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Influence of Fungicides and Fungicide Spray Regimes on Vegetative Growth and Yield of Three Cultivars of Cocoyam (*Colocasia esculenta* L.) in Early and Late Planting Seasons in Nsukka Derived Savanna

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Field trials were conducted at the Teaching and Research Farm of the Department of Crop Science, University of Nigeria, Nsukka during early planting season (April - November) and late planting season (July – December) in 2013 to determine the impact of fungicides and fungicide spray intervals on vegetative growth and yield of three cultivars of taro ("Nachi", "Ugwuta" and "Odogolo") in early planting and late planting season respectively in Nsukka derived savanna. The experimental design was a 3 x 3 x 5 factorial trial in a randomized complete block design (RCBD) with three replications. The treatments consist of three cultivars of taro ("Nachi", "Ugwuta" and "Odogolo"),

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three fungicides treatments [(Ridomi lGold 66WP plus; active ingredient (a.i) 6% metalaxyl and 60% copper, Ridomil Gold 66WP plus + Champ DP; (a.i) copper hydroxide 50%:50% mixture $^{w}/_{w}$ and no fungicide (control)] and five fungicide spray regimes (no spray, 1 weekly spray, 2 weekly spray, 3 weekly spray and 4 weekly spray) in all treatment combinations (forty-five treatment combinations). The Result showed that "Odogolo" had the tallest height at 60 days after planting (34.54 cm), 90 days after planting (79.63 cm), 120 days after planting (81.44 cm) and 150 days after planting (63.81 cm) than the other cultivars when sprayed with Ridomil Gold 66WP plus at one weekly interval in the early planting season."Nachi"(12.13) and "Odogolo" (11.95) had the highest number of leaves at 120 days after planting and at 150 days after planting at one weekly spray interval in the late and early planting season respectively."Ugwuta" had the highest percentage establishment at 15 days after planting (65.56%) and 30 days after planting (81.56%) in the late planting season. "Odogolo" had the widest corm diameter with a value of 6.63 cm, number of cormel per stand (16.20), weight of cormel per stand (0.31 kg plant^{-1}), weight of corm per stand (0.81 kg plant^{-1}), weight of cormel per hectare (12228 kg ha^{-1}), weight of corm per hectare (7297 kg ha^{-1}), total tuber yield per stand (0.49 kg ha^{-1}) and total tuber yield per hectare (19524 kg ha^{-1}) than the other cultivars when sprayed with Ridomil Gold66WP plus at one week interval in the early planting season at harvest. The use of Ridomil Gold66WP plus; active ingredient (a.i) 6% metalaxyl at one weekly spray regime is recommended. "Odogolo" cultivar and early season planting proved to be the most promising technology for the cultivation of taro in Nsukka agro-ecology.

Keywords: Fungicides; spray regimes; seasons; cocoyam; vegetative growth; yield.

1. INTRODUCTION

Cocoyam belongs to a group of crop called roots and tubers. Root and tubers are the major carbohydrate staples in most countries of West Africa. In Nigeria, it is estimated that 31 million tons of root and tubers such as cassava, yam, sweet potatoes and cocoyam are produced annually [1]. Cocoyam occurs in different varieties, but the major and commonly grown cultivars are *Colocasia esculenta* (Taro) and *Xanthosoma sagittifolium* (Tannia). It is also cultivated for human nutrition, cash crop and as animal feed [2]. As food for humans, its nutritional value is superior when compared to cassava and yam in terms of digestibility, crude protein content, essential minerals and vitamins, providing magnesium, calcium and phosphorus for building up human protoplasm [3]. Taro (*Colocasia*) is a good source of potassium. The leaves of taro when cooked is eaten as vegetable, It contains β- carotene, iron and folic acid which protects humans against anemia [4].

In recent years, there has been a serious destruction of cocoyam by fungal disease known as leaf blight caused by *Phytophthora colocasiae* [5,6,7]. This pathogen occurs mostly during continuous rain with little seasonal variation and daily temperatures of 25 -28℃ (Trujilo, 1965 and [6]). Cocoyams are mostly cultivated in later part of late season of the year in Nsukka region after early yam, maize, yellow pepper, cassava and garden eggs [9]. [10] reported that cocoyam should be planted at the onset of rains so that they can utilize the entire rainy season for proper growth and development. Early planting of cocoyam (April - June) has been reported in order to control leaf blight and improve growth and yield in the field [5]. [7] in a field trial reported that fungicides like Nordox and Kocide were effective in controlling taro leaf blight and boosting growth and yield of taro. A range of protestants and systemic fungicides have been found to provide effective control to taro leaf blight [11]. However, [12] reported that Mancozeb, did not control the disease in Solomon Islands suggesting that the result with fungicides treatments can be variable. [13] stated that the efficacy of fungicide is strongly controlled by the severity of the disease at the time of spray and the prevailing weather conditions. Fungicides are most effective when disease inoculum are low and regular spray reduces inoculums levels which would improve growth and yield [6,5].

There is paucity of information on the impact of fungicides and fungicide spray intervals on vegetative growth and yield of three cultivars of taro ("Nachi", "Odogolo" and "Ugwuta") in early (April - November) and late (July - December) planting season respectively in Nsukka derived savanna. Thus, the specific objectives of this study were:

(i) To determine the fungicide and fungicide spray regime that will improve the vegetative growth and yield of three

cultivars of cocoyam (*Colocasia esculenta* L.).

(ii) To obtain the best cultivar of taro and planting season for the cultivation of cocoyam in Nsukka, derived savanna, South East Nigeria.

2. MATERIALS AND METHODS

2.1 Description of the Experimental Site

Field trials were conducted at the Teaching and Research Farm of the Department of Crop Science, University of Nigeria, Nsukka during early planting season (April - November) and late planting season (July – December) in 2013. Nsukka is located in the derived savanna region of Nigeria (latitude 06°54'N, longitude 07°24'E and 477.26 meter above sea level. The area is characterized by humid tropical climate with wet season (April – October) and dry season (November – March). The rainfall pattern is bimodal with peaks in July and September and a short dry period around mid August (August breaks). The mean annual rainfall is 1500 – 1900 mm with a mean annual temperature of 25 – 29°C [14]. The soil belongs to ultisol with well drained sandy clay loam [15].

2.2 Experimental Design and Field Operations

The experimental design was a 3 x 3 x 5 factorial trial in a randomized complete block design (RCBD) with three replications. The treatments consist of three cultivars (Fig. 1i - iii) of taro ("Nachi", "Ugwuta" and "Odogolo"), three fungicides treatments (Ridomi lGold 66WP plus; active ingredient (a.i) 6% metalaxyl and 60% copper, Ridomil Gold 66WP plus + Champ DP;(a.i) copper hydroxide 50%:50% mixture $^{w}/_{w}$and no fungicide (control)and five fungicide spray regimes (no spray, 1 weekly spray, 2 weekly spray, 3 weekly spray and 4 weekly spray) in all treatment combinations (forty-five treatment combinations). The cultivars of taro were obtained from Opi - Nsukka, in the study area. The land was cleared of grasses, ploughed, harrowed and made into crest of mounds with hoe. Prior to mound making, 15 t ha^{-1} of well cured poultry manure was broadcasted and incorporated into the soil before mounding. A total land area measuring 53 m x 29 m (1537 m^2) was used in each planting season. Three blocks measuring 53 m x 9 m (477 m^2) separated by one meter apart each were divided into nine sub-plots of size 5 m x 9 m and separated by one meter pathway. Each plot was made into five rows crest of mounds manually with hoes at an intra and inter row spacing of 0.5 m x 0.5 m separated by one meter apart to check for chemical drift.

The fungicide application was done by the use of 50 g per 16 liters knap sacker sprayer at the rate of 2.5 kg a.i per hectare. Spraying of fungicides was done early in the morning hours when wind action was calm and at the stipulated weeks. Cocoyam cormels (average weight of 25 – 35 g $cormel^{-1}$) was sown at a depth of 5 cm in the soil. The plant population of 100 stands per plot (40, 000 stand per hectare) was used. Weeds were manually controlled with hoe and hand-picking whenever necessary. The second dose of poultry manure (15 t ha^{-1}) was applied at seven weeks after planting, followed immediately by re-mounding at eight weeks after planting. The cormels and corns were harvested manually with hoe at full maturity in November and December for early and late planting season, respectively. Five plants at the center row were sampled during data collection.

2.3 Soil Sample Collection and Analysis

Three representative soil samples were randomly collected from each plot and bulked together to

i ii iii

Fig. 1i-iii. Cultivars of taro

form a composite sample per plot. Soil samples were collected from the top soil at a depth of 0 - 30 cm before planting in both planting seasons (early and late planting season) respectively.

Samples were air dried, ground and passed through a sieve of 2 mm standard mesh size. The soil pH was determined with a pH meter using 1:2.5 soil to water ratio and 1: 2.5 soil to 0.1 N KCl (potassium chloride) suspension according to [16]. Organic carbon was determined using the Walkley and Black wet digestion method [17]. Soil organic matter content was obtained by multiplying the value of organic carbon by 1.724 (Van Bemmeler factor). Total nitrogen was determined by micro-kjeldahl procedure [16]. Available phosphorus was extracted with Bray II extractant as described [18] and determined colorimeterically using ascorbic acid method [19]. Exchangeable potassium was extracted using 1 N ammonium acetate (NH_4OAC) solution and determined by the flame emission spectroscopy as outlined by [20]. Aluminum and Hydrogen content (exchangeable acidity) were determined by titrimetric method after extraction with 1.0 N KCl [21]. The cation exchange capacity was determined by NH_4OAC displacement method [22]. Calcium and magnesium were determined by the complexiometeric titration method as described by [23]. Particle size distribution analysis was done by the hydrometer method [24] and the corresponding textural class determined from the United States Department of Agriculture Soil Textural Triangle. Base saturation was determined by the method outline by [16].

2.4 Agro-metrological Data

Weather information in 2013 cropping year was obtained from the Faculty of Agriculture Meteorological Station, University of Nigeria, Nsukka.

2.5 Data Collection

Percentage establishment was determined by counting the number of emerged cormels per plot over the total number of cormels planted multiplied by 100 at 15 days and 30 days after planting, plant height per plant was obtained by measuring the plant height of the individual sampled stand from the ground base to the topmost growing tip with a meter rule and recorded in centimeter, number of leaves per stand was determined by visual counting of the number of leaves in individual tagged stands per plot at 30, 60, 90, 120, 150 days after planting, number of cormels per stand was determined by counting the number of cormels from the sampled plants, cormels weight per stand and corm weight per stand was determined by weighing the cormels and corm harvested from each of the sampled stand and expressed in kilograms, corm diameter per plant was determined by measuring the diameter of each corm from selected stands by using 12.5 cm vernier calliper, total tuber weight per stand was obtained by weighing all the corms and cormels from each sampled stand with a weighing balance and expressed in kilograms. Corm and Cormels weight per hectare was extrapolated by from the sampled plants from each of the plots. Total tuber yield per hectare was measured by taken the weight of all corm and cormels from the sampled stands and equate to hectare.

2.6 Data Analysis

Data collected were subjected to analysis of variance (ANOVA) as outlined by [25]. Significant means were separated using Fishers' least significant difference (F-LSD) at 5% probability level. Statistical analysis was executed using [26].

3. RESULTS AND DISCUSSION

3.1 Meteorological Data

A summary of the meteorological data comprising, total monthly rainfall, rain days, relative humidity (10 a.m. and 6 p.m.) and temperatures (minimum and maximum values) of the experimental site in 2013 are presented in Table 1. Total rainfall amount received during the period (January to December) was 1537.28 mm with 101 rain days and the mean was 128.10 mm for the year. Rain fell more frequently in the months of July and September. July had the highest amount of rainfall (283.96 mm) with 19 rain days. On the other hand, the mean minimum and maximum temperatures were 21.14℃ and 29.54℃ for the year. The results also show that the mean monthly relative humidity at 10 a.m. and 4 p.m. were 74.67% and 72.64% respectively for the year.

3.2 Soil Sample Characteristics before Planting in Early and Late Planting Season

The data shown in Table 2 indicated that the soil of the study area before planting was acidic (pH

4.9 in early planting season and 5.4 in late planting season). The soil textural class was sandy clayey loam in early planting season and loamy sandy in late planting season, which contained 41% (early planting season) and 69% (late planting season) coarse sand, 21% (early planting season) and 16% (late planting season) fine sand, 24% (early planting season) and 8% (late planting season) clay and 14% (early planting season) and 7% (late planting season) silt. The organic carbon content was found to be 1.75% (early planting season) and 1.09% (late planting season), organic matter content was 3.017% (early planting season) and 1.879% (late planting season) and total nitrogen contents were 0.252% (early planting season) and 0.252% (late planting season). The exchangeable base [sodium 0.127 meg/100 g soil (early planting season) and 0.08 meg/100 g soil (late planting season), potassium 0.17 meg/100 g soil (early planting season) and 0.16 meg/100 g soil (late planting season) calcium 1.20 meg/100 g soil (early planting season) and 2.20 meg/100 g soil (late planting season) and magnesium 0.60 meg/100 g soil (early planting season) and 0.80 meg/100 g soil (late planting season).] The cation exchange capacity of the soil was 14.00 meg/100 g soil (early planting season) and 8.0 meg/100 g soil (late planting season) for the base saturation 14.98% (early planting season) and 41% (late planting season). The hydrogen 0.60 meg/100 g soil (early planting season) and 2.60 meg/100 g soil (late planting season) and aluminum content was found to be 1.00 meg/100 g soil (early planting season) and was undetected in late planting season and available phosphorus (Bray 11) was found to be 9.38 parts per million (early planting season) and 9.87 parts per million (late planting season).

3.3 Main Effects of Fungicide Treatment, Fungicide Spray Regime, Cultivar and Season on the Vegetative Growth of Three Cultivars of Cocoyam (*Colocasia esculenta* L.)

The results presented in Table 3, showed that "Odogolo" had the tallest height at 60 days after planting (34.54 cm), 90 days after planting (79.63 cm), 120 days after planting (81.44 cm) and 150 days after planting (63.81 cm) than the other cultivars when sprayed with Ridomil Gold66WP plus at one week interval in the early planting season expect "Ugwuta" whose height (20.00 cm) was the tallest at 30 days after planting.

More so, "Ugwuta" had more number of leaves at 30 days after planting (4.30), 60 days after planting (5.85) and 90 days after planting (11.38) than the other cultivars when sprayed with Ridomil Gold 66WP plus at two weekly interval in the early planting season expect at 90 days which was higher in one weekly spray regime and late planting season. "Nachi" (12.13) and "Odogolo" (11.95) had the highest number of leaves at 120 days after planting and at 150 days after planting at one weekly spray interval in the late and early planting season respectively (Table 3).

Table 1. The Total rainfall amount (mm), Rain days, Mean temperature (℃) and Mean relative humidity (%) of the experimental site in 2013

Month	Total rainfall (mm)	Rain day	Mean temperature(°C)		Relative humidity (%)	
			Mini	Max	10 a.m.	4 p.m.
January	21.84	2.00	20.55	31.23	75.00	75.00
February	0.00	0.00	22.18	32.86	75.00	75.00
March	38.10	5.00	22.58	32.81	72.74	62.94
April	183.81	10.00	22.30	30.67	74.00	68.90
May	198.63	11.00	21.61	29.52	74.77	69.87
June	168.60	11.00	21.17	28.67	75.67	72.70
July	283.96	19.00	20.71	27.35	74.90	73.61
August	219.18	12.00	20.26	26.61	76.13	76.16
September	197.60	16.00	20.50	27.43	77.00	77.00
October	167.90	11.00	20.74	28.55	77.00	77.00
November	41.91	2.00	21.70	30.37	77.00	77.00
December	15.75	2.00	19.39	29.35	66.77	66.03
Total	**1537.28**	**101.00**	**253.69**	**354.42**	**895.98**	**871.66**
Mean	**128.10**	**8.42**	**21.14**	**29.54**	**74.67**	**72.64**

Source: University of Nigeria, Nsukka, Metrological Centre

Table 2. Soil characteristics before planting in early and late planting season

Properties	Early planting site	Late planting site
Particle size distribution (%)		
Clay	24	8
Silt	14	7
Fine sand	21	16
Coarse sand	41	69
Textural class	Sandy Clay Loam	Loamy Sandy
Chemical properties		
pH (H_2O)	49	5.4
pH (KCl)	1.01	0.63
Organic carbon (%)	1.75	1.09
Organic matter (%)	1.75	1.09
Total nitrogen (%)	0.252	0.252
Exchangeable bases (Meq/100 g Soil)		
Sodium (Na^+)	0.127	0.08
Potassium (K^+)	0.17	0.16
Calcium (Ca^{2+})	1.20	2.20
Magnesium (Mg^{2+})	0.60	0.80
Cation exchange capability (Meq/100 g Soil)	14.00	8.00
Base Saturation (%)	14.98	41.50
Phosphorus (ppm)	9.38	9.87
Exchangeable acidity (Meq/100 g soil)		
Aluminum oxide (AL^{3+})	1.00	-
Hydrogen oxide (H^+)	0.60	2.60

- Not detected

Furthermore, Table 3, revealed that "Ugwuta" had the highest percentage establishment at 15 days after planting (65.56%) and 30 days after planting (81.56%) in the late planting season. Variation among the cultivars on vegetative growth parameters could be attributed to inherent cultivar differences and weather factors which varied across the planting seasons (early and late planting season). This outcome was in agreement with the reports of [27,28] who reported varietals differences among the cultivars on growth traits.

3.4 Main Effects of Fungicide Treatment, Fungicide Spray Regime, Cultivar and Season on the Yield of Three Cultivars of Cocoyam (*Colocasia esculenta* L.)

The data in Table 4, indicated that "Odogolo" had the widest corm diameter with a value of 6.63 cm, number of cormel per stand (16.20), weight of cormel per stand (0.31 kg $plant^{-1}$), weight of corm per stand (0.81 kg $plant^{-1}$), weight of cormel per hectare (12228 kg ha^{-1}), weight of corm per hectare (7297 kg ha^{-1}), total tuber yield per stand (0.49 kg ha^{-1}) and total tuber yield per hectare (19524 kg ha^{-1}) than the other cultivars when sprayed with Ridomil Gold66WP plus at one week interval in the early planting season at harvest, expect at two weekly spray regime at late planting season where the number of cormel was16.8 which was the highest. The significant variations among the cultivars on yield attributes is due to the differences in the genetic endowment of the cultivars and differences in sowing season weather parameters within a year. [29,30] reported that considerable variations exist both within and between varieties for most characters and the coefficient of variation for genotypes and phenotypes were largest for root and tuber crop yield. This study also agreed with the report by [28] who reported that "Ugwuta" and "Odogolo" in that order produced the highest yields. The differences in the planting seasons can be attributed to the influence of weather factors such as rain and air temperature. The observed less yields recorded in late planting season than early planting season may be due to the short growing periods that prevailed before the onset of dry season. This findings was in support of [10] who stated that cocoyam are mostly planted at the onset of rain so that they can utilize the entire rainy season to develop well under full sunlight intensity within March - June. Further [5] reported that early season planting (early April – June) boosts yield of cocoyam.

Table 3. Main effects of Fungicide Treatment, Fungicide Spray Regime, Cultivar and Season on the Vegetative Growth of Three Cultivars of Taro

Fungicide Treatment (F)	Plant height (cm)					Number of leaves per plant					Percentage establishment	
	30	60	90	120	150	30	60	90	120	150	15	30
	DAP											
Control	18.04	31.91	70.83	64.30	49.32	3.48	4.70.	6.84	9.57	11.01	34.08. (5.39)	7.25 (8.43)
RD+CHP	17.97	32.90	25.90	74.56	53.75	3.32	4.47	9.45	11.14	11.06	340.06(5.43)	75.83 (8.68)
Ridomil	19.50	34.79	79.62	79.10	57.93	3.43	4.62	10.13	12.60	11.27	34.56 (5.50)	72.29 (8.48)
F-LSD $_{(0.05)}$ for any 2 F	0.81	1.11	2.38	2.50	2.96	NS	NS	0.65	0.82	NS	NS	NS
Spray Regime (Sl)												
No spray	17.47	31.14	71.06	64.86	48.40	3.39	4.58	6.9	9.24	10.36	36.30 (5.60)	74.72 (8.61)
1 week	19.92	35.10	79.30	81.06	60.08	3.35	4.56	10.48	13.00	11.84	35.19 (5.54)	70.83 (8.32)
2 weeks	19.11	33.97	77.45	75.80	54.47	3.49	4.67	9.59	12.02	10.84	32.14 (5.25)	72.43 (8.46)
3 weeks	18.27	33.24	75.56	72.72	52.74	3.47	4.67	9.36	11.28	11.17	34.26 (5.43)	75.65 (8.66)
4 weeks	17.76	32.53	73.89	68.84	52.54	3.36	4.51	7.70	9.98	11.36	32.96 (5.38)	74.07 (8.59
F-LSD $_{(0.05)}$ for any 2 SI	1.05	1.43	3.08	3.33	3.82	NS	NS	0.84	1.06	NS	NS	NS
Cultivar (C)												
Nachi	16.75	33.61	79.46	77.52	56.30	3.10	4.11	9.31	12.13	11.41	23.67 (4.72)	79.22 (8.89)
Odogolo	18.76	34.54	79.63	81.44	63.81	2.83	3.84	5.72	9.63	11.95	13.44 (3.50)	59.84 (7.66)
Ugwuta	20.00.	31.44	67.26	59.01	40.89	4.30	5.85	11.38	11.55	9.98	65.57(8.09)	81.56 (9.04)
F-LSD $_{(0.05)}$ for any 2 C	0.81	1.11	2.38	2.50	2.96	0.13	0.16	0.65	0.82	NS	0.25	0.22
Season (S)												
Early	19.36	32.89	78.45	74.55	63.26	3.56	4.87	8.13	9.80	12.76	32.74 (5.10)	67.63 (8.15)
Late	17.65	33.51	72.45	70.70	44.07	3.27	4.33	9.48	12.41	9.47	35.71 (5.77)	79.45 (8.91)
F-LSD $_{(0.05)}$ for any 2 S	0.67	NS	1.95	2.04	2.41	0.11	0.13	0.53	0.67	0.72	0.31	0.18

DAP = Days after planting, RD+CHP -Ridomil Gold 66WP plus + Champ DP 50%:50% mixture w/w, F-LSD$_{(0.05)}$ =Fishers least significant difference at 0.05 probability level, values in parentheses indicate the square root transformed values for which F –LSD value is applicable, NS = Non significant at 0.05 probability level

Table 4. Main effects of Fungicide Treatment, Fungicide Spray Regime, Cultivar and Season on the Yield of Three Cultivars of Taro

Fungicide Treatment (F)	CMD	CMLN	CMLW	CMW	CML/ha	CMW/ha	Tty/Plt	Tty/ha
Control	5.80	8.60	0.20	0.12	8195	4930	0.33	13125
RD+CHP	6.00	10.60	0.29	0.13	11431	5267	0.42	16698
Ridomil	6.21	15.40	0.34	0.15	13524	6131	0.49	19655
F-LSD $_{(0.05)}$ for any 2 F	0.18	NS	0.03	0.01	1233	598	0.04	1636
Spray Regime (SI)								
No spray	5.76	8.70	0.22	0.13	8963	5083	0.35	14046
1 week	6.17	12.10	0.33	0.15	13276	6137	0.49	19413
2 weeks	6.10	16.80	0.29	0.14	11494	5452	0.42	16946
3 weeks	6.00	10.00	0.27	0.13	10792	5190	0.40	15981
4 weeks	5.98	10.10	0.27	0.13	10725	5351	0.40	16077
F-LSD $_{(0.05)}$ for any 2 SI	NS	NS	0.04	NS	1592	NS	0.05	2113
Cultivar (C)								
Nachi	6.10	9.30	0.22	0.12	8821	4940	0.34	13761
Odogolo	6.63	16.20	0.31	0.18	12228	7297	0.49	19524
Ugwuta	5.27	9.10	0.30	0.10	12102	4091	0.40	16193
F-LSD $_{(0.05)}$ for any 2 C	0.18	NS	0.03	0.01	1233	598	0.04	163
Season (S)								
Early	6.21	10.80	0.34	0.15	13633	6012	0.49	19645
Late	5.80	12.30	0.21	0.12	8467	4873	0.33	13340
F-LSD $_{(0.05)}$ for any 2 S	0.15	NS	0.03	NS	1007	488	0.03	1336

RD+CHP- Ridomil Gold 66WP plus + Champ DP 50%:50% mixture w/w, F-LSD$_{(0.05)}$ =Fishers least significant difference at 0.05 probability level, NS = Non significant at 0.05 probability level, CMLN - number of cormel per stand, CMLW - weight of cormel per stand, CMW - corm weight per stand, CMLW/ha - weight of cormel per hectare , CMW/ha - corm weight per hectare, Tty/Plt - total tuber yield per stand, Tty/ha - total tuber yield per hectare

4. CONCLUSION

The vegetative growth and yield traits of three cultivars ("Nachi", "Ugwuta" and "Odogolo") of cocoyam (*Colocasia esculenta* L.) in the early planting season (April - November) and late planting season (July – December) in Nsukka agro-ecology can be improved by the use of fungicide treatments (Ridomil Gold 66WP plus; active ingredient (a.i) 6% metalaxyl and 60% copper and Ridomil Gold66WP plus + Champ DP; (a.i) copper hydroxide 50%:50% mixture $^{w}/_{w}$). The use of Ridomil Gold 66WP plus; active ingredient (a.i) 6% metalaxyl at one weekly spray regime is recommended. "Odogolo" cultivar and early season planting proved to be the most promising technology for the cultivation of taro in Nsukka agro-ecology and other areas with similar climatic conditions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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