PRINT ISSN 1119-8362
Electronic ISSN 2659-1499

Full-text Available Online at
https://www.ajol.info/index.php/jasem
https://www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 28 (7) 2033-2040 July 2024

Performances of Maize Grown as Intercrop with Cowpea under Different Planting Patterns

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ABSTRACTS: A field experiment conducted in two different agro ecologies, Ibadan and Ilora in southwest Nigeria, explored the benefits of intercropping and the impact of varying plant populations on crop yield. The study focused on three different maize varieties (Quality protein maize, high protein maize, and the farmer's variety SUWAN-1-SR-Y) intercropped with Cowpea (Ife brown) under different cropping patterns (0.9x0.4 m and 1.0x0.5 m). The experiment was carried out in split design using randomized complete block design (RCBD) (r=4). The results of the experiment demonstrated that the performance of maize when intercropped with cowpea at wider spacing (1.0x0.5 m) outperformed maize planted at closer spacing (0.9x0.4 m) in both locations. This finding suggests that the wider spacing between crops had a positive impact on crop growth and yield in both agro ecologies. The study revealed that the farmer's variety, SUWAN-1-SR-Y, exhibited superior growth and grain yield compared to the other improved maize varieties when grown both as intercrops and as sole crops. This finding highlights the resilience and adaptability of the farmer's variety, which performed well in different cropping systems. The research noted variations in maize yield between the two locations, with Ibadan recording higher yields compared to Ilora. This difference in yield could be attributed to variations in climatic conditions between the two regions which significantly influence maize performance. The results obtained indicate that intercropping maize with cowpea at wider plant spacing (1.0x 0.5m) enhanced maize performance compared to closer spacing (0.9x 0.4m).

DOI: https://dx.doi.org/10.4314/jasem.v28i7.14

Cite this Article as: ADEBAYO, A. K; ANJORIN, F. B; OLANIPEKUN, S. O; ALUKO, O. A; ADEWUMI, A. D. (2024). Performances of Maize Grown as Intercrop with Cowpea under Different Planting Patterns. *J. Appl. Sci. Environ. Manage.* 28 (7) 2033-2040

Dates: Received: 21 May 2024; Revised: 17 June 2024; Accepted: 23 June 2024 Published: 02 July 2024

Keywords: chlorophyll; growth; intercrop; planting pattern; yield components

The increasing number of urban clusters, overpopulation, and industrialization in the developing countries have led to a decline in the quantity and quality of available arable land for farming (Sermon, 2008). This trend poses significant challenges to agricultural productivity and food security. In such circumstances, implementing high-intensity cropping systems can be a viable solution to enhance overall agricultural productivity and food availability. Consequently, farmers in Africa have adopted various cropping practices, including mixed cropping and intercropping, to improve productivity and sustainability (Lose *et al.,* 2003). Intercropping, specifically, is a common and sustainable crop production method practiced in the humid tropics (Agegnehu *et al.,* 2008) where multiple crops are grown simultaneously on the same field either in close proximity or in alternate rows (Carruthers *et al.,* 2000). One popular intercropping combination is maize (*Zea mays*) and cowpea (*Vigna unguiculata),* which have

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been successfully intercropped in many regions around the world (Dahmardeh *et al.,* 2010) Maize is a widely cultivated cereal crop that serves as a staple food for millions of people (Su *et al.,* 2014). It has high carbohydrate content and provides essential nutrients in the diet (Shiferaw *et al.,* 2011). On the other hand, cowpea is a leguminous crop known its protein-rich seeds and its ability to fix atmospheric nitrogen. This combination of intercropping offers numerous advantages from both agronomic and economic perspectives. By intercropping cowpea and maize, cowpea serves as a valuable nitrogen source, reducing the reliance on synthetic fertilizers and supporting sustainable agricultural practices (Hinsinger *et al.,* 2011). Moreover, cowpea demonstrates strong weed competitiveness, effectively suppressing weeds (Varret *et al.,* 2017) that could otherwise hinder maize growth. This natural weed control characteristic of intercropping reduces the need for herbicides and manual weed management (Darayanto *et al.,* 2020). Additionally, cowpea's extensive root system contributes to improved soil structure, aeration, and water infiltration, fostering a healthier soil environment that promotes sustained productivity. Intercropping cowpea and maize also provide farmers with risk diversification. In the event of adverse weather conditions or pest and disease outbreaks affecting one crop (Huang *et al.*, 2015), the other crop has the potential to thrive, ensuring a certain level of harvest and income (Emede and Adegoke 2011). Furthermore, the intercropped system can generate multiple income streams as cowpea can be marketed separately or utilized for household consumption (Mucheru-*Muna et al.,* 2010; van Asten *et al.,* 2011). However, when multiple crops are grown simultaneously in an intercropping system, they share the available resources, leading to competition between them, hence, enough space is crucial throughout the growing period of intercropped plants. Plant population, which is determined by planting pattern, has been identified as a key farming technique that influences crops most especially maize performance and production (Islam *et al*., 2011). Proper plant spacing ensures that each crop has adequate access to essential resources such as sunlight, water, and nutrients. By providing sufficient space between plants, competition for resources is reduced, allowing both maize and cowpea to thrive and utilize available resources efficiently. Intercropping maize with cowpea is widely practiced in Africa, but there is limited available information on the ideal plant population density for newly released maize varieties when intercropped with cowpea. Therefore, the purpose of this study was to assess the performance of maize when intercropped with cowpea using different planting patterns.

MATERIALS AND METHODS

In the rainy season, specifically from May to September 2019, a field experiment was conducted in two different locations in southwestern Nigeria. The first location was the Institute of Agricultural Research and Training farm in Ibadan (latitude 07° 22' N, 30° 50' E), situated in the rainforest agro-ecology. The second location was Orin-Ekiti (latitude 08° 02' N, 04° 02' E), located in the derived savanna agro-ecology. The maximum and minimum temperatures recorded during the experiment were 30°C and 18°C, respectively. Both locations experience a bimodal rainfall pattern, with the rainy season typically occurring from March to September. The soils in both locations were sandy loam in texture, moderately well-drained, and had been previously cultivated before being left fallow for one cropping season. The dominant soil type in both locations is alfisol

Pre-cropping soil analysis: Prior to the setting of the experiment, composite samples were randomly taken using 5mm soil auger at 0 - 30 cm depth for analyses. The chemical analyses included: *p*H, nitrogen, available phosphorus and available potassium. Soil *p*H was determined using soil: water ratio of 1:2 by a pH meter with a glass electrode and nitrogen by the Kjeldahl method. Organic carbon (OC) was determined by the Walkley and Black wet digestion (Nelson and Sommers, 1996). Potassium (K) was determined by flame photometer. Available phosphorous was determined by Bray-1 extraction and determined colourimetrically by the molybdenum blue procedure (Bray and Kurtz, 1945). Exchangeable cation (Ca and Mg) were extracted using IMNH_4OAC and determined on atomic absorption spectrophotometer.

Experimental design and treatments: Four maize varieties; DMR-LSR-Y, ART-98-SW6-SR-W (QPM), ILE-OB (HPM popularly known as Oloyin), and SUWAN- 1-SR-Y (farmer's local varieties) were intercropped with cowpea variety (Ife brown) and two planting patterns (0.9 x 0.4m and 1.0 x 0.5m) were evaluated on the field after land preparation (ploughing and harrowing) The experiment was a split plot in randomized complete block design (RCBD) replicated four times. Plot size was 4x5 m^2 and were separated from each other with a space of 1.0 m. Alley pathways of 2 m was used to separate one block from another using randomized complete block design in split plot arrangement (r=4) at both locations (Ibadan and Orin-Ekiti). The main plot consisted of the planting pattern and the sub plot was maize varieties intercropped with cowpea. Treatments include: T1= DMR-LSR-Y + Ife brown, T2= ILE-OB + Ife brown, T3= ART98-SW-1 8 + Ife brown, T4= SUWAN- 1-SR

+ Ife brown, T5= DMR-LSR-Y, T6= Sole ILE-OB, T7= Sole ART-98-SW-6-SR-W, T7, T8 Sole SUWAN-1-SR-Y

Chlorophyll determination: Chlorophyll was determined four weeks after planting. This was carried out by incubating 1.0g of fresh maize leaves in 15mL of 96% (v/v) ethanol in a water bath for 3 h at a temperature of 79.8°C until complete discolorations of samples. The absorbance of chlorophylls a and b was measured at 665 and 649 nm, respectively. Total chlorophyll was determined according to Wintermans and Mots (1965) in equations 1.

$$Chl\ (a+b) = (6.10 \times A665 \times 20.04 \times A649) \times 15 / 1000 / F.W\ (mg/g\ F.W) \quad (1)$$

Data collection: Data on growth and yield components were collected on five tagged plants from each plot fortnightly after seedling establishment. These include; chlorophyll concentration, plant height, leaf area and stem girth which were collected on the field (before harvesting) while 1000 seed weight, cob weight, cob length, number of grains/cob and total grains weight (t/ha) were obtained after harvest and drying at 12.0 % moisture level.

Data analysis: Data collected were analyzed by analysis of variance (ANOVA). The means from the analysis of variance were separated using the Duncan's multiple range tests (DMRT) at $P<0.05$ confidence level (Duncan, 1995).

RESULTS AND DISCUSSION

Soil Analysis: The results of analysis of chemical and physical properties of the soil used for the experiment showed that the soil was sandy loam in texture for both locations with pH of 6.0 and 6.10 respectively. The soil was low in essential nutrients like Nitrogen (0.10 and 0.13%*),* Phosphorus *(*0.52 and 0.56 Cmol/kg*)*, Potassium (3.13 and 3.5 ppm) and Magnesium (0.54 and 0.65 Cmol/kg at both locations. The soil was also low in Organic carbon (Table 1).

Table 1: Pre-cropping soil chemical and physical properties of the soil used.

Parameters	Ibadan	Ilora
pH (H_2o)	6.00	6.20
N%	0.10	0.13
P (ppm)	3.13	3.51
Org.C (%)	0.54	6.43
Exchangeable K(cmol/kg)	0.52	0.56
Exchangeable ca (cmol/kg)	4.13	3.00
Exchangeable Na(cmol/kg)	0.37	0.22
Exchangeable Mg(cmol/kg)	0.54	0.50
Sand (%)	75.5	81.20
Silt (%)	15.9	10.70
Clay (%)	10.1	8.10

Effect of planting pattern on maize growth and yield in intercropped with cowpea at Ibadan and Ilora. Maize plants grown with wider spacing (1.0 x 0.5 m) exhibited the tallest heights at both locations, measuring 113.30 cm and 33.31 cm, respectively. A similar pattern was observed for leaf area formation, where maize plants grown with wider spacing showed a significantly higher mean value (351.00 cm^2 and 340.5 cm^2) compared to those grown with closer spacing at Ibadan and Ilora, respectively. In contrast to the findings regarding plant height and leaf area, where wider spacing was shown to be more effective than closer spacing (0.9 m x 0.4 m), maize grown on closer spacing at Ibadan exhibited a higher stem girth. However, this difference in stem girth between the two spacing treatments was not found to be statistically significant. Regardless of the plant spacing, maize grown at Ilora exhibited taller plants, better leaf area development, and larger stem girth. Wider spacing proves effective than closer spacing in all yield parameters across the locations. Maize grown with a spacing of 1.0 x 0.5 m resulted in seeds and cobs with higher weights compared to maize grown with closer spacing (0.9 x 0.4 m) at both locations. However, the weight of the seeds and cobs was significantly higher at Ilora than at Ibadan. No significant difference was observed in husk weight of maize grown at both locations irrespective of spacing (Table 3). Maize cobs were longer in maize grown at wider spacing at both locations (17.26 and 17.13 cm) compared to closer spacing (16.03 and 15.77 cm). The length of maize cobs in Ilora is significantly higher at Ilora compared to Ibadan. Number of grain/cobs was similarly higher at Ilora with maize grown at wider spacing having the highest number of cobs than maize grown at closer spacing. For the chlorophyll (biochemical component) formation, maize planted at wider plant spacing (1.54 and 1.98) produced leaf with higher chlorophyll concentration compared to closer spacing (1.70 and 1.91) at Ibadan and Ilora respectively (Table 2).

No significant difference was observed between root fresh weight of maize planted at both spacing at both locations, closer spacing had the highest root fresh weight (206.32 g) at Ibadan than the wider spacing (193.33 g) whereas, wider spacing had the highest root fresh weight (212.18 g) than closer spacing (203.73 g) at Ilora. Intercropping cowpea with maize had significant effect on maize parameters. SUWAN- 1-SR -Y maize variety intercropped with cowpea (Ife brown) had the tallest maize plant at both locations. The height of SUWAN- 1-SR-Y intercropped was significantly higher compared to other treatments even to the sole maize planted at the two locations. Among maize intercropped, DMR-LSR-Y variety had the shortest plant. Sole SUWAN- 1-SR -Y variety performed better compared to other treatments when intercropped and when was planted solely at both locations (Table 2).

At Ibadan, leaf area formation was high in all maize varieties intercropped with Ife brown with the highest leaf area formation in SUWAN-1-SR-Y variety intercropped with cowpea (474.32 cm^2). This was followed by ART-98-SW-6-SR-W intercropped with cowpea (455.74 $cm^{2)}$ and ILE-OB intercropped (411.90 cm^2). Similar to what was observed for plant height, DMR-LSR-Y had the least leaf area formation among all maize varieties intercropped. Same trend was also observed for all the growth parameters at Ilora. The leaf chlorophyll formation was higher in SUWAN-1-SR-Y maize variety intercropped with Ife brown at both locations. All maize varieties intercropped had significant higher chlorophyll formation compared to maize varieties planted solely (Table 2). Intercropping of cowpea with maize provides a range of benefits that positively influence maize performance. This is evidence from the results from maize growth, yield and photosynthetic pigment obtained. Among the intercropped maize varieties, SUWAN-1-SR-Y (Local variety) exhibited the highest performance when intercropped with cowpea. This was followed by ART-98-SW6-SR-W+ Ife brown (QPM), ILE-OB+ Ife brown (HPM popularly known as Oloyin), and the least performing variety was DMR-LSR-Y+ Ife brown. However, regardless of the maize varieties planted, the intercropped plots that included both maize and cowpea consistently exhibited higher maize leaf area compared to the sole cropping of maize. This can be attributed to the distinct canopy architectures of the two crops. Maize typically exhibits an upright growth habit, while cowpea tends to spread or climb. When intercropped, these crops occupy different vertical and horizontal positions, effectively utilizing available sunlight and resources in a complementary manner (Richardson *et al*., 2009). The spreading nature of cowpea serves to cover the ground, reducing weed competition and creating an advantageous microclimate for maize growth. Consequently, the maize plants can allocate more energy towards leaf production, resulting in a greater leaf area and dry matter accumulation obtained from the study in both locations. Similarly, the height of maize plants in the intercropping system was observed to be greater than that in the sole maize system. This can be attributed to the competition among associated crops for intercepted light intensity. When multiple crops are grown together in an intercropping system, they compete for available sunlight. As a result, the maize plants in the intercropping system respond to this competition by increasing their height in order to access more sunlight and capture a greater amount of light energy for photosynthesis. This height increased in maize plants in plots intercropped with cowpea is a mechanism to maximize light interception and maintain their competitive advantage within the intercropped system (Refay, *et al*., 2013). The highest 100 seed, cob and husk weight was observed in SUWAN-1-SR -Y variety intercropped with cowpea at both locations. This was followed by ART-98-SW-6-SR-W, ILE-OB and DMR-LSR-Y intercropped with cowpea respectively. The sole SUWAN- 1-SR -Y variety had significant higher weights (cob, husk and 100 weight) compared to other varieties solely planted. Similarly, higher number of grain/cob and cob length was observed in SUWAN-1-SR-Y maize variety intercropped. The length of cobs in SUWAN-1-SR-Y maize intercropped with cowpea were longer compared to other treatments across the locations (Table 3). The highest grain yield of intercropped maize with cowpea can be attributed to several factors, including the highest values for cob weight, number of grains per cob, cob length and 100grain weight. These yield components play a crucial role in increasing the overall grain yield compared to sole maize cultivation (Essien *et al*., 2015). Intercropping systems create a more favorable growing environment that can positively impact yield components (Zhang *et al.,* 2013). When maize is intercropped with other crops, such as cowpea, the interaction between the crops can result in improved cob weight (Legwaila *et al*., 2012). The presence of cowpea in the intercropping system can enhance nutrient availability and soil fertility, leading to healthier maize plants with larger cobs. The shared resources and interactions between the crops can promote optimal nutrient uptake and utilization, contributing to an increase in cob weight. Moreover, intercropping can enhance pollination efficiency and increase the number of grains per row. The presence of cowpea plants can attract more pollinators (Dingha *et al*., 2021), leading to improved pollination in maize. This results in a higher rate of successful fertilization, which in turn leads to a greater number of grains per row. Additionally, the intercropped system can influence the 100grain weight, which is an important determinant of grain yield. The combined effects of improved nutrient availability and optimized resource utilization in the intercropped maize plants can contribute to larger and heavier grains, ultimately increasing the 100grain weight. By achieving higher values for cob weight, number of grains per row, and 100grain weight, the intercropped maize plants exhibit superior yield components compared to sole maize. These factors collectively contribute to the highest grain yield observed in the intercropped system, highlighting the benefits of intercropping for maximizing maize productivity. From this experiment, it has shown that plant spacing plays a significant role in intercropping systems and can influence the performance and productivity of intercropped plants. The study conducted at two locations revealed that wider spacing (1.0 x 0.5 m) between maize plants was found to be more effective compared to closer spacing (0.9 x 0.4 m).

This observation can be attributed to the fact that wider spacing allows individual plants to have increased access to sunlight, which is crucial for photosynthesis, plant growth, and leaf development (Ibeawuchi *et al.,* 2008). This result is in agreement with Ngala et al. (2013) which reported that wider row spacing showed more potential to realize high seed yield than the closest spacing. With wider spacing, plants have the opportunity to expand their canopies and capture sunlight from various angles, leading to enhanced photosynthetic activity and consequently, higher chlorophyll content in maize leaves as shown in the study. As a result, the maize plants exhibit increased height and larger leaf areas, thereby maximizing their capacity for energy production and overall growth (Muoneke and Mbah, 2007). This is substantiated by the observation of higher chlorophyll content values in plots with wider plant spacing in comparison to those with closer spacing.

Table 2: Effect of planting pattern on maize growth in intercropped with cowpea at Ibadan and Ilora.

Growth Parameters								
	PH (cm) @maturity		LA(cm^2)@ maturity		Chlorophyll content		SG @ maturity	
Treatments	Ibadan	Ilora	Ibadan	Ilora	Ibadan	Ilora	Ibadan	Ilora
Planting pattern								
1.0 x 0.5 m	113.30a	133.31a	351.00a	340.50a	1.84a	1.98a	28.41a	35.90a
0.9 x 0.4 m	104.11b	120.08a	332.28b	270.50b	1.70b	1.91a	26.67a	49.5a
Maize varieties intercropped								
DMR-LSR-Y + Ife brown	105.31bc	110.72ab	310.5c	318	1.88c	1.99c	23.22c	31.7a
ILE-1-OB + Ife brown	112.32b	115.00ab	41.90d	418c	1.95c	2.22b	27.28bc	28.00b
ART98-SW-1 8 + Ife brown	112.22b	228.60a	455.74a	466b	2.10b	2.37ab	29.65b	30.5b
SUWAN- 1-SR + Ife brown	131.38a	137.90ab	474.1a	488a	2.29a	2.43a	35.27a	37.10a
Sole DMR-LSR-Y	92.20d	95.54b	234.81d	244d	1.31g	1.43e	23.61c	25.60b
Sole ILE-1-OB	99.10cd	101.81ab	270.33cd	279d	1.44f	1.54de	27.18bc	28.30b
Sole ART98-SW-1 8	103.31bcd	107.63ab	273.75c	223d	1.62e	1.69d	24.98bc	25.90b
Sole SUWAN- 1-SR	113.81b	116.34ab	302.16c	208d	1.77d	1.87c	27.16bc	26.00b
S.E+	1.91	14.09	11.69	403.63	0.04	0.05	0.68	0.78

Means followed by the same letter within a column are not significantly different according to DMRT at P=0.05; PH= Plant height, L.A= Leaf area, S.G=Stem girth, S.E= Standard error

Table 3: Effect of planting pattern on maize yield traits in intercropped with cowpea at Ibadan and Ilora.

Yield Components												
	100 SW(g)		CW (g)		HW (g)		CL (cm)		GRAIN/COB		Yield (t ha^{-1})	
Treatments	Ibadan	Ilora	Ibadan	Ilora	Ibadan	Ilora	Ibadan	Ilora	Ibadan	Ilora	Ibadan	Ilora
Planting pattern												
1.0 x 0.5 m	94.34a	96.86a	926.10a	797.65a	201.12a	206.84a	17.26a	17.13a	270.07a	268.47a	2.76a	2.85a
0.9 x 0.4 m	77.29b	78.31b	701.30b	717.91b	201.36a	206.69a	16.02b	15.77b	260.28b	257.44a	2.65b	2.71b
Maize + Cowpea intercropped												
DMR-LSR-Y + Ife brown	73.38c	74.38cd	724.0a	733.71d	182.51b	190.23b	16.96bc	17.04bc	281.38b	277.04b	2.55d	2.68de
ILE-1-OB + Ife brown	92.96b	93.96bc	949.0	837.99c	197.25b	202.45b	17.17bc	17.08bc	275.38b	273.15b	2.86bc	2.90bc
ART98-SW-18 + Ife brown	109.7b	112.35b	949.0a	968.68b	204.51b	209.83a	18.80b	18.26b	291.63b	285.50b	2.99b	3.03b
SUWAN-1-SR + Ife brown	150.10a	154.41a	1048.8a	1084.73a	280.61a	279.83a	23.47a	22.65a	328.53a	228.23a	3.38a	3.47a
Sole DMR-LSR-Y	60.71d	62.83d	1122.3a	577.94e	178.06b	185.64b	11.68f	14.73dde	235.95cd	237.93cd	2.22e	2.34f
Sole ILE-1-OB	60.57d	62.08d	550.1a	559.58e	179.55b	193.84b	14.92de	14.72de	221.01d	220.35d	2.49d	2.60de
Sole ART98-SW-1 8	67.37d	70.24cd	556.1a	563.86e	187.21b	193.84b	14.07e	13.75ef	225.85d	223.55d	2.43d	2.49ef
Sole SUWAN-1-SR	72.60cd	74.49cd	724.1a	559.58e	200.26b	205.13b	16.07cd	16.10de	261.73bc	257.93b	2.72c	2.78cd
S.E+	4.78	4.9	70.89	25.61		4.76		0.44		5.58		0.04

Means followed by the same letter within a column are not significantly different according to DMRT at P=0.05. S.E: Standard error. CW= Cob weight, SW= Seed weight, HW= Husk weight, CL=Cob length.

In contrast, closer spacing results in more intense competition among intercropped plants for limited soil nutrients and water resources (Rusinamhodzi *et al*., 2012). This heightened competition can lead to reduced availability of nutrients and water for individual plants, limiting their growth potential. On the other hand, wider spacing provides plants with greater access to these essential resources, minimizing competition and facilitating more efficient nutrient uptake and water absorption (Li *et al*., 2011). The improved availability of nutrients and water promotes plant growth, resulting in taller plants with larger leaf areas. Therefore, the wider spacing between maize plants not only allows for increased sunlight exposure but also reduces competition for soil nutrients and water, leading to improved plant growth and leaf development (Lithourgidis *et al.,* 2011). Significant increases in dry matter accumulation across the maize-cowpea intercrop densities were observed, implying that intercropping and increasing plant densities increases both shoot and root dry matter accumulation of maize (Miyazawa *et al*., 2010). Root dry matter content was low in sole plot and in closer plot and higher in intercropped and wider spacing. This finding, contradicts a previous study by Ebwongu *et al.* (2001), where reduction in potato tuber dry matter accumulation due to intercropping was reported.

Table 4: Effect of planting pattern on maize dry matter content in intercropped with cowpea at Ibadan and Ilora.

DRY MATTER ACCUMULATION								
	SFW(g)		**SDW (g)**		**RFW (g)**		**RDW(g)**	
Treatments	**Ibadan**	**Ilora**	**Ibadan**	**Ilora**	**Ibadan**	**Ilora**	**Ibadan**	**Ilora**
Planting pattern								
1.0 x 0.5 m	1726.57a	2468.60a	453.42b	491.42a	193.33a	212.18a	58.29a	58.96a
0.9 x 0.4 m	1618.23a	1771.80a	486.60a	451.44a	206.32a	203.73a	54.66b	56.64a
Maize and Cowpea intercropped								
DMR-LSR-Y + Ife brown	1626.20cd	2574.00b	529.09c	542.13c	214.91bc	218.86c	59.66b	60.33bc
ILE-1-OB + Ife brown	1797.10c	1856b	604.01bc	609.01bc	208.15c	236.15bc	59.25bc	63.87ab
ART98-SW-1 8 + Ife brown	2050.4b	2113.00b	650.53b	651.31b	244.34ab	251.71ab	62.98ab	66.88ab
SUWAN- 1-SR + Ife brown	2515.10a	3426.00a	769.40a	771.91a	261.65a	267.38a	65.00ab	68.88a
Sole DMR-LSR-Y	1288.80e	2787.00b	293.63d	304.30d	157.53d	167.16dc	68.11a	48.27e
Sole ILE-1-OB	1310.20e	1363.00c	284.16d	291.26d	162.03d	163.43e	46.60e	46.36e
Sole ART98-SW-1 8	1366.50e	1397.00c	288.00d	296.85d	181.40cd	186.92d	44.88e	51.81de
Sole SUWAN- 1-SR	1423.80de	1446.00c	341.91d	304.66d	168.64d	172.02de	49.66de	56.18cd
S.E+	56.65	279.89	24.51	25	5.94	5.32	1.31	1.30

Means followed by the same letter within a column are not significantly different according to DMRT at P=0.05. SFW: Shoot fresh weight, SDW: Shoot dry weight, RFW: Root fresh weight RDW: Root dry weight

Conclusion: The findings of this study demonstrate that both plant spacing and intercropping with cowpea (*Vigna unguiculata*) have a notable impact on the performance of maize. The results obtained indicate that intercropping maize with cowpea at wider plant spacing (1.0x 0.5m) resulted in superior growth performance of maize compared to closer spacing (0.9x 0.4m).

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