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Abundance and Diversity Index of Weeds in Oil Palm and Vegetable Intercropping in Rainforest Zone of Nigeria

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Abstract

The problem of severe weed infestation often arises during the early phases of establishment of oil palm field due to the spacing requirement and growth habit of young oil palm plantation until later years when the canopy closes. This study was conducted at Ala, Akure-North Local Government Area, Ondo State, Nigeria, to investigate the composition of weed species and their distribution in fruit vegetable-juvenile oil palm intercrop. The fallow alleys within the immature oil palm were intercropped with 2 accessions of tomato (NGB 01665 and NG/AA/SEP/09/053) and eggplant (NGB 01737). The sampling of the weed species was carried out with a quadrat (0.25 m^2). Weed species parameters and the Diversity Index (D) were quantitatively analyzed. The results revealed that members of *Asteraceae* and *Poaceae* gave the highest weed species at 3 and 6 weeks after intercropping (WAI) (17.857% and 19.04%) respectively. A total of 23 and 16 were found at 3 and 6 WAI, while the least diversity index of 0.734 was recorded in the immature oil palm/tomato (NGB 01665) plot at 6 WAI. Farmers should be persuaded to simultaneously intercrop fruit vegetables within the alley of juvenile oil palm, particularly at the earlier years prior to closure of the oil palm canopy.

Keywords: distribution; diversity; intercrop; oil palm; weed

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INTRODUCTION

The standard spacing requirement of 6 – 9 m deployed during the field cultivation of oil palm gives room for a waste of solar radiation and has resulted in severe weed invasion from field transplanting to the stage of canopy closure when the palms become fruitful. During the long juvenile phase, most farmers expend a lot of their capital on labor cost to control weeds in the plantation yearly without any significant monetary returns (Oluwatobi et al., 2020). Weeds compete with main crops for nutrients, water, sunlight and space when these resources are limited. They reduce the utilization of fertilizer, interfere with and cut down the production of main crops (Suryaningsih and Darmadi, 2011; Susanti and Safrina, 2018). Ali et al. (2014) documented that weeds constitute the most serious and extensive biological limitation on crop production and cause significant damage until the crops are harvested.

Weeds also cause inhibitory activity on the germination parameters of desired crops (Susanti et al., 2021). The fallow and empty alley within the newly established oil palm plantation, consequent of the pattern of spacing, has culminated in underutilization of

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the environmental resources such as space, CO_2, sunlight, water, etc. (Rezig et al., 2012). Therefore, the introduction of annual crops such as vegetables, groundnut and soybeans into the fallow alley in the young oil palm plantation would be advisable, as it would furnish the farmers with the opportunity to improve the land productivity and facilitate proficient deployment of the environmental resources (Amanullah et al., 2006; Abera and Feyisa, 2008; Aynehband et al., 2010; Rezig et al., 2012).

Tree canopy encourages surface litter accumulation and promotes soil fertility (Livesley et al., 2016; Rahayu et al., 2020). Many grass species thrive well and exhibit good traits under sunny environmental condition, contrary to what is obtainable under shaded environment (Rahayu et al., 2020). Shade lessens solar radiation and influences the microclimate around the environment (Rahayu et al., 2020). Growth of weed species is hindered as a result of reduction in photosynthetic activities, CO_2 generation and other aesthetic features when they are subjected to shade condition (Okeyo et al., 2014; Rahayu et al., 2020). Reduced light situation contributes to fewer green coverage because tree leaves sort the photosynthetically vital red and blue light wavelengths before they reach weed leaf surfaces. Various plant species possess varying shade tolerance and rate of responses to the intensity of sunlight received (Peterson et al., 2014; Audina et al., 2016). The reaction of plants to the intensity of solar radiation differs according to the species; that is shade or full sun plants (Rahayu et al., 2020). Plants with full sun conditions tend to have higher root dry weight than those subjected to shade conditions. At low light intensity, shade tolerant plants can accumulate photosynthetic products than those grown in full sunlight (Pantilu et al., 2012).

The kind of weeds and their density are one of the major factors that influence the competition for resources and performance of desired crops (Susanti et al., 2021). Weed management approaches like using cover crops to smother weeds, seedbed treatment or tillage operations may be used for additional efficient weed management in integrated and organic farming systems (Devkota and Jha, 2010; Kanatas et al., 2020). Evaluation of the impacts of the various intercropping arrangements, coupled with the component crop mixtures on the distribution of weed is crucial in identifying a better intercropping models and crop mixtures that would contribute to the alleviation of weeds infestation tremendously, coming up with superior weed management system, increased yield and ultimately and support sustainable agriculture. Irrespective of the cropping designs employed, weed concern remains a critical cause of yield loss during cultivation. Thus, comprehensive knowledge and understanding of their distribution and mechanism of survival would facilitate further studies to diminish distressing impacts of weeds to agricultural farms (Oluwatobi et al., 2020).

The number of weed species within a community could be used to measure the distribution of weed species present with regards to the species richness. Weed species distribution maybe between or within communities; as two communities that share the same number of species may vary in terms of species evenness and thus it is valuable to have the knowledge of the proportion or relative species abundance found in the community (Karaye et al., 2007). Therefore, this study was aimed at determining the composition and diversity index of weed species within the intercropped alleys and control plot.

MATERIALS AND METHOD

Study area

Description of study area

The study was conducted during the rainy season of 2017 within an established 2 year-old oil palm plantation situated at Ala, Akure-North Local Government Area, Ondo State, Nigeria. The plantation can be found at a coordinate between longitude 5°21’15.19177”-5°21’15.47179” E and latitude 7°5’34.8857”-7°5’35.59837” N, in the tropical rain forest region of Nigeria. Variation in annual rainfall is between 1,150 to 2,550 mm, while the temperature is described to be moderately high year-round, with a range of 22 – 34 °C (Ogunrayi et al., 2016). Seeds of tomato accessions (NGB 01665 and NG/AA/SEP/09/053) and eggplant (NGB 01737) obtained from National Centre for Genetic Resources and Biotechnology, Ibadan, Oyo State, Nigeria, were transplanted separately into the alleys of the juvenile oil palm plantation after being raised in the nursery for 4 weeks.

The soil pH is slightly acidic. Organic matter content and cation exchange capacity ranges are 2.317-4.565 g kg^{-1} and 2.439-4.298%, respectively.

Collection of weed species

The survey of weed species was carried out within each plot by following the methods described by (Olorunmaiye et al., 2011). An ‘M’ guide-pattern for collection of weeds was precisely identified and mapped out in each of the plots and 0.25 m^2 quadrat was used for sampling. Collected data were subjected to ecological analysis (Oluwatobi and Olorunmaiye, 2014; Dingaan and Du Preez, 2017). Weeds were identified using a standard Handbook of West African Weeds (Akobundu and Agyakwa, 1998).

Weed species parameters and diversity indices

The parameters were calculated according to methods of Olorunmaiye et al. (2013) and Oluwatobi and Olorunmaiye (2014). Weed frequency was calculated as number of quadrats where weed species was found. The density of weeds was calculated as number of species per area of quadrat. Determinations of other parameters were as follows:

$$\text{Relative frequency} = \frac{\text{frequency of species}}{\text{total frequency of all species}} \times 100$$

$$\text{Relative density} = \frac{\text{density of species}}{\text{total density of all species}} \times 100$$

$$\text{Relative importance value (RIV)} = \text{relative frequency} + \text{relative density}$$

$$\text{Abundance} = \frac{\text{relative frequency} + \text{relative density}}{2}$$

$$\text{Dominance} = \frac{\text{absolute density of species}}{\text{number of quadrats where species are found}} \times 100$$

Simpson’s Diversity Index (D): This index indicates the chance that two individual weed species randomly selected from a sample will fit into the same species. This index was computed as follows:

$$\text{Simpson's diversity index (D)} = \frac{\sum n\,(n-1)}{N\,(N-1)}$$

Where:
n = total number of a particular weed species;
N = total number of all weed species.

Simpson’s index of diversity (1 – D): This was computed by subtracting Simpson’s diversity index (D) from 1.

Simpson’s reciprocal index (1/D): This index started with 1 as the lowest probable figure. It was achieved by finding the inverse of Simpson’s index of diversity (D) (Oluwatobi and Olorunmaiye, 2014).

Data analysis

The data gathered were computed using Microsoft Excel Package (2010) and the results were presented in tables.

RESULTS AND DISCUSSION

Composition and distribution of weed species

A total of 28 different weed species were recorded across the 4 plots surveyed at 3 and 6 WAI and belong to 19 families. Members of the *Poaceae* recorded the highest number (21.43%), followed by members of *Asteraceae* and *Euphorbiaceae* (21.43% and 7.14%) respectively. Other families each of which has one member present (3.57%) are *Campanulaceae*, *Cleomaceae*, *Commenlinaceae*, *Convolvulaceae*, *Cyperaceae*, *Lamiaceae*, *Leguminosae-Papilionoideae*, *Loganaceae*, *Malvaceae*, *Nyctaginaceae*, *Phyllanthaceae*, *Piperaceae*, *Portulaceae*, *Rubiacea*, *Solanaceae* and *Urticaceae*. Broadleaf weeds represent 75% of the weed species encountered during the survey, while grasses and sedge represent 21.43% and 3.57% respectively (Table 1 – Table 8).

The decline observed in number of weed species at 3 through to 6 WAI may be ascribed to the combined shade effect of the 2-year-old oil palm and the fruit vegetables. This observation agrees with the submissions of Shadiul et al. (2011) and Ademabayoje et al.

(2020). The impact of soil tillage carried out in the fallow alley before intercropping may be responsible for the reduction in the number of weeds. This thought is in tandem with earlier report that tillage operation enhances weed suppression capability (Lawson et al., 2006; Kanatas et al., 2020). This concurs with the submission of Baker et al. (2018) that weed seeds amass in the top soil in sustainable agriculture-in which minute or reduced tillage was practiced. This corroborates an earlier study by Weber et al. (2017), who attributed prompt weed growth to the accessibility of favourable germination conditions at the top soil.

Significantly elevated broadleaf weeds were reported in many of the intercropped plots in comparison to grasses and this may be ascribed to the abundance of weed propagules in seedbank of shaded soil in (Sherifi and Berisha, 2019; Ademabayoje et al., 2020). Canopy cover presented by the immature oil palm could translate to diminished light availability, thus promoting the growth of broadleaf weeds. Olorunmaiye et al. (2011) reported high concentration of broadleaf weeds underneath the canopies of adult citrus trees. Alridiwirsah et al. (2020) also reported similarly that there was abundance of broadleaf weeds in guava plants (monocrop) of 26.11%.

Table 1. Weed species distribution parameters in tomato (NGB 01665)-oil palm intercropped plot at 3 WAI

No.	Weed species	Total	Frequency	Density	Relative frequency	Relative density	Importance value	Abundance	Dominance
1.	*Ageratum conizoides* Linn.	35	5	28.0	9.4	6.7	16.1	8.1	560.0
2.	*Borreria ocymoides* (Burm. f.) DC.	193	5	154.4	9.4	36.9	46.3	23.2	3,088.0
3.	*Brachiaria deflexa* (Schumach.) C.E. Hubbard ex Robyns	26	4	26.0	7.5	6.2	13.8	6.9	650.0
4.	*Cleome rutidosperma* DC.	1	1	4.0	7.5	1.0	8.5	4.3	400.0
5.	*Commelina benghalensis* L.	28	5	22.5	9.4	5.4	14.8	7.4	450.0
6.	*Digitaria horizontalis* Willd.	53	5	43.2	9.4	10.3	19.8	9.9	864.0
7.	*Euphorbia heterophylla* Linn.	4	3	5.3	5.7	1.3	6.9	3.5	177.7
8.	*Euphorbia hirta* Linn.	10	4	10.0	7.5	2.4	9.9	5.0	250.0
9.	*Evolvulus alsinoides* (Linn.) Linn.	29	5	23.5	9.4	5.6	15.1	7.5	470.0
10.	*Mariscus alternifolius*Vahl. (=*M. umbellatus* Vahl.)	76	5	60.8	9.4	14.5	24.0	12.0	1,216.0
11.	*Paspalum conjugatum* Berg.	4	3	5.3	5.7	1.3	6.9	3.5	177.7
12.	*Phyllanthus amarus* Schum. & Thonn.	39	5	31.2	9.4	7.5	16.9	8.4	624.0
13.	*Sida acuta* Burm. F.	3	3	4.0	5.7	1.0	6.6	3.3	133.3

Table 2. Weed species distribution parameters in tomato (NGB 01665)-oil palm intercropped plot at 6 WAI

No.	Weed species	Total	Frequency	Density	Relative frequency	Relative density	Importance value	Abundance	Dominance
1.	*Ageratum conizoides* Linn.	39	5	31.2	10.9	7.6	18.5	9.2	624.0
2.	*Bidens pilosa* Linn.	31	4	31.0	8.7	7.6	16.3	8.1	775.0
3.	*Boerhavia diffusa* L.	25	5	20.0	10.9	4.9	15.7	7.9	400.0
4.	*Borreria ocymoides* (Burm. f.) DC.	49	5	39.2	10.9	9.6	20.4	10.2	784.0
5.	*Commelina benghalensis* L.	2	2	4.0	4.3	1.0	5.3	2.7	200.0

Table 2. Continued

6.	*Croton lobatus* L.	5	3	6.7	6.5	1.6	8.1	4.1	222.2
7.	*Hyptis lanceolata* Poir.	3	2	6.0	4.3	1.5	5.8	2.9	300.0
8.	*Mariscus alternifolius* Vahl. (=*M. umbellatus* Vahl.)	55	5	44.0	10.9	10.7	21.6	10.8	880.0
9.	*Peperomia pellucida* (L.) H. B. & K.	231	5	184.8	10.9	45.1	55.9	28.0	3,696.0
10.	*Setaria barbata* (Lam.) Kunth	39	5	31.2	10.9	7.6	18.5	9.2	624.0
11.	*Sida acuta* Burm. f.	2	2	4.0	4.3	1.0	5.3	2.7	200.0
12.	*Solanum nigrum* L.	6	3	8.0	6.5	2.0	8.5	4.2	266.7

Table 3. Weed species distribution parameters in tomato (NG/AA/SEP/09/053)-oil palm intercropped plot at 3 WAI

No.	Weed species	Total	Frequency	Density	Relative frequency	Relative density	Importance value	Abundance	Dominance
1.	*Ageratum conizoides* Linn.	62	5	49.6	9.6	16.5	26.1	13.0	992.0
2.	*Axonopus compressus* (Sw.) P. Beauv.	7	4	7.0	7.7	2.3	10.2	5.0	175.0
3.	*Bidens pilosa* Linn.	4	3	5.3	5.8	1.8	7.5	3.8	177.7
4.	*Borreria ocymoides* (Burm. f.) DC.	62	5	49.6	9.6	16.5	26.1	13.0	992.0
5.	*Brachiaria deflexa* (Schumach.) C.E. Hubbard ex Robyns	42	5	33.6	9.6	11.2	20.8	10.4	672.0
6.	*Digitaria horizontalis* Willd.	38	5	30.4	9.6	10.1	19.7	9.9	608.0
7.	*Euphorbia hirta* Linn.	1	1	4.0	1.9	2.3	3.3	1.6	400.0
8.	*Evolvulus alsinoides* (Linn.) Linn.	6	3	8.0	5.8	2.7	8.4	4.2	266.7
9.	*Hyptis lanceolata* Poir.	2	1	8.0	1.9	2.7	4.6	2.3	800.0
10.	*Mariscus alternifolius* Vahl. (=*M. umbellatus* Vahl.)	3	2	6.0	3.8	2.0	5.8	2.9	300.0
11.	*Paspalum conjugatum* Berg.	4	2	8.0	3.8	2.7	6.5	3.3	400.0
12.	*Pouzolzia guineensis* Benth.	2	2	4.0	3.8	1.3	5.2	2.6	200.0
13.	*Synedrella nodiflora* Gaertn.	50	5	40.0	9.6	13.3	22.9	11.4	800.0
14.	*Talinum triangulare* (Jacq.) Willd.	14	3	18.7	5.8	6.2	12.0	6.0	622.3
15.	*Tephrosia pedicellata* Bak.	4	2	8.0	3.8	2.7	6.5	3.3	400.0
16.	*Tridax procumbens* Linn.	21	4	21.0	7.7	7.0	14.7	7.3	525.0

Table 4. Weed species distribution parameters in tomato (NG/AA/SEP/09/053)-oil palm intercropped plot at 6 WAI

No.	Weed species	Total	Frequency	Density	Relative frequency	Relative density	Importance value	Abundance	Dominance
1.	*Ageratum conizoides* Linn.	67	5	53.6	12.2	20.6	32.8	16.4	1,072.0
2.	*Bidens pilosa* Linn.	46	5	36.8	12.2	14.1	26.3	13.2	736.0
3.	*Borreria ocymoides* (Burm. f.) DC.	8	3	10.7	7.3	4.1	11.4	5.7	355.6
4.	*Commelina benghalensis* L.	45	5	36.0	12.2	13.8	26.0	13.0	720.0
5.	*Euphorbia hirta* Linn.	5	3	6.7	7.3	2.6	9.9	4.9	233.3
6.	*Mariscus alternifolius* Vahl. (=*M. umbellatus* Vahl.)	4	2	8.0	4.9	3.0	7.9	4.0	400.0

Table 4. Continued

7.	*Peperomia pellucida* (L.) H. B. & K.	41	5	32.8	12.2	12.6	24.8	12.4	656.0
8.	*Phyllanthus amarus* Schum. & Thonn.	4	3	5.3	7.3	2.0	9.4	4.7	177.7
9.	*Setaria barbata* (Lam.) Kunth	73	5	58.4	12.2	22.4	34.0	17.3	1,168.0
10.	*Solanum nigrum* L.	3	3	4.0	7.3	1.5	8.9	4.4	133.3
11.	*Talinum triangulare* (Jacq.) Willd.	4	2	8.0	4.9	3.0	7.9	4.0	400.0

Table 5. Weed species distribution parameters in eggplant (NGB 01737)-oil palm intercropped plot at 3 WAI

No.	Weed species	Total	Frequency	Density	Relative frequency	Relative density	Importance value	Abundance	Dominance
1.	*Ageratum conizoides* Linn.	24	4	24.0	6.5	5.8	12.3	6.1	600.0
2.	*Bidens pilosa* Linn.	3	2	6.0	3.2	1.5	4.7	2.3	300.0
3.	*Boerhavia diffusa* L.	4	3	5.3	4.8	1.3	6.1	3.1	177.7
4.	*Borreria ocymoides* (Burm. f.) DC.	14	3	18.7	4.8	4.5	9.4	4.7	622.3
5.	*Brachiaria deflexa* (Schumach.) C.E. Hubbard ex Robyns	27	4	27.0	6.5	6.6	13.0	6.5	675.0
6.	*Cleome rutidosperma* DC.	8	4	8.0	6.5	1.9	8.4	4.2	200.0
7.	*Commelina benghalensis* L.	24	4	24.0	6.5	5.8	12.3	6.1	600.0
8.	*Euphorbia heterophylla* Linn.	9	4	9.0	6.5	2.2	8.6	4.3	225.0
9.	*Euphorbia hirta* Linn.	6	3	8.0	4.8	1.9	6.8	3.4	266.7
10.	*Mariscus alternifolius* Vahl. (=*M. umbellatus* Vahl.)	50	5	40.0	8.1	9.7	17.8	8.9	800.0
11.	*Paspalum conjugatum* Berg.	37	4	37.0	6.5	9.0	15.5	7.7	925.0
12.	*Peperomia pellucida* (L.) H. B. & K.	54	5	43.2	8.1	10.5	18.6	9.3	864.0
13.	*Phyllanthus amarus* Schum. & Thonn.	5	3	6.7	4.8	1.6	6.5	3.2	222.3
14.	*Spigelia anthelmia* Linn.	7	5	5.6	8.1	1.4	9.4	4.7	112.0
15.	*Synedrella nodiflora* Gaertn.	178	5	142.4	8.1	34.7	42.7	21.4	2,848.0
16.	*Talinum triangulare* (Jacq.) Willd.	6	4	6.0	6.5	1.5	7.9	4.0	150.0

Table 6. Weed species distribution parameters in eggplant (NGB 01737)-oil palm intercropped plot at 6 WAI

No.	Weed species	Total	Frequency	Density	Relative frequency	Relative density	Importance value	Abundance	Dominance
1.	*Ageratum conizoides* Linn.	113	5	90.4	11.1	27.3	38.4	19.2	1,808.0
2.	*Borreria ocymoides* (Burm. f.) DC.	79	5	63.2	11.1	19.1	30.2	15.1	1,264.0
3.	*Brachiaria lata* (Schumach) C.E.	1	1	4.0	2.2	1.2	3.4	1.7	400.0
4.	*Cleome rutidosperma* DC.	3	3	4.0	6.7	1.2	7.9	3.9	133.3
5.	*Commelina benghalensis* L.	29	5	23.2	11.1	7.0	18.1	9.1	464.0
6.	*Mariscus alternifolius* Vahl. (=*M. umbellatus* Vahl.)	4	4	4.0	8.9	1.2	10.1	5.0	100.0

Table 6. Continued

7.	*Peperomia pellucida* (L.) H. B. & K.	25	5	20.0	11.1	6.0	17.1	8.6	400.0
8.	*Phyllanthus amarus* Schum. & Thonn.	6	3	8.0	6.7	2.4	9.1	4.5	266.7
9.	*Setaria barbata* (Lam.) Kunth	110	5	88.0	11.1	26.5	37.7	18.8	1,760.0
10.	*Spigelia anthelmia* Linn.	12	4	12.0	8.9	3.6	12.5	6.3	300.0
11.	*Talinum triangulare* (Jacq.) Willd.	5	3	6.7	6.7	2.0	8.7	4.3	222.2
12.	*Tridax procumbens* Linn.	4	2	8.0	4.4	2.4	6.9	3.4	400.0

Table 7. Weed species distribution parameters in control plot at 3 WAI

No.	Weed species	Total	Frequency	Density	Relative frequency	Relative density	Importance value	Abundance	Dominance
1.	*Ageratum conizoides* Linn.	269	5	53.8	7.7	16.1	23.8	11.9	1,076.0
2.	*Bidens pilosa* Linn.	52	5	41.6	7.7	12.4	20.1	10.1	832.0
3.	*Borreria ocymoides* (Burm. f.) DC.	85	5	68.0	7.7	20.3	28.0	14.0	1,360.0
4.	*Brachiaria deflexa* (Schumach.) C.E. Hubbard ex Robyns	47	5	37.6	7.7	11.2	18.9	9.5	752.0
5.	*Cleome rutidosperma* DC.	12	5	9.6	7.7	2.9	10.6	5.3	192.0
6.	*Commelina benghalensis* L.	4	3	5.3	4.6	1.6	6.2	3.1	177.7
7.	*Digitaria horizontalis* Willd.	33	5	26.4	7.7	7.9	15.6	7.8	528.0
8.	*Euphorbia hirta* Linn.	9	4	9.0	6.2	2.7	8.8	4.4	225.0
9.	*Mariscus alternifolius* Vahl. (=*M. umbellatus* Vahl.)	29	5	23.2	7.7	6.9	14.6	7.3	464.0
10.	*Peperomia pellucida* (L.) H. B. & K.	34	5	27.2	7.7	8.1	15.8	7.9	544.0
11.	*Spigelia anthelmia* Linn.	7	3	9.3	4.6	2.8	7.4	3.7	311.0
12.	*Synedrella nodiflora* Gaertn.	14	4	14.0	6.2	4.2	10.3	5.2	350.0
13.	*Talinum triangulare* (Jacq.) Willd.	7	3	9.3	4.6	2.8	7.4	3.7	311.0

Table 8. Weed species distribution parameters in control plot at 6 WAI

No.	Weed species	Total	Frequency	Density	Relative frequency	Relative density	Importance value	Abundance	Dominance
1.	*Ageratum conizoides* Linn.	107	5	85.6	9.4	15.5	25.0	12.5	1,712.0
2.	*Bidens pilosa* Linn.	154	5	123.2	9.4	22.4	31.8	15.9	2,464.0
3.	*Borreria ocymoides* (Burm. f.) DC.	82	5	65.6	9.4	11.9	21.3	10.7	1,312.0
4.	*Commelina benghalensis* L.	114	5	91.2	9.4	16.6	26.0	13.0	1,824.0
5.	*Euphorbia hirta* Linn.	25	5	20.0	9.4	3.6	13.1	6.5	400.0
6.	*Mariscus alternifolius* Vahl. (=*M. umbellatus* Vahl.)	45	5	36.0	9.4	6.5	16.0	8.0	720.0
7.	*Peperomia pellucida* (L.) H. B. & K.	13	4	13.0	7.5	2.4	9.9	5.0	325.0
8.	*Digitaria horizontalis* Willd.	2	2	4.0	3.8	0.7	4.5	2.3	200.0
9.	*Setaria barbata* (Lam.) Kunth	109	5	87.2	9.4	15.8	25.3	12.6	1,744.0
10.	*Spigelia anthelmia* Linn.	9	4	9.0	7.5	1.6	9.2	4.6	225.0

Table 8. Continued

11.	*Talinum triangulare* (Jacq.) Willd.	7	4	7.0	7.5	1.3	8.8	4.4	175.0
12.	*Tridax procumbens* Linn.	9	4	9.0	7.5	1.6	9.2	4.6	225.0

Broadleaf weeds of families *Asteraceae* and *Euphorbiaceae* were noticed to have elevated numbers of members. This could be credited to the lifecycle, resources need and seed dispersal apparatus of these families of weeds. This agrees with a previous report by Olorunmaiye et al. (2011) who proposed high colonizing influence of these two families. This is further upheld by Oluwatobi and Olorunmaiye (2014), who recognized towering light necessity, aggressive growth, brief life cycle and enormous seed generation as qualities that may be responsible. *Ageratum conizoides, Borreria ocymoides* and *Mariscus alternifolius* were found to be predominant. This agrees with earlier study by Yakubu et al. (2006) and Karaye et al. (2007) who reported that several weeds and crops are site specific, while others will flourish over a broad array of habitat.

Simpson's diversity indices of juvenile fruit vegetable-oil palm intercrops

The tomato (NG/AA/SEP/09/053)-juvenile oil palm and the control plots recorded the peak and least weed species diversity (0.186 and 0.242) respectively. The maximum diversity at 6 WAI was obtained at the control plot with Simpson's Diversity Index of 0.123 (Table 9).

Table 9. Simpson's diversity indices of weed species in fruit vegetables-juvenile oil palm intercrop

Simpson's diversity	3 WAI			6 WAI		
	D	1-D	$^{1}/D$	D	1-D	$^{1}/D$
Plot A	0.198	0.802	5.051	0.266	0.734	3.759
Plot B	0.186	0.814	5.376	0.173	0.827	5.780
Plot C	0.195	0.805	5.128	0.213	0.787	4.695
Plot D	0.242	0.758	4.132	0.123	0.877	8.130

Note: Plots A = tomato (NGB 01665)-juvenile oil palm; B = tomato (NG/AA/SEP/09/053)-juvenile oil palm; C = eggplant (NGB 01737)-juvenile oil palm; D = control plots

Lower weed species diversity was noticed in control plots. This may be explained by the lack of canopy cover that would have provided shade as obtained in the intercropped plot. This is in harmony with a previous research by Baker et al. (2018), that intercropping practice facilitates effective weed control; with detrimental impacts on weed growth. Also, the study by Mhlanga et al. (2016) reported lessened weed diversity through prominent shading of weeds. Further, the research by Rahimi et al. (2019) is in unison with the finding of this work. They asserted higher diversity of weed species in intercropped plot than in monocrop.

CONCLUSIONS

This study revealed a progressive decline in the number of weed species composition at 3 through 6 WAI. Intercrop involving fruit vegetables and 2-year-old oil palm culminated in greater abundance of broadleaf weed species than grass species. Broadleaf weed species most predominant belong to families *Asteraceae* and *Euphorbiaceae*. Simultaneous cultivation of fruit vegetables within the fallow alley of immature oil palm should be promoted amid farmers, particularly at the earlier years prior to canopy closure.

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