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RESEARCH ARTICLE

Genetic variability and inter-relationship among yam (*Dioscorea spp*.) genotypes in Jalingo, Taraba State, Nigeria

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Abstract

The current study was conducted at the Taraba State University, Jalingo, Taraba State, Nigeria during 2022 cropping season to investigate the magnitude of genetic variability, correlation and path analysis. Ten yam genotypes were evaluated in a randomized complete block design with three replications. The result revealed the presence of significant difference ($p \leq 0.01$) for all the characters except percentage emergence and number of leaves. High genotypic and phenotypic coefficient, heritability and genetic gain were observed for petiole length, number of tubers per plant, weight of tubers per plant, weight of tubers per plot and tuber yield per hectare. Correlation analysis showed that tuber yield per hectare exerted significant and positive correlation for weight of tubers per plot, weight of tubers per plant, and number of tubers per plant. Path analysis revealed that weight of tubers per plot, petiole length, and tuber width exerted higher positive direct effect on tuber yield. These traits can be considered to be determinant for yield improvement in yam.

Keywords: Yam, genotypes, tuber yield, character, correlation

Introduction

Yam (*Dioscorea spp*.) belongs to the family Dioscoreaceae, genus Dioscorea (USDA, 2020), with more than 800 species of climbing vines and woody shrubs (Barton, 2014), of which only six are of important in terms of food, cash and medicine (IITA, 2009). It is the second most important tuber crop after cassava in Africa (Andres *et al.*, 2017), and the fifth most harvestable crop following cassava, maize, guinea corn and cowpea in Nigeria (NBS, 2012). Yam a major source of more than 200 calories to 60 million people in the tropical and subtropical regions (Nweke *et al.*, 1991). The crop are consumed as cooked starchy vegetable, boiled and then mashed into a sticky paste or dough, they may also be fried, roasted or baked (Britannica, 2020). Barton (2014) stated that yams are good source of dietary fiber and are rich in carbohydrates, vitamin C, and essential minerals, and plays a vital role in the economy, medicine and food security of the developing countries (Obidiegwu *et al.,* 2020). As reported by Kumar *et al.,* (2017), Dioscorea species have found to have anti-microbial, anti-fungal, anti-mutagenic, immunomodulary and hypoglycemic effects. Aliyu *et al.,* (2013), reported that the potential for the genetic improvement of any crop relies on the ability to successfully use the existing genetic resources. Genetic component of variation is important in crop improvement, being the only component that is transmitted to the future generation (Singh, 1993).

Heritability tells the breeder how much confidence to place on the phenotypic performance of individual when choosing parents for next generation (Bennet, 2001). Petal *et al.,* (2018) reported that the knowledge of interrelationship between yield and its components is necessary, and important for planning breeding program (Panwar et al., 2012). Herojit *et al.,* (2017) emphasized that evaluation of local cultivars or land races into different morphological variability groups makes it easy for plant breeders in identifying and also selecting the desired promising lines of different characters. Farmers rely on landraces characterized with low genetic capacity, susceptible to biotic and abiotic stresses which resulted to low yield, low nutritional advantage and low storability, these factors have led to decrease in yam production over the years, food insecurity and unemployment in the area, with little research attention toward crop improvement. The study was undertaken to assess the extent of genetic variability, heritability as well as the interrelationship; and direct and indirect correlation effect on growth, tuber yield and quality of yam genotypes in the area.

Materials and methods

The ten yam genotypes used for the study include eight varieties obtained from diverse yam producing areas in the state, two varieties were obtained from National Root Crop Research Institute, Umudike (NRCRI), Abia State. The land for the study was cleared, ploughed and heaps were made. The whole seeds were sown into mounds of 60 cm height at spacing of 1m x1m inter row and intra row spacing at the Teaching and Research Farm of the Department of Agronomy, Taraba State University, Jalingo. Jalingo lies in the Northern Guinea Savannah on latitude 8º45′ N and longitude 11º25′ E of the equator. The rainfall ranges from 1000-1500mm and an average temperature of 37.5ºC, and at an elevation of 351 m above sea level. The experiment was laid out in a Randomized Complete Block Design, which was replicated three times. Each replicate consists of ten plots of 10m x 8m, distance of 2 m was maintained between replicates and 1.5m between plots respectively.

All management practices were carried out as recommended for yam production. The parameters measured include percentage emergence %, vine length (m), petiole length (cm), number of vines per plant, number of leaves per plant, number of tubers per plant, tuber width (cm), tuber length (cm), weight of tubers per plant (kg), number of tubers per plot, weight of tubers per plot (kg), tuber yield/ha (tons), moisture content (%), tuber dry matter content(%), starch content (g/100g), ash content, ascorbic acid (mg), and total sugar (g/100g). moisture content, tuber dry matter content, starch content, ash content, ascorbic acid, and total sugar were determined by standard procedures. Analysis of variance was performed on all the characters using SAS (2016). Means were separated using the Duncan's Multiple Range Test as described by Duncan (1955). Genotypic variance (δ^2g), phenotypic variance (δ^2p), environmental variance (δ^2e), genotypic coefficient of variation (GCV), and phenotypic coefficient of variation (PCV) according to the method described by Burton and Devane (1953) and are classified as low (<10 %), moderate (10-20 %), and high (> 20%) as suggested by Sivasubramanium and Madhavamanon (1973). Broad sense heritability (H2) was computed by the formula described by Hanson et al. (1956), and classified by Robinson (1966), as low (< 50%), moderate (50-70%) and high (>70 %). Genetic advance (GA) and Genetic advance as percent of mean (GAM) of each character was calculated as described by Johnson et al. (1955) and classified as low (< 10 %), moderate (10-20 %), and high (> 20%). The degree of association between pairs of characters was computed using statistical analysis system (SAS, 2016). The matrix method was used to estimate the path coefficient as described by Singh and Chaudhary (1985).

Table 1: Genotypes and area of collection

Genotypes	Area of collection
Ben	Zing
Tinzen	Yorro
Yanzo	Yorro
Ogoja	Wukari
Takalafia	Donga
Faketsa	Donga
Anasure	Donga
Gyumdugagu	Donga
Alamaco	NRCRI, Umudike
UMUDr-20	NRCRI Umudike

Results and discussion

The analysis of variance (Table 2) revealed the presence of significant difference among the genotypes for most of the characters studied indicating the existence of variation. The genotypes differed significantly ($p \leq 0.01$) for all the characters except percentage emergence and number of leaves per plant which recorded non-significant influence. Nwankwo and Bassey (2013) observed significant difference among the yam genotypes for all characters used except tuber shape. Vandna *et al.*, (2020) recorded highly significant difference among the yam genotypes for all the characters used in the study. However, Anyanwu and Idefonso (2015), reported non-significant difference for all the characters studied except percentage of plant survival, tuber fresh weight and total yield per variety at harvest in yam. Ahsan *et al.*, (2015) reported that the presence of variation among genotypes is very important for the plant breeders and selection is rewarding when the magnitude of variation is of great range. The coefficient of variability (CV) ranges from 1.27 % for tuber dry matter content to 19.23 % for number of veins per plant, the lower CV values observed for most of the characters implied high level of precision for the study as suggested by Gomes (2009), low (< 10 %) high precision, medium (10 -20 %) good precision, high (20 - 30%) low precision, and very high (> 30 %) very low precision in the field experiment (Table 2). The mean ± SE, environmental, genotypic and phenotypic variance, genotypic and phenotypic coefficient of variation, heritability, genetic advance as percent mean were presented in Table 3. The genotypic variances were generally higher than the environmental variance for most of the characters except percentage emergence and number of leaves per plant, suggesting the effect of additive gene on the expression of most of characters studied. Similarly, higher phenotypic coefficient of variability in magnitude compared to its corresponding genotypic coefficient variability indicates the presence of environmental factors in the expression of those characters, however, the effects were low due to slight difference between them. This is in agreement with the findings of Vandna *et al.*, (2020) and Norman *et al.*, (2021).

This study showed that characters such as weight of tubers per plot (331.98 and 329.01), weight of tubers per plant (36.95 and 35.50), tuber yield per hectare (34.76 and 34.50), number of tubers per plant (30.82 and 26.78), number of vein per plant (31.39 and 24.81), moisture content (25.78 and 24.12), and petiole length (25.67 and 24.88) exhibited high (>20 %) phenotypic and genotypic coefficient of variations which indicates high chances of improvement through selection of these characters. Similar results were seen in Nwankwo and Bassey (2013) and Nwankwo *et al.,* (2019), and Vandna *et al.,* (2020).

Table 2: Analysis of variance for agronomic, yield and quality traits of yam varieties

Trait	Replication (2)	Genotypes (10)	Error (20)	CV (%)
Percentage emergence (%)	13.33	13.33	13.33	3.68
Vine length (cm)	2.40	740.75**	13.56	2.47
Petiole length (cm)	0.58	17.67**	0.32	5.88
Number of vines /plant	0.25	3.59**	0.60	19.23
Number of leaves /plant	1341.16	521.75	404.36	10.18
Number of tubers plant	0.11	3.59**	0.35	15.21
Tuber width (cm)	2.51	147.46**	2.96	4.74
Tuber length (cm)	7.43	199.52**	2.65	3.89
Weight of tuber(s) /plant (kg)	0.29*	2.21**	0.06	10.36
Number of tubers /plot	2.53	60.24**	0.83	4.51
Weight of tubers /plot (kg)	0.01	2.46.40**	0.74	3.46
Tuber yield/ha (tons)	0.72	57.18**	0.29	4.26
Moisture content (%)	3.95	29.44**	1.33	9.07
Tuber dry matter content (%)	0..005	26.18**	0.45	1.27
Starch content (g/100g)	0.65	14.88**	0.67	1.32
Ash content	0.04	0.45**	0.02	3.17
Ascorbic acid (mg)	0.39	4.37**	0.39	3.63
Total sugar (g/100g)	0.002*	0.007**	0.0004	3.34

****** = highly significant, * = significant difference

In this study, broad sense heritability estimates (Table 3) were high (>70 %) for vein length (95%), petiole length (95%), number of leaves per plant (90%), number of tubers per plant (76%), tuber width (94%), tuber length (96%), weight of tubers per plant (92%), number of tubers per plot (96%), weight of tubers per plot (99%), tuber yield per hectare (98%), moisture content (88%), tuber dry matter content (95%), starch content (88%), ash content (88%), ascorbic acid (77%), while, number of vein per plant (63%), and total sugar (67%), had moderate heritability. Conversely, low broad sense heritability were observed for percentage emergence (0%). Higher broad sense heritability obtained by most of the characters indicates that these characters are most likely under additive gene effects and selection based on phenotypic expression could be effective. Several studies tend to show similar results Nwankwo *et al.,* (2019), Vandna *et al.,* (2020). The lowest heritability (0 %) observed for percentage emergence was a result of zero value recorded by the genetic variance which resulted to zero values for both genotypic coefficient of variation and heritability indicating strong environmental influence on the expression of this character.

The magnitude of GAM (Table 3) were high (> 20 %) for petiole length (49.71%), number of vein per plant (40.41%), number of tubers per plant (47.95%), tuber width (38.27), tuber length (39.20), weight of tubers per plant (70.26%), number of tubers per plot (44.52%), weight of tubers per plot (74.56%), tuber yield per hectare (70.53%), moisture content (46.50%), ash content (72.10%), and total sugar (84.29%). Similar results were seen in Padhan *et al.,* (2019). The high GAM values obtained by these characters signified effects of additive gene on the expression of these characters. High heritability in broad sense coupled with high genetic advance as percent of mean were computed for petiole length, number of tuber per plant, tuber width, tuber length, weight of tubers per plant, number of tuber per plot, tuber yield per hectare, moisture content, and ash content.

Table 3: Means and their standard error, coefficient of variability, heritability and genetic advance as percent mean

Trait	Mean ± SE	δ^2_e	δ^2_g	δ^2_p	GCV (%)	PCV (%)	H^2 (%)	GA %	GAM (%)
Percentage emergence (%)	99.33± 3.65	13.33	0	13.33	0	3.91	0	0	0
Vine length (cm)	148.99±3.68	13.55	242.40	255.96	10.45	10.74	0.95	31.21	20.95
Petiole length (cm)	9.62±0.57	0.32	5.73	6.10	24.88	25.67	0.95	4.78	49.71
Number of vines /plant	4.33±0.78	0.60	1.00	1.60	24.81	31.39	0.63	1.63	40.41
Number of leaves /plant	197.53±2011	404.36	39.13	43.47	3.17	10.66	0.90	12.23	6.19
Number of tubers plant	3.88±0.59	0.35	1.08	1.43	26.78	30.82	0.76	1.86	47.95
Tuber width (cm)	36.26±1.72	2.95	48.17	51.12	19.14	19.71	0.94	13.88	38.27
Tuber length (cm)	41.73±1.63	2.65	65.62	68.27	19.41	19.80	0.96	16.36	39.20
Weight of tuber (kg)	2.39±0.25	0.06	0.72	0.78	35.50	36.95	0.92	1.68	70.26
Number of tubers /plot	20.17±0.91	0.83	19.80	20.63	22.06	22.52	0.96	8.90	44.52
Weight of tubers /plot (kg)	24.89±0.86	0.74	81.89	82.63	329.01	331.98	0.99	18.56	74.56
Tuber yield /ha (kg)	12.62±0.54	0.29	18.96	19.25	34.50	34.76	0.98	8.90	70.53
Moisture content (%)	12.69±1.15	1.33	9.37	10.70	24.12	25.78	0.88	5.90	46.50
Tuber dry matter content (%)	53.16±0.67	0.45	8.57	9.03	5.51	5.65	0.95	5.87	11.05
Starch content ($g100g^{-1}$)	62.13±0.82	0.67	4.74	5.41	3.50	3.74	0.88	4.20	4.19
Ash content	4.66± 0.15	0.02	0.14	0.16	8.03	8.58	0.88	0.72	72.1
Ascorbic acid	17.22±0.63	0.39	1.33	1.72	6.69	7.61	0.77	2.09	12.12
Total sugar	0.63±0.02	0.0004	0.002	0.003	7.09	8.69	0.67	10.69	84.29

Consequently, high phenotypic and genotypic coefficient of variation, high heritability and genetic advance as a percent of mean observed indicates that these characters are governed under additive gene action with less influence by the environment, therefore, meaningful improvement of the crop can be achieved through simple selection.

The current investigation (Table 4) revealed that genotypic correlation coefficients were generally higher than their corresponding phenotypic counterpart for most of the characters studied suggesting predominantly high influence of additive gene with little environmental effect. Higher magnitude of genotypic correlations than phenotypic correlations were reported previously by numerous researchers Babu Rao *et al.,* (2017), Nwankwo *et al.,* (2019), Hunde *et al.,* (2022). Tuber yield per hectare exhibited highly significant and positive correlations with weight of tubers per plots (0.993**and 0.986**), weight of tubers per plant (0.723**and 0.697**), and number of tubers per plant (0.673**and 0.597**) at both genotypic and phenotypic levels. This indicates that the three traits are closely related and interrelated with tuber yield per hectare and selection for yield increase is possible by considering these characters. In addition, number of leaves per plant ((-0.821**) exerted highly significant and negative association with tuber yield per hectare at genotypic level. Hunde *et al.,* (2022) highlighted that negative relationship between two characters indicates that selection for improving one trait will likely cause decrease in the other character.

Similarly, weight of tubers per plot was found to be highly significantly and positively correlated with number of tubers per plant (0.644**and 0.545**) and weight of tubers per plant (0.742**and 0.705**) at both genotypic and phenotypic levels, while positively and significantly correlated with tuber width (0.540**) and number of tubers per plot (0.414**) at phenotypic level. High significant and positive values observed between weight of tubers per plant and number of tubers per plant with weight of tubers per plot signifies their importance as yield attributes in influencing yield of yam, hence, the heavier the weight of tubers per plant, the heavier the weight of tubers per plot.

In this present study, tuber length per plant registered highly significant and positive association with tuber width (0.827**and 0.802**) at both genotypic and phenotypic levels. This implies that these characters are related, hence selection for improvement of one character may simultaneously result to the increase of the other character.

Similar result can be seen in Goler *et al.,* (2017) and Babu Rao *et al.,* (2019). Weight of tubers per plant exerted highly significant positive correlations with tuber width (0.671**and 0.618**) and tuber length (0.685**and 0.634**) at both genotypic and phenotypic levels. Number of tubers per plot exhibited strong positive and significant genotypic and phenotypic association with number of tubers per plant (0.922**and 0.806**). Concurrently, tuber dry matter content revealed highly significant and positive correlations with tuber weight (0.693**and 0.638**) at genotypic and phenotypic levels, but highly significant and positive with tuber length (0.554**) at phenotypic level. However, Goler et al. (2017) 0bserved negative and insignificant relation between tuber dry matter content with tuber length and tuber girth in sweet potato. Highly positive and significant genotypic and phenotypic relationship were recorded between starch content with number of tubers per plant (0.686**and 0.636**), also genotypically correlated with number of leaves per plant (0.686**), as well as phenotypically correlated with number of tubers per plot (0.536**), weight of tubers per plot (0.473**) and tuber yield per hectare (0.519**).

Significant and positive phenotypic association between number of tubers per plot, weight of tubers per plot and tuber yield per hectare with starch content indicates that this relationship is most likely due to environmental influence and selection for improvement may not be meaningful. Babu Rao *et al.,* (2019) reported significant and positive relationship between starch content and number of leaves per plant at both genotypic and phenotypic levels. Positive and significant genotypic and phenotypic correlations were observed between ash content with number of veins per plant (0.673**and 0.467**), while significant and positive relationship was obtained with tuber length (0.545**) at phenotypic level. Total sugar exhibited positive and significant association with vein length (0.593**and 0.499**) at genotypic and phenotypic levels respectively.

The result of path analysis (Table 5) revealed that weight of tubers per plot (0.919 and 0.895) observed maximum positive direct effect on tuber yield per hectare at genotypic and phenotypic levels. The significant and positive association obtained between weight of tubers per plot with tuber yield per hectare was the result of contribution of both direct and indirect effects of weight of tubers per plot to tuber yield per hectare. While petiole length (0.145 and 0.087), tuber width (0.123 and 0.101), number of veins per plant (0.028 and 0.009), number of tubers per plant (0.016 and 0.098), and moisture content (0.096 and 0.073), exerted low direct effect at both genotypic and phenotypic levels with tuber yield per hectare, whereas, tuber length (0.007), and starch content (0.002) showed low positive direct effect at genotypic level. Traits having positive direct effect with tuber yield implying positive association and are the determinants of tuber yield per hectare. Similarly, the maximum indirect effect on tuber yield per hectare was exerted by weight of tubers per plant via weight of tubers per plot. On the other hand, maximum negative direct effect were exerted by percentage emergence (-0.054 and -0.016), vein length (-0.001 and -0.054), number of tubers per plot (-0.050 and -0.057), and tuber dry matter content (-0.027 and -0.077) at both genotypic and phenotypic levels with tuber yield per hectare, but number of leaves per plant (-0.013), weight of tubers per plant (-0.013), ash content (-0.028), ascorbic acid (-0.026), and total sugar (-0.082) exerted negative direct effect at genotypic level. Path analysis for various morphological, yield and internal quality traits was studies by Babu Rao *et al.,* (2017) in cassava, Goler et al. (2017) in sweet potato, Tewodros et al. (2020) in yam, and Hunde *et al.,* (2022) in potato.

The result of the study revealed significant difference among the genotypes tested indicates the existence of substantial genetic variability. Higher values for phenotypic and genotypic coefficient of variation, heritability and genetic gain, strong positive association and positive direct effect exhibited by most of the characters signifies more influence of addictive effect. These variations among the genotypes indicated that there is a great potential for genetic improvement of this crop through breeding program.

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Table 4: Genotypic and phenotypic correlation coefficients among characters in yam genotypes

Traits		Percentage emergence	Vine length (cm)	Petiole length (cm)	Number of vines /plant	Number of leaves /plant	Number of tubers plant	Tuber width (cm)	Tuber length (cm)	Weight of tuber (kg)	Number of tubers /plot	Weight of tubers /plot (kg)	Tuber yield /ha (kg)	Moisture content (%)	Tuber dry matter content (%)	Starch content ($g100g^{-1}$)	Ash content	Ascorbic acid	Total sugar
Percentage emergence (%)	G	1																	
	P																		
Vine length (cm)	G	0.320	1																
	P	0.195																	
Petiole length (cm)	G	0.458	0.383	1															
	P	0.403*	0.356																
Number of vines /plant	G	0.940**	0.390	0.333	1														
	P	0.598**	0.252	0.303															
Number of leaves /plant	G	-0.390	-0.748	-0.652	-1.104**	1													
	P	-0.228	-0.124	-0.179	-0.266														
Number of tubers plant	G	-0.529	-0.001	0.226	-0.252	-0.656*	1												
	P	-0.383*	-0.034	0.182	-0.008	-0.259													
Tuber width (cm)	G	0.271	-0.289	0.121	-0.039	-0.054	0.184	1											
	P	0.214	-0.275	0.111	0.008	0.074	0.176												
Tuber length (cm)	G	0.352	-0.388	-0.066	0.125	0.503	-0.093	0.827**	1										
	P	0.272	-0.375*	-0.058	0.137	0.197	-0.054	0.803**											
Weight of tuber (kg)	G	0.194	-0.382	0.139	0.168	-0.289	0.269	0.671**	0.685**	1									
	P	0.138	-0.333	0.133	0.158	-0.154	0.249	0.618**	0.634**										
Number of tubers /plot	G	-0.259	0.160	0.287	-0.014	-0.371	0.922**	0.164	-0.028	0.253	1								
	P	-0.212	0143	0.271	-0.009	-0.123	0.806**	0.162	-0.019	0.248									
Weight of tubers /plot (kg)	G	-0.169	-0.332	-0.043	0.042	-0.876**	0.644**	0.570	0.304	0.742**	0.426	1							
	P	-0.152	-0.324	-0.032	0.040	-0.254	0.545**	0.540**	0.292	0.705**	0.414*								
Tuber yield /ha (kg)	G	-0.163	-0.314	0.059	0.033	-0.821**	0.673**	0.576	0.288	0.723**	0.454	0.993**	1						
	P	-0.171	-0.307	0.056	0.038	-0.247	0.597**	0.550**	0.282	0.697**	0.450*	0.986**							
Moisture content (%)	G	-0.456	0.063	-0.454	-0.284	0.525**	0.042	-0.133	-0.053	-0.487	0.096	-0.215	-0.186	1					
	P	-0.359	0.097	0.416*	-0.270	0.423**	-0.015	0.151	-0.075	-0.439	0.082	-0.196	-0.189						
Tuber dry matter content (%)	G	0.389	-0.195	-0.248	0.150	0.244	-0.056	0.693**	0.598	0.150	0.098	0.188	0.147	0.134	1				
	P	0.346	-0.189	0.236	0.109	0.042	-0.047	0.638**	0.554**	0.150	0.083	0.181	0.136	0.155					
Starch content ($g100g^{-1}$)	G	-0.574**	-0.485	-0.050	-0.328	0.686**	0.686**	0.303	0.340	0.407	0.586	0.508	0.560	0.388	-0.014	1			
	P	-0.482**	0.455*	-0.058	-0.231	0.181	0.636**	0.282	0.308	0.340	0.536**	0.473**	0.519**	0.336	0.005				
Ash content	G	0.488	-0.392	-0.101	0.673**	0.199	-0.086	0.207	0.615	0.362	0.020	0.072	0.053	-0.049	0.349	0.286	1		
	P	0.302	-0.338	-0.109	0.467**	0.038	-0.073	0.154	0.545**	0.322	0.018	0.077	0.051	0.032	0.345	0.282			
Ascorbic acid	G	0.537	0.040	-0.231	0.305	0.216	-0.895**	-0.079	0.337	-0.032	-0.747**	-0.567**	-0.639**	-0.292	0.093	-0.628	0.333	1	
	P	0.438	0.002	-0.183	0.221	0.111	-0.659**	-0.085	0.284	-0.038	-0.618**	-0.488**	-0.546**	-0.217	0.108	-0.535**	0.347		
Total sugar	G	0.055	0.593**	0.150	-0.292	0.220	0.045	0.333	0.112	-0.244	0.075	-0.253	-0.246	0.155	0.284	-0.282	-0.508	0.096	1
	P	-0.038	0.499**	0.121	-0.210	-0.081	0.016	0.261	0.119	-0.231	0.078	-0.218	-0.205	0.110	0.245	-0.195	-0.377	0.070	

****** = highly significant, * = significant difference

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Table 5: Genotypic and phenotypic path coefficient analysis among seventeen characters in yam genotypes

		Percentage emergence (%)	Vine length (cm)	Petiole length (cm)	Number of vines /plant	Number of leaves /plant	Number of tubers plant	Tuber width (cm)	Tuber length (cm)	Weight of tuber (kg)	Number of tubers /plot	Weight of tubers /plot (kg)	Moisture content (%)	Tuber dry matter content (%)	Starch content ($g100g^{-1}$)	Ash content	Ascorbic acid	Total sugar	Corr. With TYHA
Percentage emergence (%)	G	**-0.054**	-0.000	0.066	0.027	0.005	-0.008	0.033	0.002	-0.003	0.013	-0.155	-0.044	-0.010	0.028-	-0.014	-0.014	-0.004	-0.163
	P	**-0.016**	-0.003	0.035	0.005	-0.001	-0.037	0.021	-0.011	0.005	0.012	-0.136	-0.026	-0.026	0.001	0.014	-0.027	-0.001	-0.171
Vine length (cm)	G	-0.017	**-0.001**	0.055	0.011	0.010	-0.000	-0.035	-0.003	0.007	-0.008	-0.305	0.006	0.005	-0.001	0.011	-0.001	-0.049	-0.314
	P	-0.003	**-0.054**	0.031	0.002	-0.001	-0.003	-0.028	0.016	-0.014	-0.008	-0.290	0.007	0.014	0.026	-0.016	-0.000	0.013	-0.307
Petiole length (cm)	G	-0.025	-0.000	**0.145**	0.009	0.008	0.003	0.015	-0.001	-0.002	-0.014	-0.039	-0.044	0.006	-0.000	0.002	0.006	-0.012	0.059
	P	-0.006	-0.019	**0.087**	0.002	-0.000	0.017	0.011	0.002	0.005	-0.015	-0.029	-0.030	0.018	0.003	-0.005	0.011	0.003	0.056
Number of vines /plant	G	-0.051	-0.000	0.048	**0.028**	0.014	-0.004	-0.004	0.001	-0.003	0.001	0.039	-0.027	-0.004	-0.000	-0.019	-0.008	0.024	0.033
	P	-0.009	-0.013	0.026	**0.009**	-0.001	-0.000	0.001	-0.005	0.006	0.001	0.036	-0.019	-0.008	0.013	0.023	-0.013	-0.005	0.038
Number of leaves /plant	G	0.021	0.000	-0.095	-0.031	**-0.013**	-0.011	-0.006	0.003	0.005	0.018	-0.806	0.128	-0.006	0.001	-0.005	-0.005	-0.018	-0.821
	P	0.004	0.006	-0.015	-0.002	**0.004**	-0.025	0.007	-0.008	-0.006	0.007	-0.228	0.031	-0.003	-0.010	0.001	-0.006	-0.002	-0.247
Number of tubers plant	G	0.028	0.000	0.033	-0.007	0.008	**0.016**	0.022	-0.001	-0.005	-0.046	0.593	0.004	0.001	0.001	0.002	0.024	-0.003	0.673
	P	0.006	0.001	0.015	-0.000	-0.001	**0.098**	0.018	0.002	0.010	-0.046	0.488	-0.001	0.003	-0.037	-0.003	0.041	0.000	0.597
Tuber width (cm)	G	-0.014	0.000	0.017	-0.001	0.000	0.003	**0.123**	0.006	-0.012	-0.008	0.524	-0.012	-0.018	0.001	-0.005	0.002	-0.027	0.576
	P	-0.003	0.015	0.009	0.000	0.000	0.017	**0.101**	-0.034	0.026	-0.009	0.484	-0.011	-0.049	-0.016	0.007	0.005	0.007	0.550
Tuber length (cm)	G	-0.019	0.000	-0.009	0.003	-0.006	-0.001	0.102	**0.007**	-0.013	0.001	0.280	-0.005	-0.016	0.001	-0.017	-0.009	-0.009	0.288
	P	-0.004	0.020	-0.005	0.001	0.001	-0.005	0.081	**-0.042**	0.026	0.001	0.262	-0.005	-0.043	-0.018	0.026	-0.017	0.003	0.282
Weight of tuber (kg)	G	-0.010	0.000	0.020	0.004	0.003	0.004	0.008	0.005	**-0.013**	0.001	0.683	-0.047	-0.004	0.001	-0.010	0.001	0.020	0.723
	P	-0.002	0.018	0.011	0.001	-0.001	0.024	0.063	-0.027	**0.042**	-0.014	0.632	-0.032	-0.011	-0.019	0.015	0.002	-0.006	0.697
Number of tubers /plot	G	0.014	-0.000	0.004	-0.000	0.004	0.015	0.020	-0.000	-0.004	**-0.050**	0.392	0.009	-0.002	0.001	-0.001	0.020	-0.006	0.454
	P	0.003	-0.007	0.023	-0.000	-0.001	0.079	0.016	0.001	0.010	**-0.057**	0.371	0.006	-0.006	-0.031	0.001	0.038	0.002	0.450
Weight of tubers /plot (kg)	G	0.009	0.000	-0.006	0.001	0.011	0.010	0.070	0.002	-0.014	-0.021	**0.919**	-0.020	-0.005	0.001	-0.002	0.015	0.002	0.993
	P	0.002	0.017	-0.002	0.000	-0.001	0.053	0.055	-0.012	0.030	-0.023	**0.895**	-0.014	-0.014	-0.027	0.003	0.030	-0.006	0.986
Moisture content (%)	G	0.025	-0.000	-0.066	-0.008	-0.017	0.000	-0.016	-0.000	0.009	-0.004	-0.198	**0.096**	-0.003	0.000	0.001	0.007	-0.012	-0.186
	P	0.031	-0.005	-0.036	-0.002	0.001	0.001	-0.015	0.003	-0.018	-0.004	-0.175	**0.073**	-0.012	-0.019	0.001	0.013	0.003	-0.189
Tuber dry matter content (%)	G	-0.021	0.000	-0.036	0.004	-0.003	-0.000	0.085	0.004	-0.002	-0.004	0.173	0.013	**-0.027**	-0.000	-0.010	-0.002	-0.023	0.147
	P	-0.005	0.010	-0.020	0.001	0.000	-0.004	0.065	0.023	0.006	--0.004	0.162	0.011	**-0.077**	-0.000	0.017	-0.006	0.006	0.136
Starch content ($g100g^{-1}$)	G	0.031	0.000	-0.007	-0.009	-0.009	0.011	0.037	0.002	-0.007	-0.029-	0.468	0.037	0.000	**0.002**	-0.008	0.016	0.023	0.560
	P	0.007	0.024	-0.005	-0.002	0.001	0.062	0.028	-0.013	0.014	0.030	0.423	0.024	-0.000	**-0.058**	0.013	0.033	-0.005	0.519
Ash content	G	-0.026	0.000	-0.014	0.019	-0.002	-0.001	0.025	0.004	-0.006	-0.001	0.066	-0.004	-0.009	0.001	**-0.028**	-0.008	0.042	0.053
	P	-0.004	0.018	-0.009	0.004	0.000	-0.007	0.015	-0.023	0.013	-0.001	0.068	0.002	-0.026	-0.016	**0.049**	-0.021	-0.010	0.051
Ascorbic acid	G	-0.029	-0.000	-0.033	0.008	-0.002	-0.015	-0.009	0.002	0.000	0.003	-0.521	-0.028	-0.002	-0.001	-0.009	**-0.026**	-0.007	-0.639
	P	-0.007	-0.000	-0.016	0.002	0.000	-0.064	-0.008	0.012	0.001	0.035	-0.437	-0.016	-0.008	0.031	0.017	**0.062**	0.002	-0.545
Total sugar	G	-0.003	-0.000	0.021	-0.008	-0.002	0.001	0.004	0.001	0.004	-0.003	-0.233	0.015	-0.007	-0.001	0.014	-0.002	**-0.082**	-0.246
	P	0.001	-0.027	0.010	-0.001	0.000	0.001	0.027	-0.005	0.009	-0.004	-0.198	0.008	-0.019	0.011	-0.019	-0.004	**0.022**	-0.209

****** = highly significant, * = significant difference

References

1. Ahsan, M.Z.,Majidano, M.S.,Bhutto, H.,Soomno, A., Panhwar, F.H.,Channa and K.B. Sial 2015. Genetic variability, coefficient of variance, heritability and genetic advance of some *Gossypium hirsutum* L. accessions, J. Agril. Sci., 7(2):147-151.
2. Aliyu, B., Zamzam, M.S., Jandong, E.A and Micheal C.G. 2013. Evaluation of some descriptors of Togolese and Guinean Cassava germplasm in Taraba State, North-East Nigeria. Taraba J. Agric. Res., 1(2):88-91.
3. Andres, C., Ade Oluwa, O.O and Bhuller, G.S. 2017. Encyclopedia of Applied plant sciences, 2nd edition, (3): 435-441
4. Anyanwu, C.F. and Idefonso, R.L. 2015. Performance and Adaptability of two yam (*Dioscorea spp.)* varieties under Ifugao conditions. Inter. J. Advanced Res., 3(7): 110-116.
5. Barton, H. 2014. Yams: Origin and Development, In: Smith, C. (eds) Encyclopedia of global archaeology. Springer, New York.
6. Bennet, C. 2001. Using heritability for genetic improvement, Virginia cooperative extension. genetic and management technology, Virginia, USA.
7. Britannica 2020. Yam Plant. Encyclopaedia Britannica.www.britannica.com.
8. Burton, G.W. and Devane, D. 1953. Estimating heritability in tall Fescues (*Festuca arundinacea*) from replicated clonal material. Agron. J., 45:478-485.
9. Goler, E.E., Namo, O.A.T. and Mwanja, Y.P. 2017. Metric Associations and Path Analysis in Sweet potato (*Ipomoea batata* (L) Lam) in Jos, Plateau State, Nigeria. FU Lafia. J. Sci. Tech., 3(1): 1-11.
10. Duncan, D. 1955. Multiple ranges and multiple F-tests. Biometrics, 11:1-42
11. Gomes, F.P. 2009. Curso de estatistica experimental. 15. ed. Piracicaba: Esalq. Pp. 477.
12. Hanson, G.H., Robinson, H. F and Comstock, R.F. 1956. Biometrical studies of yield in segregating population of Korean Lespedeza. Agron. J., 48: 268-272.
13. Herojit, S.A., Noarem B.S., Loitongbam, S.D. and Bijaya Devi, A.K. 2017. Characterization of some germplasms on physiology, yield and quality of greater yam (*Dioscorea alata* L.) Int. J. Adv Res. Engin. Sci. Techn.,.4(5):86-92.
14. Hunde, N.F., Galalcha, D.T. and Limeneh, D.F. 2022. Correlation and path coefficient analyses of tuber yield and yield components among potato (*Solanum tuberosum* L.) genotypes at Bekoji, Southeastern Ethiopia. Int. J. Agric. Res. Inno. Tech., 12(2):144-154.
15. International Institute of Tropical Agriculture, (IITA) 2009. Yam (*Dioscorea species*). Available at: http://www.iita.org/yam. Ibadan, Nigeria.
16. Johnson, H. W; Robinson, H. F and Comstock, R.E. 1955. Estimation of genetic and environmental variability in soybean. Agron. J., 47: 314-318.
17. Kumar, S., Das, G., Shin, H. S. and Patra, J. K. 2017. Dioscorea spp. (A Wild Edible Tuber): A Study on its ethnopharmacological potential and traditional use by the local people of similipal biosphere reserve, India. Front. Pharmacol. 8: 52.
18. National Bureau of Statistics (NBS) 2012. LSMS-Integrated surveys on agriculture: general household survey panel 2010/11. Available at: www.nigerianstat. gov.ng/pages /download/194.
19. Norman, P.E., Tongoona, P.B., Danquah, A., Danquah, E.Y., Agre, P.A., Agbona, A., Asiedu, R. and Asfaw, A. 2021. Genetic parameter estimation and selection in advanced breeding population of white guinea Yam. J. Crop Improv., 35(6):790-815.

20. Nwankwo, I.I.M. and Bassey, E.E. 2013. A study of variability and heritability for yield and yield related traits in guinea white yam (*Dioscorea rotundata* Poir) genotypes in Umudike, South eastern Nigeria. Wudpecker J. Agric. Res.,2(4):112-127.
21. Nwankwo, I.I.M., Akinbo, O.K. and Ikoro, A.I. 2019. Environmental Effects on the Heritability of Quantitative Traits of Hybrids for white Guinea yam (*Dioscorea rotundata*) in the Rainforest Agro-ecological zone of Southeastern Nigeria. Nigerian Agric. J. 50(2):65-73.
22. Nweke, F.I., Ugwu, B.O., Asadu, C.L.A. and Ay, P. 1991. Production costs in the yam basedcropping systems of southeastern Nigeria. RCMP research monograph No. 6. Resource and crop management program, IITA. Pp.29.
23. Obidiegwu, J.E., Lyons, J.B. and Chilaka. A.C. 2020. The Dioscorea genus (Yam) - An appraisal of nutritional and therapeutic potential. Review Foods., 9:1304: 1- 45.
24. Padhan, B., Mukherjee, A.K., Mohanty, S.K., Lenka, S.K. and Panda, D. 2019. Genetic variability and inter species relationship between wild and cultivated yams (*Dioscorea spp*.) from Koraput, India based on molecular and morphological markers. Physiol. Mol. Biol. Plants., 25(5):1225-1233.
25. Panwar, S., Singh, K. P., Prasad, K. V., Satyavathi, C. T. and Namita 2012. Character association and path coefficient analysis in rose (Rosa × Hybrida). Indian J. Horti., 69(2): 231-8.
26. Patel, R. A., Bhavani, R.T., Patel, D.K. and Patel, R.J. 2018. Character association and path coefficient studies for yield and its components in Potato (*Solanum tuberosum* L.). Int. J. Curr. Microbiol. App. Sci.7 (8):1942-1950.
27. Rao, B., Swami, D.V., Ashok, P., Kalyana Babu, B., Ramajayam, D. and Sasikala, K. 2017. Correlation and path coefficient analysis of cassava (*Manhot esculenta* Crantz) genotypes. Inter. J.Curr. Microbiol. App. Sci., 6(9):549-557
28. Robinson, H. S. 1966. Quantitative genetics in relation to breeding on the central of Mendalism. Indian J. Genet. Plant Breedi., 26:171-187.
29. SAS Institute Inc. 2016. SAS System. Cary, NC, USA.
30. Singh, B.D. 1993. Plant Breeding, Principles and Methods. Kalyani, Publisher, New Delhi, India.
31. Sivasubramanian, J. and Madhavamenon, P. 1973. Genotypic and phenotypic variability in rice. Madras Agril. J., 12:15-16.
32. Tewodros, M., Firew, M., Shimelis, H. and Endale, G. 2020. Interrelationship and Path Analysis of Tuber yield and related traits in yam (*Dioscorea spp*.) from Ethiopia. Res. J. Pharmacognosy and Phytochem., 12(4):1-11
33. USDA-NRCS 2020. Taxonomy of yam. https://plants.usda.gov/java.
34. Vandna., Ameta, K.D., Kaushi, R.A. and Meena, M.K. 2020. Genetic Variability Analysis in Greater Yam (*Dioscorea alata* L.) in Southern Rajasthan conditions. Int., J. Curr. Microbiol. App. Sci. 9(8):3920-3925.