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RESEARCH ARTICLE
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Growth and productivity of cucumber (*Cucumis sativus* L.) intercropped with maize as affected by cropping pattern and weed control in Forest –Savanna transition Agro-ecological zone of Southwestern Nigeria

Crecimiento y productividad del pepino (*Cucumis sativus* L.) y maíz intercalados con diferentes patrones de cultivo y control de malezas en la zona agroecológica de transición bosque-sabana del suroeste de Nigeria

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Abstract

Field experiments were carried out within the crop seasons of 2014, 2015, and 2016 at the Federal University of Agriculture, Abeokuta, Nigeria to evaluate the influence of intercropping and weed control methods on the growth and yield of cucumber. Treatments were arranged in a split-plot arrangement in a randomized complete block design (RCBD) with three replications. The main plot was a cropping pattern of maize intercropped with cucumber sowed at 100 cm x 37.5 cm, and 75 cm x 50 cm, sole cucumber sowed at 75 cm x 75 cm. The sub-plot treatments were weed control methods: pre-emergence application of active ingredient of Propaben at 2 kg.ha^{-1}, 1.6 kg.ha^{-1}, and 1.6 kg.ha^{-1}followed by (fb) supplementary hoe weeding (SHW), Superunion at2kg.ha^{-1}, 1.6 kg.ha^{-1}, and 1.6 kg.ha^{-1}fb SHW, two hoe weddings, and the weedy check. Data collected were subjected to Analysis of Variance while significant means were separated using Duncan`s Multiple Range Test (p<0.05). At 3 weeks after sowing (WAS) in 2015, and 3 and 6 WAS in 2016 cucumber planted alone resulted in significantly higher crop stand of 82 100, 67 800 and 56 000 plants per hectare than the corresponding intercrop in the same periods. Results indicated that cucumber intercropped with maize at 75 cm x 50 cm significantly reduced weed dry matter in 2014 compared to sole cropping. All combinations of pre-emergence herbicides reduced weed dry biomass compared to the weedy check. Although there was no significant difference in production between growing cucumbers as a sole crop and as an intercropping with maize, weeding twice at 3 and 6 weeks after sowing, resulted in the highest yield of cucumber of 437 kg.ha^{-1} in 2014 and 315 kg.ha^{-1} in 2015. Conclusively, the application of Propaben and Superunion caused a reduction in the fruit yield of cucumber between 48.9 % to 97.8 % in maize and cucumber intercrop.

Keywords: Cucumber, Propaben, Superunion, yield, weedy check

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Resumen

Se llevaron a cabo experimentos de campo dentro de las temporadas de cultivo de 2014, 2015 y 2016 en la Universidad Federal de Agricultura, Abeokuta, Nigeria para evaluar la influencia de los métodos de cultivo intercalado y control de malezas en el crecimiento y rendimiento de pepino. Los tratamientos se dispusieron en un arreglo de parcelas divididas en un diseño de bloques completos aleatorizados (RCBD) con tres repeticiones. La parcela principal fue un patrón de cultivo de maíz intercalado con pepino sembrado a 100 cm x 37.5 cm, y 75 cm x 50 cm, pepino único sembrado a 75 cm x 75 cm. Los tratamientos de las subparcelas fueron métodos de control de malezas: aplicación de pre-emergencia del ingrediente activo Propaben a 2 kg.ha^{-1}, 1.6 kg.ha^{-1}, y 1.6 kg.ha^{-1}seguido de (fb) desyerbe suplementario con azada (SHW), Superunion a 2 kg.ha^{-1}, 1.6 kg.ha^{-1}, y 1.6 kg.ha^{-1} fb SHW, dos bodas con azada, y el testigo de malezas. Los datos recogidos se sometieron a análisis de varianza, mientras que las medias significativas se separaron mediante la prueba de rangos múltiples de Duncan (p<0.05). A las 3 semanas después de la siembra (SSA) en 2015, y a las 3 y 6 SSA en 2016, el pepino plantado solo dio lugar a una masa de cultivo significativamente mayor de 82 100, 67 800 y 56 000 plantas per hectare que el cultivo intercalado correspondiente en los mismos períodos. Los resultados indicaron que el pepino intercalado con maíz a 75 cm x 50 cm redujo significativamente la materia seca de las malas hierbas en 2014 en comparación con el cultivo único. Todas las combinaciones de herbicidas de preemergencia redujeron la biomasa seca de malas hierbas en comparación con el control de malas hierbas. Aunque no hubo diferencias significativas en la producción entre el cultivo de pepino como cultivo único y como cultivo intercalado con maíz, escardar dos veces a las 3 y 6 semanas después de la siembra, resultó en el mayor rendimiento de pepino de 437 kg.ha^{-1} en 2014 y 315 kg.ha^{-1} en 2015. En conclusión, la aplicación de Propaben y Superunion causó una reducción en el rendimiento de fruto de pepino entre 48.9 % a 97.8 % en el cultivo intercalado de maíz y pepino.
Palabras clave: *Pepino, Propaben, Superunion, rendimiento, control de malas hierbas.*

Introduction

Cucumber (*Cucumis sativus* L.) is a widely cultivated cucurbit in various parts of the world. Although the origin is traced to India (Johnson & Mullinix, 2009; Wiro & Iyagba, 2020), the cultivation of the crop is rapidly gaining popularity both among peasant and large scale farmers in Nigeria. The crop is a monoecious with creeping nature and vines that produce very beneficial fruits which are used in a variety of ways such as salads, depending on individuals and cultural backgrounds. Apart from possessing Vitamin A, B1, B2, B6, B12 and Vitamin C, which keeps the body healthy, the fruits also contain about 92 % water which provides hydration to human body (Wiro & Iyagba, 2020).

It was predicted that 80.4 million tons of cucumbers would be produced worldwide in 2016, with contributions from China, Russia, Turkey, and Iran accounting for roughly 76.9 %, 2.48 %, 2.25 %, and 2.12 % of that total. According to Tridge (2018), just 0.65 % of the world's cucumbers were grown in Africa. A population of 98 838 to 222 386 plants per hectare is normally used to produce the crop; however, under some circumstances, this number can rise to 370 644 plants per hectare. Cucumbers require a sandy loam that drains well and has a high level of organic matter, according to Motes (1975) and O'Sullivan (1980). Depending on the cultivar and location, cucumbers can reach maturity between 36 and 40 days after sowing.

Ojo et al. (2010) observed that Cucurbitaceae crops such as watermelon (*Citrullus lanatus*) and Cucumber can suppress weed populations in mixed cropping systems as good cover crops. A similar cucurbit, 'Egusi' melon (*Colocynthis citrullus*) is a vegetable crop commonly cultivated in West Africa (van der Vossenet al., 2004). Because of its creeping nature similar to that of cucumber, and its ability to provide cover on the soil, farmers use it as a weed suppressant in their mixed crop farms (Van der Vossen et al., 2004). Akpan & Akata (2017) reported that cucumber intercropped with cassava as a cover crop enhanced good weed control in Eastern Nigeria.

Weed infestation constitutes a major production challenge in cucumber, especially during the initial growth period before forming a sufficient crop canopy that enhances ground cover.

This study therefore aimed at determining the effect of intercropping and weed management methods on the performance of cucumber. The herbicide rates included Propaben with active ingredient at 2 kg.ha^{-1}, Propaben at 1.6 kg.ha^{-1}, Propaben at 1.6 kg.ha^{-1}fb SHW, Superunion at 2 kg.ha^{-1}, Superunion at 1.6 kg.ha^{-1}, Superunion at 1.6 kg.ha^{-1} fb SHW

Materials and Methods

Field research was carried out at the Teaching and Research Farm, the Federal University of Agriculture Abeokuta (07° 20 'N and 07° 25' N, 03' 23' E and 03' 25' E) in 2014, 2015, and 2016 during the early cropping season between June to September.During the periods of crop growth, rainfall was at its peak in September (160.8 mm and 165.1 mm) in 2014 and 2015, whereas a maximum rainfall of 226.2 mm was recorded in 2016. Whereas a maximum temperature of 29.3 °C was recorded in February both in 2014 and 2015, in 2016 mean temperature of 30 ° C was recorded in Table 1. Laboratory soil analysis was carried out to determine both the physical and chemical properties of the experimental site before planting and treatment application (Table 2). The main plot had three cropping patterns: maize intercropped with cucumber at plant spacings of 75 cm x 50 cm, and 100 cm x 37.5 cm, and sole cucumber planted at 75 cm x 75 cm. There were eight sub-plot treatments of weed control methods these included: PROPABEN at 2 kg.ha^{-1}, PROPABEN at 1.6 kg.ha^{-1}, PROPABEN at kg.ha^{-1} fb SHW, SUPERUNION at 2 kg.ha^{-1}, SUPERUNION at 1.6 kg.ha^{-1}, SUPERUNION at 1.6 kg.ha^{-1} followed by Supplementary Hoe Weeding, Hoe weeding at 3 and 6 WAS and Weedy check. PROPABEN is a commercially formulated mixture of metolachlor 200 g.L^{-1} with prometryne 200 g.L^{-1}, while SUPERUNION is a commercial formulated mixture of acetochlor 38 % with prometryne 13 %. All treatments in various combinations were laid out in a split – plot design with a Randomized Complete Block arrangement.

The experimental site was plowed twice and harrowed once at two weeks later with tractor mounted implement. Maize seeds were sowed at 3 to 4 seeds per hill at spacings indicated earlier according to the treatments. A population of 53 333 plants per hectare was achieved by thinning maize plants to two plants per stand at two weeks after sowing (WAS). Following the treatments, cucumbers were planted in rows between and equally spaced from the rows of corn. At 3 WAS, 400 kg.ha^{-1} of NPK 15-15-15 fertilizer was applied, and at 6 WAS, 100 kg.ha^{-1} of urea (46 % N) was applied. The fertilizers were added to the maize stands as a side dress at a depth of roughly 6 cm. One day following planting, the CP3 backpack was used to apply the pre-emergence herbicide chemicals, PROPABEN

Table 1: Monthly weather data during the periods of experiment

	Mean Temperature			Total Rainfall		
	2014	2015	2016	2014	2015	2016
January	28.9	28.9	28.1	8.2	0	32
February	29.3	29.3	30.3	15.5	51.3	0
March	28.8	28.8	29.5	149.1	66.8	150.3
April	28.2	28.2	29.2	87.2	69	68.2
May	27.8	27.8	29	113.8	60.4	226.2
June	27.4	27.4	26.7	116.5	164.9	150.5
July	26.6	26.6	26.3	90.7	65.6	65.2
August	25.6	25.6	25.7	92.7	29.4	63.6
September	26.3	26.3	26.9	160.8	165.1	229
October	26.3	26.3	27.6	205.9	159.1	155.4
November	27.5	27.5	28	17.6	16.6	5.9
December	27.9	26.1	22.5	0	0	0
Total				1058.0	848.2	1146.3
Mean	27.6	27.4	27.5	88.2	70.7	95.5

Table 2: Physical and chemical properties of soil from 0 cm – 15 cm depth prior to planting

Properties	Level of Composition		
Soil properties	2014	2015	2016
Particle size			
Sand (g.kg^{-1})	832	802	802
Clay (g.kg^{-1})	140	148	180
Silt (g.kg^{-1})	28	50	18
pH	5.1	5.9	4.3
Organic carbon (g.kg^{-1})	39.9	18.15	22.34
Exchangeable Acidity (cmol.kg^{-1})	1.4	1.5	2.6
Total Nitrogen (g.kg^{-1})	14.1	13.1	19.9
Exchangeable Bases			
Na (cmol.kg^{-1})	0.5	0.5	0.6
K (cmol.kg^{-1})	0.5	0.4	0.4
Ca(cmol.kg^{-1})	0.3	0.3	0.3
Mg (cmol.kg^{-1})	0.2	0.2	0.2
Available P (mg.kg^{-1})	41	40	39

and SUPERUNION, to the relevant plots. The New Duncan's Multiple Range Test was used to separate significant means at the 5 % probability level after data on cucumber stand count, canopy height, canopy spread, fruit yield, and dry matter output were analyzed using variance.

Results

Stand Count

In 2014, the cucumber used exhibited slow and poor emergence as reflected in the stand count at 3 WAS which later increased to a maximum of 10 500 plants per hectare. The stand count of cucumber at 3 WAS was significantly affected by cropping patterns in 2015 and 2016 when the sole crop had higher values than the intercrop with maize at both spacings which had similar values (Table 3). Weed control treatments also had a significant effect on cucumber stand count at 3 WAS in all the trials and at 6 WAS in 2015 and 2016. Except at 3 WAS in 2015 with active ingredient of Propaben at 1.6 kg.ha^{-1} alone, application of herbicides resulted in a lower cucumber stand count compared with no herbicide treatments in 2014 and 2015 while those with active ingredient of Propaben at 1.6 kg.ha^{-1}with and without SHW had higher values than the minimum for those with active ingredient of Superunion at 1.6 kg.ha^{-1} and 2 kg.ha^{-1} alone at 3 WAS in 2015. At 6 WAS in 2015, the plots hoe weeded without herbicide had the highest cucumber stand count while those with Probaben at 1.6 kg.ha^{-1}alone and those left weed infested also had higher values than all those with Superunion treatments.

At 3 WAS, the plots without herbicide in 2016 had a higher cucumber stand count (active ingredient 1.6 kg.ha^{-1}) than the minimum of those with Superunion. Plots with Superunion at 1.6 kg.ha^{-1} fb SHW, however, yielded values similar to the maximum at 6 WAS in two hoe-weeding plots (Table 3).

Canopy Height and Spread

Cucumber canopy spread was significantly affected by the intercrop with maize at 9 WAS in 2015 (Table 4) when sole cucumber had a wider canopy spread (32.4 cm) than that intercropped with maize spaced at 100 cm x 37.5 cm (25.1 cm).

Fruit yield

Weed control methods had a significant effect on cucumber fruit yield in 2014 and 2015 (Table 5). In 2014, two hoe weedings resulted in significantly higher fruit yields (437 kg.ha^{-1}) than all the other weed control treatments which caused similar yields (12 kg.ha^{-1} to 157 kg.ha^{-1}).

Table 3: Effects of cropping pattern and weed control methods on cucumber stand count in maize production in 2014, 2015, and 2016 early wet seasons at Abeokuta

Treatment		Cucumber Stand Count (x000 ha^{-1})					
Cropping Pattern (CP)		2014		2015		2016	
Maize Intercropped with		3WAS	6WAS	3WAS	6WAS	3WAS	6WAS
100 cm x 37.5cm	Cucumber	6.1	8.5	53.3 b	34.6b	40.3b	30.3b
75 cmx 50cm	Cucumber	5.1	11.4	59.2b	36.3b	40.3b	29.6b
75 cm x 75cm	Sole Cucumber	3.9	8.7	82.1a	53.3a	67.8a	56.0a
SED (CP)		1.8 ns	1.5 ns	3.0**	7.0 ns	11.4	15
Weed Control Method (WC)							
Probaben at 2 kg.ha^{-1} of active ingredient		2.3 b	10.3	45.6 de	33.3 bc	53.7abc	32.7bc
Probaben at 1.6kg.ha^{-1} of active ingredient fb SHW		3.3 b	10.5	70.0 cd	32.2 bc	48.2abc	40.7abc
Probaben at 1.6kg.ha^{-1} of active ingredient		3.1 b	10.3	85.6 bc	55.6 b	40.7bc	29.6 bc
Superunion at 2 kg.ha^{-1} of active ingredient		1.7 b	8.4	21.1 e	15.6 c	39.5bc	39.5abc
Superunion at 1.6 kg.ha^{-1} of active ingredient fb SHW		1.7 b	9.2	44.4 de	20.0 c	46.3abc	47.5ab
Superunion at 1.6 kg.ha^{-1} of active ingredient		2.5 b	7.3	26.7e	16.7 c	26.5c	42..0abc
Hoe weeding at 3 and 6 WAS		13.4 a	10.3	104.4ab	106.7a	65.4ab	56.2a
Weedy check		12.2 a	10.1	121.1a	51.1 b	75.3a	21.00c
SED (WC)		2.00**	1.1 ns	15.0**	12.6**	15.4 ns	9.52*
SED (CP × WC)		3.7 ns	2.4 ns	24.0 ns	21.6 ns	27.4 ns	21.5 ns

Table 4: Effects of cropping pattern and weed control methods on cucumber canopy height and cucumber canopy spread in maize production in 2014, 2015, and 2016 early wet seasons at Abeokuta

Cropping Pattern (CP)		Canopy Height (cm)			Canopy Spread (cm)		
Maize Intercropped with		2014	2015	2016	2014	2015	2016
100 cm x 37.5cm	Cucumber	23.9	14.7	13.8	116.2	25.05 b	29.3
75 cm x 50cm	Cucumber	22.1	14.2	14.7	96.8	28.96 ab	37.1
75 cm x 75cm	Sole Cucumber	25.9	14.8	13.4	64.8	32.43 a	27.8
SED (CP)		8.8 ns	2.1 ns	2.5 ns	28.4 ns	2.45**	5.7 ns
Weed Control Method (WC)							
Probaben at 2 kg.ha^{-1} of active ingredient		21.8	15	11.6	96.2	25.9	27.9
Probaben at 1.6 kg.ha^{-1} of active ingredient fb SHW		19.4	13.9	15.3	102	34.8	28.4
Probaben at 1.6 kg.ha^{-1} of active ingredient		20.4	14.7	15.2	85.9	32	32.8
Superunion at 2 kg.ha^{-1} of active ingredient		25.4	18	12.9	89.2	32.1	23.5
Superunion at 1.6 kg.ha^{-1} of active ingredient fb SHW		20	15.7	14.1	99.7	20.6	42.1
Superunion at 1.6 kg.ha^{-1} of active ingredient		22	11.9	15.5	81.3	20.6	24.6
Hoe weeding at 3 and 6 WAS		23.5	16.2	13.4	106.9	41.7	43.2
Weedy check		39.3	11.4	13.5	79.6	22.9	28.9
SED (WC)		8.7 ns	3.2 ns	2.11 ns	12.8 ns	11.5 ns	7.6 ns
SED (CP x WC)		16.6 ns	5.6 ns	4.2 ns	35.2 ns	9.3 ns	13.5 ns

Table 5: Effects of cropping pattern and weed control methods on cucumber fruit yield in maize production in 2014 and 2015 early wet seasons at Abeokuta

Treatment					
Cropping Pattern (CP)		Fruit Yield (kg ha-1)		Dry Matter Production (kg/ha)	
Maize Intercropped with		2014	2015	**2015**	**2016**
100 cm x 37.5 cm	Cucumber	118	15	3.79	1.27
75 cm x 50cm	Cucumber	53	32	3.65	1.57
75 cmx 75cm	Sole Cucumber	193	185	4.38	1.51
SED (CP)		69.7 ns	89.8 ns	0.72 ns	0.30 ns
Weed Contrl Method (WC)					
Probaben at 2 kg.ha^{-1} of active ingredient		77 b	28b	3.60 bc	0.99 b
Probaben at 1.6 kg.ha^{-1} of active ingredient fb SHW		154 b	161ab	7.20 ab	1.79 ab
Probaben at 1.6 kg.ha^{-1} of active ingredient		28 b	10b	4.00 bc	1.79 ab
Superunion at 2 kg.ha^{-1} of active ingredient		85 b	10b	1.95 c	1.14 b
Superunion at 1.6 kg.ha^{-1} of active ingredient fb SHW		47 b	7b	2.55 c	2.70 a
Superunion at 1.6 kg.ha^{-1} of active ingredient		13 b	81b	1.63 c	0.91 b
Hoe weeding at 3 and 6 WAS		437a	315a	7.78 a	1.34 b
Weedy check		133 b	7b	2.82 c	0.97 b
SED (WC)		106.2**	136.9	1.71**	0.584*
SED (CP × WC)		185.70 ns	239.3 ns	2.90 ns	0.98 ns

A Similar trend was observed in 2015 except plots that received Propaben at 1.6 kg.ha^{-1} fb SHW with a fruit yield of 161 kg.ha^{-1} which was comparable to the maximum of two hoe weedings (315 kg.ha^{-1}) (Table 5).

Dry Matter Production

Cucumber dry matter was significantly affected by weed control methods in 2015 and 2016 (Table 5). In 2015, the pre-emergence application of Propaben at 1.6 kg.ha^{-1} of active ingredient fb SHW resulted in a dry matter yield (7.2 kg.ha^{-1}) comparable to the maximum (7.78 kg.ha^{-1}) of two hoe weedings and significantly higher than the minimum of all the treatments of Superunion and weedy check (2.8 kg.ha^{-1}).However, in 2016, the plots that received Propaben at 1.6 kg.ha^{-1} of active ingredient with and without SHW (1.79 kg.ha^{-1}) produced cucumber dry matter comparable to the maximum (2.70 kg.ha^{-1}) of Superunion at 1.6 kg.ha^{-1} of active ingredient fb SHW (Table 5).

Weed Dry Matter

The cropping pattern of maize significantly affected broad-leaf dry matter 12 WAS in 2014 and 2015 (Table 6). In 2014 and 2015, broadleaf dry matter production was significantly lower on plots of maize intercropped with cucumber planted at 75 cm x 50 cm compared with the maximum of sole cucumber (Table 6).

In comparison to the weedy check, all weed control techniques decreased the dry matter of broadleaf weeds. In every instance, additional hoe weeding on plots treated with the herbicides decreased broadleaf dry matter on those plots even more than herbicide application alone, resulting in values similar to those of two hoe weedings in every trial. While the numbers were comparable for all weed management techniques in 2016, a similar trend was also seen with grass weed dry matter output in 2014 and 2015 (Table 6).

Discussion

In this study, the various weed control methods improved the performance of the cover crop. The highest cucumber fruit yield was obtained on the plots hoe weeded twice while all the other treatments produced lower but similar yields. However, herbicide application at all rates led to a significant reduction in the growth and yield parameters of cucumber. Both herbicides, irrespective of dosage except superunion at 1.6 kg.ha^{-1} of active ingredient alone led to a significant reduction in the stand count of cucumbers in 2016. This probably confirms the non-suitability of cucumber as a cover crop in maize which was meant to enhance the effectiveness of pre - emergence herbicides in weed control especially when these particular herbicides are used. A similar observation was previously reported by Obiazi et al. (2020) where various degrees of injuries were reported when different preemergence herbicides were evaluated on chemical weed management okra (*Abelmoschus esculentus* (L.) Moench) growth and tolerance. From this, it can be inferred that cucumbers are less resistant to these pre-emergence herbicides when applied early in their growth cycle. The lower weed dry matter production on the herbicide-treated plots and hoe-weeded plots compared to the weedy check was a result of the effectiveness of the pre-emergence herbicide in preventing early emergence, growth, and development of weeds thereby limiting their competition with the crop. Similarly, the reduction in the weed dry matter observed in these trials supports earlier reports of Adigun et al. (2022), Ajani et al. (2017) who contributed that manual hoe weeding within the

Table 6: Effects of maize cropping pattern and weed control methods on weed dry matter production (kg/ha) in 2014, 2015, and 2016 early wet seasons at Abeokuta

TREATMENT							
Cropping Pattern (CP)		2014		2015		2016	
Maize	Intercropped with	Broadleaf	Grass	Broadleaf	Grass	Broadleaf	Grass
100 cm x 37.5cm	Cucumber	110ab	82	717ab	486	217	3
75 cm x 50cm	Cucumber	59b	84	573b	653	330	8
75 cm x 75cm	Sole Cucumber	220a	103	957a	966	448	20
SED (CP)		56.7	69.8ns	136.8	228.3ns	167.8ns	26.1ns
Weed Control Method (WC)							
Probaben at 2 kg.ha^{-1} of active ingredient		199b	107bc	866b	900b	446b	15b
Probaben at 1.6 kg.ha^{-1} of active ingredient fb SHW		29c	9.0c	422c	190c	147c	0.0b
Probaben at 1.6 kg.ha^{-1} of active ingredient		223b	235a	922b	890b	612b	26b
Superunion at 2 kg.ha^{-1} of active ingredient		267ab	171ab	854b	961b	622b	37ab
Superunion at 1.6 kg.ha^{-1} of active ingredient fb SHW		19c	9.0c	373c	276c	135c	0.0b
Superunion at 1.6 kg.ha^{-1} of active ingredient		217b	144ab	850b	1024b	434b	13b
Hoe weeding at 3 and 6 WAS		16c	14c	478c	349c	125c	0.0b
Weedy check		331a	147ab	1251a	1512a	1059a	73a
SED (WC)		42.8	51.3	102.5	146.4	114.6	19
SED (CP × WC)		126.6ns	152.5ns	303.9ns	449.7ns	346.6ns	56.7ns

first six to nine weeks after planting of cowpea, and groundnut consistently reduced weed density, weed cover score as well as weed dry matter production. Furthermore, lower weed dry matter production in plots where chemical weed management was supplemented with manual hoe weedings suggest that weed control potentials of these herbicides only are not sufficient enough to sustain weed management in cucumber and suppress weed growth up till 12 weeks after crop planting hence a post-emergence weed management is required to further enhance the effectiveness of the pre-emergence herbicide applied. In their previous reports, Adigun et al. (2022), Ajani et al. (2017) and Osunleti et al. (2021) observed that application of pre-emergence herbicides with supplementary hoe weedings usually reduces weed growths consequently extend herbicide activities on weeds in cowpea (*Vigna unguiculata*L.Walp), pepper (*Capsicum annum* L.) and mango ginger (*Curcuma amada* Roxb). The herbicide applied at planting killed the emerging weeds from the soil thereby reducing the number of weeds on the treated plots. Generally, the highest fruit yield of cucumber in manually weeded plots as well as chemical weed control with supplementary hoe weeding suggested that cucumber is a very sensitive vegetable crop to selected chemical weed control and management. At that rate, the sole application of the pre-emergence herbicides reduced the fruit yield of cucumber. Additionally, the weed control potentials of the sole herbicides applied could not sustain and suppress weed activities throughout crop growth consequently allowing some levels of weed competition with crops thereby reducing the yield output. In related weed management approaches previously reported by Adigun et al. (2022), Ajani et al. (2017), Daramola et al. (2022) and Falade et al. (2023) economic yield of cowpea, soybean (*Glycine max* L.), maize (*Zea mays*L.) was found to be higher when chemical weed control was supplemented with manual hoe weeding than when single weed control approaches were applied with herbicides.

Conclusion

While the pre-emergence herbicides used in this trial effectively controlled weeds, they hurt the growth and yield of cucumber, resulting in cucumber yield reduction. In this trial, there was 48.9 % to 97.8 % reduction in cucumber yield as a result of herbicide application in maize and cucumber mixture. Given the phytotoxicity injuries to cucumber plants at all rates of both Propaben and Superunion in all the trials, there is a need to carry out further trials to determine the appropriate rates that could eliminate phytotoxicity to cucumber and still offer effective control on weeds.

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Authors contribution:

AAF: Participated in experimental design, conducted field research, interpretation of result and participated in manuscript preparation.

JOI: Participated in field research and Data analysis

STOL: Experimental design and interpretation of results

Conflicts of interest:

There are no conflicts of interest among authors

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