MULCHING AND VARIETY INTERACTIONS ON WEED MANAGEMENT AND YIELD OF OKRA IN OWERRI SOUTH EASTERN NIGERIA.

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ABSTRACT
Field trials were carried out in 2016 and 2017 early cropping seasons at the Teaching and Research Farm of Federal University of Technology Owerri, Southeastern Nigeria, to study the effect of mulch materials and okra varieties on weed management and yield of okra in early okra production. The field experiment was a 5 x 3 factorial laid out in a Randomized Complete Block Design (RCBD) at three replications. The treatments comprised five mulching materials and three okra varieties. Parameters measured included, soil temperature, weed composition, weed control efficiency, plant height, leaf area, number of branches, number of leaves, days to 50% flowering, number of aborted fruits, number of fruits produced per plant and number of seeds produced per pod. Okra varieties did not influenced weed growth but mulch materials applied influenced weed composition. The unmulched plots recorded the highest weed composition of 42.08 % and 38.85 % whereas the lowest weed composition of 1.42 % and 2.69 % were recorded under black plastic mulched plots in 2016 and 2017 early cropping seasons, respectively. The annual weed (61.11 % and 57.14 %) and broad leave weed (61.11 % and 64.71 %) dominated the weed flora in early 2016 and 2017 cropping seasons, respectively. Weed flora composition of the field was dominated by *Pennisetum pedicelatum, Trimffeta cordifolia and Digiteria horizontalis*, while *Pennisetum pedicelatum* was the most frequent weed in both years. Black plastic mulched plots gave significant ($P \leq 0.05$) weed control efficiency of 99.62%, 98.60% and 99.40 % at 3, 6 and 9WAP in 2016 and 99.80 %, 95.40 % and 98.90 % at 3, 6 and 9WAP in early 2017 cropping seasons, respectively. Black plastic mulch suppressed weed species better than other mulches. Okra growth and yield characters differed significantly ($P \leq 0.05$) among varieties and weed control methods applied. NHAe47-4 produced the tallest plant and largest leaf area whereas, V_{35} variety was better in number of leaves, ,branches, early flowering, number of pods produced and number of seeds per pod. The lowest okra yield was recorded in plots mulched with groundnut (live mulch) across the seasons. The V_{35} variety mulched with black plastic mulch is recommended for effective weed management and higher okra production in Southeastern Nigeria.

Keywords: mulch materials, weed management, growth, yield, okra varieties.

INTRODUCTION
Okra (*Abelmoschus esculentus*) is an important fruit vegetable mainly produced for domestic consumption. Vegetables like okra have played vital roles in food security by providing nutritional requirements of the low income groups. Babatunde *et al.*, (2007) stated that okra is the most important vegetable crop and a good source of calorie (4550 kcal/kg) for human consumption. In Nigeria, okra ranks third in terms of consumption and production after tomato and pepper (Ibeawuchi, 2007). People are now going into okra production because of its increasing demand (Roy *et al*., 2014). Okra belongs to the family malvaceae and its geographical origin is disputed but believed to be either Asia or West Africa and Ethiopia (Craig, 2013). The name okra most often used in the united state and Philippines is of West African origin and is cognate with "okuru" in Igbo, a language spoken in Nigeria (Mcwhoter, 2000; Nobles, 2013). Okra is cultivated in every part of Nigeria as well as other tropical regions because of the mucilaginous property of the fresh capsule and its ability to grow well under most tropical conditions (Akoroda *et al*, 1985; Vincent *et al*., 2005). Amongst many important fruit vegetables, okra (*Abelmoschus esculentus*) has its significant role in supplying nutritive value to human diets. Okra can be used to prepare popular drawing soup in Nigeria often eaten with fufu or garri. The tender leaves are often used as vegetable and provide vitamin A and C, protein, calcium and iron in the diet. The okra leaves are edible among the people of Ibarapas and Oke Oguns of Oyo State in Nigeria (Dauda *et al.*, 2010). Okra capsules are excellent source of anti-oxidant vitamin, vitamin C, providing about 36 % of daily recommended levels. According to Mike, (2013), okra known for harnessing a superior fiber, help in digestion, stabilize blood sugar level and to help control the rate at which sugar is absorbed. Despite the numerous importance of okra to human health, weed incident and interference have been a major constraint in okra production, especially in south eastern Nigeria where environmental conditions (rainfall, sunlight and ambient temperature) tends to favour rapid weeds to growth. Okra production is constrained by many factors, mainly weed control. According to Casper and Jackson, (1997) weed adversely affects okra production by competing for nutrient, sunlight, water and space. In Nigeria uncontrolled weed reduce crop yield by 40 % in maize and 84 % in upland rice (Akobundu, 1980),

31 – 70 % in groundnut (Lagoke *et al.*, 1991) and 73 – 78 % in Cayenne pepper (Awodoyin and Ogunymi, 2005). However, most of the weed management strategies used by the farmers to combat weed problems especially, herbicide, use of labourers for manual weeding are very costly, labour intensive and time demanding, and with environmental negative effect. Therefore to manage weed competition in okra production requires system that is sustainable and cost effective. Mulching has been reported by many researchers as an important weed management (Radices and Ognar, 2004; Jodaugiene *et al.*, 2006). Manual weeding is the most common and effective method of weed control in Nigeria, but is no longer economical because of scarcity of labourers and mulching could be a one way out. It is therefore, necessary to assess the effect of mulching and variety interactions on weed management in okra production in southeastern Nigeria.

MATERIALS AND METHODS

Location

A two cropping seasons field experiment was conducted in 2016 and 2017 early cropping seasons respectively at the Teaching and Research Farm, Federal University of Technology Owerri Imo State Nigeria (Latitude 5^0 27 N and 7^0 02 E). The region was characterized by wet and dry seasons. The wet season mainly starts mid March and ends November whereas the dry season begins at the third quarter of November and ends March, with an annual precipitation of 2500mm and minimum and maximum temperatures of 20^0 C and 32^0 C respectively. "The soil of the area is a deep porous utisol derived from sandy deposit in the coastal plains which are highly weathered, low in mineral reserve and natural fertility" (Eshett, 1993).

Experiment

The experiment is a 5 x 3 factorial laid out in a randomized complete block design (RCBD) with three replications. The treatments comprised three okra varieties (V_{35}, lady's finger and NHAe47 -4) and five different mulch materials { dry trash, palm frond, black plastic, groundnut as live mulch and unmulch (control)}. The dry trash and palm frond were applied at 20tons each. The experimental size measuring 48 m x 15 m which was marked out and cleared manually, subsequently experimental plots measuring 3 m x 2 m were marked out with 0.5 m separating plots and 1 m separating blocks.

The early maturing okra varieties of V_{35}, lady's finger and NHAe47-4 were obtained from National Institute of Horticultural Research and Teaching, Okigwe substation Imo State. Planting were done on April 19th and 25th in 2016 and 2017 cropping seasons, respectively. Blanket application of 5 kg of dried poultry manure was applied in each of the plot twelve days before planting to boast soil nutrient of the area. The mulching materials were applied a day before planting according to treatments, while groundnut (live mulch) was planted alongside with okra varieties. Okra seeds for the experiment were soaked in water over night before planting. This was to hasten germination. Three seeds from the early maturing varieties were sown directly into the soil at a depth of 2 cm with a spacing of 60 cm x 45 cm inter and intra rows, while the groundnut (live mulch) was planted at a spacing of 60 cm x 25 cm inter and intra rows according to treatment. Emerged okra seedlings were thinned down to one plant per stand two weeks after sowing. Prior to land preparation, weed identification and classification was done to determination weed abundant of the experimental site. Weed samples were collected three times at 3, 6 and 9WAP using 1m x 1m quadrant which was permanently marked in each of the plot at planting. The weeds within the 1 m x 1 m permanently marked quadrant were taken, identified and classified based on growth form. All weed samples collected were oven dried after classification at a temperature of 60 ^{0}C for 48 hours to determine weed dry weight. Weed Control Efficiency (WCE) was also calculated according to Subramanian *et al.* (1991). Water extract collected from 100g neem seeds were spread on the okra plant from two weeks after planting at weekly interval to control insect pest attack as recommended by Orjiako *et al.* (2012).

Plant height was measured from ground level to the tip of the shoot apex, stem girth was measured using measuring tape at 3cm above soil level per plant, leaf area was determined by measuring the length of the midrib and the widest width of the second to the last developed leaf, stem branches and number of leaves were recorded by counting number of branches and number of leaves on the sampled plants. Reading was taken from five randomly selected plant samples at 3, 6, 9 and 12 WAP. Days to 50% flowering, number of aborted fruits per plant, number of fruits produced per plant and number of seeds per pod were measured and recorded.

Data analysis

All data collected and recorded were subjected to analysis of variance using Genstat, (2012) software version. Mean separation were done using the Least Significant Difference (LSD) at 5% probability level.

RESULTS AND DISCUSION

Weed abundance before land preparation

Weed abundant prior to land preparation showed a total of 21 and 20 weed species in 2016 and 2017 early cropping seasons, respectively, and this spread across 11 and 12 plant families in both seasons respectively. The Poaceae family with 28.57 % and 30.0 % appeared most, followed by Asteraceae with 19.05 % and 1.05 %

in both years, respectively. Broadleaf weed species dominated the experimental site with 66.67 % and 65.0 % in both years, respectively (Table 1). The most common and prominent weed species in the experimental sites in 2016 and 2017 early cropping seasons were *Aspilia africana, Chromolaena odorata, Panicum maximum, Triumffeta cordifolia, Ipomoea involucrate,* and *Croton hirtus* with *Chromolaena odorata* appeared most 56 and 73 while *Euphorbia hetrophylla* and *Mimosa invisa* were the least 3 and 2 respectively.

Table 1 Weed abundance before land preparation

Weed species	Family	Cropping seasons	
		Early 2016	Early 2017
Aspilia africana	Asteraceae	33.0	64.0
Chromolaena odorata	Asteraceae	56.0	73.0
Emilia coccinea	Asteraceae	3.0	7.0
Asystasia gangetica	Acanthaceae	14.0	29.0
Atternanthera pungens	Amaranthaceae	13.0	0.0
Cyathula prostrate	Amaranthaceae	0.0	4.0
Cyperus species	Cyperaceae	21.0	14.0
Mariscus alternifolius	Cyperaceae	0.0	0.0
Commelina benghalensis	Commonelinceae	11.0	9.0
Momordica carantia	Cucurbitaceae	0.0	0.0
Ipomoea involucrate	Convolvulaceae	17.0	9.0
Euphobia hetrophylla	Euphorbiaceae	0.0	3.0
Croton hirtus	Euphorbiaceae	36.0	17.0
Mimosa invisa	Leguminosae	2.0	0.0
Anthonotha macrophylla	Leguminosae	2.0	0.0
Dialium guineense	Leguminosae	7.0	15.0
Isoberlina doka craib	Leguminosae	5.0	0.0
Chloris pilosa	Poaceae	17.0	19.0
Setaria barbata	Poaceae	8.0	4.0
Brachiaria lata	Poaceae	17.0	13.0
Sida acuta	Malvaceae	6.0	9.0
Perotis indica	Poaceae	12.0	17.0
Panicum maximum	Poaceae	46.0	65.0
Pennisetum pedicellatum	Poaceae	13.0	19.0

Talinum triangulare	Portulacaceae	0.0	6.0
Triuffetta codifolia	Tiliaceae	31.0	27.0

Weed composition

Weed composition across the treatments recorded a total of 18 and 14 weed species in 2016 and 2017 early cropping seasons, respectively. The 2016 and 2017 early cropping seasons witnessed 61.11 % and 57.14 % annual weed species with 38.89 % and 42.86 % perennials, respectively, among which were 61.11 % and 64.71 % dicotyledonous weeds and 38.89 % and 35.20 % monocotyledonous weed species (Table 2 and 3).

The composition of weed flora across the treatments varies as a result of mulch type applied. The unmulched plots in 2016 early cropping season produced the highest number of weed composition with 41.66 % in NHAe47-4 plots, 42.08 % in V_{35} plots and 40.98 % in lady's finger plots whereas the least weed composition was observed under black plastic mulch with 1.16 % NHAe47-4 plots, 1.43 % in V_{35} plots and 2.79 % in lady's finger plots, respectively. In 2017 early cropping season, weed composition followed similar trend, unmulch plots had the highest weed composition of 31.19 % in NHAe47-4 plots, 38.85 % in V_{35} plots and 38.60 % in lady's finger plots while the least weed appearance was observed under black plastic mulch with 3.47 % in NHAe47-4 plots, 2.69 % in V_{35} plots and 5.39 % in lady's finger. Weed flora composition was dominated with annual broadleaf weed species.

Weed flora composition of the field was dominated by *Pennisetum pediccelatum, Commelina benghlensis, Truimffeta cordifolia, Digiteria horizontalis, Ipomoea involucrate* and *Croton hirtus* weed species in both seasons. *Digiteria horizontalis* and *Pennisetum pediccelatum* appeared to be the most abundant weed species in 2016 and 2017 cropping seasons, respectively.

Table 2 Effect of mulching and okra variety on weed composition at 6WAP early 2016 cropping season (%).

		Okra varieties (%)						
Mulching materials	**Weed species**	**NHAe47**	**V_{35}**	**Lady's finger**	**Annual spp**	Perennial spp	**M. spp**	**D. spp**
Unmulch	*Ipomoea involucrate*	2.61	3.11	2.29	X	✓	X	✓
	Ageratum conyzoides	0.00	0.57	1.72	✓	X	X	✓
	Commelina benghalensis	3.76	2.82	3.15	X	✓	X	✓
	Chromolaena odorata	1.45	0.57	0.00	X	✓	X	✓
	Croton hirtus	3.19	3.67	4.01	✓	X	X	✓
	Aspilia Africana	0.00	1.42	0.58	X	✓	X	✓
	Cyperus spp	6.61	2.82	4.58	✓	X	✓	X
	Senna occidentalis	2.61	1.92	1.72	✓	X	X	✓
	Triumffeta cordifolia	5.22	4.82	6.59	X	✓	X	✓
	Perotis indica	0.29	0.00	0.58	✓	X	✓	X
	Asystasia gangetica	0.87	0.28	0.00	✓	X	X	✓
	Digitaria horizontalis	8.41	11.86	5.73	✓	X	✓	X
	Pennisetum pedicellatum	4.93	6.21	4.87	✓	X	✓	X
	Mariscus atternifolus	1.66	1.97	0.86	X	✓	✓	X
Groundnut mulch	*Aspilia Africana*	0.00	0.00	1.72	X	✓	X	✓
	Euphorbia heterophylla	0.58	1.42	0.00	✓	X	X	✓
	Ipomoea involucrate	2.03	2.26	3.44	X	✓	X	✓
	Commelina benghalensis	3.19	2.54	3.15	X	✓	X	✓
	Phyllantus amaru	0.00	0.00	0.58	✓	X	X	✓
	Pennisetumpedicellatum	3.76	1.97	2.29	✓	X	✓	X
	Digitaria horizontalis	8.41	7.91	4.58	✓	X	✓	X
	Croton hirtus	2.32	3.11	3.15	✓	X	X	✓

	Chromolaena odorata	0.29	0.00	0.00	X	✓	X	✓
	Triumffeta cordifolia	4.63	6.50	3.72	X	✓	X	✓
Plastic mulch	*Pennisetum pedicellatum*	0.00	0.57	0.86	✓	X	✓	X
	Commelina benghalensis	0.00	0.57	0.00	X	✓	X	✓
	Degitaria horizontalis	1.16	0.28	1.44	✓	X	✓	X
Dry mulch	*Ipomoea involucrate*	2.61	1.59	1.14	X	✓	X	✓
	Pennisetum pedicellatum	2.32	4.42	5.44	✓	X	✓	X
	Aspilia Africana	2.32	1.13	1.44	X	✓	X	✓
	Euphobia hetrophylla	0.58	0.85	0.00	✓	X	X	✓
	Commelina benghalensis	1.74	1.13	2.29	X	✓	X	✓
	Triumffeta cordifolia	2.32	2.54	2.29	X	✓	X	✓
	Croton hirtus	0.58	1.97	2.00	✓	X	X	✓
	Digitaria horizontalis	3.19	2.26	2.00	✓	X	✓	X
	Panicum maxixum	0.00	0.57	0.58	X	✓	✓	X
	Cyperus spp	2.03	0.57	0.00	✓	X	✓	X
Palm frond	*Digitaria horizontalis*	2.61	3.67	3.15	✓	X	✓	X
	Croton hirtus	2.32	2.82	2.29	✓	X	X	✓
	Commelina benghalensis	1.45	0.00	2.00	X	✓	X	✓
	Ipomoea involucrate	2.03	3.11	2.00	X	✓	X	✓
	Seteria barbata	0.58	0.00	1.14	✓	X	✓	X
	Pennisetum pedicellatum	3.00	2.36	3.15	✓	X	✓	
	Triumffeta cordifolia	3.00	2.54	3.15	X	✓	X	✓

D.spp = dicotyledonous species, M.spp = monocotyledonous species, √ = presence, X = absent.

Table 3 Effect of mulching and okra variety on weed composition at 6WAP early 2017 cropping season (%).

Mulching materials	**Weed species**	**Okra varieties (%)**						
		NHAe47	**V_{35}**	**Lady's finger**	**Annual spp**	Perennial spp	**M. spp**	**D. spp**
Unmulch	*Ipomoea involucrate*	1.97	2.31	0.84	X	✓	X	✓
	Centrocema pubescens	0.99	1.53	1.24	X	✓	X	✓
	Commelina benghalensis	1.97	1.93	0 84	X	✓	X	✓
	Euphobia hetrophila	0.00	1.93	1.66	✓	X	X	✓
	Croton hirtus	3.96	3.84	0.84	✓	X	X	✓
	Aspilia Africana	0.99	1.53	0.00	X	✓	X	✓
	Cyperus spp	3.96	3.84	6.64	✓	X	✓	X
	Cyathula prostrate	2.97	0.77	0.00	✓	X	X	✓
	Triumffeta cordifolia	3.46	4.24	2.08	X	✓	X	✓
	Asystasia gangetica	0.00	0.00	0.84	✓	X	X	✓
	Digitaria horizontalis	2.48	5.00	2.08	✓	X	✓	X
	Pennisetum pedicellatum	6.95	10.3 9	17.84	✓	X	✓	X
	Mariscus atternifolus	1.48	0.00	0.41	X	✓	✓	X
Groundnut mulch	*Croton hirtus*	1.48	1.53	3.32	✓	X	X	✓
	Euphorbia heterophylla	0.99	1.93	0.00	✓	X	X	✓

	Ipomoea involucrate	0.49	1.15	0.84	X	✓	X	✓
	Commelina benghalensis	4.49	1.93	2.90	X	✓	X	✓
	Pennisetum pedicellatum	8.42	8.46	5.39	✓	X	✓	X
	Emilia coccinea	0.49	0.00	0.00	✓	X	X	✓
	Digitaria horizontalis	0.00	0.77	2.90	✓	X	✓	X
	Centrocema pubescens	0.99	1.53	0.00	X	✓	X	✓
	Triumffeta cordifolia	6.43	3.84	4.57	X	✓	X	✓
Plastic mulch	*Pennisetum pedicellatum*	0.99	0.77	2.08	✓	X	✓	X
	Commelina benghalensis	0.00	0.00	0.41	X	✓	X	✓
	Croton hirtus	1.48	0.38	0.84	✓	X	X	✓
	Centrocema pubescens	0.99	0.00	000	X	✓	X	✓
Dry mulch	*Ipomoea involucrate*	0.99	2.31	4.15	X	✓	X	✓
	Pennisetum pedicellatum	3.96	8.08	6.44	✓	X	✓	X
	Aspilia Africana	2.97	1.53	2.49	X	✓	X	✓
	Euphobia hetrophylla	2.48	0.00	0.84	✓	✓	X	✓
	Commelina benghalensis	2.97	1.53	3.32	X	✓	X	✓
	Triumffeta cordifolia	3.96	3.84	2.08	X	✓	X	✓
	Centrocema pubescens	0.00	0.77	0.84	X	✓	X	✓
	Croton hirtus	1.48	2.69	1.66	✓	X	X	✓
	Digitaria horizontalis	0.99	1.93	1.66	✓	X	✓	X
	Cyperus spp	3.48	1.93	1.66	✓	X	✓	X
Palm frond	*Centrocema pubescens*	1.48	0.00	1.66	X	✓	X	✓
	Croton hirtus	2.97	2.69	0.84	✓	X	X	✓
	Commelina benghalensis	0.00	0.77	0.41	X	✓	X	✓
	Ipomoea involucrate	0.00	1.53	2.90	X	✓	X	✓
	Triumffeta cordifolia	5.45	3.84	2.90	X	✓	X	✓
	Pennisetum pedicelatum	6.43	7.70	5.39	✓	X	✓	X
	Cyathula prostate	3,46	0.00	1.24	✓	X	X	✓
	Sida acuta	0.00	0.00	0.84	X	✓	X	✓

D.spp = dicotyledonous species, M.spp = monocotyledonous species, √ = presence, X = absent**.**

Weed control efficiency

All mulched plots were significantly (P≤0.05) effective in weed control efficiency except in groundnut (live mulch) plot at 3 and 6 WAP (Table 4). At 3 and 6 WAP, plots mulched with black plastic mulch gave the highest weed control efficiency of 99.62 % and 98.60 % in early 2016 and 99.80 % and 95.40 % in early 2017 cropping seasons, respectively whereas, the unmulched plots (control) recorded lowest weed control efficiency of 0.00 % at all stages across the seasons. The effectiveness of black plastic mulch could be probably as a result of its ability to block weed seed germination stimuli by intercepting radiant energy (sunlight) from reaching the weed seeds. Aminu-Taiwo *et al*, (2014) reported that black plastic mulch significantly recorded the lowest weed density, weed fresh and dry weight and weed species composition than other mulches. Black plastic mulched plots was closely followed by palm frond and dry trash (*Panicum maximum and Aspilia africana*) mulched plots at 3 and 6WAP, while groundnut (live mulch) recorded the lower weed control efficiency at 3WAP and 6WAP among the mulches but was better than palm frond and dry trash at 9WAP (Table 4). This could be probably as a result of well developed canopy cover by groundnut (live mulch) which suppressed weed growth and denied weed seeds assess to required environmental factor like sunlight. Olorumaiye, (2010) observed that simultaneous planting of leguminous cover crops are suitable for effective weed suppression.

Table 4 Effect of mulching and okra variety on weed control efficiency (%) in 2015 early and late cropping seasons

Okra Variety	2016 early						2017 early					
	Mulching materials					Mean	Mulching materials					mean
	Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	Unmulch		Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	Unmulch	
3WAP												
LADY'S FINGER	90.91	9.47	85.46	98.85	0.00	56.94	78.30	9.90	73.30	100.00	0.00	52.30
NHAe47-4	70.67	7.72	87.88	100.00	0.00	53.25	69.60	11.30	78.40	99.50	0.00	51.70
V_{35}	84.52	7.26	85.62	100.00	0.00	55.48	74.70	4.60	76.70	100.00	0.00	51.20
Mean	82.03	7.15	86.32	99.62	0.00		74.20	8.60	76.10	99.80	0.00	
CV(%) =	3.8						10.60					
$LSD_{(0.05)}$ for Variety =	NS						NS					
$LSD_{(0.05)}$ for Mulch M. =	5.68						11.38					
$LSD_{(0.05)}$ for interaction	NS						NS					
6WAP												
LADY'S FINGER	69.20	33.60	65.60	98.00	0.00	53.30	50.20	45.30	59.30	100.00	0.00	50.90
NHAe47-4	43.60	19.40	53.70	99.40	0..00	43.20	79.20	38.90	85.20	99.10	0.00	60.48
V_{35}	50.20	26.30	72.10	98.40	0.00	49.40	86.70	28.20	88.00	87.10	0.00	58.00
Mean	54.30	26.40	63.80	98.60	0.00		72.00	37.40	77.50	95.40	0.00	
CV(%) =	8.0						14.60					
$LSD_{(0.05)}$ for Variety =	NS						NS					
$LSD_{(0.05)}$ for Mulch M. =	11.38						20.11					
$LSD_{(0.05)}$ for interaction =	NS						NS					
9WAP												
LADY'S FINGER	78.90	90.00	71.10	99.80	0.00	68.00	74.90	88.40	63.90	99.00	0.00	65.20
NHAe47-4	79.20	93.80	87.10	98.50	0.00	71.70	53.40	87.50	65.50	97.50	0.00	60.80
V_{35}	66.40	94.20	75.20	100.00	0.00	67.20	73.20	89.30	92.40	100.00	0.00	71.00
Mean	74.80	92.60	77.80	99.40	0.00		67.20	88.40	73.90	98.90	0.00	
CV(%) =	6.7						12.1					
$LSD_{(0.05)}$ for Variety =	NS						NS					
$LSD_{(0.05)}$ for Mulch M.	11.45						16.97					

=		
$LSD_{(0.05)}$ for interaction	NS	NS
=		

CV = coefficient of variation, WAP = weeks after planting, NS = not significant

Growth parameters

Okra plant height and leaf area varies significantly ($P \leq 0.05$) due to different varieties and weed management applied and increased with plant age across the seasons. At 3WAP there was no significant ($P \leq 0.05$) difference among okra varieties across the seasons. Meanwhile, at 6, 9 and 12WAP NHAe47-4 variety progressively produced taller okra plants of 27.79 cm, 74.30 cm and 117.40 cm while the lowest of 20.93 cm, 52.29 cm and 69.50 cm were recorded under lady's finger variety in 2016 early cropping season. Similar results was recorded in 2017 early cropping season with NHAe47-4 and lady's finger recording the highest and lowest plant heights respectively (Table 5). Okra leaf area recorded similar trend as witnessed in plant height with NHAe47-4 variety recording the widest leaf area of 36.23 cm^2, 268.50 cm^2, 350.70 cm^2, and 154.70 cm^2 while the least of 22.19 cm^2, 178.90 cm^2, 234.30 cm^2 and 111.40 cm^2 was recorded under lady's finger at 3, 6, 9 and 12WAP in 2016 early cropping seasons, respectively. Similar results was also recorded in 2017 early cropping season with NHAe47-4 and lady's finger recording the widest and smallest leaf area at 3, 6, 9, and 12WAP, respectively (Table 6). The better plant height and leaf area recorded in NHAe47-4 variety could be attributed its genetic potential. Mulched plots significantly ($P \leq 0.05$) increased okra plant height and leaf area compared to unmulched (control) except in groundnut (live mulched) plots which recorded the poorest. Plots mulched with dry trash and black plastic produced taller plant height (94.30 cm and 92.60 cm) and (87.90 cm 92.40 cm) while the shortest plant height of 75.30 cm and 70.50 cm was recorded in groundnut (live mulch) plot at 12WAP in 2016 and 2017 early cropping seasons, respectively. The inferior plant height recorded in plots mulched with groundnut (live mulch) could be as a result of competition for growth resources (nutrient, moisture, sunlight and space) between the okra plant, groundnut and even weeds species. Ijoyah and Dzer, (2012) reported greater yield in sole okra plant compared with that obtain from okra plant intercropped with maize as a result of greater competition for available nutrients and sunlight. This result is also in line with Rasheed and Oluseun (2009) who observed in their study that inter-planting okra with a cover crop or mulch plant for weed management may not be appropriate as it will interfere with okra performance.

Table 5 Effect of mulching and okra variety on plant height (cm) in 2015 early and late cropping seasons

Okra Variety	2016 early						2017 early					
	Mulching materials					Mean	Mulching materials					Mean
	Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	Unmulch		Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	unmulch	
3WAP												
LADY'S FINGER	10.10	8.13	9.97	8.82	7.87	8.98	10.30	8.83	11.63	9.50	8.55	9.76
NHAe47-4	9.75	7.17	10.07	9.01	8.15	8.83	9.75	7.13	10.69	10.27	7.50	9.07
V_{35}	9.78	7.45	11.11	8.87	7.71	8.98	10.17	7.72	12.24	9.63	8.13	9.58
Mean	9.88	7.58	10.38	8.90	7.91		10.07	7.89	11.52	9.8	8.06	
CV(%) =	7.3						9.1					
$LSD_{(0.05)}$ for Variety =	NS						NS					
$LSD_{(0.05)}$ for Mulch M. =	0.66						1.43					
$LSD_{(0.05)}$ for interaction	NS						NS					
6WAP												
LADY'S FINGER	20.65	20.11	22.12	21.44	20.34	20.93	21.78	19.77	23.04	22.20	21.67	21.69
NHAe47-4	28.45	26.85	29.81	27.65	26.20	27.79	31.05	22.33	32.16	28.79	23.28	27.52
V_{35}	24.01	19.55	25.57	22.45	19.98	22.31	24.23	20.45	26.88	25.29	22.71	23.91
Mean	24.87	22.17	25.83	23.84	22.18		25.68	20.85	27.36	25.43	22.55	
CV(%) =	3.7						8.3					
$LSD_{(0.05)}$ for Variety =	1.66						2.60					
$LSD_{(0.05)}$ for Mulch M. =	2.14						3.36					
$LSD_{(0.05)}$ for interaction =	NS						NS					
9WAP												
LADY'S FINGER	53.02	51.05	52.15	52.41	52.83	52.29	46.90	44.30	43.20	46.30	45.40	45.20
NHAe47-4	80.49	68.77	75.93	76.38	69.92	74.30	81.60	59.70	73.10	77.40	66.30	71.60
V_{35}	63.11	49.93	58.79	62.08	54.89	57.56	52.80	44.40	54.90	58.39	54.00	52.90
Mean	65.20	56.59	62.29	63.62	59.21		50.50	39.40	47.10	50.70	45.20	

CV(%) =	1.6						10.6					
$LSD_{(0.05)}$ for Variety =	2.55						5.66					
$LSD_{(0.05)}$ for Mulch M. =	3.29						7.31					
$LSD_{(0.05)}$ for interaction	NS						NS					
12WAP												
LADY'S FINGER	69.70	63.70	72.90	73.60	67.60	69.50	63.80	62.00	58.80	67.20	61.10	62.60
NHAe47-4	126.00	98.50	122.50	123.80	116.40	117.40	125.80	89.50	125.90	124.80	117.30	116.70
V_{35}	87.10	63.90	77.00	80.40	69.90	75.70	74.10	60.00	77.70	85.10	81.20	75.70
Mean	94.30	75.30	90.80	92.60	84.70		87.90	70.50	87.50	92.40	86.60	
CV(%) =	0.5						6.9					
$LSD_{(0.05)}$ for Variety =	5.07						10.91					
$LSD_{(0.05)}$ for Mulch M. =	6.55						14.09					
$LSD_{(0.05)}$ for interaction =	NS						NS					

CV = coefficient of variation, WAP = weeks after planting, NS = not significant

Table 6 Effect of mulching and okra variety on leaf area (cm^2) in 2015 early and late cropping seasons

	2016 early						2017 early					
	Mulching materials						Mulching materials					
Okra Variety	Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	Unmulch	Mean	Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	unmulch	Mean
3WAP												
LADY'S FINGER	26.43	18.92	23.83	24.05	17.71	22.19	30.50	23.30	21.90	36.30	23.00	27.00
NHAe47-4	44.67	26.12	37.77	44.15	28.44	36.23	49.50	21.50	41.00	40.80	34.00	37.40
V_{35}	29.52	18.70	25.90	27.25	16.94	23.66	33.80	17.90	35.00	31.60	22.80	28.20
Mean	33.54	21.25	29.17	31.82	21.03		38.00	20.90	32.60	36.20	26.60	
CV(%) =	13.1						12.2					
$LSD_{(0.05)}$ for Variety =	4.15						7.62					
$LSD_{(0.05)}$ for Mulch M. =	5.35						9.84					
$LSD_{(0.05)}$ for interaction	NS						NS					
6WAP												
LADY'S FINGER	203.60	144.10	187.70	215.20	144.10	178.90	218.70	149.40	171.90	187.30	190.60	183.60
NHAe47-4	302.00	186.30	316.80	327.40	210.00	268.50	336.30	190.59	290.60	310.40	277.00	281.00
V_{35}	216.40	138.40	195.00	217.40	150.30	183.50	227.60	162.30	184.20	216.60	202.60	198.70
Mean	240.70	156.30	233.20	253.30	168.10		260.90	167.49	215.60	238.10	223.40	
CV(%) =	8.5						1.6					
$LSD_{(0.05)}$ for Variety =	21.88						43.26					
$LSD_{(0.05)}$ for Mulch M. =	28.25						55.84					
$LSD_{(0.05)}$ for interaction =	NS						NS					
9WAP												
LADY'S FINGER	269.20	162.70	234.60	285.20	219.80	234.30	246.00	191.00	211.00	288.00	199.00	227.00
NHAe47-4	363.80	301.10	368.30	424.40	295.70	350.70	445.00	313.00	294.00	444.00	324.00	364.00
V_{35}	291.30	193.90	250.70	299.10	222.20	251.40	233.00	188.00	247.00	323.00	243.00	247.00
Mean	308.10	219.20	284.69	336.20	245.90		308.00	231.00	251.00	351.00	255.00	
CV(%) =	4.2						5.4					
$LSD_{(0.05)}$ for	30.03						58.90					

Variety =												
$LSD_{(0.05)}$ for Mulch	38.77						76.10					
M. =												
$LSD_{(0.05)}$ for interaction	NS						NS					
12WAP												
LADY'S FINGER	127.60	81.80	109.50	125.70	112.30	111.40	109.90	95.40	87.50	125.30	88.60	101.30
NHAe47-4	149.70	140.50	162.10	167.70	153.60	154.70	190.70	197.30	162.60	144.40	147.40	168.50
V_{35}	122.70	105.90	130.80	120.20	112.50	118.40	137.30	116.60	109.80	153.70	114.10	126.30
Mean	133.40	109.40	134.20	137.80	126.20		146.00	136.50	120.00	141.10	116.70	
CV(%) =	5.1						16.2					
$LSD_{(0.05)}$ for	24.93						44.61					
Variety =												
$LSD_{(0.05)}$ for Mulch	NS						NS					
M. =												
$LSD_{(0.05)}$ for interaction =	NS						NS					

CV = coefficient of variation, WAP = weeks after planting, NS = not significant

Number of branches and number of leaves per plant varies among the different mulch materials and varieties across the seasons. Number of branches and number of leaves per plant increased with the plant growth in all the varieties across the seasons. NHAe47-4 variety significantly ($P \leq 0.05$) lowered number of leaves from 6 and 9 WAP compared with other varieties. At 6 WAP the lowest number of leaves 11.23 and 11.24 were recorded in NHAe47-4 variety whereas the highest number of 12.84 and 14.28 was recorded lady's finger variety in 2016 and 2017 cropping seasons, respectively (Table 8). Plots mulched with black plastic increased the number of leaves higher than other mulches. At 9 WAP plots mulched with black plastic produced the highest number of leaves 24.58 and 26.22 whereas, the lowest number of 13.56 and 12.56 was recorded under groundnut (live mulch) plots in 2016 and 2017 cropping seasons, respectively. NHAe47-4 variety significantly ($P \leq 0.05$) lowered the number of okra branches compared with lady's finger and V_{35} varieties at 6 WAP in 2017 cropping season (Table 8). Whereas, plots mulched with black plastic increased the number of branches at all stages across the seasons. At 12 WAP the highest number of branches of 4.96 and 5.56 was recorded under black plastic mulched plot while, the lowest of 0.80 and 1.87 was recorded in groundnut (live mulch) plots in 2016 and 2017 cropping seasons, respectively. The lower number of leaves and branches recorded in NHAe47-4 variety could be probably as a result of genetic potentials of the variety. Mulched plots significantly ($P \leq 0.05$) increased number of leaves and number of branches per plant compared with unmulched plots and groundnut (live mulch) plots across stages in both years. Plants under black plastic mulch recorded the highest branches and number of leaves whereas plants under groundnut (live mulch) produced the lowest number of branches and leaves in both seasons. Singh *et al.* (2007) observed that mulch improves plant growth and yield qualities. There was no statistical significance between black plastic mulched plots and dry trash mulched plots in terms of growth parameters mentioned above across the seasons. The higher number of leaves and branches recorded under black plastic mulched plots could be attributed to effective weed management provided by this mulch material to the plants. Similar finding was reported by Iraj *et al.* (2013) who observed that mulching control weed interference, causes better nutrient absorption and temperature adjustment and enhance growth and yield of okra plant.

Table 7. **Effect of mulching and okra variety on number of branches in 2016 and 2017 early cropping seasons**

	2016 EARLY						2017 EARLY					
	Mulching materials						Mulching materials					
Okra Variety	Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	Unmulch	Mean	Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	Unmulch	Mean
3WAP												
LADY'S FINGER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NHAe47-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V_{35}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CV(%) =	0.00	0.00	0.00	0.00	0.00	0.00	NS					
$LSD_{(0.05)}$ for Variety =	NS						NS					
$LSD_{(0.05)}$ for Mulch M. =	NS						NS					
$LSD_{(0.05)}$ for interaction	NS											
6WAP												
LADY'S FINGER	1.87	0.20	0.53	1.60	0.47	0.93	3.07	1.20	2.67	3.47	2.67	2.61
NHAe47-4	1.67	0.07	0.53	1.53	0.13	0.79	1.27	0.47	0.80	1.00	1.80	1.07
V_{35}	2.00	0.40	1.40	1.47	0.60	1.17	2.67	0.87	2.80	2.47	2.47	2.25
Mean	1.84	0.22	0.82	1.53	0.40		2.33	0.84	2.09	2.31	2.31	
CV(%) =	23.6						10.8					
$LSD_{(0.05)}$ for Variety =	NS						0.88					
$LSD_{(0.05)}$ for Mulch M. =	0.68						NS					
$LSD_{(0.05)}$ for interaction =	NS						NS					
9WAP												
LADY'S FINGER	3.20	0.53	1.93	3.87	1.87	2.28	4.60	1.27	4.20	5.13	3.53	3.75
NHAe47-4	3.53	0.47	2.27	3.87	1.80	2.39	4.60	1.60	2.73	3.60	3.87	3.28
V_{35}	4.13	0.87	2.87	4.33	1.73	2.79	4.00	1.73	4.87	5.80	3.80	4.04
Mean	3.62	0.62	2.36	4.02	1.80		4.40	1.53	3.93	4.84	3.73	
CV(%) =	1.9						4.9					
$LSD_{(0.05)}$ for	NS						NS					

Variety =												
$LSD_{(0.05)}$ for Mulch M. =	0.70						1.41					
$LSD_{(0.05)}$ for interaction	NS						NS					
12WAP												
LADY'S FINGER	4.27	0.73	3.00	4.93	2.20	3.03	5.13	1.67	4.60	5.80	3.67	4.17
NHAe47-4	5.07	0.60	2.93	5.20	2.27	3.21	5.47	1.80	3.67	4.87	4.00	3.96
V_{35}	4.53	1.07	3.60	4.73	2.47	3.28	4.40	2.13	5.40	6.00	4.20	4.43
Mean	4.62	0.80	3.18	4.96	2.31		5.00	1.87	4.56	5.56	3.96	
CV(%) =	4.5						5.3					
$LSD_{(0.05)}$ for Variety =	NS						NS					
$LSD_{(0.05)}$ for Mulch M. =	0.74						1.53					
$LSD_{(0.05)}$ for interaction =	NS						NS					

CV = coefficient of variation, WAP = weeks after planting, NS = not significant

Table 8. Effect of mulching and okra variety on number of leaves in 2016 and 2017 early cropping seasons

	2016 early						2017 early					
	Mulching materials						Mulching materials					
Okra Variety	Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	Unmulch	Mean	Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	Unmulch	Mean
3WAP												
LADY'S FINGER	6.53	5.53	6.07	6.27	5.20	5.92	6.70	6.30	5.70	6.50	5.70	6.20
NHAe47-4	6.67	5.47	6.13	6.20	5.53	6.00	6.20	5.20	6.50	6.50	5.90	6.06
V_{35}	6.33	4.93	4.73	5.73	5.07	5.36	6.80	5.70	6.40	6.40	6.10	6.30
Mean	6.51	5.31	5.64	6.07	5.27		6.60	5.70	6.20	6.50	5.90	
CV(%) =	2.1						2.4					
$LSD_{(0.05)}$ for Variety =	0.35						NS					
$LSD_{(0.05)}$ for Mulch M. =	0.45						0.39					
$LSD_{(0.05)}$ for interaction	NS						NS					
6WAP												
LADY'S FINGER	17.00	9.27	11.73	16.00	10.20	12.84	15.73	11.40	13.53	17.00	13.73	14.28
NHAe47-4	12.33	8.07	11.67	14.13	9.93	11.23	11.87	9.20	10.87	11.13	13.13	11.24
V_{35}	15.20	9.87	12.40	15.33	10.53	12.67	14.13	11.00	14.40	16.87	14.93	14.27
Mean	14.84	9.07	11.93	15.16	10.22		13.91	10.53	12.93	15.00	13.93	
CV(%) =	9.1						0.5					
$LSD_{(0.05)}$ for Variety =	1.29						2.05					
$LSD_{(0.05)}$ for Mulch M. =	1.67						2.65					
$LSD_{(0.05)}$ for interaction =	NS						NS					
9WAP												
LADY'S FINGER	25.73	13.40	20.00	24.13	18.60	20.37	23.87	14.13	21.93	31.00	19.67	22.12
NHAe47-4	20.53	13.27	18.87	24.93	15.13	18.55	19.53	9.47	15.13	18.53	18.73	16.28
V_{35}	23.20	14.00	21.87	24.67	20.07	20.76	19.87	14.07	22.53	29.13	22.13	21.55
Mean	23.16	13.56	20.24	24.58	17.93		21.09	12.56	19.87	26.22	20.18	
CV(%) =	5.7						6.0					
$LSD_{(0.05)}$ for	NS						3.97					

Variety =												
$LSD_{(0.05)}$ for Mulch	2.76						5.12					
M. =												
$LSD_{(0.05)}$ for interaction	NS						NS					
12WAP												
LADY'S FINGER	14.90	6.90	11.10	15.70	10.60	11.80	10.20	5.30	10.90	16.30	10.80	10.70
NHAe47-4	13.60	5.90	12.80	13.50	9.30	11.00	13.50	7.30	15.00	11.80	10.70	11.70
V_{35}	14.50	6.50	12.40	13.80	9.80	11.40	14.50	7.90	11.60	16.20	10.20	12.10
Mean	14.30	6.40	12.10	14.30	9.90		12.70	6.80	12.50	14.80	10.50	
CV(%) =	4.5						11.7					
$LSD_{(0.05)}$ for	NS						NS					
Variety =												
$LSD_{(0.05)}$ for Mulch	1.56						4.39					
M. =												
$LSD_{(0.05)}$ for interaction =	NS						NS					

CV = coefficient of variation, WAP = weeks after planting, NS = not significant

Results from days to 50 % flowering revealed the significant (P≤0.05) influence of different varieties under different mulch sources to attain 50% anthesis. V_{35} variety significantly (P≤0.05) recorded the least number of days to attain 50% flowering with 47.40 days and 47.60 days against 59.00 days and 59.07 days recorded in NHAe47-4 variety in 2016 and 2017 cropping seasons, respectively (Table 9). NHAe47-4 variety prolonged number of days to attain 50 % flowering by 11 – 13 days compared V_{35} variety and 7 - 10 days compared to lady's finger variety. This could be attributed to the genetic makeup of the varieties. However, mulched plots lowered number of days to attain 50% flowering compared with the unmulched (control) and groundnut (live mulch). Dry trash and black plastic mulched plants recorded least number of days to attain 50 % flowering. The lesser number of days to attain 50 % flowering observed in dry trash and plastic mulched plants could be as a result of effective weed suppression, favourable soil temperature and increased soil nutrient which increased the number of leaves for high photosynthetic activity. This result is in conformity with the finding Oroka and Omovbude, (2016) who stated that weed infestation increased days to flowering in okra plant.

Fruit abortion was significantly (P≤0.05) lower in NHAe47-4 varieties compared to V_{35} and lady's finger varieties. NHAe47-4 variety produced least number of aborted fruits of 2.21 and 1.53 while the highest number of 4.19 and 4.52 was recorded in V_{35} variety in 2016 and 2017 cropping seasons, respectively (Table 9). The retention of fruits in NHAe47-4 variety could be attributed to its genetic potential.

Table 9 Effect of mulching and okra variety on days to 50% flowering and fruit abortion in 2016 and 2017 early cropping seasons

Okra Variety	Mulching materials					Mean
	Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	Unmulch	
50% FLOWERING						
EARLY 2016						
LADY'S FINGER	49.00	51.33	51.00	49.67	51.33	50.47
NHAe47-4	58.67	59.67	58.67	58.67	59.33	59.00
V_{35}	47.00	48.67	46.67	47.00	47.67	47.40
Mean	51.56	53.22	52.11	51.78	52.78	
CV(%) =	0.6					
$LSD_{(0.05)}$ for Variety =	1.01					
$LSD_{(0.05)}$ for Mulch M. =	NS					
$LSD_{(0.05)}$ for interaction	NS					
EARLY 2017						
LADY'S FINGER	48.33	52.00	51.67	49.67	51.00	50.53
NHAe47-4	57.67	59.00	60.00	59.00	59.67	59.07
V_{35}	47.00	48.67	46.33	46.67	49.33	47.60
Mean	51.00	53.22	52.67	51.78	53.33	
CV(%) =	0.7					
$LSD_{(0.05)}$ for Variety =	1.36					
$LSD_{(0.05)}$ for Mulch M. =	NS					
$LSD_{(0.05)}$ for interaction =	NS					
FRUIT ABORTION						
EARLY 2016						
LADY'S FINGER	4.47	3.67	3.20	4.33	3.47	3.83
NHAe47-4	2.40	2.27	2.27	2.40	1.73	2.21
V_{35}	4.07	3.33	4.53	4.27	4.73	4.19
Mean	3.64	3.09	3.33	3.67	3.31	
CV(%) =	9.6					

$LSD_{(0.05)}$ for Variety =	0.73					
$LSD_{(0.05)}$ for Mulch M. =	NS					
$LSD_{(0.05)}$ for interaction	NS					
EARLY 2017						
LADY'S FINGER	5.00	4.00	4.40	5.27	3.47	4.43
NHAe47-4	1.87	1.67	1.20	1.40	1.53	1.53
V_{35}	4.27	3.13	3.80	4.87	6.53	4.52
Mean	3.71	2.93	3.13	3.84	3.84	
CV(%) =	6					
$LSD_{(0.05)}$ for Variety =	1.09					
$LSD_{(0.05)}$ for Mulch M. =	NS					
$LSD_{(0.05)}$ for interaction =	NS					

CV = coefficient of variation, NS = not significant

Yield parameter

The application of mulch materials for weed management resulted in high yield of okra fruits compared to unmulch and groundnut (live mulch) plots. Among mulched plots, black plastic mulched plots significantly (P≤0.05) produced the highest number of fruits of 14.47 and 15.11 whereas, the lowest number of fruits of 6.60 and 7.78 was recorded in groundnut (live mulch) in 2016 and 2017 cropping seasons, respectively (Table 10). The higher fruit yield recorded in black plastic and dry grass mulched plots could be associated with effective weed management, suitable soil temperature, enhancement of soil nutrient and the protection these mulch materials provided the crops against erosion and nutrient leaching. These finding is in accordance with Iyagba *et al.* (2013) who reported that better weed management increased fruit yield higher than weedy plots. The result is also in tuned with findings of Olubode *et al.* (2006) who also reported that plastic and grass (*Panicum maximum*) mulches significantly enhanced the performance of rain-fed okra in South geuinea savanna of Nigeria. According to *Wei et al.* (2015) there was significant increase in maize mulched with black plastic and straw as a result of improved soil temperature and soil nutrient.

Mulched plots significantly (P≤0.05) increased the number of seeds produced per capsule compared with the unmulched and groundnut (live mulch) plots. Black plastic mulched plants produced the highest number of seeds of 90.70 and 92.00 while the lowest number of seeds of 72.90 and 70.40 was recorded under groundnut (live mulch) per capsule in 2016 and 2017 cropping seasons, respectively (Table 10). This could be attributed to the efficiency in weed management which would have been competing for limited environmental resources available for the plant and for providing suitable soil temperature for the plant. Awal *et al*. (2016) observed that black polyethylene mulched plants exhibited the highest number of pod per plant and seed per pod whereas unmulched ones produced the lowest.

Table 10 Effect of mulching and okra variety on total number of fruits produced in 2016 and 2017 early cropping seasons

Okra Variety	Mulching materials					Mean
	Dry trash	Live mulch (groundnut)	Palm frond	Black plastic	Unmulch	
NUMBER OF FRUITS						
EARLY 2016						
LADY'S FINGER	13.40	6.20	11.73	14.73	8.53	10.92
NHAe47-4	13.20	8.07	12.20	13.47	9.07	11.20
V_{35}	13.87	5.53	12.53	15.20	9.80	11.39
Mean	13.49	6.60	12.16	14.47	9.13	
CV(%) =	12.3					
$LSD_{(0.05)}$ for Variety =	NS					
$LSD_{(0.05)}$ for Mulch M. =	1.49					
$LSD_{(0.05)}$ for interaction	NS					

EARLY 2017						
LADY'S FINGER	15.33	6.40	11.13	16.00	7.00	11.17
NHAe47-4	14.00	7.27	11.80	12.93	7.47	10.69
V_{35}	15.93	9.67	13.00	16.40	11.47	13.29
Mean	15.09	7.78	11.98	15.11	8.64	
CV(%) =	7.6					
$LSD_{(0.05)}$ for Variety =	NS					
$LSD_{(0.05)}$ for Mulch M. =	3.16					
$LSD_{(0.05)}$ for interaction	NS					
SEEDS PER POD						
EARLY 2016						
LADY'S FINGER	86.20	73.20	83.90	90.80	79.50	82.70
NHAe47-4	91.90	72.30	88.10	88.60	81.40	84.50
V_{35}	92.20	73.20	91.30	92.70	86.40	87.20
Mean	90.10	72.90	87.80	90.70	82.40	
CV(%) =	4.0					
$LSD_{(0.05)}$ for Variety =	NS					
$LSD_{(0.05)}$ for Mulch M. =	7.93					
$LSD_{(0.05)}$ for interaction =	NS					
EARLY 2017						
LADY'S FINGER	89.50	69.80	87.80	90..00	78.80	83.20
NHAe47-4	89.60	71.00	87.10	89.50	84.50	84.30
V_{35}	93.50	70.30	93.70	96.50	92.00	89.20
Mean	90.80	70.40	89.60	92.00	85.10	
CV(%) =	1.6					
$LSD_{(0.05)}$ for Variety =	NS					
$LSD_{(0.05)}$ for Mulch M. =	8.00					
$LSD_{(0.05)}$ for interaction =	NS					

CV = coefficient of variation, NS = not significant

CONCLUSION

Efficacy of mulch materials to limit weed interference and enhance growth and yield of okra was studied. Mulched plots effectively limited weed growth than unmulch and groundnut (live mulch) plots. Black plastic mulched plots were significantly ($p \leq 0.05$) more effective at all levels than other mulch materials. Plots mulched with black plastic, dry trash and palm frond gave okra seedling good start with no or minimum weed interference. Among okra varieties, V_{35} gave better okra fruit yield compared to NHAe47-4 and lady's finger. Plots mulched with black plastic increased growth and yield of okra plant better than other mulches except dry trash mulched plots. Therefore, for effective weed management and to achieve desirable optimum okra yield in South-eastern Nigeria V_{35} variety mulched with black plastic is recommended.

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