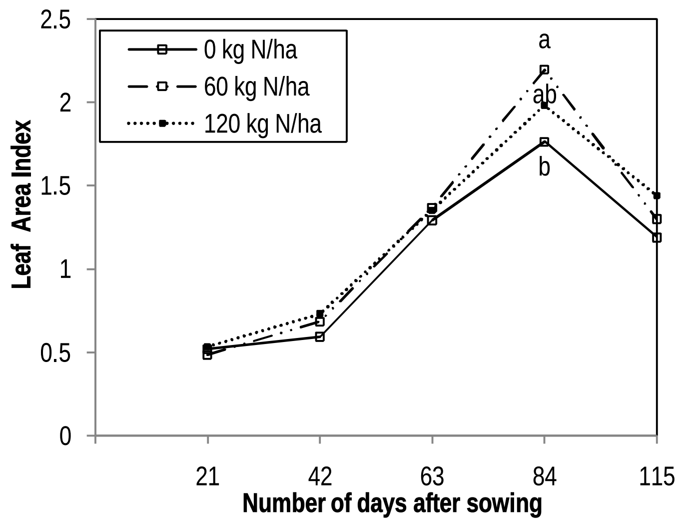

Fig 4: Evolution of theleaf isanindexofplantsconsidering thevarious dosesof

Interaction between tillage and nitrogen rates on root biomass plant cotton

The results of the analysis of variance showed that the combined effect of tillagemethods and nitrogen fertilization was significant (P <0.05) at 120 days after sowing (DAS) and this at 0-10 cm; 10 to 20 cm depth (Table 2). The effect of nitrogen and tillage become insignificant as the sampling depth increases. In fact, growth and root development not only depend on the soil type of work but also on the amount of available nitrogen in the soil. The best root biomass production was obtained with the combination of CT-treatment and the high rate of nitrogen (120 kg/ha), resulting thereby a good colonization of the soil by the roots and betterdevelopment of root front. However, the difference was significant (LSD 0.05) between treatments (CT and 120 kg N/ha) and (RTand 120 kg N/ha) on the root biomass in the layers 0-10; 10-20; 20-30; 30-40 cm depth with positive effect of CT on root biomass production (Table 7).

Table 7: Effect of conjugated tillage type and nitrogen fertilization on cotton root biomass

Depths (cm)	**Root biomassplantcotton(g / plant) to 120 DAS**							
	NutrientN-Rates (kg / ha)							
	0			**60**			**120**	
	CT	**RT**		**CT**	**RT**		**CT**	**RT**
0-10	5,43±0,93b	5,73±0,76b		7,36±1,26ab	9,12±1,27a		11,36±2,16a	6,00±0,37b
10-20	1,42±0,26a	1,63±0,35b		1,73±0,39a	2,62±0,34a		3,12±0,92a	0,96±0,17b
20-30	0,26±0,04a	0,32±0,06ab		0,45±0,08a	0,54±0,09a		0,70±0,30a	0,31±0,05b
30-40	0,35±0,06a	0,14±0,02b		0,30±0,07a	0,24±0,03a		0,26±0,11a	0,19±0,03ab

CT Conventional tillage; RT: Reduced tillage;Values followed by the same alphabetical letter of the same character and the same factor are not significantly different (P> 0.05) after the LSD test

Interaction of the tillage type and mulching on root biomass plant cotton

Tables 8 and 9 indicate the cumulative effect of the tillage system and mulching on the root amount produced by the cotton plants. Through the analysis of variance, its result showed that the interaction was significant ($P < 0.05$) on root biomass in the sample layer 0-10 and 0-30 cm DAS 90 and 30 - 40 cm DAS 120 (Table 2). The influence of the interaction was significant positively (LSD 0.05) in the combinations "without mulching" and "RT" compared to treatment "without mulching" and "CT" (Table 8) in the first two layers excavated. These variations in root biomass must be dependent on tillage type. At that time the RT was favorable to the development of the root system. The same pattern was also observed with the CT and treatment "without mulching" in the last depths (Table 9).

Table 8: Combined effectof thetillage type andmulchingoncottonroot biomass

Root biomass(g / plant) 90DAS Depths (cm)	**Mulching**		**Withoutmulching**	
	CT	**RT**	**CT**	**RT**
0-10	4.53±0.54a	3.28±0.24a	3.86±0.38a	4.41±0.34b
10-20	0.35±0.03a	0.20±0.01a	0.41±0.07a	0.42±0.04b
20-30	0.17±0.03a	0.20±0.08a	0.14±0.02a	0.16±0.02a

CT:Conventionaltillage; RT: Reduce tillage;Values followed bythe samealphabeticalletterof the same characterandthe same factorare not significantlydifferent (P> 0.05) after theLSD test

Table 9: Combined effect of the tillagetype and mulching on cotton root biomass

Root biomass (g / plant) to 120 DAS Depths (cm)	**Mulching**		**Withoutmulching**	
	CT	**RT**	**CT**	**RT**
0 - 10	7.83±1.09a	6.93±0.82a	8.27±1.68a	6.96±0.85a
10 - 20	1.92±0.51a	1.57±0.31a	2.26±0.53a	1.90±0.31a
20 - 30	0.32±0.03a	0.35±0.06a	0.62±0.20a	0.43±0.06a
30 - 40	0.16±0.02a	0.16±0.01a	0.45±0.07b	0.21±0.03a

CT:Conventionaltillage; RT: Reduce tillage; Values followed bythe samealphabeticalletterof the same characterandthe same factorare not significantlydifferent (P> 0.05) after theLSD test

Conclusion

This study examined the effect of two types of tillage and nitrogen application on root biomass, height and leaf area index of the cotton plant. The results of the different treatments suggest that the effect of tillage method has a significant influence on the dynamics of root production. The analysis of the effect of plowing types reveals an increasing development of root biomass with conventional tillage system (CT). Low values were observed with the reduced tillage technique (RT). Similar observations were made on height growth and Leaf Area Index of the cotton plants.

Overall, the contribution of different nitrogen doses significantly improved the production of root biomass, height and leaf area index of plants. It should be noted that besides the benefits induced by conventional tillage, reduced tillage system (RT) seems more advantageous to producers due to lower expenses related to labor and time saver that it promotes.

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