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Correlation analysis of tuber yield and yield related characters in two cassava *(Manihot esculenta* Crantz*)* morphological-types grown under nine weed management systems in the Guinea savanna zone of Nigeria

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ABSTRACT

Objective: The interplay of weed management options and temporal environment on correlative responses of two cassava morphotypes were studied with the aim of elucidating growth and yield correlation patterns under weed management and temporal environment.

Methodology and results: The two cassava morphological types 'NR 8082' (short with profuse branching) and 'TMS 30555' (tall and non-branching) were subjected to nine different weed management options in a split plot design replicated three times. Data on weed biomass, cassava growth and yield parameters were subjected to multiple correlation analyses. Results revealed that weed dry matter had significant negative correlation with plant height (r = - 0.975**), plant girth (r = - 0.796**), tuber diameter (r = - 0.841**), tuber weight (r = - 0.929**), and average whole plant biomass yield (r = -0.921**) in 2008 cropping season for the branching cultivar. In 2009, a similar correlative response trend was also obtained, weed dry matter showed highly significant negative correlation with plant height (r = -0.984**), plant girth (r = -0.789**), tuber diameter (r = -0.822**), tuber weight (r = -0.911**), and average whole plant biomass yield (r = -0.901**). For the non-branching cultivar, weed dry matter also demonstrated strong and significant negative relationship with the following growth and yield parameters: plant height (r = --0.910**), plant girth (r = -0.763**), tuber diameter (r = -0.805**), tuber weight (r = -0.864**), and average whole plant biomass yield (r = -0.860**) in 2008. In 2009, the data revealed strong and significant negative relationship between weed dry matter and plant parameters as follows: plant height (r = --0.966**), plant girth (r = -0.772**), tuber diameter (r = -0.898**), tuber weight (r = -0.940**), and average whole plant biomass yield (r = -0.928**).

Conclusion and application: Irrespective of cultivar or cropping year, plant height was significantly and positively correlated with average tuber weight and average whole total plant biomass yield (in most cases, with r-values > 0.90**). The correlative responses obtained for the two cultivars expectedly suggest that weed interference limits genetic productive potentials of the crop. The implication is that weed management strategies will indirectly enhance genetic expression of the cultivar thereby improving yield.

Key words: Cassava morphological-types, correlative responses, weed biomass, tuber yield.

INTRODUCTION

Cassava *(Manihot esculenta)* was introduced in Nigeria by returnee slaves from America (Ikugbayigbe, 1992). It performs well in the country and the nation has become the largest producer globally having overtaken Brazil and Thailand (FAO, 2006). The crop is one of the major crops widely grown in Nigeria for cash, food, raw materials, for the production of starch, alcohol, pharmaceuticals and confectionaries (Francisco, 2004; Onwumere *et al;* 2006). It is consumed in various processed forms such as garri, chips/flour, fermented pastes and starch, among others (Annebunwa *et al*; 1998). According to Claussen (2004), annual production is 38.179 million metric tonnes. The yield of cassava is low owing to supra-optimal temperatures (Chang, 1991), water deficit (Grant *et al;* 1985) and inefficient redistribution of assimilates to the tubers. In cassava, yield is associated with plant girth, tuber diameter and tuber weight. Therefore, before embarking on tuber yield improvement, it is necessary to understand the relationship between tuber yield and the other metric traits of the crop. Correlation refers to a measurement of a mutual association without regard to causation (Dewey, 1959). Both correlation and path coefficient analyses have been studied in maize (Kang *et al.,* 1983), in sorghum (Chiezey and Egharevba, 1987), in winter wheat (Funseca and Patterson, 1968); in plantains and bananas (Baiyeri and Mbah, 1994; Baiyeri et al., 2000 & 2008); and in cassava (James, 1971). Information on such agronomic traits assessment and interrelationship is not available for cassava growers under Anyigba agroecological conditions.
Therefore this study was undertaken to study the differences among two cassava cultivars and the interrelationships among the different characters with the view of improving the productivity of cassava in the sandy loam soils of Anyigba, in Kogi State, Nigeria.

MATERIALS AND METHODS

Two cassava genotypes, branching variety (NR8082) and non-branching variety (TMS 30555) obtained from Ministry of Agriculture (MOA), Lokoja were used in the trial. The field experiments were conducted during 2008 and 2009 cropping seasons at the experimental farm of the Department of Crop Production, Kogi State University, Anyigba at 7^0 29" N and 7^0 11" E. The experiment was laid out as a split plot in randomized complete block design and replicated three times.
Weeds were controlled using two herbicides; primextra and taxastomp. Primextra was applied at 3.0, 3.5 and 4.0 kg a.i/ha while the rates of taxastomp were 2.0, 3.0 and 4.0 kg a.i/ha. Planting was done on 19th May, 2008 and 16th May 2009 on ploughed, harrowed and ridged fields. Cassava cuttings of about 25cm long were planted on the crest of the ridge at 1m x 1m giving 10, 000 plants/ha. The plot size was 5m x 5m ($25m^2$) each containing five ridges. Cuttings were inserted to the soil at an angle of 45^0 such that only about a third of the cutting remains visible above the ground. NPK 12:12:18 compound fertilizer was applied as a band (on both sides of each stand) 8 weeks after planting at the rate of 450kg/ha. Ten (10) cassava stands from the middle row in each plot were used for data collection. Data of weed dry matter, plant stem height, plant girth, length of tuber, tuber diameter and tuber weight were collected. Analysis of variance (ANOVA) using SAS 2002 software was applied on the data. Interdependence analysis was determined with Pearson correlation method.

RESULTS

The branching cassava genotype (NR8082) tuber yield (kg/plant) in 2008 had a highly significant ($P<0.01$) negative correlation with weed biomass and weed dry matter (Table 1). However, it had a highly significant ($P<0.01$) positive correlation with leaf weight, shoot weight, plant height, length of tuber and tuber diameter. Average whole shoot weight also correlated positively with the tuber yield. Plant girth also showed a positive correlation with leaf weight and shoot weight but negatively with weed dry matter. There was a highly significant positive correlation of tuber diameter with plant girth, leaf weight, shoot weight and stem height.
In 2009 cropping season there was a highly significant ($P<0.01$) negative correlation of tuber yield of the branching cultivar with the weed dry matter (Table 2). Tuber yield correlated positively with plant height, shoot weight, leaf weight, plant girth and length of tubers.

Table 1: Correlation Analysis: Branching Cultivar (2008 Cropping Season)

Character	WB	WDM	PSH	SW	LW	PG	ALT	ATD	ATW	AWSW	AWPBY
WB	1.000	0.802**	-0.796**	-0.891**	-0.462*	-0.814**	-0.648**	-0.834**	-0.868**	0.863**	-0.874**
WDM		1.000	-0.975**	-0.771**	-0.554**	-0.796**	-0.652**	-0.841**	-0.929**	-0.836**	-0.921**
PSH			1.000	0.782**	0.560**	0.802**	0.613**	0.861**	0.937**	0.853**	0.931**
SW				1.000	0.524**	0.894**	0.657**	0.932**	0.909**	0.969**	0.925**
LW					1.000	0.577**	0.462*	0.553**	0.572**	0.623**	0.585**
PG						1.000	0.675**	0.957**	0.929**	0.910**	0.933**
ALT							1.000	0.670**	0.708**	0.685**	0.710**
ATD								1.000	0.960**	0.949**	0.966**
ATW									1.000	0.945**	0.999**
AWSW										1.000	0.961**
AWPBY											1.000

*, ** Correlation significant at the 0.05 and 0.01 probability level, respectively
WB: Weed biomass; WDM: Weed dry matter; SW: Stem weight; LW: Leaf weight; PG: Plant girth; ALT: Average length of tuber; ATD: Average tuber diameter; ATW: Average tuber weight; AWSW: Average whole-shoot weight; AWTBY: Average whole-plant biomass yield.

Table 2: Correlation Analysis: Branching Cultivar (2009 Cropping Season)

Character	WB	WDM	PSH	SW	LW	PG	ALT	ATD	ATW	AWSW	AWPBY
WB	1.000	0.805**	-0.810**	-0.922**	-0.731**	-0.861**	-0.699**	-0.897**	-0.861**	-0.925**	-0.877**
WDM		1.000	-0.984**	-0.814**	-0.740**	-0.789**	-0.679**	-0.822**	-0.911**	-0.805**	-0.901**
PSH			1.000	0.820**	0.731**	0.798**	0.657**	0.822**	0.912**	0.811**	0.903**
SW				1.000	0.818**	0.956**	0.735**	0.976**	0.942**	0.976**	0.954**
LW					1.000	0.841**	0.714**	0.857**	0.860**	0.836**	0.862**
PG						1.000	0.736**	0.971**	0.956**	0.966**	0.965**
ALT							1.000	0.770**	0.780**	0.754**	0.781**
ATD								1.000	0.965**	0.969**	0.973**
ATW									1.000	0.946**	0.999**
AWSW										1.000	0.961**
AWPBY											1.000

*, ** Correlation significant at the 0.05 and 0.01 probability level, respectively
WB: Weed biomass; WDM: Weed dry matter; SW: Stem weight; LW: Leaf weight; PG: Plant girth; ALT: Average length of tuber; ATD: Average tuber diameter; ATW: Average tuber weight; AWSW: Average whole-shoot weight; AWTBY: Average whole-plant biomass yield

With respect to the non-branching cultivar in the 2008 cropping season, there was a negative correlation between tuber yield with weed biomass and weed dry matter (Table 3) but with a highly significant (P<0.01) positive correlation with plant height, plant girth, length of tuber and tuber diameter. Tuber yield correlated positively with average whole shoot weight while plant girth correlated positively with leaf weight and shoot weight but negatively with weed dry matter. Tuber diameter of the non-branching cultivar varied positively with plant stem girth, leaf weight and plant height. However, it showed a highly significant (P<0.01) negative correlation with weed biomass and weed dry matter.

Table 3: Correlation Analysis: Non-Branching Cultivar (2008 Cropping Season)

Character	WB	WDM	PSH	SW	LW	PG	ALT	ATD	ATW	AWSW	AWPBY
WB	1.000	0.759**	-0.745**	-0.651**	-0.727**	-0.654**	-0.571**	-0.753**	-0.676**	-0.674**	-0.679**
WDM		1.000	-0.910**	-0.792**	-0.570**	-0.763**	-0.781**	-0.805**	-0.864**	-0.797**	-0.860**
PSH			1.000	0.877**	0.605**	0.846**	0.864**	0.910**	0.919**	0.874**	0.918**
SW				1.000	0.714**	0.921**	0.830**	0.956**	0.928	0.978**	0.941**
LW					1.000	0.752**	0.622**	0.781**	0.746**	0.768**	0.754**
PG						1.000	0.817**	0.951**	0.915**	0.896**	0.918**
ALT							1.000	0.829**	0.890**	0.831**	0.886**
ATD								1.000	0.944**	0.953**	0.951**
ATW									1.000	0.952**	0.999**
AWSW										1.000	0.965**
AWPBY											1.000

*, ** Correlation significant at the 0.05 and 0.01 probability level, respectively
WB: Weed biomass; WDM: Weed dry matter; SW: Stem weight; LW: Leaf weight; PG: Plant girth; ALT: Average length of tuber; ATD: Average tuber diameter; ATW: Average tuber weight; AWSW: Average whole-shoot weight; AWTBY: Average whole-plant biomass yield.

Tuber yield in the non-branching cultivar during the 2009 cropping season indicated a highly significant positive correlation with tuber diameter, length of tuber, plant girth, leaf weight, shoot weight and plant height but negatively with weed dry matter. Plant girth showed a positive correlation with leaf weight, shoot weight and plant height (table 4). The diameter in this cultivar's tubers had a highly significant positive correlation with plant girth, leaf weight, shoot weight and plant height; but correlated negatively with weed biomass and weed dry matter.

DISCUSSION

The highly significant positive correlation between tuber yield in cassava and the leaf weight, plant height, shoot weight, plant girth, length of tuber and tuber diameter per plant reflects their importance in tuber yield formation in the crop. The results show that the greater the stem girth, the taller the plant and hence foliage, which contribute photosynthetically to crop yield.

In most situations, economic yield is determined largely by the fruit number per plant, which is related to plant size (Whiteman, *et al* 1985) and quite often tuber yield is to a large extent influenced by the number of leaves, stem height and stem girth (Okeleye, 1999). However, Idache (2005) reported a non-significant relation of stem girth to tuber weight. The interdependence of the different agronomic characters studied showed that weed dry matter had a highly significant ($P<0.01$) negative effect on plant height, plant girth, tuber diameter and tuber yield. This trend was observed in both cropping seasons (2008 and 2009) irrespective of the cassava genotype indicating that poor weed management results in intense competition between the crop and weeds for nutrients and other growth factors and consequently poor growth terminating in poor tuber yield. This agrees with earlier findings of Chikoye (1999) that weedy conditions considerably reduce yield output in cassava.

Table 4: Correlation Analysis: Non-Branching Cultivar (2009 Cropping Season).

Character	WB	WDM	PSH	SW	LW	PG	ALT	ATD	ATW	AWSW	AWPBY
WB	1.000	0.808**	-0.825**	-0.734**	0.765**	-0.730**	-0.726**	-0.829**	-0.796**	-0.779**	-0.801**
WDM		1.000	-0.966**	-0.878**	-0.957**	-0.772**	-0.863**	-0.898**	-0.940**	-0.797**	-0.928**
PSH			1.000	0.893**	0.940**	0.831**	0.882**	0.938**	0.943**	0.850**	0.938**
SW				1.000	0.925**	0.953**	0.888**	0.968**	0.969**	0.959**	0.976**

LW		1.000	0.832**	0.871**	0.932**	0.963**	0.866**	0.958**
PG			1.000	0.851**	0.949**	0.911**	0.975**	0.928**
ALT				1.000	0.898**	0.915**	0.873**	0.918**
ATD					1.000	0.971**	0.980**	0.768**
ATW						1.000	0.928**	0.999**
AWSW							1.000	0.946**
AWPBY								1.000

*, ** Correlation significant at the 0.05 and 0.01 probability level, respectively.
WB: Weed biomass; WDM: Weed dry matter; SW: Stem weight; LW: Leaf weight; PG: Plant girth; ALT: Average length of tuber; ATD: Average tuber diameter; ATW: Average tuber weight; AWSW: Average whole-shoot weight; AWTBY: Average whole-plant biomass yield

REFERENCES

Anuebunwa, F.O.C; C. Ezedinma; G.N. Asumugha, and E.C. Nnodu, 1998. Research report on the "Extent of Adoption of NRCRI Developed Technology: Cassava Varieties; NR 8082, NR 8083 and TMS 4(2) 1425 in Anambra and Delta states of Nigeria". Submitted to NARP management Abuja, NRCRI, Umudike.

Baiyeri, K. P. and B. N. Mbah, 1994. Growth and yield correlation in false horn plantain (*Musa* AAB cv. Agbagba) in a sub-humid zone of Nigeria. *MusAfrica* 5: 3 – 4.

Baiyeri, K. P.; B.N. Mbah and A. Tenkouano, 2000. Relationship between phenological and yield traits of the plant crop and first ratoon crop of *Musa* genotypes as affected by ploidy and genomic group. *AgroScience* 1(1): 113 – 121.

Baiyeri, K. P., M. Pillay and A. Tenkouano, 2008. Phenotypic relationships between growth, yield and black leaf streak disease responses of *Musa* genotypes. *Journal of Crop Improvement* 21(1): 41 – 54.

Chang, J.H., 1991. Corn yield in relation to plants period light, temperature and sole radiation. Agricultural meteorology 24: 251 – 254.

Chiezey, U.F. and P.N. Egharevba, 1987. Correlation studies in sorghum. Niger J.23:22 – 25.

Chikoye, D., 1999. Impact of natural planted *Leucaena leucocephala* fallow and land use intensity on weed seedling emergence pattern and density in cassava intercropped with maize.

Claussen, D., 2004. Value creation in Nebrasca local farm supply and garri marketing cooperative. Unpublished M.A.B. Ihesin Department of Agricultural Economics Kausas State University, Menhatta.

Dewey, J.R. and K.H. La, 1959. A correlation and path. Coefficient analysis component of crested wheatgrass seed production, Agron. J. 51:515p.

Food and Agricultural Organization (FAO), 2006. A cassava industrial revolution in Nigeria. FAO corporate government Repository.

Francisco, D.R.U, 2004. The determinants of firms growth. "An empirical examination". Series documents of Trabjo, April 2004.

Funseca, S. and Patterson, F.L., 1968. Yield component heritability and interrelationships in winter's wheat *(iriticum aectivum L.)*. Crop Sci. 8 (600).

Grant, R.F., Jackson, B.S., Kiniry, J. R. and Arkin, G.F. (1985). Water deficit timing effects on yield components in cassava. Agron. J.81:61 – 64.

Grant, R.F; Jackson, B.S, Kiniry, J.R. and Arkin, G.F., 1989. Water deficit timing effects in yield components in maize. Agron J. 51:61 – 63.

Idache, P.E., 2005. Effect of organic and inorganic sources of nutrients in total graded yield of cassava in Jos, Plateau State, Nigeria. Journal of Agriculture and Technology 2(2):116 – 119.

Ikugbayigbe, O., 1992. "Cassava Production in Nigeria: Need for Government Assistnace" Sunday sketch in IITA in the weeds Jan – June 1992 36p.

James, N.I. (1971). Yield components in random and selected sugar population. Crop Sci. 11:906 – 908.

Kang, M.S. and Miller, J.D., 1983. Genetic variation and advance for rind hardness flowering and sugar yield traits in sugarcane. Field Crop Research, 23(1):66p.

Kormawa, J.F.B., 2002. "Cassava Initiative in Nigeria". First Presidential Research, Communications Unit, Abuja. April 6, 2002.

Okeleye, T.C., 1999. Response of cassava to two spacing. An analysis of biomass accumulation, canopy interception and components of tuber yield. Field crops research 5:12 and 13.

Onwumere, J. Nwajuba, C.U. and Asumugha, G.N., 2006. Intersectoral linkapers in cassava based agribusiness in Abia state. In conference proceedings of Nigeria Association of Agricultural Economics LAUTECH, Ogbomoso 2006, Oyo state. 53 – 55p.

Whiteman, P.C; D.E. Byth and E.E. Wallis, 1985. Pigeon-pea (*Cajanus cajan (L.) Mill)*. In Grain legume (Crops eds. Summerfield R.J. Roberts, E.H.) First Edition. Published by Collins Professional and Technical Books 158p.