Arid Zone Journal of Engineering, Technology and Environment. October, 2007; Vol.5, 54-59

Print ISSN: 1596-2490, Electronic ISSN: 2545-5818
www.azojete.com.ng

EFFECTS OF TILLAGE TREATMENTS ON WEED CONTROL IN A MAIZE FIELD ON SANDY LOAM SOIL OF NORTH EASTERN NIGERIA

Kawuyo, U.A.[1], M. A. Haque[1] and A.M. Usman[1]

Abstract

This study was carried out to determine the effects of tillage treatments; namely: zero-tillage (T_1), disc ploughing (T_2), disc harrowing (T_3) and disc ploughing followed by disc harrowing (T_4) on weed control in a maize field. Plant height (cm), weed density (No/m^2) and fresh weed weight i.e. weed biomass (g/m^2) were measured at various growth stages of the crop, while grain yield (Kg/ha) was determined after harvest. The study was conducted in 1999 and 2000 farming seasons.

The results showed that there were significant differences between tillage treatments for all the measured parameters in both years. The grain yield increased by 34and 36% for the year 1999 and 2000 respectively when treatments T_1 and T_4 were compared. A reduction in weed density at harvest by 57 and 52% in 1999 and 2000 respectively was obtained when treatments T_1 and T_4 were compared. Also, there was a 53 and 34% reduction in 1999 and 2000 respectively for the weed biomass when these two treatments were compared. It was recommended that treatment T_4 be adapted for better weed control.

1. Introduction

Tillage in agriculture is defined as the mechanical manipulation of soil to provide conditions suitable for the growth of crops, control of weeds, maintenance of infiltration capacity and aeration (Farral and Basselman, 1979; ASAE, 1993). Reasons for tilling the soil have also been given by many authors and these include seedbed preparation, weed control, improvement of soil physical conditions, management of plant residues, minimizing soil erosion, incorporation f fertilizers and to improve productivity (Foth 1978; Kepner *et al*. 1978 and Ohu, 1995).

In agriculture, a weed is any plant growing in a place not meant for it. This may be herbaceous or woody, creeping or erect. Almost any kind of plant can, therefore, be a weed as long as it exists in a location or situation where it is considered undesirable. Weed is certainly a major nuisance for farmers. In any crop production, weed is one of the major factors affecting crop yield. This is due to competition for a number of vital resources such as light, water and nutrients (Anonymous, 1987). According to Rouanet (1987), maize needs to be weeded two or three times (for optimal yield). First, at the plantlet stage, that is, 10-15 days after emergence; secondly, at the start of booting, and thirdly, before harvesting to facilitate harvesting operations. He further reported that, weeding by hoe at three and seven weeks after planting is required for optimum yield. If herbicide is used, Primextra, a pre-emergence herbicide (5L/ha) should be applied within two days after planting (DAP) in the case of conventional tillage. For strip tillage, Primextra (5L/ha) plus Gramaxone (4 L/ha) should be used (Rouanet, 1987).

Data from many experiments support the conclusions that the major reason for cultivation is weed control. It was reported by Matasova *et al*. (1971) that high yield on plots with two

[1] Department of Agric. & Environmental Resources Engineering, University of Maiduguri, Maiduguri. Nigeria

cultivations was due to effective weed control. Stach (1992) conducted a study on soil cultivation in relationship to the development of weeds and reported that weeds occurred at higher frequencies on no-tilled plots. In a study on the effect of reduced tillage systems on weed population in Denmark, Thorup (1985) reported that, in general, reduced tillage cost less, gave higher yields and significantly reduced the stand of weeds.

Even though there are many reported literature (some as cited above) on the effects of tillage practice on weed control, there are only very few information on this for the semi-arid environment of North-Eastern Nigeria. Therefore, the objective of this study was to compare the effects of four tillage treatments on weed control in a maize field on a sandy loam soil and to establish the most suitable weed control tillage method in semi arid environment like North-east Nigeria.

2. Materials and methods

2.1 Experimental area

The experiment was carried out under rain-fed conditions at the University of Maiduguri Teaching and Research farm in 1999 and 2000 farming seasons. The soil has a sandy loam texture (77% sand, 6% silt and 17% clay) (Rayar, 1984). Rainy period in the study area is usually between June and September, a period of about four months. The total rainfall in the area was recorded as 822.6mm in 1999 and 650 .4 mm in 2000 (Daura, 2001). Some of the common weeds available in the study area are: *striga generoides, striga hermontheca, striga aspera*, Gamba grass *macuna* and some volunteer plants.

2.2 Experimental treatments and field layout

A 16-plot experiment consisting of four tillage treatments with four replications was set up in a randomised complete block design. The treatments were: zero tillage (T_1), disc ploughing (T_2), disc harrowing (T_3), and disc ploughing followed by disc harrowing (T_4). The plot size was 18 m x 5 m with alleys of 4 m between replications and 8 m between the plots. This was to accommodate the width and length of the tractor with the implement and to allow the tractor gain speed before the tillage operation was carried out. Disc ploughing was done at an average depth of 20 cm with a 3 – furrow mounted plough, and harrowing with an offset disc harrow at an average depth of 15 cm. Zero tillage involved planting on bare land with minimum soil disturbance. Treatment T_4 involved ploughing followed by harrowing.

2.3 Determination of plant and weed parameters

Maize variety, Suwan-1-SR was planted on 8th July 1999 and 28th June 2000. Planting was done manually by placing 3 seeds/hole at an interval of 0.30 m along the rows and 0.90 m between the rows at an average depth of 5 cm. Thinning to 1 stand/hole was done at 3 weeks after planting (WAP). Fertilizer, in the form of NPK (15:15:15), was applied at the rate of 400 kg/ha at 2 WAP followed by a second dose of urea at 200 kg/ha at 6 WAP as recommended by Anonymous (1989). First weeding was done manually using a hoe at 3 WAP. Second weeding using the same tool was carried out at 7 WAP. The last weeding was done to facilitate harvesting at 12 WAP. For both years, the crop was harvested at 13 WAP.

The parameters studied during the growth period were plant height (cm), weed density (No/m^2), fresh weed weight i.e. weed biomass (g/m^2) and the grain yields (kg/ha). Two weeks

after emergence, five plants from each plot were selected at random and their heights measured using a meter rule. The measurement was done from the ground surface to the tip of the last leaf. Average of these was taken and recorded. At each weeding period, the weed density was determined according to the method described by FAO (1994), while the method described by Olofintoye (1989) was used to determine the weed biomass. The yield from each plot was obtained and expressed in kg/ha. Average values of the plots for each treatment were recorded as the yield of that treatment.

Analysis of variance was used to study the statistical differences between the treatments for each parameter at 5% level of significance. Where there was statistical difference, Duncan Multiple Range Test was used to compare the different treatment means.

3. Results and discussion

3.1 Plant parameters

Plant heights were measured from 2 WAP at two weeks intervals up to 12 WAP and the values are shown in Tables 1 and 2 for 1999 and 2000 respectively. In the first 2 measurements, the rate of growth was low in all the treatments for both years. As from 6 WAP, plants in the tilled treatments were observed to be taller than those in zero-tillage treatments. Treatment T_4 was the best within the tilled treatments in terms of plant height. It was observed that there were significant differences in the plant height as from 4 WAP up to harvest. The significance in the plant height could be due to tillage treatments. Ojeniyi(1986) also reported that different tillage treatments caused significant differences in the height of maize plants.

Table 1: Effects of tillage treatments on plant height, cm (1999)

Treatment	Weeks After Planting (WAP)					
	2	4	6	8	10	12
T_1	12.09*NS	29.50 a	58.09 6	137.36 a	156.55 c	159.97 a
T_2	13.56 NS	35.646	82.94 a	159.46ab	180.41 a	184.876c
T_3	12.68NS	35.426	64.696	141.20ab	168.86abc	172.79abc
T_4	13.19NS	37.99b	90.98a	165.38b	179.92ab	186.45c
SE	0.80	2.14	6.74	10.34	7.52	6.21

* = Mean values of four replicates
NS = Not significant
a,b,c = Means in the same column followed by the same letter are not significantly different at P<0.05(DMRT).

Table 2: Effects of tillage treatments on Plant height, cm (2000)

Treatment	(WAP)					
	2	4	6	8	10	12
T_1	12.95*NS	27.41b	61.94c	141.62bc	163.41c	169.28c
T_2	13.71 NS	31.15ab	85.32ab	163.15ab	191.32ab	215.13ab
T_3	13.12NS	32.54ab	83.16ab	158.76abc	178.15abc	192.81b
T_4	14.23NS	34.73a	91.75a	169.81a	205.36a	221.57a
SE	0.91	2.36	7.42	9.85	9.04	5.46

* = Mean values of four replicates
NS = Not significant
a,b,c = Means in the same column followed by the same letter are not significantly different at P<0.05(DMRT).

3.2 Grain yield

The grains were weighed after threshing and average values obtained were converted to kilogramme per hectare as recorded in Table 3. The highest yield of 854.26 and 972.73 kg/ha were obtained in treatment T_4 and the least of 638.78 and 714.25 kg/ha in treatment T_1 for 1999 and 2000 respectively. Water logging was observed in some plots during the growth period. Also, termites attacked the plots, which led to falling down of some stalks. This happened when there was a short period of dry spell during the growth period. Statistical analysis showed that grain yield was significantly affected by tillage treatments. Tillage significantly increased grain yield in both years.

Table 3: Effects of Tillage treatments on grain yield, Kg/ha

Treatment	(Year)	
	1999	2000
T_1	638.74*a	714.25c
T_2	767.04bc	872.37ab
T_3	750.10abc	815.01bc
T_4	854.26c	972.73a
SE	53.35	56.12

* = Mean values of four replicates
a,b,c = Means in the same column followed by the same letter are not significantly different at P<0.05(DMRT).

3.3 Weed parameters

Table 4 shows the values of weed density in the studied tillage treatments for 1999 and 2000 farming seasons. The values indicated that treatment T_1 had the highest number of weed per square meter throughout the period of study for both years. It was observed that the highest value of weed density (171.25 and 197.12 No/m^2) occurred in treatment T_1 and the least of (72.25 and 81.18 No/m^2) in 1999 and 2000 respectively in treatment T_4 before the first weeding was conducted. Even at harvest, the highest weed density was observed in treatment T_1 and least in T_4 for both years. This could be the reason why plants in treatment T_1 were shorter than those in the tilled treatments as seen in Tables 1 and 2. The weed densities were

lower in the tilled treatments when compared to treatment T_1. This may be the reason for higher grain yields in the tilled treatments. Since for higher yield, the crop should be more competitive and thus tend to suppress the weed population.

Statistical analysis shows that tillage treatments had significant difference on weed density. This result agrees with the report of Campbell *et al*. (1998) which said that differences in weed density with tillage treatments were significant.

Table 4: Effects of tillage treatments on weed density, No/m^2

Treatments	1999 WAP			2000 WAP		
	3	7	12	3	7	12
T_1	171.25*a	103.13a	47.83a	197.12a	120.46a	61.34a
T_2	76.756	39.88b	23.42b	121.35b	77.38a	51.13a
T_3	79.75b	49.88b	27.75b	137.57b	82.14a	54.15a
T_4	72.25b	36.38b	20.42b	81.18c	31.75b	29.24b
SE	11.62	17.82	5.50	15.13	20.25	7.24

* = Mean values of four replicates

a,b,c = Means in the same column followed by the same letter are not significantly different at P<0.05(DMRT).

The mean weed biomass is shown in Table 5 for both 1999 and 2000 farming seasons. At first measurement, the highest value of weed biomass was recorded in treatment T_1 (707.22 and 825.12 g/m^2) and least of 155.68 and 215.81 g/m^2 for 1999 and 2000 respectively in treatment T_4 .This could be attributed to the ploughing and harrowing operations that buried the weed seeds in the tilled treatments. These operations finally resulted to lower weed density and consequently the weed biomass in those treatments. At harvest, the highest weed biomass was observed in treatment T_1 for both years. This observation was similar to that of Mimorovic *et a*l. (1998) where no-tillage gave the highest weed biomass at harvest. Statistical analysis showed that weed biomass was significantly affected by different tillage treatments throughout the study period.

Table 5: Effects of tillage treatments on weed biomass, g/m^2

Treatments	1999 WAP			2000 WAP		
	3	7	12	3	7	12
T_1	707.22*a	309.98a	34.05a	825.12a	481.39a	54.75a
T_2	159.15b	243.74b	16.18b	268.31b	302.05b	40.32ab
T_3	183.30b	282.79b	18.74b	294.17b	357.21b	43.67ab
T_4	155.68b	197.87b	15.84b	215.81b	276.17b	36.32b
SE	46.95	31.41	4.06	51.26	43.14	9.31

* = Mean values of four replicates

a,b,c = Means in the same column followed by the same letter are not significantly different at P<0.05(DMRT).

4. Conclusion

The results obtained from this study showed that there were significant differences between tillage treatments and all the measured parameters. It was found that treatment T_4 performed the best in terms of grain yield and weed control, while treatment T_1 performed the least. Grain yield in treatment T_4 was 34 and 36% higher than in treatment T_1 for the year 1999 and 2000 respectively. When comparing treatments T_1 and T_4 on the basis of weed control at harvest, there was a decrease of about 57 and 52% of weed density in 1999 and 2000 respectively. Weed biomass also decreased by 53 and 34% in 1999 and 2000 respectively. Based on these findings, it is recommended that disc ploughing followed by disc harrowing should be adopted by farmers for better weed control in maize field in the North-Eastern region on a sandy loam soil. However, the ploughing can be done at a shallow depth so as to avoid waterlogging problems since the soils are light soils.

References

Anonymons (1987). Maize production. *Extension bulletin*, A.B.U., Zaria, 13:1-13.

Anonymons(1989). Fertilizer use and management practise for crops in Nigeria. Fertilizer procurement and distribution division of the F.M.A.W.R and R.D.,Lagos.

ASAE (1993). American Society of Agricultural Engineers standards. St. Joseph, Michigan,

Campbell, C.A.; A.G. Thomas; V.O. Biederback; B.G McConkey; F. Selles; D. Spur and R.P Zentner (1998). Converting from no-tillage to pre-seeding tillage: Influence on weeds, spring wheat grain yields and soil quality. *Soil and Tillage Research*, 46:175-185.

Daura, M. (2001). Rainfall data records for 1980-2001. Geography Department, University of Maiduguri (Unpublished).

FAO (1994). Testing and evaluation of agricultural machinery and equipment. Principles and practices. *Agricultural services bulletin*, Rome. Number 110.

Farral, A.W. and J.A. Basselman (1979) *Dictionary of Agricultural and Food Engineering*. The Interstate Printers and Publishers. Inc. Danville.

Foth, H.D. (1978). *Fundamentals of Soil Science* 6th edition. John Wiley and Sons. New York.

Kepner, R.A; B.Roy and L.E. Barger (1978) *Principals of farm machinery*, 3rd edition. McGrow Hill Books Company, N.Y.

Matasova, E.P; N.Sh. Kelbiev and D.A Abakarova (1971). Increasing grain (Maize) production. In: *Field Crop Abstracts*, 1972 – 25(1).

Mimorovic, N.; B.Sinzar and L. Stefanovic (1998). Effect of conservation tillage and herbicide application on weeds and yield of maize in a double cropping system. In: *Maize Abstracts*. 15,2.

Ohu,J.O.(1995). Soil dynamics in agriculture: North-Eastern Nigeria experience. Seminar paper delivered at the Faculty of Engineering, University of Maiduguri (Unpublished).

Ojeniyi, S.O. (1986). Effect of zero-tillage and disc ploughing on soil water, soil temperature and growth and yield of maize. *Soil and Tillage Research*, 7(1 and 2): 173-182.

Olofintoye, J.A. (1989). Effects of tillage and weed control methods on weed growth and performance of upland rice in the guinea savannah of Nigeria. *Nig.J. of Agron*. 2 & 3: 82-87.

Rayar, A.J. (1984). University of Maiduguri Farm Development Planning Report for Faculty of Agriculture. Annex A, Soil survey Details.(Unpublished).

Rouanet, G. (1987). *Maize*: *The Tropical Agriculturalist*. Macmillan, Hongkong.

Stach,J. (1992) Soil cultivation in relationship to the development of weeds. In: *Weed Abstracts*, 1993. 42(5): 248.

Thorup, S. (1985). The effect of soil treatment on weeds. In: *Weed Abstracts*, 1988. 37 (8).