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Effect of time of introduction of mucuna (*Mucuna cochinchinensis* (Lour) A. Chev.) in cassava (*Manihot esculenta* Crantz.) on weed management in Makurdi, Southern Guinea Savannah of Nigeria.

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1 ABSTRACT

Afield experiment was conducted in 2013/2014 to 2014/2015 to investigate the effect of time of introduction of Mucuna (*Mucuna cochinchinensis* (Lour.) A.Chev.), on weed suppression and yield of cassava (*Manihot esculenta* Crantz) in an intercropping system at different planting dates. The cover crop (mucuna) was introduced at 3, 6, 9 and 12 weeks after planting (WAP) cassava in the subplots with sole cassava as control. The main crop (cassava) consisted of two plant populations 10,000 and 14,925.37 plants /ha. Results showed that mucuna introduced 3WAP gave the highest percentage weed suppression of 85.75% and 89.50% for 2013/2014 and 87.50% and 94.25% in 2014/2015. Followed by 6weeks after planting cassava with 70.25% and 72.75% in 2013/2014 and 64.25% to 70.75% in 2014/2015. The intense competition that gave significantly lower weed densities with mucuna introduced at 3weeks after planting cassava did not translate to an increase in tuber yield. Tuber yield values of 17.53 t/ha and 14.32 t/ha for both years were obtained in the population of 10,000 plants/ha when mucuna was introduced 6weeks after planting cassava. For both years, sole cassava population of 10,000 plants/ha with no mucuna introduced had the least yield values of 2.48t/ha and 1.83tonnes/ha for two cropping seasons. The present study therefore recommends that *Mucuna cochinchinensis* could be intercropped in a cassava population of 10,000 plants ha^{-1}at 6 weeks after planting cassava for a good yield and avoidance of weeding regimes.

2 INTRODUCTION

For many farmers in Africa, cassava is a dual purpose crop namely a staple food and a source of income (Nweke, 1994). Nigeria is the world largest producer of cassava with over 54million metrics tonnes (FAO, 2013) while Thailand is the largest exporter with 68million tonnes of cassava worth 1.5 billion U.S dollars shipped annually (Romanenko, 2015). The intensive cultivation of cassava has led to an increase in pests in which weed are the most important constraint (Akobundu *et al.*, 1999). In Nigeria, farmers spend more time in controlling weeds than on any aspect of crop production (Olorumaiye, 2010). Akobundu (1987) observed that weed control is one of the major determinants of family size in developing countries as the practice benefits from free labour from large family sizes. Weeds can cause yield loss of about 50 – 94% in cassava (Alabi, 1997). Onochie (1975) reported that the most weed sensitive period of cassava in Nigeria occurs during the third month after planting when root tuberization takes place. Some methods of weed control practice like hoe weeding in a stooped position for long periods may result in permanent spinal deformation (Oyedemi *et al*., 2002). The use of synthetic pesticides though effective are not sustainable and may lead to replacement of soft weeds by noxious weeds, destroy habitat of predators of insects, eradicate useful insects, pollute natural resources and enhance weed resistance in commercial agriculture (Adam *et al*., 2010). Therefore, the need to develop better weed control methods that will satisfy the needs of both the resource poor and progressive farmers. This involves the use of leguminous cover plants (Carsky *et al*., 1998). Leguminous cover plant like mucuna, beside medicinal properties like Levodopa (L-3,4-dihydroxyphenylalanine) which is used in the treatment of Parkinson disease (Singh *et al*., 1995) is known to accumulate large biomass (Carsky *et al*., 2001). It fixes large amounts of nitrogen in the soil (Sanginga *et al*., 1996) and effectively suppresses weed growth by physical smothering (Versteeg and Koudokpon, 1990) and through allelopathic effect (Fujii *et al*., 2005). The current recommendation for the integration of cover crops in farming system is relay cropping of the cover crop into the primary crop (Versteeg and Koudokpon, 1990). Awiti *et al*. (2000) however noted some limitations of cover crop damage to the intercrop component due to their aggressive nature, which may cause problems such as competition for growth resources and entanglement of the main crop. Earlier report by Chikoye *et al*., (2000) has shown that the simultaneous cropping of cover crops with food crops has a good potential for reducing cost of weed control. Therefore, this study was designed to determine the effect of time of introduction of mucuna and cassava population densities on weed suppression and yield of cassava.

3 MATERIALS AND METHODS

3.1 Experimental Site Description: The field experiment was carried out in 2013/2014 and 2014/2015 at the university of Agriculture Makurdi, Nigeria located on Latitude 07'41°N and Longitudes 08°37'E, 106.4m above sea level

3.2 Planting Materials: The test crop cassava (*Manihot esculenta* Crantz) TMS 30572 variety was obtained from NRCRI Otobi, Benue State, while the legume cover crop (*Mucuna cochinchinensis*(Lour) A. Chev) was procured from the Crop Production Department of the University of Agriculture Makurdi

3.3 Experimental Procedure: The treatment consisted of two cassava population densities – A (10,000) and B (14,925.37) plants/ha in the main plots and four times of mucuna introduction (0, 3, 6, 9 12 WAP) were placed in the subplots.

3.4 Design and Plant Culture: The experiment was laid in a split plot design. The experimental field was ploughed, harrowed with a tractor and ridged manually with an inter-ridge spacing of one meter. Each sub plot measured 50m x 10m with 1m between plots and 2m between blocks and 2m as experimental guard areas. Cassava cuttings of 20cm containing at least 5 nodes were planted at least 2/3 of its length into the ridge at spacing of 1m× 1m (10,000/ha) and 0.67m × 1m (14,925.37/ha) in the two main plots immediately after ridging. Mucuna the legume intercrop was planted by the side of ridge at a spacing of 0.25m×1m. Two seeds of mucuna were planted 2-3cm deep. These were later thinned down to one plant per hole at two weeks after germination. No fertilization and weed was done

3.5 Details of Intercrop Treatment

Code	Details of Treatments
T1	10,000 Cassava + mucuna introduced at 3WAP Cassava
T2	10,000 Cassava+ mucuna introduced at 6WAP Cassava
T3	10,000 Cassava+ mucuna introduced at 9WAP Cassava
T4	10,000 Cassava+ mucuna introduced at 12WAP Cassava
T5	10,000 Cassava no mucuna introduced (Control)
T6	14,925.37 cassava + mucuna introduced at 3WAP cassava
T7	14,925.37 cassava + mucuna introduced at 6WAP cassava
T8	14,925.37 cassava + mucuna introduced at 9WAP cassava
T9	14,925.37 cassava + mucuna introduced at 12WAP cassava
T10	14,925.37 cassava no mucuna introduced (control)

3.6 Data Collection

3.6.1 Weed Parameters: The following parameters were collected: common weed at the beginning and end of the experiment was assessed with the use of a quadrat 1m x 1m and frequency of occurrence estimated. Weed density (No/m^2) were estimated from a quadrat (1m x 1m) samples taken systemically along diagonal transect in each subplot and weed control efficiency assessed.

3.6.2 Cassava Crop Parameters: Plant girth (cm), stems weight (kg), tuber diameter (cm), tuber yield in t/ha,

3.6.3 Soil Sample Collection and Analysis: At the beginning of the experiment soil samples were randomly collected with a soil auger at a plough layer of 0 – 20cm from different spots of the experimental field. The soil samples were bulked and analysed in the laboratory for physical and chemical properties using a standard procedure described in the laboratory manual of the international institute of tropical agriculture (IITA, 1981). Total Nitrogen number was determined using the micro Kjeldahl method (Stewart *et al*., 1974). Soil available phosphorus (P) was extracted using a spectrometer, the exchangeable potassium (K) was determined using the method described by Rowell (1994) and K concentration determined using flame photometer. The organic carbon (OC) content of soil was determined, using the wet oxidation method (Walkley and Black, 1934). Soil pH was determined in distilled water using the Beckman Zeromatic pH meter.

3.7 Data Analysis: All data collected were subjected to analyses of variance using SAS version 9.4. Significant means were separated by Duncan Multiple Range Test at 5% probability level

Plate 1: Seeds of mucuna (*Mucuna cochinchinensis*)

Plate 2 : Cassava (*Manihot esculenta Crantz*) TMS 30572 cutting

Plate 3: Interaction of Mucuna and Cassava

Plate 4: Pods and flower of mucuna at Senescence

Plate5: Cassava plants before harvest

Plate 6: Cassava fresh tubers at harvest.

4 RESULTS

4.1 Soil Characteristics: The result of the soil analysis showed 76.3% and 72% sand. The soil pH was neutral in 2013/2014 with 6.87 and slightly acidic in 2014/2015. The exchangeable cations of calcium, potassium and sodium were low while magnesium was moderate. The organic carbon in experiment 1 was low while in experiment 11 it was very low. Experiment 1 had a very high organic matter of 3.38 while experiment II had a very low organic carbon. Total nitrogen content of the soil in the two experiments was very low. (Metson (1961)

Table 1: Some physical and chemical properties of soil used in the studies

Soil properties	Experiment I 2013 – 2014	Experiment II 2014 – 2015
pH (H_2O)	6.87	6.54
Sand (g/kg)	76.36	72.08
Clay (g/kg)	13.64	13.92
Silt (g/kg)	10.00	14.00
% C	1.96	0.44
% O.M	3.38	0.76
% N	0.048	0.039
Av. P (mg/ml)	0.31	0.39
K (cmol/kg)	0.26	0.28
Ma (cmol/kg)	0.23	0.26
Mg (cmol/kg)	2.80	2.60
Ca (cmol/kg)	3.10	2.90
ECEC (cmol/kg)	7.39	7.05
% Base sat.	86.50	85.80

4.2 Weed Abundance: Weed species identified at the beginning of the experiment and at harvest in Table 2 were classified into family, broadleaves, grasses and sedges. At the beginning of the experiment, twenty five (25) weed species identified belonged to eleven families, *Ludwigia hyssopifolia* and *Hyptis suaveolens* were the most common broadleaves while Grasses had *Andropogon gayanus* and *Rottboellia cochinchinensis* were the most common. *Cyperus iria* was the most dominant sedge. At the time of harvest (Table 2) Twenty (20) weed species identified belonged to Twelve families, *Oldenlandia corymbosa* and *Ludwigia hysopifolia* were the most common broadleaves while *Brachiaria lata* was the most common grass weed species on the trial field. The only dominant sedge in the flora was *Cyperus iria*. There was a sharp decrease of grasses at the end of harvest in 2015 with the following persisting: *Rottboellia cochinchinensis*, *Imperata cylindrica, Paspalum scrobiculatum* and *Panicum subalbidum,* while broadleaves had *Commelina benghalensis, Schwenkia Americana,Boerhavia diffusa,Euphorbia hirta, Hibiscus asper, Tephrosia bracteolata* , *,Daniella oliveri and Piliostigma thonningii* as persistent weeds. On the part of sedges, *Cyperus iria* persisted (Table 3).

Table 2: Common weed species at the experimental sites, before cropping and at harvest (2013-2014)

Family	Weed Species	Level of Infestation		
		Before ploughing 2013	At harvest 2014	Persistent weed
GRASSES				
Poaceae	*Andropogon gayanus* Kunth *var. Gayanus*	+++	–	
Poaceae	*Rottboellia cochinchinensis* (Lour) Clayton	+++	+	Persistent
Poaceae	*Brachiaria lata* (schumach) C. E Hubbard	–	+	
Poaceae	*Imperata cylindrica*(Linn)	++	+	Persistent
Poaceae	*Paspalum scrobiculatum* (Linn)	++	+	Persistent
Poaceae	*Panicum subalbidum*Kunth	+	+	Persistent
Poaceae	*Rynchelytrum repens* (Wild) C. E. Hubbard	+	–	
Poaceae	*Pennisetum polystachion* (Linn) Schult	+	–	
Poaceae	*Panicum maximum* Jacq.	+	–	
Poaceae	*Eragrostis tenella* Linn.	+	–	
	*Echinochloa obtusiflora*Stapf	+	–	
	Eleusine indica Gaertin	+	–	
BROADLEAVES				
Asteraceae	*Vernonia ambigua* Kotchy&Peyr	+	–	
Rubiaceae	*Oldenlandia corymbosa* Linn	–	+++	
Onagraceae	*Ludwigia hyssopifolia* (G. Don) Excell	++	+++	Persistent
Lamiaceae	*Hyptis suaveolens* Poit	++	++	Persistent
Commelinaceae	*Commelina benghalensis* Linn.	+	++	Persistent
Loganiaceae	*Spigelia anthelmia* Linn.	+	+	Persistent
Lamiaceae	*Hyptis spicegera* Linn	+	–	
Leguminosae	*Indigofera hirsuta* Linn. *var* hirsuta	+	–	
Caryopthyllaceae	*Polycarpaea corymbosa* (Linn.) Lam	+	–	
Convolvuceae	*Ipomoea involucrata* P. Beauv	+	–	
Acanthaceae	*Hypoestes cancellata* Nees	+	–	
Hydrophyllaceae	*Hydrolea palustris* (Aubl.) Rausch	–	+	
Euphorbiaceae	*Euphorbia hirta* Linn.	–	+	
Euphorbiaceae	*Phyllantus amarus* Schum&Thonn	–	+	
Asteraceae	*Ageratum conyzoides* Linn	–	++	
Leguminosae	*Desmodium scorpiurus* (SW) Desv	–	+	
Rubiaceae	*Mitracarpus villosus* (SW) DC.	–	+	
Asteraceae	*Tridax procumbens* Linn.	–	+	
SEDGES				
Cyperaceae	*Cyperus iria* Linn.	++	+++	Persistent
Cyperaceae	*Cyperus haspan* Linn.	+	++	Persistent
Cyperaceae	*Kyllinga squamulata* Thonn. exvohl	+	+	Persistent
Cyperaceae	*Kyllinga pumila* Michx	+	–	

NOTE: +++ = Higher Infestation (60 – 90% occurrence), ++ = Moderate Infestation (30 – 59% Occurrence), + = Low Infestation (1 – 29% occurrence) and – Nil (Presences Not Noticeable)

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Table 3: Common weed species at the experimental sites, before cropping and at harvest (2014-2015)

Family	Species	Level of infestation Before ploughing 2014	At harvest 2015	Persistence
GRASSES				
Poaceae	*Imperata cylindrica* (Linn)	+++	++	Persistent
Poaceae	*Paspalum scrobiculatum* (Linn)	++	–	
Poaceae	*Brachiaria lata* (schumach) C. F Hubbord	++	++	Persistent
Poaceae	*Andropogon gayanus* Kunth var. Gayanus	+	–	
Poaceae	*Dactyloctenium aegyptium* (Linn) P. Beauv	+	–	
Poaceae	*Digitaria horizontalis*Willd	+	–	
Poaceae	*Rottboellia cochinchinensis* (lour) Clayton	+	+	Persistent
Poaceae	*Eleusine indica* Gaertin	–	+	
BROADLEAVES				
Commelinaceae	*Commelina benghalensis* Linn	+++	+	Persistent
Leguminosae	*Indigofera hirsuta* Linn. Var. hirsuta	++	–	
Scrophuolariaceae	Scoparia *dulcis* Linn	+	–	
Solanaceae	*Schwenckia americana* L.	+	++	Persistent
Nyctaginaceae	*Boerhavia diffusa* L.	+	+	Persistent
Euphorbiaceae	*Euphorbia hirta* Linn	+	++	Persistent
Malvaceae	*Hisbiscus asper* Hoof. F.	+	+	Persistent
Leguminosae	*Tephrosia bracteolata*Guill&Perr	+	+	Persistent
Leguminosae	*Desmodium scorpiurus* (SW) Desv	+	–	
Leguminosae	*Daniellia oliveri* (Rolfe) Hutch &Dalz	+	+	Persistent
Aizoaceae	*Trianthema protulacastrum* Linn.	–	+++	
Asteracraceae	*Ageratum haustonianum* Linn.	–	+++	
Leguminosae	*Piliostigma thonningii* (Schum.) Milne Redhead	+	+	Persistent
Asteraceae	*Tridax procumbens* Linn	–	+	
Lamiaceae	*Hyptis suaveolens* Poit	–	++	
Rubiaceae	*Oldenlandia corymbosa* Linn	–	+	
Convolvuaceae	*Ipomaea involucrata* P. Beauv	–	+	
SEDGES				
Cyperaceae	*Cyperus iria* Linn	+	+	Persistent
	Cyperus haspan Linn	–	+	

NOTE: +++ = Higher Infestation (60 – 90% occurrence), ++ = Moderate Infestation (30 – 59% Occurrence), + = Low Infestation (1 – 29% occurrence) and – Nil (Presences Not Noticeable)

Table 4: Percentage ground cover of *M.cochinchinensis* at 4, 8, and 12 weeks after introduction of mucuna (WAI)

Treatment	2013 – 2014			2014 – 2015		
	% ground cover					
Cassava pt/ha	4 WAI	8 WAI	12 WAI	4 WAI	8 WAI	12 WAI
10,000	24.54a	31.37a	38.37b	25.45a	32.70b	40.22a
14,925.37	25.49a	32.31a	43.45a	26.43a	35.26a	41.69a
SE(±)	0.62	1.04	1.47	0.54	0.56	1.06
Time of mucuna introduction in weeks						
0	0.00e	0.00d	0.00e	0.00c	0.00e	0.00e

3	41.98a	55.22a	76.45a	37.41a	58.91a	72.12a
6	37.75b	46.16b	55.74b	31.81b	40.59b	54.57b
9	26.66c	30.05c	40.50c	30.74b	36.57c	41.79c
12	18.69d	27.78c	31.86d	29.70b	33.83d	36.29d
SE (±)	0.97	1.64	2.32	1.20	1.26	1.26
Interaction						
Pop× Time	*	*	*	*	*	*

Means followed by the same letter (s) in a column are not significantly different by DMRT ($P < 0.05$) * Significant at ($P < 0.05$). WAI = Weeks after introduction.

The percentage ground cover as shown in (Table 4) reveals that mucuna had significantly the highest ground cover at 12WAI in 2013-2014 and 8WAI in 2014-2015 in the cassava population of 14,925.37 with 43.45% and 35.2% respectively. All other intervals of assessment where not significant, based on time of introduction of mucuna, significant differences of mucuna in planted cassava existed from 4, 8 and12WAI for both years. Three (3) weeks after introduction gave consistently the highest percentage ground cover of 41.98%, 55.22%, 76.45% and 37.41%, 58.91% and 72.12% for the both years followed by six week after introduction with 37.75%, 46.16%, 55.74% and 31.81%, 40.59%and 54.57% respectively for both years. While 12WAP mucuna had the least percentage ground cover. Mucuna showed substantial weed suppression potentials as reflected in the percentage ground cover (Table 5). The interaction between cassava population and time of introduction of mucuna gave significantly the highest percentage groundcover of 84.30 and 74.65% for both years at 12WAI in the cassava population of 14,925.37 + 3WAP followed by 3WAP in cassava population of 10000 Plant ha^{-1} with 68.68%, however, at 12WAP, the percentage ground cover at 3WAP had 69.60% which was statistically similar to 74.65% in the cassava population of 14,925.37 while mucuna introduced 12WAP had the least percentage ground cover of 31.22%, 32.50% and 35.24%, 37.24% for bothyields.

Table 5: Interaction of Time of Introduction of *M.cochinchinensis* and Cassava population on percentage ground cover at 4, 8 and 12 WAI of mucuna

Treatment	**2013 – 2014**			**2014 – 2015**		
Cassava pop/ha x Time of mucuna introduction in weeks	**Mean Percentage Ground Cover**					
	4 WAI	8 WAI	12 WAI	4 WAI	8 WAI	12 WAI
10,000 + 0	0.00e	0.00d	0.00f	0.00c	0.00g	0.00d
10,000 + 3	40.23ab	52.23ab	68.60b	36.97a	55.24b	69.60a
10,000 + 6	38.14b	46.40b	54.39cd	31.30b	39.13cd	54.61b
10,000 + 9	26.41c	30.45c	37.66e	30.28b	36.02def	41.64c
10,000 + 12	17.92d	26.77c	31.22e	28.73b	33.12f	35.24c
14,925.37 + 0	0.00e	0.00d	0.00f	0.00c	0.00g	0.00d
14,925.37 + 3	43.74a	51.21a	84.30a	37.85a	62.59a	74.65a
14,925.37 + 6	37.37b	45.92b	57.08c	32.32b	42.05c	54.53b
14,925.37 + 9	26.91c	29.64c	43.34de	31.19b	37.12de	41.95c
14,925.37 + 12	19.45d	28.79c	32.50e	30.80b	34.55ef	37.34c
SE (±)	1.38	2.32	3.28	1.20	1.26	2.36

Means followed by the same letter (s) in a column are not significantly different by DMRT ($P < 0.05$)
Significant at 5% level of probability, WAI = Weeks after planting, Pop= Population

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Table 6: Effect of Time of Introduction of *M. cochinchinensis* in cassava on weed density at 3, 6,9,12 and 52 WAP

Treatment	2013 – 2014					2014 – 2015				
	Mean Weed Density No/m^2									
Cassava pt/ha	**3WAI**	**6WAI**	**9WAI**	**12WAI**	**52WAP**	**3WAI**	**6WAI**	**9WAI**	**12WAI**	**52WAP**
10,000	254.55a	228.90a	130.70a	129.30a	91.20a	259.80a	274.32a	153.65a	132.40a	105.80a
14,925.37	214.45b	203.95b	130.50a	119.25b	73.80b	259.10a	199.88b	144.35a	145.35a	100.25a
SE(±)	2.04	1.53	6.74	1.67	5.12	3.32	3.20	3.50	5.60	4.63
Time of mucuna introduction in weeks										
0	313.50a	287.00a	218.00a	259.00a	114.25a	267.61a	263.49a	246.75a	269.38a	218.25a
3	158.25e	149.38e	50.38d	32.00d	46.25c	255.38a	211.25c	37.81e	22.88e	26.50e
6	196.25d	195.13d	90.00c	74.25c	73.25b	255.50a	22.56c	109.00d	85.31d	48.38d
9	217.25c	217.13c	142.88b	125.13b	84.00b	258.25a	242.56b	163.38c	126.88c	96.25c
12	287.25b	233.00b	151.00b	130.50b	94.75b	260.56a	245.63b	188.06b	189.94b	125.75b
SE (±)	3.23	2.42	10.66	2.65	8.10	5.25	5.06	5.53	9.48	7.33
Interaction										
Pop × time	*	*	*	*	*	*	*	*	*	*

Means followed by the same letter (s) in a column are not significantly different by DMRT ($P < 0.05$) WAI= weeks after introduction.* Significant at ($P < 0.05$).

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Table 7: Interactions of time of introduction of *M. cochinchinensis* and cassava population on weed density

Treatment	2013 – 2014					2014 – 2015				
	Mean Weed Density N0/m^2									
Cassava pop/ha + Time of mucuna Introduction	**3WAI**	**6WAI**	**9WAI**	**12WAI**	**52WAP**	**3WAI**	**6WAI**	**9WAI**	**12WAI**	**52WAP**
10,000 + 0	316.00a	305.50a	215.50a	275.00a	116.00a	268.98a	298.35a	249.75a	303.75a	213.25a
10,000 + 3	171.50d	161.25g	55.50de	39.50f	66.25c	253.63a	247.25cd	39.38e	28.00g	26.25e
10,000 + 6	216.00c	207.50e	95.50cd	82.00d	77.00bc	254.00a	261.50bc	111.75d	81.00f	45.75de
10,000 + 9	261.00b	223.75d	140.75bc	122.25c	89.75abc	260.88a	281.00ab	170.88c	136.63de	106.25bc
10,000 + 12	308.25a	246.50a	146.25b	127.75c	107.00ab	261.50a	283.50ab	196.50b	179.36cd	137.50b
14,925.37 + 0	311.00a	268.50b	222.00a	243.00b	117.50a	266.25a	228.63de	243.75a	235.00b	223.25a
14,925.37 + 3	145.00e	137.50h	45.25e	25.50g	26.25d	257.13a	175.25h	36.25e	17.75g	26.75e
14,925.37 + 6	176.50d	182.75f	84.50de	66.50e	69.50c	256.88a	183.63gh	106.25d	89.63ef	51.00de
14,925.37 + 9	173.50d	210.50e	145.00b	128.00c	78.25bc	255.63a	204.13fg	155.88c	115.13ef	86.25cd
14,925.37 + 12	266.25b	222.50d	155.75b	133.25c	82.50abc	259.63a	207.75ef	179.63bc	200.50bc	114.00bc
SE (±)	4.57	3.42	15.07	3.74	11.45	7.43	7.15	7.82	13.41	10.37

Means followed by the same letter (s) in a column are not significantly different by DMRT at ($P < 0.05$)
WAI=Weeks after introduction

Table 8: Effect of time of introduction of *M. cochinchinensis* in cassava yield and yield Component

Treatment	**2013 – 2014**			**2014 – 2015**		
Cassava Pop/ha	Tuber diameter (cm)	Stem weight (t/ha)	Fresh Cas tub (t/ha)	Tuber diameter (cm)	Stem weight (t/ha)	Fresh Cas tub (t/ha)
10,000	3.51a	6.55a	9.86a	2.77a	5.16a	7.64a
14,925.37	3.52a	6.99a	9.16a	2.52a	5.16a	6.88a
SE(±)	0.10	0.41	0.26	0.12	0.29	0.34
Time of mucuna introduction						
0	2.66b	3.30d	4.60d	1.91c	2.42d	3.39c
3	3.51a	6.81bc	5.65d	2.56b	5.09bc	4.25c
6	4.01a	9.37a	14.66a	3.40a	7.57a	11.61a
9	3.78a	8.42ab	12.37b	2.80b	6.23ab	9.32b
12	3.58a	5.95c	10.26c	2.55b	4.40c	7.76b
SE (±)	0.16	0.64	0.42	0.12	0.47	0.50
Interaction Pop*time	*	*	*	*	*	*

Means followed by the same letter (s) in a column are not significantly different by DMRT ($P < 0.05$) * Significant at ($P < 0.05$).
Tub= Tuber
Pop=Population

Table 6 shows that significant differences were recorded in the cassava population at 3, 6, 12, 52 weeks in the first year and at 6, 9.12 and 52weeks after introduction in the second year. The cassava population of 10,000 plants per hectare had consistently the highest weed density while cassava population of 14, 925.37 had consistently the least significant weed density. However, no significant weed densities where observed at 9WAI in the first year and at 3, 9, 12 and 52 weeks in the second year. Significant differences Occurred in weeks of mucuna introduction in the first year at (P<0.05). However, at three weeks after introduction in the second there were no significant differences in the time interval of introduction. The time interval of three of weeks after mucuna introduction in cassava as assessed, except for the second year had consistently the least significant weed density followed by 6WAI while the control had the highest weed mean densities in both years at (P<0.05). Table 7 shows significantly lower weed densities were obtained at three weeks on sowing cassava in the two-cassava population with the exception of three weeks of assessment in the second year 2014-2015. The population of cassava 14,925.37 with mucuna introduced at three weeks after planting cassava has significantly the least weed densities followed by the population of cassava of 10, 000 plant $ha^{-1}$with mucuna introduced at three weeks after planting cassava. However, in the second year, the two populations had statistically the same densities at P<0.05 when assessed at 9, 12, and 52 weeks after introduction. As shown in Table 8, tuber diameter, stem weight and weight of fresh cassava tubers did not differ significantly at p < 0.05 in the first year while only tuber diameter differed significantly in the second year in the two cassava population of 10,000 and 14925.37 plants/ha respectively. Cassava tuber diameter, stem weight and fresh tuber weight significantly had the highest values in the two seasons when mucuna was introduced 6 weeks after planting cassava followed by 9weeks after introduction of mucuna in the cassava populations, while the control with no mucuna introduced had significantly the least values in both years. The interaction of time of introduction of *M. cochinchinensis* and cassava population as revealed in Table 9 produced significantly the highest value of tuber diameter, cassava stem weight and fresh cassava tuber weight in both years in 10,000 plants/ha with mucuna introduced at 6 weeks after sowing cassava followed by the cassava population of 14,925.37 plants/ha with mucuna introduced at 6weeks with the second highest values of tuber diameter and fresh tuber yield of cassava, however, the interaction of cassava population of 14,925.37 plants/ha and mucuna introduced at 3 weeks after planting cassava had the highest significant stem weight in both years with 10.44 tonnes/ha and 7.80 tonnes/ha respectively. The control of 10000 plants/ha had the least significant values of tuber diameter stem weight and fresh cassava tuber as measured in both years.

Table 9: Interactions of time of introduction of *M. cochinchinensis* and cassava population on tuber diameter stem weight and fresh cassava tuber weight

Treatment	**2013 – 2014**			**2014 – 2015**		
Cassava pop/ha + Time of mucuna Introduction	Tuber diameter (cm)	Stem weight (t/ha)	Fresh Cas tub (t/ha)	Tuber diameter (cm)	Stem weight (t/ha)	Fresh Cas tub (t/ha)
10,000 + 0	2.66d	2.15d	2.48e	1.93d	1.59d	1.83f
10,000 + 3	2.84cd	3.18d	3.18e	2.40cd	2.38d	2.35f

10,000 + 6	4.33a	11.10a	17.53a	3.78a	9.42a	14.32a
10,000 + 9	4.02ab	10.28a	14.70ab	3.03b	7.71a	11.09b
10,000 + 12	3.70ab	6.03bc	11.40bcd	2.73bc	4.52bc	8.63bcd
14,925.37 + 0	2.67d	4.44cd	6.72de	1.90d	3.25cd	4.95e
14,925.37 + 3	4.19ab	10.44a	8.12cd	2.73bc	7.80a	6.15de
14,925.37 + 6	3.69ab	7.64b	11.80bc	3.03b	5.72b	8.90bc
14,925.37 + 9	3.58abc	6.56bc	10.04cd	2.58bc	4.76bc	7.56cde
14,925.37 + 12	3.47bc	5.88bc	9.12cd	2.38cd	4.29bc	6.88cde
SE (±)	0.22	0.90	1.49	0.17	0.66	0.76

Means followed by the same letter (s) in a column are not significantly different by DMRT ($P < 0.05$) Tub= Tuber.

5 DISCUSSION

The dominance of broadleaves in the experimental plots showed that mucuna effectively suppressed grasses while broadleaves were more resilient to control by mucuna, this suggest the differences in their photosynthetic efficiencies. Grasses are C4 plants which are less shade tolerant than broadleaves. This conforms to the work of Akobundu (1987) in which *Centrosema pubescens* suppressed the growth of grasses but encouraged the growth of broadleaves. The smothering of weed as shown on Table 6 reveals significantly lower densities of weed when mucuna is introduced early in an intercropping system while the control was observed to have significantly higher weed densities. Early introduction causes intense competition, which affects the yield of the primary crop. The entanglement effect of mucuna was well noticed after sowing cassava. This aggress with the work of Awiti *et al.* (2000) who noted some limitations of the cover crop due to their aggressive nature which may cause problems such as competition for growth resources and entanglement of the main crop.

The plant canopy covers of the cover crop increased with growth of mucuna. This agrees with the findings of Carsky *et al.* (2000) who reported that canopy development increased with time of assessment. The agronomic component of yield and yield of cassava that mucuna introduces at 6 weeks after sowing cassava in the population of 10,000 plants/ha had significantly the highest values of tuber diameter, stem weight and fresh cassava yield than other treatments.

6 RECOMMENDATIONS

It is hereby recommended that to obtain a good yield and avoid multiple weeding regimes in cassava fields. Mucuna should be introduced at 6 weeks after sowing cassava in 10,000 (1m x 1m) plants/ha with mucuna at 40,000 plants ha^{-1} (0.25m x 1.00m)

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