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WEED DRY MATTER ACCUMULATION AND YIELD OF CUCUMBER AS INFLUENCED BY VARIETY AND ORGANIC FERTILIZER RATE

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ABSTRACT

Fertilizer application to sustain a cropping system can influence weed infestation, and weed growth along with crop yields. Two field trials were conducted between April and December, 2019 at the Federal University of Agriculture, Abeokuta, in the tropical rainforest-savannah transition zone of south-western Nigeria. The aim is to determine optimum rate of Organic Fertilizer (Gateway Organic Fertilizer - GOF) on weed infestation and fruit yield of three cucumber varieties. Treatments were: GOF applied at 0, 5, 10, and 15 t.ha-1 to three cucumber varieties: Marketmore, Poinsett and Marketer. Treatments were arranged in a split - plot fitted into Randomized Complete Block Design (RCBD) with 4 replicates. Data collected on weed fresh weight, dry matter contents and total yield were subjected to analysis of variance using GENSTAT discovery. Organic Fertilizer (Gateway Organic Fertilizer) application had positive influence on fruit yield of cucumber and weed dry matter accumulation. Weed dry matter from plots cultivated to Poinsett variety with either 10 or 15 t.ha-1 GOF were lower than from other fertilized varieties. Poinsett variety cultivated with either 10 or 15 t.ha-1 GOF had significantly higher fruit yield compared with other interactions. It is concluded and recommended that application of GOF at10 t.ha-1 with Poinsett variety is optimum for reduced weed dry matter accumulation and yield of cucumber in the tropical rainforest-savannah transition zone.

Keywords: *Cucumis sativus;* weed; dry weight; fruit yield; correlation.

INTRODUCTION

Weed infestation and low soil fertility are important factors constraining crop production, particularly in the tropical regions. Weed interference in cucumber results in high yield reduction ranging from 45 to 95% in different agro-climatic conditions (Berry et.al. 2006: Mc Gowan et. al., 2018). In Nigeria, losses of up to 22% in the potential yield of Egusi melon have been attributed to unchecked weed infestation (Udensi *et al.,* 2017). Weed invasion is a major biotic stressor that lowers cucumber yield and quality (Arogundade *et al*., 2021). Weeds and crops are basically biological plants and so respond similarly to environmental growth resources such as water, nitrogen, carbon dioxide, soil nutrients and light that are used for optimum growth and development (Daramola *et al.,* 2021). Intensity of

weed growth, among other attributes plays a major role in determining the degree of crop damage and yield loss caused by weeds (Chauhan *et al.,* 2020).

Cucumber (*Cucumis sativus* L) is a monoecious annual crop in the Cucurbitaceae family usually cultivated for its high moisture contents and nutrient contents (Adetula and Denton, 2003; Okonmah, 2011). It is the fourth most widely grown vegetable, ranked behind tomatoes, cabbage, and onions (Jamir and Sharma*,* 2014). Characteristically, cucumber has a creeping vine that has broad leaves that form a canopy over the fruits (Molaei and Ghatrehsamani, 2022). Cucumber is commonly grown in almost all agro - ecological zones of Nigeria from the coastal areas to the savanna zones (Enujeke, 2013). Cucumber is utilized for diverse functions ranging from culinary to therapeutic and cosmetic uses (Mukherjee *et al.,* 2013; Muruganantham *et al.,* 2016; Oboh *et al.,* 2017). Cucumber varieties are majorly three types: slicing, pickling, and burpless. Within each variety, several different cultivars have emerged with varying shapes, sizes, skin colour and carotene content (Tahir *et al*., 2019).

General methods used in weed control include manual, mechanical and chemical means which are usually labour intensive, costly and not easily available at the right time of need. Biological methods of planting appropriate cultivars (Daramola, 2021) with cultural methods of crop fertilizer application can be alternative cheap means. Cultivar growth differences can allow or suppress weed growth. Cucumber cultivars differ in ability to suppress weeds. Cucumber Ashley variety was reported to have higher weed control efficiency with lower weed dry weight than Marketmore variety (Aliyu et al., 2019). Cucumber cultivar differences to weed tolerance have been reported (Al-Khatib et al., 1995) as well as to resistance to cucurbit downy mildew (Call et al., 2012). Fertilizers can also be applied to boost crop growth and so suppress weeds (Makinde et al., 2000).

In decision-making crop production process, cultivar selection is one of the critical considerations. Desirable traits required for local cultivars include high productivity, high fruit crispness and firmness, as well as resistance to pests and diseases.

This study was conducted to determine the rate of Organic fertilizer for optimum weed suppression and fruit yield of cucumber as influenced by variety and organic fertilizer (Gateway Organic Fertilizer). It also aimed at determining the relationship between weed dry matter accumulation and yield of cucumber.

MATERIALS AND METHODS

The experiment was conducted at the Research Farm of the Federal University of Agriculture Abeokuta in the tropical rainforest-savannah transitional zone of southwestern Nigeria, latitude 7°15'N; longitude 3°25'E. Pre-planting soil samples were taken randomly up to 15 cm depth from 5 locations, using a soil auger and bulked to have a composite sample that was air dried and analyzed to determine soil nutrient status. The first season (Early season) field trial was conducted from April to July, while the second season (Late season) field trial was conducted from September to December, 2015. The Oxic Paleudulf soil (Adetunji, 1991) was mechanically ploughed. Harrowing was done 2 weeks after ploughing. Main plot was cucumber variety (Marketmore, Poinsett and Marketer) while sub treatment was organic

fertilizer rate at 0, 5, 10 and 15 t.ha-1 in a split - plot arrangement fitted into Randomized Complete Block Design (RCBD) with 4 replicates. The field was demarcated into 48 plots of 3.0 x 2.0 m each, separated by 1.0 m path-ways. Gateway Organic Fertilizer (a commercial brand of organic fertilizer produced in Ogun State, Nigeria**)** was applied in a single dose at 2 weeks before planting at the rate of 5, 10 and 15 t.ha-1 while unfertilized plots served as control. Three cultivars of cucumber used for the experiment were: 'Market more', (open pollinated variety that is resistant to cucumber scab and cucumber mosaic virus); Poinsett (open pollinated variety that is resistant to angular leaf spot, anthracnose, downy mildew and powdery mildew) and Marketer (open pollinated variety that is resistant to downy and powdery mildew) variety. Planting was done at two weeks after organic fertilizer application. Two seeds of cucumber were planted on flat beds at a spacing of 1.0 x 0.5 m.

For the late season cropping, the plots were prepared manually and re-established, but without manure application.

At 6 weeks after planting (WAP), a 1m2 quadrat was used randomly to harvest weeds from each plot. The weeds were weighed to determine the weed fresh weight and oven dried at 70^{0}C to determine the weed dry matter content. Weed dry weight was expressed in grams per m2. Healthy and mature fruits were harvested and weighed for the total fruit yield.

Data were subjected to analysis of variance using GENSTAT discovery (12th ed., VSN International, Hemel Hempstead, UK), with cucumber variety and organic fertilizer rates as factors. The interactions were majorly significant and so were used to explain the results, and were separated using DMRT at P≤ 0.05.

RESULTS

The chemical composition and the physical characteristics of the soil varied between seasons (Table1A). The pH values were near neutral. It was 7.2 in the early season but 7.3 in the late season. Organic matter composition was higher in the early season cropping (4.3%) relative to 1.5% in the late season. This translated to higher nitrogen content. Values in late season cropping were higher for available phosphorus, magnesium, calcium and zinc than in early season cropping (Table 1A).

The organic fertilizer used had a moderately alkaline pH (6.50). It contained nitrogen (2.14 %), available phosphorus (43.12 mg.kg-1), potassium (1.5 cmol.kg-1), calcium (6.10 cmol.kg-1) and 2.86 cmol.kg-1 magnesium (Table 1A).

Table 1A: Pre-cropping soil and organic fertilizer analysis

Parameter Chemical Composition	Early season	Late season	Organic fertilizer
pH	7.20	7.30	6.50
O.M (%)	4.32	1.55	12.32
Total N (%)	0.15	0.08	2.14
Avail. P (mg.kg-1)	12.58	18.2	43.12
Exch. Bases			
Mg (cmol.kg-1)	0.37	2.51	2.86
K (cmol.kg-1)	0.61	0.5	1.50
Na (cmol.kg-1)	0.52	0.39	1.48
Ca (cmol.kg-1)	0.21	0.63	6.10
Zn(mg.kg-1)	0.10	0.11	2.11
Fe (mg.kg-1)	0.41	0.32	2.02
Physical			
Sand %	52.67	70.2	
Slit %	31.00	14.00	
Clay %	16.00	15.8	
Soil Textural Class	sandy loam	sandy loam	

Post – cropping soil Nitrogen was increased with Marketmore cultivation; maintained with Poinsett and reduced with Marketer variety (Table 1B). The phosphorous was reduced with Marketer and Marketmore cultivation but increased with Poinsett (Table 1B).

Table 1B: Effects of variety, fertilizer application rates and thier interaction on Post-planting soil nutrient analysis (N, P, K, Mg and Ca)

		N (%)	P(mg/kg)	K(cmol/kg)	Mg(cmol/kg)	Ca(cmol/kg
Pre cropping		0.15	12.58	0.61	0.37	0.21
Variety (V)						
Marketmore		0.32a	9.47b	0.36b	0.38a	0.33a
Poinsett		0.15b	14.6a	0.49a	0.35a	0.31a
Marketer		0.11b	10.32b	0.52a	0.33a	0.28a
GOF Rate (R)						
0 t.ha-1		0.08b	6.74b	0.21b	0.16b	0.13b
5 t.ha-1		0.27a	13.40a	0.50a	0.35a	0.28a
10 t.ha-1		0.21a	12.65a	0.54a	0.36a	0.31a
15 t.ha-1		0.22a	13.05a	0.57a	0.36a	0.30a
Variety × fertilizer rate (t.ha-1)						
Marketmore	0	0.07f	6.91c	0.23f	0.16e	0.15cde
	5	0.54b	10.15c	0.33e	0.38abc	0.47b
	10	0.33b	10.45c	0.41d	0.40ab	0.48a
	15	0.35a	10.36de	0.47d	0.41a	0.49ab
Poinsett	0	0.08ef	7.38e	0.25f	0.16e	0.14de
	5	0.14cde	17.08a	0.55c	0.34abc	0.14de
	10	0.18cd	17.43a	0.57bc	0.37bcd	0.15cde
	15	0.19c	18.23a	0.57bc	0.38abc	0.16cde
Marketer `	0	0.08h	7.65e	0.16g	0.17d	0.11e
	5	0.12ef	12.97b	0.61abc	0.33cd	0.22cd
	10	0.12d	10.08c	0.63ab	0.32cd	0.23cd
	15	0.13cd	10.56c	0.68a	0.30d	0.24c

Means with the same letter(s) in the same column are not significantly different (P < 0.05) using Duncan Multiple Range test (DMRT).

Total rainfall during the early cropping season was higher and sunshine hours longer than during the late cropping season (Table 2). During the experimental period, total rainfall and rainfall during the vegetative phase in the first four weeks of growth were higher in late season than in early season. However, during the reproductive phase in the third month of growth, rainfall was higher in early season than in the late season. Mean temperatures were higher during the vegetative phase but lower during the reproductive phase in early cropping season while in the late cropping season, mean temperatures were lower during the vegetative phase but higher during the reproductive phase (Table 2).

Table 2: Meteorological data during the period of experiments

	Rainfall (mm)	Sunshine (hr)	Maximum temperature (^{o}C)	Minimum temperature (^{o}C)
January	0.00	6.10	35.40	20.50
February	17.10	2.10	33.10	24.60
March	149.00	5.60	35.30	25.10
April	87.20	6.10	33.80	24.10
May	113.80	6.70	33.10	23.80
June	116.50	4.20	31.00	22.80
July	90.70	3.60	23.50	28.30
August	92.70	2.40	22.90	22.90
September	160.00	2.80	30.40	22.50
October	205.90	5.90	31.60	23.00
November	17.60	6.30	33.50	23.80
December	0.00	5.90	33.50	19.30

There were significant interaction effects of cucmber variety and organic fertilizer rate on yield of cucumber during the early and late season productions (Table 3). During the early season, all three unfertilized cultivars had comparable yields lower than yields from fertilized plants. Yields from 15 t.ha-1 GOF application were highest but comparable with yields from 10 t.ha-1 GOF in 5 all the three cultivars. Yields from Marketmore and Poinsett varieties were higher than that of Marketer.

In the dry season, the unfertilized plants still had lower yields relative to the fertilized plants. Application of 15 t.ha-1 GOF still had the highest yields for Poinsett and Marketer varieties. They were higher than yields from 10 t/ha GOF application. However, for Marketmore, highest yield was from 10 t.ha-1 GOF. It was also higher than yield from 15 t.ha-1 GOF application.

The Poinsett variety cultivated with 10 t.ha-1 GOF application gave the highest yield of

the three varieties, with all fertilizer rates, in the dry season (Table 3).

There were significant interaction effects of cucmber variety and organic fertilizer rate on weed growth during the early and late season (Table 4). During the early season, weed infestation was generally heavier in plots cultivated with Marketer variety than from plots of Marketmore variety. Plots cultivated with Poinsett variety had the least weed infestation. The unfertilized Marketer plots had the highest weed infestation of the three varieties with all fertilizer rates when plots cultivated to Poinsett with 10 t.ha-1 GOF application had the least weed infested plots (Table 4).

During the late season, the unfertilized plots of the three varieties had higher weed infestation than the fertilized plots. Plots cultivated to Marketmore were more weed- infested than Marketer while Poinsett plots had the least weed infestation. Poinsett variety planted with 15 t.ha-1 GOF had the least weed infestation in all the three varieties and all fertilizer rates.

Weed dry weight in the early season was highest with unfertilzed Marketer, which was higher than Marketmore which was also higher than with Poinsett. The Poinsett variety cultivated with 15 t.ha-1 GOF had the least weed dry weight of all three varieties with all fertilizer rates. The trend was similar in the late season but generally with lower weights (Table 4).

Table 3: Interaction effect of cucumber variety and organic fertilizer rate on yield of cucumber

		Early season	Late season
Marketmore	0	27.72gh	20.16j
	5	40.32e	49.56h
	10	69.72a	83.16f
	15	73.92ab	72.24g
Poinsett	0	29.40g	25.20i
	5	73.00b	99.96d
	10	73.92ab	111.72a
	15	75.60a	108.36b
Marketer	0	27.72gh	21.00j
	5	37.80f	72.24g
	10	39.48ef	94.92e
	15	40.32e	101.64c

Means with the same letter(s) in the same column are not significantly different ($P < 0.05$) using Duncan Multiple Range test (DMRT).

Table 4: Interaction effect of cucumber variety and organic fertilizer rate on weed fresh weight and dry matter

		Weed Fresh Weight (g/m2)		Weed Dry Matter (g/m2)	
variety/rate		Early Season	Late Season	Early Season	Late Season
Marketer					
	0	542.00a	207.10b	86.00a	30.30c
	5	427.00b	151.30g	53.00d.	23.90ef
	10	424.00b	151.52f	52.08d	26.00d
	15	207.00f	131.80j	37.73g	20.30h
Marketmore					
	0	360.00c	246.50a	75.00b	38.60a
	5	334.00d	137.20i	50.00e	24.00ef
	10	206.00f	157.00e	32.00i	25.80d 13
	15	236.00e	131.40k	40.00f	23.00fg
Poinsett					
	0	240.00e	202.00c	64.00c	33.80b
	5	186.00g	176.40d	35.00h	24.50e
	10	168.00h	141.70h	30.00j	22.50g
	15	198.00f	111.70l	28.00k	18.80i

Means with the same letter(s) in the same column are not significantly different ($P < 0.05$) using Duncan Multiple Range test (DMRT).

During the early season, there was a significant correlation among Yield and Weed Parameters production (Table 5). Increased weed fresh weight significantly decreased the dry matter content when cucumber yield was significantly reduced with increased weed fresh weight (Table 5). In the late season, the trend was similar as with the early season (Table 6). Weed fresh weight was negatively correlated with the weed dry matter and the fruit yield (Table 6).

Table 5: Correlation among Yield and Weed Parameters for the early season production

	Dry matter	Fresh weight
Dry matter		
Fresh weight	-0.381**	
Yield	-0.166	-0.756***

Table 6: Correlation among Yield and Weed Parameters for the late season production

	Dry matter	Fresh weight
Dry matter		
Fresh weight	-0.449**	
Yield	-0.009	-0.622***

DISCUSSION

Sandy soils are known for the peculiarity of low water retention ability. The sandy loam textural class of the soil used could adversely affect the performance and productivity of cucumber plant due to the low water and nutrient retention ability of such soil. Hence, soil amendment using organic fertilizer like Gateway Organic Fertilizer used in this study could improve the soil structure thereby enhancing its performance.

For nutrients to be released adequately and timely for optimum plant growth, organic manures were applied before crop establishment. The relatively good yield performance of Poinsett variety cultivated with 10 t.ha-1 Gateway Organic Fertilizer in both early and late cropping seasons compared to other treatment combinations, confirms the findings that varieties of crops can differ in response to fertilizer, as reported by Anderson *et al* (2007) and Nedunchezhiyan *et al* (2010) that crops respond differently to different types of organic manure. It can therefore be inferred that cucumber uses nutrients efficiently when sourced from organic materials.

Weed dry matter accumulation/biomass was observed to increase as the manure rate increased which could be due to more nutrients and organic amendment which enhances plant photosynthetic activities resulting in high dry matter accumulation. It corroborates the findings of Adeniji *et al*., (2019) who reported increased dry matter in *Jetropha curcas* with increasing organic manure application.

Negative and significant correlation of yield and weed dry matter accumulation implies that there can be competition for resources especially nutrients which translates to dry matter accumulation when weeds are not effectively controlled. This study corroborates the findings of Garko et al., (2020) that there is a negative and significant correlation among grain yield and weed attributes in maize cultivation. It is therefore concluded and recommended that Poinsett variety cultivated with 10 t.ha-1 gateway organic fertiliz-

er is efficient for optimum yield resulting in reduced weed dry matter accumulation.

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