

Evaluation of Tillage Practices on Weed Control and Yield of Groundnut (*Arachis hypogaea*) in Sudan Savanna Ecological Zone of Nigeria

ABSTRACT

To evaluate the effect of various tillage practices on weed control and yield of groundnut, a three year field study was conducted at teaching and research farm of Faculty of Agriculture Bayero University Kano. The study consisted of 9 treatments comprising of two zero tilled, three minimum and four conventional tillage practices arranged in randomized complete block design with three replications. Weed samples were identified to species level and data were collected on weed count, cover score and weed dry weight. Stand count and kernel yield of groundnut were assessed at maturity. Data generated were analyzed using SAS. The frequency of weed occurrences and level of infestations of individual species were generally higher in zero and minimum tillage practices than in conventional tillage practices in all the years. Perennial weeds species were more frequent in Zero tilled plots than in conventional tilled plots. Application of paraquat at 0.8 kg a. i.ha⁻¹ followed by (fb) Fluazifop at 0.4 kg a.i. ha⁻¹ produced the highest weed cover score and weed dry weight while plowing fb harrowing fb ridging fb pendimethalin at 1.0 kg a.i. ha⁻¹ fb supplementary hoe weeding (SHW) had the least weed cover score and dry weight. However plowing fb harrowing fb ridging fb pendimethalin at 1.0 kg a.i. ha⁻¹ fb supplementary hoe weeding recorded the highest stand count and kernel yield in both years while paraquat at 0.8 kg a. i.ha⁻¹ fb Fluazifop at 0.4 kg a.i. ha⁻¹ recorded the lowest stand count and kernel yield. Tillage practices modify weed floral composition of the study area. Conventional tillage reduced the level of weed occurrences and resulted in better weed control with higher kernel yield than zero tillage practices.

Keywords: Tillage, weed control, groundnut, yield, Sudan savanna

1. INTRODUCTION

Groundnut (*Arachis hypogaea*) is an important tropical legume and oil crop produced for both domestic and industrial purposes. It used to be one of the most important export crops in Nigeria. It is the sixth most important oil seed crop in the world (1). It contains 48-50% oil and 26-28% protein, and is rich on dietary fiber, mineral and vitamin. Despite enormous importance of groundnut, its production has been affected by different practices including

tillage and weed control (2,3). Weed control and tillage practices in crop production are inseparable (4). When the land is properly tilled, weeds are effectively controlled and this will certainly increase crop yield. Soil tillage, which dated back to the beginning of agriculture was aimed at optimizing soil condition for seed germination, seedling emergence and growth as well as weed control (3). Weed shifts are known to occur in continuously cultivated land in response to tillage practices, cropping systems, weed control and other changes in the habitat (2).

Agriculture still relies heavily on mechanical forms of soil disturbances from plowing, harrowing and on use of herbicides for weed control both prior and after planting. These tools reduce weed density very well, which also result in favorable yield response from weed control. Soil tillage was reported to have determined the absolute and relative abundance of weeds with different traits in a given cropping system (5). Tillage practices control weeds by breaking, cutting or tearing them from the soil thus exposing the vegetative parts to desiccation and smothering them with soils. Tillage assists greatly in breaking seed dormancy and stimulating seed germination through mechanical scarification. In soils with uniform seed density, cultivation generally stimulates weed seedling emergence causing a faster decline of the soil seed reserves compared to treatment without cultivation. Where weeds are permitted to re-seed, population of annual grasses increased faster in non-tillage than in conventional tillage systems. Thus, tillage practices strongly influence number and diversity of seeds in soil weed seed bank depending predominantly on period of induced seed dormancy (2). Conventional tillage operations primarily invert the soil burying viable weed seeds in topsoil thereby lowering their germination.

Groundnut is normally cultivated as rain-fed crop without sufficient tillage. This leads to high weed infestation. Yield losses in groundnut due to weed infestation can be as high as 77% (6). Apart from competition for moisture, nutrient and sunlight, weeds may inhibit pegging in groundnut and interfere with crop harvest. Weed competition in groundnut is critical up to 45 days after sowing and weed free environment during this period may likely give higher yield (6). Manual hoe weeding and row cultivation after emergence but before pegging are effective in controlling weeds establishment but do not provide complete weed free environment necessary for high yield. Manual hoe cultivation during pegging destroys roots and pegs. Thus, once pegging begins, soil disturbance should be avoided or kept to a minimum so as not to interfere with the developing pods. It is desirable therefore to determine the best methods of tilling the soils that will effectively control weeds and produce high groundnut yield. Very little was done in the tropics on the effect of tillage practices on weed control and yield of groundnut. This study was therefore initiated to investigate the effect of different tillage practices on weed control and yield of groundnut.

2. MATERIAL AND METHODS

Three years trials were conducted in Teaching and Research Farm of Faculty of Agriculture Bayero University, Kano to investigate the effect of different tillage practices on weed control and yield of groundnut. In the conduct of the experiment, nine (9) tillage treatments were considered. They are as follows:

T1= Paraquat at 0.8 kg a. i. ha⁻¹ followed by (fb) Fluazifop at 0.4 kg a.i. ha⁻¹

T2= Paraquat at 0.8 kg a. i. ha⁻¹ fb Pendimethalin at 1.0 kg a. i. ha⁻¹ fb Fluazifop at 0.4 kg a.i. ha⁻¹

T3 = Hoe tilling fb Paraquat at 0.8 kg a. i. ha⁻¹ fb Fluazifop at 0.4 kg a. i. ha⁻¹

T 4 = Plow fb Paraquat at 0.8 kg a.i. ha⁻¹ fb Fluazifop at 0.4 kg a. i ha⁻¹

91 T5 = Harrow fb Paraquat at 0.8 kg a. i ha-1 fb Fluazifop at 0.4 kg a. i. ha-1

92 T 6= Animal Traction fb SHW

93 T 7= Manual Cultivation fb SHW

94 T8 = Harrow fb Ridging fb Pendimethalin at 1.0 kg a. i. ha-1 fb SHW

95 T 9= Plow fb Harrow fb Ridging fb Pendimethalin at 1.0 kg a.i. ha-1 fb SHW

96 T1 and T2 represent zero tillage where herbicide was applied before planting as pre-plant
97 application and followed by post-emergence application of Fluazifop. During sowing only
98 small cut necessary to bury the seed into the soil was made. The T3, T4 and T5 represent
99 minimum tillage where there was incomplete loosening of soil layer with hoe, plow or harrow.
100 It was followed by pre-planting and post-emergence application of herbicide. The T6, T7, T8
101 and T9 represent conventional tillage where the soil was loosened and turned with hoe,
102 plow, harrow and ridger. It was followed by supplementary hoe weeding. The treatments
103 were laid out in randomized complete block design replicated three times. The gross and net
104 plots sizes were 22.5 m² and 15 m², respectively. The gross plots were demarcated and
105 pegged with iron rods for easy identification in subsequent years. The same site for each
106 treatment was maintained for the whole experimental period. Pre-plant herbicide application
107 was achieved by spraying plots with paraquat at 0.8 kg a.i.ha-1 one week before sowing;
108 pre-emergence application was done with pendimethalin at 1.0 kg a.i. ha-1 immediately after
109 sowing and post-emergence application with fluazifop at 0.4 kg a. i ha-1 at 4 weeks after
110 sowing (WAS).

111 Two seeds of groundnut (SAMNUT 23) obtained from IAR/ABU, Samaru Zaria were sown
112 2cm deep at inter-row and intra-row spacing of 0.75 m and 0.25 m, respectively. Thinned
113 to 1 plant per hole at 2 WAS. It was an early maturing with 90-100 days maturity period. The
114 variety was high yielding and rosette resistant. Fertilizer was applied 2 WAS using a mixture
115 of NPK (15-15-15) and single super phosphate (18% P₂O₅) to supply 20 kg N ha⁻¹, 40 kg
116 P₂O₅ ha⁻¹ and 20 kg K₂O ha⁻¹.

117 Weed sample was collected from 1M² quadrat. Weeds within the quadrat were identified,
118 counted and recorded. Samples within the quadrat were separated by species and the level
119 of infestation determined and cut from the ground level using sickle and oven dried at 750C
120 to constant weight for determination of dry weight. Weed cover score was recorded at crop's
121 (g/nut) physiological maturity by visual observation on scale of 1-10; where 1 represented
122 uncovered plots while 10 represented plots completely covered by weeds. Relative weed
123 frequency was estimated using the equation below as suggested by (7):

124
$$\text{Relative weed frequency} = \frac{\text{Weed cover score}}{\text{Crop cover score}} \times 100$$

125 Stands count were recorded by counting the number of groundnut stands at physiological
126 maturity from each net plot area and extrapolated to per hectare basis. Kernel yield was
127 obtained by threshing and winnowing the pods obtained from the net plot area and weighed
128 then converted to kg per hectare. Data generated were subjected to statistical analysis of
129 variance using SAS package. Where treatment means were significant, they were separated
130 using Duncan's Multiple Range Test at 5% level of probability. Correlation analysis was
131 carried out among the cowpea and weed attributes as suggested by (8).

132 3. RESULTS AND DISCUSSION

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134 A total of 35 weed species belonging to 29 genera and 22 families were reported 2008
 135 (Table 1). Of these, T8, T2 and T4 had the highest total relative frequency of 12.7% each
 136 followed by T7 while T9 had the least 2009, a total of 32 weed species belonging to 26
 137 genera and 19 families were enumerated (Table 2). Of these, T2 (16.8%) had the highest
 138 total relative frequency followed by T1 (15%) while T9 had the least (6.4%). A total of 20
 139 weed species belonging to 17 genera and 10 families were reported 2010 (Table 3). Of
 140 these, T1, T2, T3, T4 and T6 had the highest total relative frequency 6.4-12.3% each followed
 141 by T7 (11.1%), T5 and T8 (9.8% each) while T9 had only 7.4%. Perennial weed species
 142 (grasses, sedges and broadleaf) were the most predominant species associated with most
 143 of the treatments in all the years. The frequency of occurrences and level of infestations of
 144 individual species were generally higher in zero

145 **Table 1.** Influence of Tillage Practices on Weed Species Compositions and their Level of
 146 Infestation of Groundnut Field in 2008 Season.

Weed species	Family	Grow th Habit	Zero Tillage		Minimum Tillage			Conventional Tillage			
			T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉
<i>Acanthospermum</i>	Asteraceae	ABL	-	-	*	*	-	-	-	*	-
<i>hispidum</i>											
<i>Alysicarpus vaginalis</i>	Fabaceae	PBL	-	-	-	-	-	*	-	-	-
<i>Aneilema beninience</i>	Commelinaceae	ABL	-	*	-	*	*	*	*	-	*
<i>Cassia mimosoides</i>	Caesalpiniaceae	ABL	*	**	-	*	*	*	*		-
<i>Cassia obtusifolia</i>	Caesalpiniaceae	ABL	***	**	*	*	-	*	*	*	-
<i>Chamaecristus absus</i>	Caesalpiniaceae	ABL	-	*	*	*	**	*	*	-	-
<i>Chonchorus oliteruis</i>	Tiliaceae	ABL	-	*	*	*	*	*	*	-	-
<i>Chloris pilosa</i>	Poeceae	AG	-	-	-	**	-	**	*	*	**
<i>Cleome viscosa</i>	Cleomaceae	ABL	-	-	*	-	-	-	-	-	-
<i>Commilina species</i>	Commelinaceae	AN	-	-	*	*	-	-	-	-	-
<i>Cyperus difformis</i>	Cyperaceae	PS	***	**	**	***	***	*	*	*	*
<i>Cyperus rotundus</i>	Cyperaceae	PS	**	-	*	**	-	-	-	-	-

UNDER PEER REVIEW

<i>Crotelera sretusa</i>	Mimosoidae	ABL	-	-	*	-	*	-	-	-	-
<i>Cynadon dactylon</i>	Poaceae	PG	**	**	**	**	**	*	*	*	*
<i>Dactylocteniumm aegyrium</i>	Poaceae	AG	-	*	*	-	-	-	-	-	-
<i>Digitaria debilis</i>	Poaceae	AG	**	*	*	-	-	-	-	-	*
<i>Euphorbia hirta</i>	Euphorbiaceae	ABL	-	-	-	-	*	-	-	-	-
<i>Heteropogon contortus</i>	Poaceae	PG	-	**	**	-	***	**	*	***	-
<i>Hibiscus subdariffa</i>	Malvaceae	ABL	-	-	-	-	*	-	-	-	-
<i>Hyphis lanceolata</i>	Lamaceae	ABL	-	-	**	-	-	-	-	-	-
<i>Imperata cylindrical</i>	Poaceae	PG	**	*	*	*	-	**	-	-	-
<i>Indigofera hirtusa</i>	Fabaceae	ABL	-	-	-	-	*	-	*	*	-
<i>Ipomea acquatica</i>	Convovulaceae	PBL	*	*	-	*	*	*	*	*	*
<i>Ipomea asorifolia</i>	Convovulaceae	PBL	-	-	-	-	*	-	-	-	-
<i>Ipomea vagans</i>	Convovulaceae	ABL	-	-	*	*	-	-	-	-	-
<i>Kylinga pumilla</i>	Cyperaceae	PS	**	-	-	-	-	-	*	-	-
<i>Kylinga squamulatus</i>	Cyperaceae	PS	***	**	**	*	*	**	**	*	**
				*	*						
<i>Leucas martinicensis</i>	Labiatae	ABL	*	**	**	**	*	**	*	*	*
<i>Melochia cordifolia</i>	Sphenocaceae	ABL	*	*	*	**	**	**	-	*	*
<i>Mitracarpus villosus</i>	Portulacaceae	ABL	-	*	*	-	-	-	-	-	-
<i>Monechum ciliatum</i>	Acanthaceae	ABL	**	**	*	*	**	**	*	**	*

<i>Oldenlandia herbacia</i>	Rubiaceae	ABL	*	*	-	-	-	-	-	-	*
<i>Pennisetum</i>	Poaceae	AG	*	-	-	-	*	-	*	**	-
<i>pidicelatum</i>											
<i>Stirga gesneriodes</i>	Scrophurariacea	ABL	-	-	*	-	-	-	-	-	-
	e										
<i>Tridax procumbens</i>	Astreraceae	ABL	*	-	-	-	-	-	**	*	-
RF %			9.6	12.	11.	12.	11.0	11.0	11.	12.4	8.2
				4	0	4			7		

147 T₁= Paraquat at 0.8 kg a. i. ha⁻¹ followed by (fb) Fluazifop at 0.4 kg a.i. ha⁻¹
 148 T₂= Paraquat at 0.8 kg a. i. ha⁻¹ fb Pendimethalin at 1.0 kg a. i. ha⁻¹ fb Fluazifop at
 149 0.4 kg a.i. ha⁻¹
 150 T₃ = Hoe tilling fb Paraquat at 0.8 kg a. i. ha⁻¹ fb Fluazifop at 0.4 kg a. i. ha⁻¹
 151 T₄ = Plow fb Paraquat at 0.8 kg a.i. ha⁻¹ fb Fluazifop at 0.4 kg a. i ha⁻¹
 152 T₅ = Harrow fb Paraquat at 0.8 kg a. i ha⁻¹ fb Fluazifop at 0.4 kg a. i. ha⁻¹
 153 T₆= Animal Traction fb supplementary hoe weeding (SHW)
 154 T₇= Manual Cultivation fb SHW
 155 T₈ = Harrow fb Ridging fb Pendimethalin at 1.0 kg a. i. ha⁻¹ fb SHW
 156 T₉= Plow fb Harrow fb Ridging fb Pendimethalin at 1.0 kg a.i. ha⁻¹ fb SHW
 157 ABL= Annual broadleaf; AG= Annual grass; PBL= Perennial broadleaf; PG=
 158 Perennial grass; PS= Perennial sedges; *=1-25%; **=26-50%; ***=51-75%;
 159 ****=76-100 %
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166 Table 2. Influence of Tillage Practices on Weed infestation of Groundnut Field in
 167 2009 season

Weed species	Family	Growth Habit	Zero Tillage		Minimum Tillage			Conventional Tillage			
			T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉

<i>Acanthospermum hispidum</i>	Asteraceae	ABL	-	-	-	*	-	-	-	-	-
<i>Alysicarpus vaginalis</i>	Fabaceae	PBL	*	*	*	-	-	*	-	*	-
<i>Aneilema beninience</i>	Commelinaceae	ABL	-	*	-	*	-	*	-	-	-
<i>Cassia mimosoides</i>	Caesalpiniaceae	ABL	*	*	-	*	-	*	-	*	-
<i>Cassia obtusiforlia</i>	Caesalpiniadeae	ABL	*	*	-	*	*	-	*	-	*
<i>Chamaecristus absus</i>	Caesalpiniadeae		-	*	-	*	-	*	-	-	-
<i>Chonchorus oliteruis</i>	Tiliaceae	ABL	*	*	-	*	*	*	*	*	-
<i>Chloris pilosa</i>	Poeceae	AG	*	-	*	*	-	-	-	-	-
<i>Cleome viscosa</i>	Cleomaceae	ABL	*	-	*	-	-	-	-	-	-
<i>Commilina species</i>	Commelinaceae	AN	-	-	*	-	-	-	-	-	-
<i>Cyperus difformis</i>	Cyperaceae	PS	**	*	*	*	*	*		*	*
<i>Cyperus rotundus</i>	Cyperaceae	PS	*	*	-	*	-	-	*	*	-
<i>Crotelera retusa</i>	Mimosoidae	ABL	*	-	-	-		-	-	-	*
<i>Cynadon dactylon</i>	Poaceae	PG	**	**	-	**	**	*	*	*	**
<i>Digitaria debilis</i>	Poaceae	AG	*	-	-	-	-	**	-	-	*
<i>Euphorbia hirta</i>	Euphorbiaceae	ABL	*	-	-	-	-	*	-	-	-
<i>Heteropogon</i>	Poceae	PG	*	*	-	-	*	-	-	*	-

<i>contortus</i>											
<i>Imperata</i>	Poaceae	PG	*	*	**	**	*	*	-	*	-
<i>cylindrical</i>											
<i>Indigofera hirtusa</i>	Fabaceae	ABL	*	*	-	-	*	*	*	-	-
<i>Ipomea acquatica</i>	Convovulaceae	PBL	*	*	*	*	*	*	-	-	-
<i>Ipomea asorifolia</i>	Convovulaceae	PBL	*	-	-	-	-	*	-	-	-
<i>Ipomea vagans</i>	Convovulaceae	ABL	-	*	*	-	-	-	-	-	-
<i>Kylinga pumilla</i>	Cyperaceae	PS	-	*	-	-	-	-	*	*	-
<i>Kylinga</i>	Cyperaceae	PS	*	**	*	*	*	**	**	*	*
<i>squamulatus</i>											
<i>Leucas</i>	Labiatae	ABL	*	**	**	**	*	**	-	*	-
<i>martinicensis</i>											
<i>Melochia</i>	Sphenocaceae	ABL	*	*	*	*	*	-	*	-	*
<i>cordifolia</i>											
<i>Mitracarpus</i>	Portulacaceae	ABL	-	-	-	-	-	*	*	-	*
<i>villosus</i>											
<i>Monechum</i>	Acanthaceae	ABL	*	*	*	-	*	-	-	-	-
<i>ciliatum</i>											
<i>Oldenlandia</i>	Rubiaceae	ABL	-	*	*	-	-	-	-	-	-
<i>herbacia</i>											
<i>Pennisetum</i>	Poaceae	AG	-	-	-	-	-	*	*	-	-
<i>pidicelatum</i>											

<i>Tridax</i>	Asteraceae	ABL	*	*	*	-	-	-	-	-	-
<i>procumbens</i>											
RF%			15	16.8	9.6	11.2	9.6	14	8.0	8.8	6.4

168 T₁= Paraquat at 0.8 kg a. i. ha⁻¹ followed by (fb) Fluazifop at 0.4 kg a.i. ha⁻¹
 169 T₂= Paraquat at 0.8 kg a. i. ha⁻¹ fb Pendimethalin at 1.0 kg a. i. ha⁻¹ fb Fluazifop at
 170 0.4 kg a.i. ha⁻¹
 171 T₃ = Hoe tilling fb Paraquat at 0.8 kg a. i. ha⁻¹ fb Fluazifop at 0.4 kg a. i. ha⁻¹
 172 T₄ = Plow fb Paraquat at 0.8 kg a.i. ha⁻¹ fb Fluazifop at 0.4 kg a. i ha⁻¹
 173 T₅ = Harrow fb Paraquat at 0.8 kg a. i ha⁻¹ fb Fluazifop at 0.4 kg a. i. ha⁻¹
 174 T₆= Animal Traction fb SHW
 175 T₇= Manual Cultivation fb SHW
 176 T₈ = Harrow fb Ridging fb Pendimethalin at 1.0 kg a. i. ha⁻¹ fb SHW
 177 T₉= Plow fb Harrow fb Ridging fb Pendimethalin at 1.0 kg a.i. ha⁻¹ fb SHW
 178 ABL= Annual broadleaf; AG= Annual grass; PBL= Perennial broadleaf; PG=
 179 Perennial grass; PS= Perennial sedges; *=1-25%; **=26-50%; ***=51-75%;
 180 ****=76-100 %
 181

182

183

184 Table 3. Influence of Tillage Practices on Weed Infestation of Groundnut Field in
 185 2010 season.

Weed species	Family	Gro wth	Zero Tillage		Minimu m Tillage		Conventional Tillage				
			T1	T2	T3	T4	T5	T6	T7	T8	T9
<i>Alysicarpus vaginalis</i>	Fabaceae	PBL	-	-	-	-	-	-	-	**	-
<i>Cassia mimosoides</i>	Caesalpiniaceae	ABL	*	*	*	*	-	-	-	-	*
<i>Cassia obtusifolia</i>	Caesalpiniaceae	ABL	-	*		*	*	-	-	-	-
<i>Chonchorus oliteruis</i>	Tiliaceae	ABL	-	-	-	-	-	-	*	-	-
<i>Cleome viscosa</i>	Cleomaceae	ABL	-	-	-	-	-	-	*	-	-
<i>Cyperus difformis</i>	Cyperaceae	PS	**	**	*	*	**	*	*	**	*

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<i>Cyperus rotundus</i>	Cyperaceae	PS	*	*	**	**	*	*	*	-	*
<i>Cynadon dactylon</i>	Poaceae	PG	**	*	**	**	*	*	*	*	*
<i>Euphorbia hirta</i>	Euphorbiaceae	ABL	*	-	-	-	-	-	-	-	-
<i>Heteropogon</i> <i>contortus</i>	Poaceae	PG	**	**	*	-	*	-	-	-	-
<i>Imperata cylindrical</i>	Poaceae	PG	-	*	**	*	-	*	-	*	-
<i>Ipomea aquatica</i>	Convolvulaceae	PBL	-	-	-	-	-	-	-	*	-
<i>Kylinga pumilla</i>	Cyperaceae	PS	*	-	*	-	-	-	*	-	-
<i>Kylinga squamulatus</i>	Cyperaceae	PS	**	*	**	**	-	*	*		-
<i>Leucas martinicensis</i>	Labiatae	ABL	*	**	*	*	*	*	-	-	-
<i>Mitracarpus villosus</i>	Portulacaceae	ABL	-	-	-	-	-	**	*	*	-
<i>Monechum ciliatum</i>	Acanthaceae	ABL	*	*	*	*	**	*	-	*	*
<i>Stirga gesneriodes</i>	Scrophurariacea	ABL	-	-	-	*	-	*	*	*	*
	e										
<i>Tridax procumbens</i>	Astreraceae	ABL	-	-	*	-	-	*	-	-	-
<i>Physalis angulata</i>	Scrophurariacea	ABL	-	-	-	-	*				
	e										
Relative Frequency %			12.	12.	12.	12.	9.8	12.	1	9.8	7.4
			3	3	3	3		3	1.		
									1		

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- 186 T₁= Paraquat at 0.8 kg a. i.ha⁻¹ followed by (fb) Fluazifop at 0.4 kg a.i. ha⁻¹
- 187 T₂= Paraquat at 0.8 kg a. i. ha⁻¹ fb Pendimethalin at 1.0 kg a. i. ha⁻¹ fb Fluazifop at
- 188 0.4 kg a.i. ha⁻¹
- 189 T₃ = Hoe tilling fb Paraquat at 0.8 kg a. i. ha⁻¹ fb Fluazifop at 0.4 kg a. i. ha⁻¹

190 T_4 = Plow fb Paraquat at 0.8 kg a.i. ha⁻¹ fb Fluazifop at 0.4 kg a. i ha⁻¹
 191 T_5 = Harrow fb Paraquat at 0.8 kg a. i ha⁻¹ fb Fluazifop at 0.4 kg a. i. ha⁻¹
 192 T_6 = Animal Traction fb SHW
 193 T_7 = Manual Cultivation fb SHW
 194 T_8 = Harrow fb Ridging fb Pendimethalin at 1.0 kg a. i. ha⁻¹ fb SHW
 195 T_9 = Plow fb Harrow fb Ridging fb Pendimethalin at 1.0 kg a.i. ha⁻¹ fb SHW
 196 ABL= Annual broadleaf; AG= Annual grass; PBL= Perennial broadleaf; PG=
 197 Perennial grass; PS= Perennial sedges; *=1-25%; **=26-50%; ***=51-75%;
 198 ****=76-100 %
 199

200 and minimum tillage practices than in conventional tillage practices in all the years (Tables 1-
 201 3)

202 Table 4 shows the effect of tillage practices on number of weeds per M², weed cover scores
 203 and weed dry weight during the experimental period. It was observed that T1 had the highest
 204 number of weeds, which was statistically different from T9 in 2008 and 2009 trials. However,
 205 no significant effect was observed in 2010. The results showed that T9 had the least cover
 206 score, which was statistically different from all other tillage practices in all the years.
 207 Influence of tillage practices on weed dry weight is presented in Table 5. The results
 208 revealed a significant effect of tillage practices on weed dry weight. In all the years, T1
 209 produced the highest weed dry matter than the other tillage practices. Significant treatment
 210 effects were also observed on number of plant stands at harvest and kernel yield (Table 5).
 211 T9 had the highest number of stands at harvest, which was statistically different from all
 212 other tillage practices in 2008, statistically different from T8, T7 and T6 in 2009 as well as
 213 different from T8 and T6 in 2010. The results also indicated that T9 had the highest kernel
 214 yield which was statistically similar with T8 but different from other tillage practices in all the
 215 years. The correlation analysis revealed that kernel yield was found to be significantly and
 216 positively correlated with number of plant stands ha⁻¹ but negatively correlated with weed
 217 density, cover score and dry weight (Table 6).

218

219 Table. 4 Effect of Tillage Practices on Weed Attributes in 2008, 2009 and 2010
 220 Rainy Seasons in Groundnut Field.

Treatments	Weed density M ⁻²			*Weed cover scores			Weed dry weight Kg ha ⁻¹		
	2008	2009	2010	2008	2009	2010	2008	2009	2010
T ₁	108a	74.6a	70.2a	7.5ab	7.3ab	7.7a	6752a	3443a	4665a
T ₂	93ab	67a	52.8a	6.66cd	6.5bc	7.1a	2493bc	1920b	2253bcd
T ₃	97a	83a	68.1a	6.3bcd	6.6bc	6.7ab	7073a	1540b	3863ab
T ₄	91ab	80.6a	65.0a	6.0cde	5.3dc	5.5bc	2323bc	1556b	1969cde
T ₅	107.3a	76.6a	69.5a	6.6bc	7.0abc	6.5ab	4587b	1443b	2627bc

T ₆	60.6ab	55.6ab	50.5a	8.3a	8.6a	6.7ab	2165bc	176b	1570dce
T ₇	71ab	58.0ab	48.0a	4.7e	4.0ed	4.8c	1567bc	1490b	1321dce
T ₈	83.7ab	86.6a	60.5a	5.1ed	5.5bcd	5.6bc	1183bc	1113bc	887de
T ₉	20.6b	22.6b	19.3b	2.3f	2.8e	2.1d	493c	393c	462e
SE _±	17.69	10.93	12.77	0.36	0.46	0.65	677.1	232.9	697.0

221 Means followed by same letter within a column are not significantly different using
 222 DMRT at 5%. a.i.= active ingredient, Kg= Kilogram, ha= hectare
 223 *Weed cover score: 1 – 10 scale: 1 = uncovered space, 10 = completely covered
 224 T₁= Paraquat at 0.8 kg a. i.ha⁻¹ followed by (fb) Fluazifop at 0.4 kg a.i. ha⁻¹
 225 T₂= Paraquat at 0.8 kg a. i. ha⁻¹ fb Pendimethalin at 1.0 kg a. i. ha⁻¹ fb Fluazifop at
 226 0.4 kg a.i. ha⁻¹
 227 T₃ = Hoe tilling fb Paraquat at 0.8 kg a. i. ha⁻¹ fb Fluazifop at 0.4 kg a. i. ha⁻¹
 228 T₄ = Plow fb Paraquat at 0.8 kg a.i. ha⁻¹ fb Fluazifop at 0.4 kg a. i ha⁻¹
 229 T₅ = Harrow fb Paraquat at 0.8 kg a. i ha⁻¹ fb Fluazifop at 0.4 kg a. i. ha⁻¹
 230 T₆= Animal Traction fb supplementary hoe weeding (SHW)
 231 T₇= Manual Cultivation fb SHW
 232 T₈ = Harrow fb Ridging fb Pendimethalin at 1.0 kg a. i. ha⁻¹ fb SHW
 233 T₉= Plow fb Harrow fb Ridging fb Pendimethalin at 1.0 kg a.i. ha⁻¹ fb SHW
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236 Table 5. Effect of Tillage Practices on Groundnut Stands and Kernel Yield in 2008,
 237 2009 and 2010 Rainy Seasons.

Treatments	Number of stands ha ⁻¹			Kernel yield kg ha ⁻¹		
	2008	2009	2010	2008	2009	2010
T ₁	16667b	21556b	20889f	146.8b	190.4b	160.2c
T ₂	20667b	20889b	22296ef	151.3b	191.3b	161.7c
T ₃	24222b	29778ab	29333b-e	183.3b	170.9b	168.1c
T ₄	17778b	20222b	25704d-e	153.3b	163.7b	179.8c
T ₅	20000b	17778b	23111def	171.6b	186.6b	181.6c
T ₆	22667b	39333a	30667a-d	181.8b	178.7b	1104.7b
T ₇	20000b	40889a	31630abc	932.2b	1231.7a	1161.3b

T ₈	25333b	41556a	35259ab	1038.8a	1108.6a	1010.3ab
T ₉	35333a	39778a	37852a	1067.7a	1188.3a	1151.3a
SE _±	2205.2	4488.1	3548.0	16.81	23.33	25.83

Means followed by same letter(s) within a column are not significantly different using DMRT at 5%
a.i.= active ingredient, Kg= Kilogram, ha= hectare
T₁= Paraquat at 0.8 kg a. i.ha⁻¹ followed by (fb) Fluazifop at 0.4 kg a.i. ha⁻¹
T₂= Paraquat at 0.8 kg a. i. ha⁻¹ fb Pendimethalin at 1.0 kg a. i. ha⁻¹ fb Fluazifop at 0.4 kg a.i. ha⁻¹
T₃ = Hoe tilling fb Paraquat at 0.8 kg a. i. ha⁻¹ fb Fluazifop at 0.4 kg a. i. ha⁻¹
T₄ = Plow fb Paraquat at 0.8 kg a.i. ha⁻¹ fb Fluazifop at 0.4 kg a. i ha⁻¹
T₅ = Harrow fb Paraquat at 0.8 kg a. i ha⁻¹ fb Fluazifop at 0.4 kg a. i. ha⁻¹
T₆= Animal Traction fb supplementary hoe weeding (SHW)
T₇= Manual Cultivation fb SHW
T₈ = Harrow fb Ridging fb Pendimethalin at 1.0 kg a. i. ha⁻¹ fb SHW
T₉= Plow fb Harrow fb Ridging fb Pendimethalin at 1.0 kg a.i. ha⁻¹ fb SHW

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Table 6. Correlation Coefficient of Kernel Groundnut Yield and Some Weed Parameters for Three Years Combined

	Kernel Yield	No. of stand at harvest	Weed cover Score	Weed Density
Kernel yield	-			
No. of Stand at harvest	0.30348*	-		
Weed cover score	-0.55778**	-0.36496*	-	
Weed density	-0.31514*	0.05568ns	0.59834**	-

Weed dry weight	-0.47454**	-0.21196ns	0.51042**	0.3236*	-
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=significant at 5%, ** = significant at 1% level of probability

3.1 DISCUSION

Continued tillage practices for 3 years on the same piece of land led to modification of weed floral composition. Similar observations were reported by (2) and (9). General decrease in number and frequency of weed occurrence were observed in all the treatments across the years. The decrease was more pronounced among conventional than minimum or zero tillage. This is because conventional tillage resulted in frequent cutting of weed seedlings and burial of weed seeds deep into the soil layer. These destroyed the established weeds and prevented viable seeds from germinating. Destruction of established weeds also helped in reduction of seeds build up in the seed bank. Perennial weeds were observed to be more persistent than the other species but their level of infestation were generally lower in conventional (T_9 , T_8 and T_7) than in minimum tillage (T_4 and T_5). Frequent cultivation in T_9 , T_8 and T_7 might have depleted the food reserve of perennating organs of these species of weed eventually causing starvation and death of the plant as reported by (10). It was observed that minimum tillage stimulated the growth of perennial species. (5) reported that in shallow tilled conditions, perennial weeds respond to breakage by producing increased number of shoots and consequently resulted in increased biomass and productivity. Similarly, (11) also reported high occurrences of perennial weeds in conventional than zero tilled plots where glyphosate was used. Broadleaf species were more in zero and minimum tillage treatments indicating that the post emergence application of fluazifop was ineffective against these species. The level of infestation and the total relative frequency of T_9 were generally lower than other conventional treatments indicating that pre-emergence application of pendimethalin and supplementary hoe weeding was effective in controlling germinating weeds.

T_1 and T_9 had consistently produced the highest and lowest number of weeds per m^2 , highest and lowest weed cover score, as well as highest and lowest weed dry weight, respectively. These may likely be due to reduction in number of weeds per m^2 , weed cover score and biomass in T_9 plots as well as fragmentation of weeds and their exposure to desiccation due plowing and harrowing. Similar observations were reported by (3). Highest weed cover score and weed biomass of zero tilled plots (T_1), suggested higher weed competition. This was confirmed by high level of weed infestation on these plots and frequency of weed occurrences as indicated in Tables 1-3. Higher number of stands and kernel yield were recorded in conventionally tilled plots while the lowest was observed in zero and minimum tilled plots. Highest number of stands in T_9 plots could be attributed to good soil pulverization, which provided an ideal environment for germination and seedling emergence. High infestation by rodents that picked the sown seeds in zero tilled plots could explain the reason for low number of stands recorded in these treatments. Reduced competition from weed for the available environmental resources due to effective weed control in the T_9 treatment, might have favored higher photosynthesis and subsequent translocation of photosynthate to kernel resulting in higher kernel yield. Similar observations were reported by (3) and (12). Lower kernel yield was recorded in zero tilled plots probably because of higher weed pressure as indicated by higher weed density, weed cover score and weed dry weight. Similar observations were reported by (6).

Significant but negative correlations were observed between kernel yield and most of weed characters studied. These indicated that as weed characters increased the grain yield decreased due to competition between the crop and the weeds for environmental resources. Similar observation was reported by (13) in cowpea. Although T_9 was more effective in

controlling weeds as evident by less weed dry weight, less weed cover score, and less weed density but it was not economical. A simple cost analysis revealed that about \$29.697 ha⁻¹ will be required for T₁, as compared to \$41.82 ha⁻¹ for T₂; \$66.06 ha⁻¹ for T₃; \$78.18 ha⁻¹ for T₄; \$66.06 ha⁻¹ for T₅; \$169.697 ha⁻¹ for T₆; \$175.757 ha⁻¹ for T₇; \$193.93 ha⁻¹ for T₈; and \$264.24 ha⁻¹ for T₉. The implements required for plowing, harrowing and ridging are also costly and not always available in the study area. Human labour required for supplementary hoe weeding was also very expensive and often not always available at the time of critical need. High cost of manual labour for weeding has been reported by (13) in rainfed and irrigated cowpea.

4. CONCLUSION

It can therefore be concluded that the conventional tillage practices provide better weed control and higher kernel yield than zero and minimum tillage practices in the study area. 

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