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Effect of land clearing and tillage methods on reduced weed incidence and growth and yield of maize-cassava intercrop

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ABSTRACT
Agricultural activities have been identified as the most common causes of land transformation. Such transformation results in changes in ecological features, such as weed flora succession. It is in view of this that a work is carried out to evaluate the effect of land clearing and tillage methods on weed incidence under maize - cassava intercropping system. The experiment was carried out at the International Board for Soil Research and Management experimental site, Epemakinde Nigeria. (4^0 45 ^{0} E, 6^0 45^0 N) after three cropping years. The treatments consist of three land clearing methods thus, given a split plot fitted into Randomized complete block design (RCMD) in which case the three land clearing methods: Slash and burn (SB), bulldozed not windrowed (BNW) and bulldozed windrowed (BW) are the main treatments while the four tillage methods namely (zero, conventional, traditional and minimum tillage) constituted the sub-treatments. Data were generated on maize and cassava morphological characteristics as well as weed incidence at 6 and 16 weeks after planting (WAP). The result indicates BW and BNW had more grain yield (2.66 tha^{-1}and 2.65 tha^{-1}) respectively, on the average representing 5.1% and 4.7% increase in yield above slash and burn (2.53tha^{-1}). Traditional and minimum tillage had more grain (2.94 and 2.59 tha^{-1}) on the average which represents 22.5% and 7.9% increase in yield above convectional tillage (2.40 tha^{-1}). Cassava fresh weight was significantly ($p<0.05$) affected by the land clearing methods, with SB and BNW (21.94 and 21.20 tha^{-1}) having higher yields than BW on the average. This represents 44.1% and 39.2% increase in cassava fresh weight above bulldozed windrowed (15.23 tha^{-1}). Weed coverage at both 6 WAP and 16 WAP showed no significant difference ($p>0.05$) among the land clearing treatments, although slash and burn had the least weed coverage (55.5%) on the average representing 9.2% and 8.9% lower than those of bulldozed windrowed (60.63%) and bulldozed not windrowed (60.46%). Zero tillage and traditional practices had the highest weed coverage of 86.11% and 82.17% respectively, representing 207.5% and 193.5% increase over conventional tillage (28.00%). In conclusion, slash and burn under minimum tillage treatment, which gave a better maize and cassava yield as well as reduced weed problem, appears a better option.

***Keywords**: land clearing, tillage methods, growth and yield, weed incidence, maize-cassava intercropping system*

INTRODUCTION
A weed to the Nigerian farmer is any undesirable plant which grows in association with his crops. They reduce crop output both qualitatively and quantitatively and consequently the farmer gets less than a fair

share of the potential value of the crop. To raise the value of crop output, the farmer must ensure that weed interference with the crop is reduced to a minimum. Several authors have documented the extent of yield losses that could be experienced in various crops grown in Nigeria under various degree of weed management. Such losses range from 10% in millet to 100% in upland rice (Akobundu 1987). Nationally these losses translate into a reduction in human efficiency brought about by insufficient food supplies and reduced economic strength due to foreign exchange losses arising from food importation. In order to reduce losses, the conservation tillage was introduced in the tropics which have been subject of review (Lal et al 1979). Conservation tillage is recommended for the lowland humid tropics with strict supervision, deep tillage appears to be better than the conservation tillage for the semi-arid tropics (Nicou and Chopart 1979). Food and Agricultural organization (FAO) estimates indicate that food production in the tropics is not keeping pace with the population growth and that the tropics must increase food production in order to meet dietary standards (FAO 1977). In an effort to boost food production in the sub Saharan Africa vast areas of forest have been cleared for agricultural purposes which unless managed properly will deteriorate rapidly and become unproductive. It has been estimated that 350,000 hectares of forest and savanna wood land of Nigeria are deforested each year through clearing for farming, uncontrolled fire or conversion to other forms of land use. (Nwoboshi 1986). The resultant effect of this is that over 50 million hectares has been lost in less than 100 years (Nwoboshi 1986).

Weed control can be achieved by physical, chemical or biological disturbance. All forms of disturbance exert selection pressure and result in the survival and proliferation of the best adapted plants (Holts 1994). There are many examples of changes in weed flora that occurred as a result of certain agricultural practices. Tillage practices (Buhler 1992; Williams et al 1993) crop sequences and herbicides use patterns (Holts 1992) are agronomic practices that shape weed population on agricultural land.

For an enhanced or optimum agricultural productivity in the humid tropics, there is need to develop a suitable cropping system that could adapt to local climatic condition and prove disease resistant, suppress weed seeds, weed management as well as improved soil management practices that will maintain high soil fertility and support increased crop yields. One of such steps in crop productivity is that of land clearing and tillage methods. If we are to develop new crop production systems, new weed management techniques that are based on sound principles of weed biology and ecology must be less destructive to the environment and specifically designed to control erosion.

In Nigeria, a dearth of information on the effects of land clearing methods and tillage systems on weed incidence in the humid tropics under an intercropping system is scanty. The objectives are to study (1) the weed incidence under the different land clearing and tillage method and (2) Assess the productivity of maize plus cassava intercrop under the different land clearing and tillage method in Epemakinde area, south western Nigeria.

MATERIAL AND METHODS

Experimental site

Field experiment was carried out at the International Board for Soil Research and Management (IBSRAM) experimental site, Epemakinde Nigeria (4^{o} 45^{o}E, 6^{o} 45^{o}N) in 1998. The soil is classified as an oxic group of Alfisol or deep ultisol is sandy loam at the surface to sandy clay/clay loam in the sub-surface horizon (Agboola and Ogunkunle 1993).

The land has been under high forest within record of disturbance for over 70 years. The high tree density and the large number of dead and standing trees give it a resemblance of an over-matured disintegrating forest as opposed to a primary forest. The area, from an ecological part of perspective, is a representative of the humid tropic of Africa. Agriculture is based mainly on tree crops – kola (*kola nitida L.*) ventenat, schott and Endicher), cocoa (*theobroma cacao* and rubber (*Hevea braziliensis*) with some arable crops like Maize (*Zea mays*), Cassava (*manihot esculenta*), cocoyam (*xanthosoma sagitifolium*) and plantain (*musa spp*). The land was first cleared in 1994/95 planting season until this period it has been under intensive cultivation. The 1st cropping system was maize – cowpea, 2nd, 3rd and 4th cropping were maize/cassava.

Experimental design

The experimental design was a split – split plot in a randomized complete block design with three replications. Three land clearing method constituted the main treatment while four tillage methods constituted the sub-treatments. Three land clearing methods;

a. Manual slash-and-burn
b. Bulldozed-not-windrowed clearing (BNW)
c. Bulldozed-windrowed clearing (BW)

Four tillage systems;

a. Traditional tillage
b. Minimum tillage
c. Conventional tillage
d. No tillage

There were a total of twelve treatment combinations per block. The plot size for each land clearing treatment was 20m x 30m. Each plot was separated from its neighbors by a 30m alley way.

a. Bulldozed and windrowed clearing (BW).

This was accomplished with a D83E komatsu bulldozer which removed all vegetation including stumps away from the plots and push logs to windrow. Care was exercised to minimize removal of the top soil, during windrowing. After clearing, the land was ready for planting.

b. Bulldozed, not windrowed clearing (BNW)

The same bulldozer was used to knock down the trees but without windrowing. Thereafter, the logs and branches from the fallen trees were cut into pieces 2-3m long to promote a faster drying of the wood before packing to the alley ways for burning.

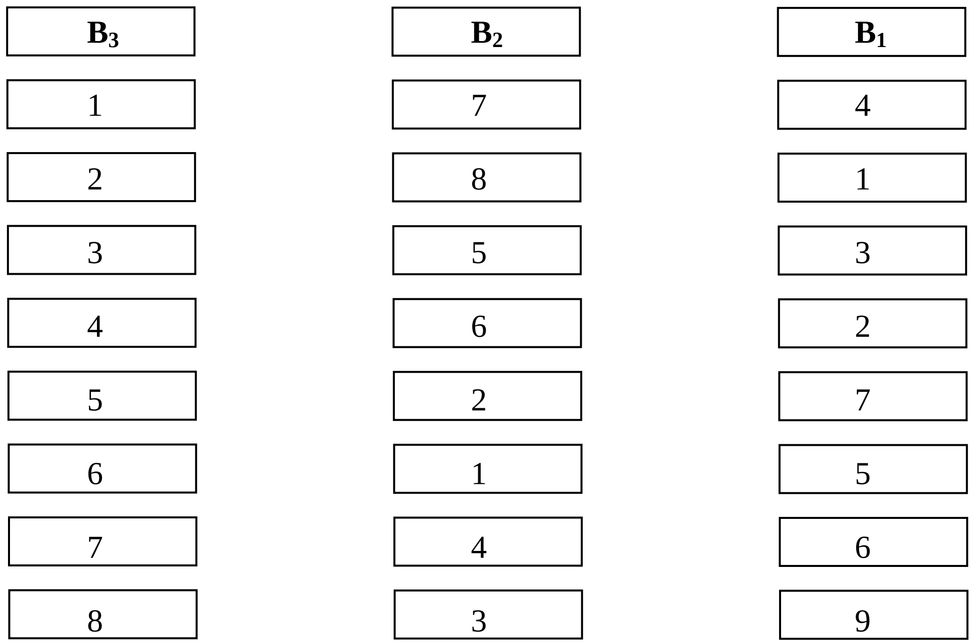
c. Slash-and-burn clearing (SB)

This is a traditional method of clearing. The small trees and vines/twigs were first under brushed, followed by felling of bigger trees at waist height using a still brand power chain saw.

Immediately after falling, trees branches were cut into pieces to enhance faster drying of the wood which resulted in a more complete burning. Burning was carried out at four weeks after clearing, in the appropriate plots. After burning, the remaining trunks were cut into 2-3m lengths with the power chain saw and moved into alley-ways to gain easier access for soil sampling and data collection. Traditional tillage involved making mounds, using the local hoes. Minimum tillage was done by plowing the plot once without harrowing, while conventional tillage involved ploughing and harrowing.

Planting and Cultural Details

The maize cultivar used in this study was "Oba Super II", a yellow variety which matures in about 90-120 days and the cassava cultivar used for this study was TMS 30572. Both crops were manually planted simultaneously as inter crops in September 1997. Maize was sown during the first week of September at a spacing of 1m x 1m with 4 seeds per hill (30,000 plants ha^{-1}) and cassava was spaced at 1m x 1m (10,000 stands ha^{-1}). Both crops were planted within the same row.



KEYS

1	=	BNWZt	SB	=	Slash and Burn
2	=	BNWTt	BW	=	Bulldozed Windrowed
3	=	BWZt	BNW	=	Bulldozed not windrowed
4	=	BWTt	Tt	=	Traditional tillage
5	=	BWCt	Mt	=	Minimum tillage
6	=	BWMt	Ct	=	conventional tillage
7	=	SBMt	Zt	=	Zero tillage
8	=	SBCt			

Fig. 1. Farm layout

Thinning/Supplying

Maize seedlings were thinned down to three seedlings one week after planting and simultaneously supplying spots where maize did not germinate. Cassava was supplied at 1 month after planting. Each plot consisted of 22 rows of maize with each row being 30m long.

Data Collection

Plant Measurement

The following measurements were taken at 3 WAP and 2 MAP to determine the growth and yield of the maize and cassava-maize. Plant height, leaf area index, stem girth was measured 10cm above ground level using string and number of jorquette by counting. Yield and yield components were measured at harvest. Yield samples from each plot was taken at an area of 12m each in three replicates and the number of fresh cobs with and without husk and grain yield obtained.

Cassava

Cassava plant height, leaf area, stem girth was measured 10cm above ground level using string and number of jorquettes. Yield and yield component measured was number of roots, root diameter, root length and yield per hectare obtained. Yield samples from each plot were taken in area of $12m^2$ in three replicates.

Weed Measurement

Measurements on week biomass, weed count and weed coverage were recorded twice in the year at 6 and 16 weeks after planting and results expressed as means of the two measurements. Weed counts were done for each treatment by harvesting and counting all weeds within 50cm x 50cm quadrants that were randomly selected from 10 locations in each plot. The samples within the quadrants were thereafter oven-dried at 105^oC for 24 hours and weighed to obtain the dry weight.

Weed coverage was determined from the mean visual score of four assessors on a scale of 1 (every minimal coverage) to 4 (very high coverage) and expressed as a percentage. Manual weeding was carried out twice at 3 and 9 (WAP) before maize was harvested. Some common weed species found on maize cassava inter cropping at Epemakinde during the beginning of the experimental period are:-

Cynodan dactylon
Calopogonium mucunoides
Imperata cylindrical
Chromolaena odorata
Pennisetum purpureum
Panicum maximum
Synedrella nodiflora
Ageratum conyzoides
Euphorbia heterophylla
Eleusine indica Gaertn
Paspalum orbiculare
Phyllanthus amarus
Echinochloa colonum
Fleurya aestuans
Mitracarpus villosus
Momordica charantia
Brachiaria deflexa
Ipomoea tribola
Cida acuta
Rottboellia cochinchinensis

All these data were subjected to analysis of variance (ANOVA) and means that differed significantly were further separated using the least significant difference (SAS 1999).

RESULTS AND DISCUSSION

Crop Performance

Maize

Plant Height

The result of this study showed a significant difference ($P \leq 0.05$) among various land clearing methods on maize plant height at 3 WAP with slash and burn having the highest plant height of 108.89cm on the average while bulldozed windrowed having the least height (89.90cm). The plant height of maize from slash and burn plot at 3 WAP was 21% longer than that of bulldozed windrowed which recorded the lowest plant height.

At 6 and 9 WAP, there was no significant difference between maize height among the land clearing methods although, maize height was generally higher in bulldozed not windrowed plots (195.89 and 228.43cm).

The variation in maize height was consistent between the land clearing method. However, the results suggest that land clearing methods have no significant effect on maize height, since maize plants tend to grow taller under an intercropping situation.

Maize height at 3 and 6 WAP was significantly different among the tillage practices with traditional and minimum tillage having higher maize height than conventional and zero tillage.

But at 9 WAP, there was no significant difference among the tillage practices although minimum tillage had taller maize plant (230.55cm) on the average while zero tillage had the smallest plant height. Maize height of minimum tillage was 8.5% longer than zero tillage which recorded the lowest plant height (Table 1). The findings agree with that reported by Nicou and Chopart (1979) that germination and early growth of maize is severely restricted on untilled and shallow – tilled naturally compacted soils than tilled soils.

Numbers of Leaves

Maize leaf number at 3 and 6 WAP was not significantly different among the land clearing methods. However, at 9 WAP bulldozed windrowed had significantly ($P \leq 0.05$) higher number of maize leaves than slash and burn and bulldozed not windrowed (Table 1).

Maize number of leaves showed a significant difference ($P \leq 0.05$) at 3 WAP among the tillage practices while at 6 and 9 WAP, maize number of leaves was not significantly different among the tillage methods. Although at 9 WAP, minimum and traditional tillage treatments had higher maize number of leaves (10.41) and (10.50) than zero and conventional tillage methods (10.08 and 10.20) (Table 1).

Stem Girth

The result of this study showed a significant difference ($P<0.05$) among various land clearing methods on maize stem girth. At 3 WAP with bulldozed not windrowed having the largest stem girth of (4.39cm) on the average while bulldozed windrowed had the smallest stem girth (3.61cm). However at 6 and 9 WAP, there was no significant difference ($P>0.05$) among the land clearing methods. Stem girth of maize at 3 and 9 WAP was significantly different ($P<0.05$) among the tillage practices with traditional tillage having (18.7 and 13.0%) larger stem girth than conventional tillage practices, although minimum tillage had the largest stem girth of (5.08cm) with 10.4% larger than conventional tillage (4.60cm) (Table 1).

Leaf Area (cm^2)

Maize leaf area was not significant at 3 and 9 WAP among the land clearing methods. However, at 6 WAP, leaf area was significant ($P<0.05$) among the clearing method with bulldozed not windrowed consistently having higher leaf area than other land clearing practices. At 3 and 9 WAP, maize leaf area in traditional tillage method (331.99cm^2) (471.06 cm^2) was higher than minimum, zero and conventional tillage.(231.86, 218.65 and 204.02 cm^2) respectively and this is (62.7 and 15.2%) higher than conventional tillage which recorded the lowest leaf areas.

At 6 WAP maize leaf area was significantly different ($P \leq 0.05$) among the tillage practices (Table 1) and this result agrees with the findings of Nicou and Chopart (1979) as earlier discussed in plant height.

Significant differences were not observed among the land clearing and tillage methods in maize grain yield and number.

Cassava

Plant Height

At 2, 4, 6, 8 and 10 MAP, observed variation was not significant among the land clearing methods. However, cassava height showed significant difference ($P<0.05$) through out the months among the various tillage practices with zero tillage having the highest plant height in 2 and 4 MAP (94 and 143cm) while conventional tillage having the highest plant height in 6 and 10 MAP (193 and 381 cm), respectively.

Table 1: Effect of Land Clearing and Tillage Methods on the Yield and Yield Components of Maize

TREATMENTS	Height (cm)			Leave Number			Stem girth (cm)			Leaf Area (cm^2)			Grain yield in ha^{-1}	Number of grains/cob
LAND CLEARING	3	6	9	3	6	9	3	6	9	3	6	9		
BNW	106.38	195.89	228.43	8.11	10.84	10.39	4.39	4.95	4.99	313.88	400.02	479.48	2.65	1769.25
SB	108.89	184.61	215.41	8.00	10.74	9.92	4.21	4.79	4.92	234.32	371.70	419.01	2.53	1611.79
BW	89.90	190.19	217.48	7.52	10.65	10.59	3.61	4.84	4.82	191.70	392.64	425.84	2.66	1663.63
LSD (5%)	7.128	NS	NS	NS	NS	0.432	0.485	NS	NS	NS	24.93	NS	NS	NS
TILLAGE														
ZT	103.3	185.81	212.57	7.85	10.47	10.08	4.04	4.70	4.92	218.65	378.20	431.48	2.51	1637.28
CT	94.34	188.04	217.27	7.45	10.72	10.20	3.74	4.60	4.63	204.02	364.15	408.99	2.40	1600.17
Tt	106.77	185.44	221.37	8.50	10.67	10.50	4.44	5.08	5.23	331.99	385.92	471.06	2.94	1859.17
Mt	102.48	201.62	230.55	7.69	11.11	10.41	4.05	5.06	4.86	231.86	424.21	454.23	2.59	1629.72
LSD (5%)	8.187	16.01	NS	0.738	NS	NS	0.557	NS	0.579	NS	28.64	NS	NS	NS

Number of Branches

Cassava branch number was not significantly different between the land clearing methods at 6, 8 and 10 MAP but was significantly different (P<0.05) at 2 and 4 MAP (Table 2), with slash and burn having the highest number of branches at 2 and 4 MAP (2.85 and 1.68). Cassava number of branches was only significant (P<0.05) at 2 MAP but was not significant among the tillage practices at 4 to 10 MAP. Minimum tillage had the highest number of branches at 4 and 10 MAP (1.72 and 2.09) and is (22.9 and 22.9%) higher in number of branches than zero and conventional tillage at the months mentioned above (Table 2).

Table 2: Effect of Land Clearing and Tillage Methods on the Yield and Yield Components of Cassava

TREATMENT	Height (cm) Months					Leave Number					Branch Number				
LAND CLEARING	2	4	6	8	10	2	4	6	8	10	2	4	6	8	10
BNW	72	114	167	270	347	38.34	68.19	118.12	225.12	427.99	2.65	1.66	1.62	1.77	1.94
SB	84	126	175	271	371	43.57	81.78	137.13	276.78	416.59	2.85	1.68	1.63	1.91	1.75
BW	75	116	166	268	347	34.80	62.73	127.58	217.15	393.11	2.47	1.25	1.72	1.87	1.91
LSD (5%)	0.087	0.1115	NS	NS	NS	NS	11.493	NS	38.823	NS	0.2818	0.3974	NS	NS	NS
TILLAGE															
ZT	94	143	155	218	343	39.06	64.09	101.17	218.41	328.25	3.72	1.40	1.52	1.79	1.82
CT	71	118	193	312	381	38.21	84.82	159.50	246.86	446.46	1.71	1.59	1.82	2.00	1.70
Tt	78	111	146	232	338	39.95	56.74	98.15	218.70	332.30	3.32	1.41	1.55	1.82	1.85
Mt	65	101	181	317	359	38.39	77.94	151.63	274.76	543.24	1.87	1.72	1.74	1.80	2.09
LSD (5%)	0.0999	0.1281	0.2355	0.2424	0.2858	NS	13.202	25.921	44.594	132.21	0.3237	NS	NS	NS	NS

Stem Girth

Cassava stem girth was significant ($P<0.05$) only at 2 MAP among the land clearing methods but not significant at the rest months (4 to 10 MAP) Table 2. However, slash and burn plot had consistently higher stem girth 4 to 10 MAP (5.01, 6.75, 8.90, 11.56 cm) than the other land clearing methods (Table 2). Irreversibly, there was significant difference in stem girth among the tillage practices at 2 to 8 MAP but was not significant at 10 MAP (Table 2). Traditional tillage had the highest stem girth (11.86cm) and was 22.8% higher in stem girth than minimum tillage which recorded the lowest stem girth.

Jorquette Number

Cassava jorquette number was not significantly different among the three land clearing methods at 2, 6, 8 and 10 MAP (Table 2) although, slash and burn consistently showed more jorquette number than the rest land clearing methods in the above mentioned months. But at 4 MAP, there was significant difference between the land clearing methods (Table2) with BNW having 38% more jorquette number than BW which recorded the lowest jorquette number.

At 8 MAP, cassava number of jorquette showed significant difference ($P<0.05$) among the tillage practices but was not significant at (2, 4, 6 and 10 MAP). The jorquette number was inconsistent among the tillage practices. However, minimum tillage had the highest cassava number of jorquette (8.94) at 8 MAP.

Table 2: Effect of Land Clearing and Tillage Methods on the Yield and Yield Components of Cassava continued

TREATMENT	Stem Girth (cm)					Jorquette Number					Leaf Area (cm^2)				
LAND CLEARING	2	4	6	8	10	2	4	6	8	10	2	4	6	8	10
BNW	2.82	4.61	6.38	8.67	9.57	0.58	2.29	2.30	6.23	18.73	65.12	72.76	73.52	72.77	67.79
SB	2.80	5.01	6.75	8.90	11.56	1.05	3.26	2.97	7.32	29.43	75.08	81.24	93.25	81.67	66.99
BW	2.60	4.69	6.47	8.75	10.01	0.88	1.66	2.44	5.65	26.08	68.83	82.61	96.93	94.36	71.70
LSD (5%)	0.1728	NS	NS	NS	NS	NS	0.3402	NS	NS	NS	NS	NS	NS	NS	NS
TILLAGE															
ZT	1.88	4.97	5.70	8.11	10.26	0.71	2.19	2.77	4.66	18.89	54.05	102.81	86.21	72.59	71.19
CT	3.14	5.16	7.35	8.83	9.74	0.88	2.02	2.54	6.98	33.02	87.65	69.52	102.22	77.31	64.88
Tt	2.08	4.30	5.76	8.54	11.86	0.57	2.04	2.52	4.99	18.33	48.97	76.93	112.25	89.88	77.76
Mt	3.25	4.66	7.32	9.60	9.66	1.17	2.02	2.45	8.94	28.73	88.04	66.22	84.24	91.97	61.48
LSD (5%)	0.1985	0.7057	0.7437	0.6483	NS	NS	NS	NS	1.9405	NS	13.684	27.358	NS	NS	11.468

Table 2: Effect of Land Clearing and Tillage Methods on the Yield and Yield Components of Cassava contd.

TREATMENT	Fresh Weight tha^{-1}	Number of Tubers	Tuber Length (cm)	Tuber Diameter (cm)
LAND CLEARING				
BNW	21.2	7.56	41.49	22.98
SB	21.94	7.47	39.12	22.58
BW	15.23	6.13	33.54	21.25
LSD (5%)	3.253	NS	7.475	NS
TILLAGE				
ZT	20.61	7.39	40.31	23.13
CT	19.34	6.37	35.92	21.29
Tt	16.57	7.28	37.25	21.80
Mt	21.31	7.16	38.73	22.86
LSD (5%)	3.737	NS	NS	NS

Leaf Area (cm^2)

There was no significant difference (P>0.05) in leaf area among the land clearing methods. However, among the tillage practices there were significant differences (P<0.05) at 2, 4 and 10 MAP (13.684, 27.358 and 11.468) with minimum tillage having the highest (88.04cm^2) at 4 MAP and traditional tillage (77.76cm^2) at 10 MAP.

Fresh Weight

There were significant difference (P<0.05) in fresh weight among the three land clearing methods with slash and burn and bulldozed not windrowed having higher fresh weight (21.94 and 21.2 tha^{-1}) than bulldozed windrowed (15.23tha^{-1}) (Table 2).

Tuber Length

Tuber length was significant among the land clearing methods (Table 2) with bulldozed not windrowed having the highest tuber length (41.49cm) and bulldozed windrowed having the least (33.54cm). However, there is no significant difference in tuber length among the tillage practices although zero tillage had the highest tuber length (40.31cm) and conventional tillage have the least (35.92cm) with zero tillage having 12.2% higher in tuber length than conventional tillage which recorded the lowest tuber length.

Observed variations were not significant among land clearing and tillage methods in cassava number of tubers and tuber diameter

Weed

Weed Coverage (%)

There is no significant difference in percentage weed coverage among the land clearing methods.

However, there is significant difference ($P \leq 0.05$) in percentage weed coverage (23.20 and 21.88) at 6 and 16 weeks after planting among tillage practices. (Table 3) with traditional tillage having the highest weed coverage (82.17%) at 6 weeks after planting and zero tillage having the highest weed coverage (81.16%) at 16 weeks after planting.

The low weed coverage noticed in minimum and conventional tillage may be brought about by the effect of tractor in burying weed seed during ploughing.

Weed dry Matter (g/cm^3)

There was no significant difference in weed dry matter among land clearing methods at 6weeks after planting. However, there was significant difference in weed dry matter among land clearing methods at 16 weeks after planting with bulldozed windrowed and bulldozed not windrowed having higher weed dry matter (538.60 and 459.38g cm^{-3}) than slash and burn (247.19cm^{-3}) and they are (117.9 and 85.8%) higher in weed dry matter than slash and burn (Table 3).

Among the tillage practices, there were significant difference ($P \leq 0.05$) in weed dry matter (180.7g cm^{-3}) at 6 weeks after planting and zero tillage having the highest weed dry matter (337.44g cm^{-3}) table 3 and this is 91.06% higher in weed dry matter than minimum tillage.

Weed Number (m^2)

There was significant difference in weed number among the land clearing method. ($P \leq 0.05$ 39.55) at 6 weeks after planting with slash and burn and bulldozed not windrowed having higher number of weeds (123.5 and 105.21m^2) and this was (81.0 and 54.2%) higher in number of weeds than bulldozed windrowed (Table 3).

At 6 weeks after the planting there was significant difference ($P<0.05$) in number of weed among the tillage practices and zero and traditional tillage had higher number of weeds (199.61 and 139.33m^2) than minimum and conventional tillage (31.06 and 25.94m^2) respectively.

The low number of weeds noticed in conventional and even minimum tillage may be brought about by the effect of tractor in burying weed seeds during ploughing.

Weed Succession

As shown in table 4.1, slash and burn (SB) plots had the highest number of broad leaved weeds which accounted for 72% of total number of weed discussed. In the bulldozed not windrowed (BNW) treatment, broad leaf accounted for 65% of the total weed flora while bulldozed windrowed (BW) only accounted for 50% of the weed flora. Invariably it could be concluded that 50% of the weed flora that occurred in the BW are grasses suggesting a decline in soil fertility or an alteration in the natural ecosystem. SB having higher number of broad leaf may be ascribed to higher nutrient availability which also enhanced better crop growth. As shown in table 4.2, traditional tillage had the highest number of broad leaf weeds which accounted for 73.1% of total number of weeds observed. In the minimum tillage treatment, broad leaf accounted for 63.2%, zero tillage accounted for 63.6% while conventional tillage which had the lowest number of broad leaf weeds accounted for 59.1% of the total weed flora. Invariably showing that 40.9% of the weed flora that occurred in conventional tillage are grasses; suggesting a decline in soil fertility as well as exposing the soil to accelerated erosion and land degradation.

SUMMARY AND CONCLUSION

The result indicated that maize height at 6 and 9 WAP, stem girth at 6 and 9 WAP, leaf number; maize grain yield and number of grain/cob were not significantly different among the land clearing method. Although bulldozed windrowed (BW) and bulldozed not windrowed (BNW) had more maize grain yield (2.66 tha^{-1} and 2.65 tha^{-1}) respectively, on the average which represents 5.1% and 4.7% increase in yield above slash and burn (2.53tha^{-1}). However, maize height at 3 WAP, stem girth at 3 WAP and leaf area at 6 WAP showed a significant difference ($P \leq 0.05$).

Among the tillage practices, minimum and traditional tillage had more maize grain (2.94 and 2.59 tha^{-1}) on the average which represents 22.5 and 7.9% increase in yield above conventional tillage (2.40tha^{-1}) and they performed better for all the maize parameters taken compared to zero and conventional tillage.

Cassava height at 6 to 10 MAP, stem girth at 4 to 10 MAP, leaf area, number of tubers and tuber diameter showed no significant difference among the land clearing methods, but only the cassava height at 2 and 4 MAP, stem girth at 2 MAP, fresh weight and length of tuber showed a significant difference. However, among the tillage practices, there were significant difference in cassava height, stem girth at 2 to 8 MAP and cassava fresh weight but showed no significant difference at cassava number of tubers, length of tubers and tuber diameter though zero and minimum tillage had higher number of tubers (40.31 and 38.73cm) and higher tuber diameter (23.13 and 22.86cm) than traditional and conventional tillage (37.25 and 35.92cm) and (21.80 and 21.29cm) respectively.

In the case of weed incidence, weed coverage at both 6 weeks and 16 weeks after planting, weed dry matter at 6 weeks after planting and weed number at 16 weeks after planting showed no significant difference. Although weed number at 16 weeks after planting in bulldozed windrowed plot exceeded that in bulldozed not windrowed and slash and burn by (36.4 and 37.0%) though no significant difference.

Among the tillage practices, there were significant differences in weed coverage at both 6 and 16 weeks after planting, weed dry weight at 6 weeks after planting and weed number at 6 weeks after planting. But there was no significant difference in weed dry matter and weed number at 16 weeks after planting. Conventional and minimum tillage showed less weed coverage, dry matter and weed number than the traditional and zero tillage.

Based on the findings in the parameters measured, traditional and minimum tillage had the best values in maize and cassava morphological characteristics but conventional and minimum tillage had lower weed incidence.

Table 3: Effect of Land Clearing and Tillage Methods on Weed Coverage, dry matter, and number of Weeds

TREATMENT	Weed Coverage (%)		Weed dry matter (g/cm^3)		Weed number (m^2)	
LAND CLEARING	6 weeks after planting	16 weeks after planting	6 weeks after planting	16 weeks after planting	6 weeks after planting	16 weeks after planting
BNW	60.46	56.29	174.83	459.38	105.21	188.13
SB	55.50	56.38	189.92	247.19	123.50	187.38
BW	60.63	49.59	151.00	538.60	68.25	256.63
LSD (5%)	NS	NS	NS	129.40	39.55	NS
TILLAGE						
ZT	86.11	81.16	337.44	415.00	199.61	248.50
CT	28.00	33.70	35.00	448.33	25.94	131.17
Tt	82.17	61.95	281.83	453.13	139.33	281.50
Mt	39.17	39.52	33.39	343.76	31.06	181.67
LSD (5%)	23.20	21.88	180.7	NS	45.43	NS

Table 4.1: Weed incidence/flora occurrence as influenced by different land clearing methods during the 4th cropping at 12 weeks after planting. Thirty-four (34) weed species were present in various land clearing method used in the study. (X = Presence of weeds
- = Absence of weeds)

Name of Weed	Land Clearing Method			Remark
	SB	BNW	BW	
Achyranthes aspera	-	-	X	Grass
Ageratum conyzoides	X	X	X	Broad leaf
Axonopus compresus	X	X	X	Grass
Brachiaria deflexa	X	X	X	Grass
Brachiraia lata	-	X	X	Grass
Callopogonium mucuniodes	X	X	X	Broad leaf
Chromolaena odorata (L)	X	X	X	Broad leaf
Sida acuta	X	X	X	Broad leaf
Cyanthula prostrata	X	X	X	Broad leaf
Cynodon dactylon	X	X	X	Grass
Cyprus rotundus	-	-	X	Sedge
Digitaria horizontalis	-	X	-	Grass
Echinochloa colanum	X	X	X	Grass
Eleusue indica	X	X	-	Grass
Erigeron floribundus	X	-	-	Broad leaf
Euphorbia heterophylla	X	X	-	Broad leaf
Ficus exasparata vahl	X	-	-	Broad leaf
Fleurya aestuans	-	X	X	Broad leaf
Ipomoea tribola	X	X	X	Broad leaf
Justica flava	-	X	X	Broad leaf
Mitracarpus villosus	X	X	X	Broad leaf
Momordica charantia	X	X	X	Broad leaf
Panicum maximum	-	-	X	Grass
Paspalum conjugatum	X	X	X	Grass
Paspalum orbiculare	X	X	X	Grass
Peperoma pellucida	X	X	-	Broad leaf
Phyllanthus anarus	X	X	X	Broad leaf
Plastosoma afficanum	X	-	X	Broad leaf
Setaria barbata	-	-	X	Grass
Sida veronicifolia	X	X	-	Broad leaf
Solenostemon monostachyus	X	-	-	Broad leaf
Solanum nigrum L	X	X	X	Broad leaf
Solanum torvum	-	X	X	Broad leaf
Synedrella nodiflora	X	X	X	Broad leaf

Table 4.2: Weed incidence/flora occurrence as influenced by different tillage methods during the 4th cropping at 12 weeks after planting. (X = Presence of weeds
- = Absence of weeds)

Name of Weed	Land Clearing Method				Remark
	ZT	CT	Tt	Mt	
Achyranthes aspera	-	X	-	-	Grass
Ageratum conyzoides linn	X	X	X	X	Broad leaf
Axonopus compresus	X	X	X	X	Grass
Brachiaria deflexa	X	X	X	X	Grass
Brachiaria lata	-	X	X	-	Grass
Callopogoniun mucunoides	X	X	X	X	Broad leaf
Chromolaena odorate (L)	X	X	X	X	Broad leaf
Cida acuta	X	X	X	X	Broad leaf
Cyanthula prostrata	X	X	X	X	Broad leaf
Cynodon dactylon	X	X	X	X	Grass
Cyprus rotundus	X	-	-	-	Sedge
Digitaria horizontalis	-	X	-	-	Grass
Echinochloa colanum	X	-	-	X	Grass
Eleusine indica	X	X	-	-	Grass
Erigeron floribundus	-	-	X	-	Broad leaf
Euphorbia heterophylloa	-	-	X	X	Broad leaf
Ficus exasparata vahl	-	-	X	-	Broad leaf
Fleurya aestuans	X	-	-	-	Broad leaf
Ipomoea tribola	X	X	X	X	Broad leaf
Justice flava	X	-	X	X	Broad leaf
Mitracarpus villosus	X	-	X	-	Broad leaf
Momordica charantia	X	-	-	X	Broad leaf
Panicum maximum	-	-	-	X	Grass
Paspalum conjugatum	X	X	X	X	Grass
Paspalum orbiculare	X	X	X	X	Grass
Peperomapellucida	-	X	X	-	Broad leaf
Phyllantus amarus	X	X	X	X	Broad leaf
Plastosoma afficanum	-	X	X	-	Broad leaf
Setaria barbata	-	-	X	-	Grass
Sida veronicifolia	-	X	X	-	Broad leaf
Solenostemon monostachyus	-	-	X	-	Broad leaf
Solanum nigrum L.	X	X	X	X	Broad leaf
Solanum forvum	X	X	X	X	Broad leaf
Synedrella nodiflora	X	X	X	X	Broad leaf

In conclusion, based on maize and cassava morphological characteristics as well as reduced weed problem, minimum tillage appears a better option.

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