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1. There were errors in the arrangement of the manuscript of **B. O Adetola and G. D Osanyinleye**: *Influence of Community Perception on Tourism Acceptability of Osun Osogbo Sacred Groove, Nigeria*. It is now corrected and reproduced in **Volume 5 Number 1, March 2017.**

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1. There were errors in the figures and tables representation in the manuscript **A.K Oluleye, A. Omotayo, C Ribeiro and A. A Fajinmi**: *Evaluation of Imported Hot Pepper Cultivars (Capsicum spp) in Ekiti State, Southwestern Nigeria*. It is now corrected and reproduced in **Volume 5 Number 1, March 2017.**

Influence of Community Perception on Tourism Acceptability of Osun Osogbo Sacred Grove, Nigeria

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Abstract

The influence of community perception on tourism acceptability in Osun Osogbo Sacred Grove (OOSG) was investigated using questionnaire and in-depth interview. The population of the study consisted of the local communities around the grove from which 200 respondents were randomly selected. Data collected were analysed descriptively (frequency, percentages, means and standard deviation) while the hypotheses of the study were tested using Multinomial Logit Regression. The OOSG has various attractions amongst which festival (4.59) had the highest mean score followed by historical buildings and monuments (4.46) while sculpure had the least (3.75). Tourism activities in OOSG have created both positive and negative perceptions of tourism development among the local communities as measured through the economic and social perceptions of the impacts. The mean score ranking showed that employment opportunities (4.11), increase in income (3.97) and improved public security (3.93) were economic impacts while social impacts were increased entertainment (4.15), positive influence on cultural activities (4.08) and increased residents pride in indigenous culture (4.05). The negative influence on cultural activities and increase in prostitution were the negative perceptions of the host community that have significant effects on tourism acceptability ($p<0.05$). The need to sensitise community stakeholders in tourism of its potential positive impacts is essential and effective measures should be developed to address the negative impacts in order to ensure sustainability of the destination.

Keywords: Tourism, community, impacts, attractions, acceptability, Osun OsogboSacred Grove

Introduction

Tourism has become the global leisure activity that relies mainly on the physical environment. Wall and Mathieson (2006) defined tourism as the study of people away from their usual environment, of the establishment which answers to the prerequisite of travellers and of the influences that they have on the economic, physical and social well-being of their host. Tourism is based on the economic and social processes and changes that are occurring in the environment of the societies where tourists come from and its development in the destinations focuses on the use of natural and cultural resources which generate impacts. The environment in which tourism occurs is the key component in tourism development and the attributes of an environment can either be viewed as natural and/or cultural (Holden, 2008).

Tourism development takes place where the natural/cultural environments are attractive and desirable. Rocks, mountains, streams, beaches, flora and fauna are examples of the natural environment that attract large numbers of tourists. The cultural environment entails the part of the environment that is man-made and developed. The material components of the cultural environment are purpose-built structures and sites, caves, historical buildings, architectural features and ancient monument. The non-material components of the cultural environment are the culture of the people which entails the folklores, dance and carnivals.

Smith (2001) defined host communities as people who live in the vicinity of the tourist attraction and are either directly or indirectly involved with, and/or affected by the tourism activities. Tourism involves some elements of interaction between the tourist and the destination environment. The consequences of these interactions can lead to positive and

negative perceptions of the impact of tourism on the local communities which can be known through a personal encounter with the host communities, knowing their beliefs and perception about tourism in their locality. The impacts of tourism can be sorted into several categories, the most common ones are: economic, environmental and socio-cultural impacts (Cook *et al.,* 2006). Each of these categories includes positive and negative perceptions. Thus, community and tourism developers must balance the opportunities and concerns of all stakeholders by working against conditions where positive impacts benefit one part of the community (geographic or social) and the negative impacts hurt another (Kreag, 2001).

The uniqueness of Osun Osogbo Sacred Grove (OOSG) with its natural and cultural attractions is that it has gradually evolved from local significance to a regional and global dimension since its declaration as World Heritage Site by UNESCO in 2005. The need to assess the host communities' acceptance of tourism activities in OOSG is of necessity in order to achieve sustainable tourism development at the site. The influence of negative perceptions on tourism acceptability was tested in the study

Materials and Methods

Study area

The study was carried out in Osun Oshogbo Sacred Grove in Osun State. Osun State is located between 6° 55′ to 8° 15′N and 4° 10′ to 5° 10′E and on a relatively flat plain of about 250m above sea level within the western Nigeria plains. The annual average temperature ranges between 21.4 and 31.1°C, and mean annual relative humidity is about 77.1% (based on 1980-2007 data from the Nigerian Meteorological Agency). Its vegetation is the tropical rainforest type such that the area favours the cultivation of cash crops and food crops. Although there are people from other parts of Nigeria, the major sub-ethnic groups in Osun State are Ife, Ilesha, Oyo, Ibolo and Igbomina. Yoruba and English are the official languages and the people practice Islam, Christianity and Traditional Religious worship.

Data collection and analysis

The study employed both qualitative and quantitative methods of data collection. The instruments used for this study are questionnaire and oral interview which was guided by interview schedule. Osogbo and Olorunda Local Government Areas (LGA) are the closest to the grove. There are ten political wards close to the grove in the LGAs in which each is distinctively distributed along seven streets. Residents 18 years and above in each of the streets were sampled. Two hundred (200) respondents (100 respondents each from Osogbo and Olorunda LGAs) were purposively sampled for the study. In-depth interviews were conducted with key informants and staff of OOSG. The data were analyzed using descriptive statistics of frequencies, percentages, means and standard deviation while multinomial logit regression analysis was carried out to identify the factors influencing tourism acceptability.

Result and Discussion

Socio-demographic characteristics of respondents and tourism awareness

The findings show that there were more male respondents (55%) than the females which is consistent with the 2006 Census (NPC, 2006) and estimates by CIA (2014) that put the sex ratio of the country's total population at 1.06:1.00 male/female. Most of the respondents (66.5%) were 20-49 years old which agrees with Nigeria's age distribution in 2008 that indicated the dominant age group at 15-64 years (NMEC, 2008). Thus, the participation of both the young and relatively-aged in this study would give the results a balanced view and thereby complement the earlier work by Olatunji and Ezenagu (2016) which gave a similar report for tourism promotion in Osun State. The religious inclinations of respondents show that 44.0 and 43.5% practiced Christianity and Islam respectively. Oladokun *et al*. (2014) had reported 37.0% as Christians in Osogbo metropolis which is lower than the result in this study. A higher percentage (59%) of the respondents was married which indicates that majority of the residents were emotionally stable with household size of mainly 1 to 5. The educational attainment of the respondents shows 31% without formal education while 16, 23.5, 26 and 3.5 had primary, secondary, tertiary and adult/vocational education

respectively. The literacy level at 69.0% is higher than the national estimated literacy rate of 61.3% (CIA, 2014) but the literacy distribution pattern indicates that the study area is not really an urban setting and it is still developing. The sample population had most as indigenes (58.5%) and 41.5% as immigrants. Also, most of the respondents were traders (27.5%) followed by civil servants (17%), artisans (16.5%) and farmers (9.5%). This shows that the communities are dominated by traders whose businesses are sustained by the presence of the grove and the high patronage from visitors. All the respondents were aware of tourism development at the grove because the Osun Osogbo Festival is a yearly activity which is the most celebrated compared to other religious festivals around the grove. It pulls a considerable number of tourists adding directly and/or indirectly to the social and economic life of the people.

Attractions in Osun Osogbo Sacred Grove as identified and ranked by residents

Tourist attractions in the destination were identified as sanctuaries and shrines, the festivals, forests and grove, traditional war fence, traditional arts and craft which fall under cultural and natural environment (Table 2). This distribution of tourist attractions complements Aremu, (2001) that the development and projection of Nigeria's natural and cultural resources would remain the centerpiece of tourism awareness in Nigeria. Festival (4.59) had the highest mean score and was seen as the major attraction by the respondents followed by Historical Buildings and Monuments (4.46), Sanctuaries and Shrines (4.37) while Sculpture had the least (3.75). This agrees with Fakiyesi (2008) that Nigeria possesses natural and cultural resources which are capable of attracting tourists.

Table 1: Socio-demographic characteristics of respondents at Osun Osogbo Sacred Grove

Variables	Freq (N)	Percent (%)
Gender		
Male	110	55.0
Female	90	45.0
Age		
0-19	2	1.0
20-29	54	27.0
30-39	33	16.5
40-49	46	23.0
50-59	41	20.5
60andabove	24	12.0
Marital Status		
Single	50	25
Married	119	59.5
Divorced	12	4.0
Widowed	8	6.0
Separated	1	5.5
Household Size		
1-5	118	59
6-10	71	35.5
11-15	11	5.5
Level of Education		
Non-formal	62	31.0
Primary	32	16.0
Secondary	47	23.5
Tertiary	52	26.0
Adult/Vocational	7	3.5

Occupation		
Artisan	33	16.5
Farmer	19	9.5
Trading	55	27.5
Civil Servant	34	17.0
Retiree	9	4.5
Others	50	25.0
Religion		
Christianity	88	44.0
Islam	87	43.5
Traditional Worshipper	24	12.0
No Religion	1	0.5
Ethnic Origin		
Indigene	117	58.5
Immigrant	83	41.5
Awareness of Tourism Devt. in OOSG	20	100

Table 2: Summary of various Tourist Attractions in Osun Osogbo Sacred Grove As described by the Respondents

VARIABLES	SA	A	U	D	SD	Mean	ST.DEV.	Rank
Sanctuary and Shrine	123	55	7	9	6	4.37	0.97	3rd
Sculpture	36	100	48	13	3	3.75	0.87	8th
Traditional Arts and Craft	97	67	22	8	6	4.18	0.99	5th
Forests/grove	105	73	11	7	4	4.32	0.89	4th
Theatres	49	82	53	13	3	3.79	0.93	7th
Historic Buildings and Monuments	110	81	2	6	1	4.46	0.72	2nd
Festivals	135	58	3	1	3	4.59	0.69	1st
Traditional War Fence	57	94	34	11	4	3.93	0.93	6th

Perception of Economic Impacts by Respondents

Table 3 presents the respondents' perceived opinions of the economic impacts of tourism activities in OOSG on the host communities. The mean score ranking shows that the higher scores were for the perceived economic impacts which include: employment opportunities (4.11), increase in income (3.97), better public security (3.93) and attraction of small-scale industry (3.89). The lower scores are for the economic impacts that the respondents disagreed with and these are: deterioration of quality of life (2.07), increase in cost of land (2.11), increase in prices of goods (2.14) and increased transportation cost (2.19). Onyebinama *et al.* (2008) had noted that tourism development tends to attract residents away from their traditional economic activities such as farming, fishing. This is because it generates employment (direct, indirect and induced). Overall, the respondents agreed that tourism has the tendency to increase the quality of life, attract small scale industries and provide job opportunities. This is because some of the respondents are involved in tourism activities as small retail shop owners, transportation providers and artisans which bring direct economic benefit to them. This has informed the support towards tourism development in the grove (Fig. 1). According to Gursoy and Rutherford (2004), residents tend to view tourism as a tool that creates job opportunities and generates additional revenue for local community and government. Generally, the residents perceived that tourism increases their quality of life (Besculides *et al.,* 2002).

Table 3: Perception of Economic Impact of Tourism Development on Host Communities

Variables	SA	A	U	D	SD	Mean	ST.DEV.
Employment Opportunities	77	97	7	9	10	4.11	1.02
Increased Income	56	111	11	15	7	3.97	0.98
Improved Infrastructures	17	38	19	84	42	2.52	1.25
Standard of Living Quality of Life	16	55	24	67	38	2.72	2.49
Creation of Variety of Jobs	24	152	5	14	5	3.88	0.79
Electricity Supply	18	32	9	73	68	2.30	1.33
Water Supply	13	26	7	87	67	2.16	1.21
Transportation Cost	8	30	18	80	64	2.19	1.16
Increased in Cost of Land	5	26	22	79	68	2.11	1.09
Deterioration of Quality of Life	7	24	12	89	68	2.07	1.09
Increase in Price of Good	12	20	15	89	64	2.14	1.15
Road Condition	2	39	10	82	67	2.14	1.11
Increased Tourism help community grow	30	140	9	14	7	3.86	0.87
Health and Safety are more Secured	41	117	24	14	4	3.89	0.88
Attraction of Small Scale Industry	31	132	23	11	3	3.89	0.78
Better Public Security	49	112	23	8	8	3.93	0.94
Overcrowding	61	80	29	18	12	3.80	1.14

Perception of Social Impacts by Respondents

Most of the respondents agreed that tourism was the major reason for increased entertainment in their community, had positive influence on cultural activities, increased residents' pride in local culture and provision of more recreational opportunities with mean scores of (4.15, 4.08, 4.05 and 4.03 respectively). Majority of the respondents disagreed to difficulty in getting tickets during the tourist peak season (2.23) since the festive celebration is opened to everybody. This corroborates the findings of Besculides *et al.* (2002) on the residents' perceptions of the cultural benefits of tourism. A higher percentage of the respondents agreed to the negative social impacts of tourism development which include: increased traffic congestion (3.96), increased prostitution (3.96) and increase in crime rate (3.94), especially during the peak tourist season (Table 4). Drawing from the social exchange theory which stated that individuals will engage in exchange if the resulting rewards are valued and the perceived cost does not exceed the perceived rewards (Brunt and Courtney 1999). The respondents viewed the rewards higher than the cost which informed the positive impact.

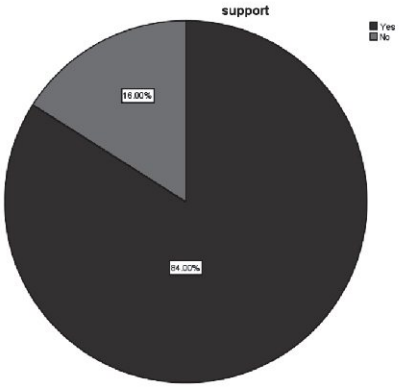

Figure 1: Respondent Support for tourism activities in Osun Osogbo Grove

Table 4: Perception of Socio Impact of Tourism Development on Host Communities

Variables	SA	A	U	D	SD	Mean	ST.DEV.
Increased Entertainment	69	106	11	7	7	4.15	0.92
Difficulty in getting ticket	8	28	8	57	99	2.23	1.21
Recreational Opportunity	28	155	7	7	3	4.03	0.67
Increased Residents Pride	41	139	10	4	6	4.05	0.77
Negative Influence on Cultural Activities	32	101	15	16	36	3.47	1.34
Positive Influence on Cultural Activities	41	139	13	4	3	4.08	0.69
Meeting Tourists is a life Enriching Experience	33	129	17	15	6	3.92	0.89
Cultural Exchange is Valuable	38	126	19	11	6	3.95	0.88
Increase in Prostitution	50	109	11	21	9	3.96	1.05
Crime Problem	50	103	15	24	8	3.94	1.06
Traffic Congestion Problem	50	106	14	23	7	3.96	1.03
Increased Gambling	44	104	24	20	8	3.88	1.02
Increased Noise Level	54	98	22	19	7	3.96	1.03

Influence of Negative Perception of the Respondents on Tourism Acceptability in Osun Osogbo Sacred Grove

The multinomial logit regression used to assess the perception of the host community on tourism acceptability (Table 5) involved the negative perception items as the independent variable and their support for tourism as the dependent variable which carries the multiple option of "yes or no" as shown in Fig. 1. The Likelihood Ratio Statistics of the regression model presented reveals that increase in transportation cost, increase in cost of land, increase in cost of goods and services, deterioration in the quality of life, deterioration of road condition, negative influence on cultural activities, increase in prostitution, increase in crime, increase in traffic, increase in gambling and increase in noise level are the 11 negative perception items included in the model. The items negative influence on cultural activities and increase in prostitution were significant ($p<0.05$). This implies that increase in prostitution and the negative influence of tourism on cultural activities were the only significant variable influencing tourism acceptability and can also influence the acceptability of tourists and tourism development in the area. This agrees with Jurowski and Uysal (2002) that negative economic, together with social and environmental factors, will influence resident perceptions of tourism and their support for tourism development

Table 5: Effects of negative perceptions of the Multinomial Logit Regression on tourism acceptability

Effect	Model Fitting criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	Df	Sig.
Intercept	81.619[a]	0.000	0	.
Increased transportation	84.177	2.558	4	.634
Increased cost of land	85.968	4.349	4	.361
Increased price of goods	85.584	3.965	4	.411
Deterioration of quality of life	83.913	2.295	4	.682
Deterioration of road	84.302	2.683	4	.612
Negative influence on cultural activity	95.808	14.189	4	.007
Increased prostitution	95.488	13.869	4	.008
High crime	87.704	6.085	4	.193
Traffic problem	89.818	8.199	4	.085
Increased gambling	89.403	7.784	4	.100
Increased noise	86.941	5.322	4	.256

Significant at $p<0.05$

Conclusion

This paper has examined the influence of communities' perception on tourism acceptability in Osun Oshogbo Scared Grove. Both natural and cultural resources were identified as major attractions in the grove capable of attracting a large number of tourists and as such creating impacts on the host communities. Tourism at the grove has been perceived to have both positive and negative impacts on the host communities in terms of economic and social changes. Moreover, the respondents viewed the rewards higher than the cost which was responsible for the positive impact and support towards tourism development in the grove. The negative influence on cultural activities and increase in prostitution were the two negative perceptions that had significant effects on tourism acceptability in the grove. These negative perceptions are capable of threatening the survival of tourism destinations if measures and policies are not developed to address the negative issues.

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Bio-prediction of Egg Weight and Egg Component Parts at Different Ages in Small-sized Japanese Quails using Pre-broken Egg Traits as Regressors

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Abstract

The present study was conducted on eggs of Japanese quail reared on deep litter at the Teaching and Research Farm, Ekiti State University, Ado-Ekiti. Three hundred eggs were randomly selected for the measurement of egg weight (g), egg length (cm) and egg width (cm); and broken to collect data of shell weight (g), albumin weight (g) and yolk weight (g) at different ages. A number of equations were developed to predict the egg weight and post-broken traits from pre-broken traits at the different ages. The prediction equations of egg weight at different ages showed that the associations were significant ($P<0.01$) and positive with adjusted R^2 at 22.1-25.9, 17.1-19.5 and 31.6-36.6% for egg length, egg width and egg length + width respectively. Egg shell weight was predictable with sufficient accuracy ($P<0.01$) from egg weight + egg length (R^2 = 8.1-9.3%); egg weight + egg width (R^2 = 7.7-9.1%) and egg weight + egg length + egg width (R^2 = 8.8-10.1%) across the ages. Egg albumin was predictable ($P<0.01$) from egg weight + egg length (R^2 = 71.5-76.3%); egg weight + egg width (R^2 = 71.9-77.9%) and egg weight + egg length + egg width (R^2 = 73.1-79.3%). The weight of egg yolk was predictable ($P<0.01$) from egg weight, length and width (, R^2 = 69.9-78.2%); from egg weight and width (R^2 = 61.4-66.8%) and from egg weight and length (R^2 = 40.0 to 48.3%). This study showed that *in vivo* prediction based on single trait was not as reliable compared to the use of more than one trait.

Key words: Deep litter, Japanese quail, post-broken, prediction equations,

Introduction

One of the major products of laying birds is the egg which can be used for breeding, sold to augment the farmers' financial needs or eaten to supply cheap and readily available animal protein (Orji *et al.*, 1998 and Khurshid *et al.*, 2003). The main components of an egg are shell, albumin and yolk (which exist in varying proportions among the different poultry species. However, the important traits that are measurable in avian eggs include the egg weight, width and length; shell weight, thickness and strength; albumin weight and height; and yolk weight and height. The egg weight, width and length are usually determined before breaking the eggs while information on the other traits can only be obtained after breaking the egg. Broken eggs are not useful, so it is imperative to develop some prediction equations that could provide information on shell weight, yolk weight and albumin weight without breaking eggs.

Information on egg weight along with egg width and length will further open the domain for trying out various prediction equations in order to determine the post-broken traits of eggs. Egg weight was easily predictable from egg length and width because of the positive association among these traits (Farooq *et al.*, 2001). The egg weight is an important trait which influences egg quality as

well as grading (Farooq *et al.*, 2001) while the shell, though non-edible, serves as a protective medium for the edible internal components- the albumen and yolk. The yolk contains all the fat and most of the vitamins in the egg while the albumin contains all the protein. Egg length is the long border of an egg while the egg width is the short border because the length predominate the width.

The relationship existing among these egg component traits can be exploited for genetic improvement strategies. The *in vivo* prediction based on single trait has been challenged because of its unreliability compared to the use of more than one trait (Raji *et al.*, 2009). It is, therefore, the aim of this study to provide information on the relationships between egg weight, shell, albumin and yolk weights and how these traits can be used singly and jointly in accurate predictions

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Materials and Methods

This study was carried out at the Aviary Unit, Teaching and Research Farm, of Ekiti State University, Ado-Ekiti. The eggs were collected from one hundred layers of Japanese quails at 8.00 am and 5.00 pm daily at week 6, 10, 14, 18, 22, 26, 30, 34, 38, 42 and 46 of age. Three hundred eggs were randomly selected to measure the egg weight (g), egg length (cm), egg width (cm); and broken to determine the shell weight (g), albumin weight (g) and yolk weight (g) at the different ages. The egg weight was determined using a digital scale sensitive to 0.01 g by gently placing the whole egg on the flat surface of the scale. Measurements of the internal components were obtained by carefully making an opening around the sharp end of the egg, large enough to allow passage of both the albumin and the yolk through it without mixing their contents together. The yolk was carefully separated from the albumen and the weights determined on wet basis. Regression analysis of the traits was carried out at different ages using SPSS version 18, 25 statistical packages.

The following model was used for prediction of egg weight, shell weight, albumin and yolk weights using egg length, width and egg weight as independent variables in different cases:

$$\dot{Y} = ß_0 + ß_1SW + ß_2AW + ß_3YW + e$$

where, $\dot{Y}$ is the response variable, ß is the intercept, $ß_1$, $ß_2$, $ß_3$ are the partial regression coefficients, SW, AW and YW are shell weight, albumen weight and yolk weight, respectively, e is the residual term.

Results and Discussion

Prediction of egg weight from egg length and width

The prediction equations of egg weight from egg length, egg width and egg length + egg width at different ages in small-sized Japanese quails are presented in Table 1. The association of egg length and width singly and jointly with egg weight was significant ($P<0.01$) and positive similar to results obtained by Farooq *et al.* (2001) such that egg weight was predictable with sufficient accuracy. The ranges of adjusted R^2 values for egg length, egg width and egg length + width as predictors of egg weight are 22.1-25.9%, 17.1-19.5% and 31.6-36.6% of the fitted models across the ages, respectively. The range of values obtained in this study agrees with the 23.13%, 17.81% and 31.86% reported by Khurshid *et al.* (2003) for egg length, egg width and egg length + egg width, respectively and the R^2 of 21.10% for egg length and 16.82% for egg width reported by

Fajemilehin (2008). Comparing the R^2 values of the predictors, it is clear that using the two traits jointly is more accurate than using the traits singly as reported by Raji *et al.* (2009) and Wawro (1990) that *in vivo* prediction based on single trait is not as reliable compared to the use of more than one trait. However, any one of the equations in the table can be used for predicting egg weight from egg length at the equivalent age

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Predicting shell weight from egg weight, length and width

The shell weight cannot be accurately known until the egg is broken and the internal contents which include the thin membrane, albumin and yolk are removed. Nevertheless, prediction equations can be developed to obtain information about this trait pre-broken. Table 2 shows the prediction equations of egg shell weight from egg weight, egg length and egg width at different ages in small-sized Japanese quails.

Table 1: Prediction equations of egg weight (μ) from egg length (y_1) and egg width (y_2) at different ages in small-sized Japanese quails

	Egg length (y_1)	R^2 (%)	Egg width (y_2)	R^2 (%)	Egg length + Egg width	R^2 (%)
Wk 6	$\mu = 7.447 + 0.986(y_1)$	23.2	$\mu = 4.940 + 0.774(y_2)$	16.5	$\mu = 8.027 + 1.104(y_1) - 0.143(y_2)$	34.6
Wk 10	$\mu = 4.172 + 0.935\ (y_1)$	23.3	$\mu = 5.688 + 0.830\ (y_2)$	18.6	$\mu = 4.122 + 0.726(y_1) + 0.273\ (y_2)$	31.6
Wk 14	$\mu = 3.424 + 0.923\ (y_1)$	25.4	$\mu = 3.891 + 0.577(y_2)$	17.1	$\mu = 6.290 + 1.484\ (y_1) - 0.668\ (y_2)$	36.6
Wk 18	$\mu = 6.117 + 0.614(y_1)$	25.9	$\mu = 8.228 + 0.204(y_2)$	17.8	$\mu = 9.334 + 2.170(y_1) - 1.738(y_2)$	35.5
Wk 22	$\mu = 7.169 + 0.322(y_1)$	23.5	$\mu = 4.687 + 0.525(y_2)$	19.5	$\mu = 4.172 - 0.744(y_1) + 1.191(y_2)$	32.8
Wk 26	$\mu = 5.372 + 0.989(Y_1)$	22.1	$\mu = 4.717 + 0.593(y_2)$	18.6	$\mu = 5.537 + 1.007(y_1) - 0.029(y_2)$	35.7
Wk 30	$\mu = -14.797 + 0.564(y_1)$	23.0	$\mu = -44.084 + 0.565(y_2)$	19.3	$\mu = -31.528 + 0.282(y_1) + 0.304(y_2)$	33.8
Wk 34	$\mu = 0.585 + 0.569(y_1)$	25.8	$\mu = 9.209 + 0.062(y_2)$	17.8	$\mu = -0.061 + 1.491(y_1) - 1.142(y_2)$	35.3
Wk 38	$\mu = -85.500 + 0.967(y_1)$	22.4	$\mu = 75.938 - 7.022(y_2)$	18.1	$\mu = -73.232 + 0.898(y_1) - 0.075(y_2)$	34.2
Wk 42	$\mu = -3.259 + 0.961(Y_1)$	23.9	$\mu = 1.683 + 0.692(Y_2)$	18.5	$\mu = -4.164 + 0.840(y_1) + 0.212(y_2)$	32.9
Wk 46	$\mu = -17.266 + 0.855(Y_1)$	24.2	$\mu = -8.583 + 0.666(Y_2)$	18.8	$\mu = -19.852 + 0.705(y_1) + 0.263(y_2)$	32.6

Eggshell weight was predictable with sufficient accuracy from egg weight + egg length ($P<0.01$, R^2 = 8.1-9.3%); egg weight + egg width ($P<0.01$, R^2 = 7.7-9.1%) and egg weight + egg length + egg width ($P<0.01$, R^2 = 8.8-10.1%) across the ages. The result agrees with the findings of Fajemilehin (2008) who obtained negative association between egg weight and shell weight and positive associations with egg length and width with R^2 of 8.8% when the three traits were used as regressors and 7.4%, 8.2% and 8.4% respectively when egg length, egg width and egg weight were used singly as a regressor in helmeted guinea fowl. However, the R^2 values obtained in this study are higher than the R^2 of 7.1-7.85% reported by Khurshid *et al.* (2003) in Japanese quails.

Predicting weight of egg albumin from egg weight, egg length and egg width

Table 3 shows the prediction equations of egg albumin weight from egg weight, egg length and egg width at different ages in small-sized Japanese quails. The weight of egg albumin was predictable from egg weight + egg length ($p<0.01$, R^2 = 71.5-76.3%); egg weight + egg width ($P<0.01$, R^2 = 71.9-77.9%) and egg weight + egg length + egg width ($P<0.01$, R^2 = 73.1-79.3%) with enough accuracy. The result agrees with the findings of Khurshid *et al.* (2003) who noted that weight of egg albumin was predicted from egg weight + egg width ($p<0.01$, R^2 = 72.75%); egg weight + egg

length ($P<0.01$, R^2 = 72.24%) and egg weight + egg length + egg width ($P<0.01$, R^2 = 72.71%).

Predicting weight of egg yolk from egg weight, length and width:

Table 4 shows that the weight of egg yolk was predictable with from egg weight, length and width ($P<0.01$, R^2 = 69.9-78.2%); from egg weight and width ($P<0.01$, R^2 = 61.4-66.8%); and from egg weight and length ($P<0.01$, R^2 = 40.0 to 48.3%). This result is similar to the report by Khurshid *et al.* (2003) using egg weight and width to predict the weight of egg yolk.

Table 2: Prediction equations of egg shell weight (μ_1) from egg weight (y_3), egg length (y_1) and egg width (y_2) at different ages in small-sized Japanese quails

	Egg weight (y_3)+length	R^2 (%)	Egg weight (y_3)+width (y_2)	R^2 (%)	Egg weight (y_3) + length (y_3) + width (y_3)	R^2 (%)
Wk 6	$\mu_1 = 37.211 - 4.779(y_3) + 4.458(y_1)$	8.8	$\mu_1 = 6.92 - 1.458(y_3) + 1.386(y_2)$	8.7	$\mu_1 = 20.642 - 3.129(y_3) + 1.945(y_1) + 1.058(y_2)$	9.5
Wk 10	$\mu_1 = 4.482 - 0.984(y_3) + 0.624(y_1)$	8.1	$\mu_1 = 5.997 - 1.557(y_3) + 1.393(y_2)$	7.7	$\mu_1 = 7.377 - -2.258(y_3) + 0.730(y_1) + 1.415(y_2)$	9.0
Wk 14	$\mu_1 = 5.489 - 0.429(y_3) - 1.114(y_1)$	8.6	$\mu_1 = 10.407 - 0.400(y_3) - 0.346(y_2)$	8.0	$\mu_1 = -33.787 + 5.170(y_3) - 8.461(y_1) + 3.538(y_2)$	8.8
Wk 18	$\mu_1 = 1.802 - 0.408(y_3) + .572(y_1)$	8.6	$\mu_1 = -0.088 - 0.139(y_3) + 0.405(y_2)$	8.0	$\mu_1 = 35.644 - 4.447(y_3) + 9.575(y_1) - 7.287(y_2)$	9.2
Wk 22	$\mu_1 = 8917.644 - 0.403(y_3) - 0.747(y_1)$	8.9	$\mu_1 = 9142.523 - 0.198(y_3) - 0.848(y_2)$	7.1	$\mu_1 = 9218.540 - 0.263(y_3) - 0.317(y_1) - 0.530(y_2)$	9.1
Wk 26	$\mu_1 = 9.684 - 4.750(y_3) + 4.032(y_1)$	8.4	$\mu_1 = 3.312 - 0.914(y_3) + 0.253(y_2)$	7.9	$\mu_1 = 9.498 - 4.699(y_3) + 3.943(y_1) + 0.063(y_2)$	9.8
Wk 30	$\mu_1 = 1.128 - 0.819(y_3) + 0.229(y_1)$	7.3	$\mu_1 = 2.202 - 0.666(y_3) - 0.042(y_2)$	7.6	$\mu_1 = 6.810 - 0.743(y_3) + 1.284(y_1) - 1.187(y_2)$	10.1
Wk 34	$\mu_1 = 12.328 - 0.142(y_3) - 0.898(y_1)$	8.4	$\mu_1 = 11.581 - 0.609(y_3) - 0.711(y_2)$	8.9	$\mu_1 = 12.309 - 0.216(y_3) - 0.754(y_1) - 0.126(y_2)$	9.5
Wk 38	$\mu_1 = 2.499 + 1.238(y_3) - 0.258(y_1)$	9.3	$\mu_1 = -2.159 + 1.299(y_3) + 0.344(y_2)$	9.1	$\mu_1 = -2.159 + 1.299(y_3) + 0.344(y_2)$	9.2
Wk 42	$\mu_1 = -6.151 - 2.402(y_3) + 2.309(y_1)$	8.5	$\mu_1 = 2.633 - 0.235(y_3) + 0.077(y_2)$	7.8	$\mu_1 = -12.379 - 3.591(y_3) + 3.090(y_1) + 0.632(y_2)$	9.2
Wk 46	$\mu_1 = 7.378 - 0.431(y_3) - 0.602(y_1)$	8.2	$\mu_1 = 4.407 - 0.869(y_3) - 0.115(y_2)$	8.5	$\mu_1 = 7.986 - 0.357(y_3) - 0.601(y_1) - 0.112(y_2)$	9.2

Table 3: Prediction equations of albumin weight (μ) from pre-broken traits singly and jointly at different ages in small-sized Japanese quails

	Egg weight (y_3) + length (y_1)	R^2 (%)	Egg weight (y_3) + width (y_2)	R^2 (%)	Egg weight (y_3) + length (y_3) + width (y_3)	R^2 (%)
Wk 6	$\mu_3 = 69.89 - 4.839(y_3) + 4.602(y_1)$	73	$\mu_3 = 14.357 - 1.411(y_3) + 1.431(y_2)$	72.6	$\mu_3 = 39.513 - 3.137(y_3) + 2.017(y_1) + 1.092(y_2)$	73.1
Wk 10	$\mu_3 = 10.411 - 0.680(y_3) + 0.680(y_1)$	73	$\mu_3 = 15.900 - 1.304(y_3) + 1.519(y_2)$	73.8	$\mu_3 = 20.906 - 2.069(y_3) + 0.796(y_1) + 1.543(y_2)$	79.1
Wk 14	$\mu_3 = 12.211 - 1.594(y_3) + 0.709(y_1)$	71.5	$\mu_3 = 10.440 - 1.304(y_3) + 0.283(y_2)$	77.3	$\mu_3 = 17.415 - 2.825(y_3) + 2.615(y_1) - 0.918(y_2)$	73.5
Wk 18	$\mu_3 = -5.450 - 0.167(y_3) + 1.022(y_1)$	72.4	$\mu_3 = -16.853 + 0.286(y_3) + 0.853(y_2)$	71.9	$\mu_3 = -63.504 + 2.239(y_3) - 4.339(y_1) + 4.339(y_2)$	79.1
Wk 22	$\mu_3 = 15.450 - 0.196(y_3) + 0.884(y_1)$	76.3	$\mu_3 = 15.040 - 0.031(y_3) - 0.856(y_2)$	72.5	$\mu_3 = 15.340 - 0.238(y_3) - 1.011(y_1) + 0.157(y_2)$	73.9
Wk 26	$\mu_3 = 8.258 - 1.157(y_3) + 1.497(y_1)$	73.2	$\mu_3 = 4.839 + 0.763(y_3) - 0.741(y_2)$	77.9	$\mu_3 = 13.419 - 1.862(y_3) + 2.734(y_1) - 0.873(y_2)$	74.3
Wk 30	$\mu_3 = 3.224 + 0.550(y_3) + 0.471(y_1)$	73.3	$\mu_3 = -0.248 + 0.458(Y_3) + 0.633(y_2)$	77.5	$\mu_3 = -1.907 + 0.485(y_3) - 0.443(Y_1) + 1.028(y_2)$	76.2
Wk 34	$\mu_3 = 10.793 + 0.912(y_3) - 0.776(y_1)$	75.8	$\mu_3 = 12.678 + 0.520(y_3) - 0.806(y_2)$	73.8	$\mu_3 = 10.257 - 0.129(Y_3) + 1.249(Y_1) - 1.775(Y_2)$	76.3
Wk 38	$\mu_3 = -20.548 - 1.486(y_3) + 1.776(y_1)$	74.5	$\mu_3 = 34.248 - 1.701(y_3) - 2.143(y_2)$	72.1	$\mu_3 = 30.478 - 1.854(y_3) + 0.208(y_1) - 2.088(y_2)$	75.1
Wk 42	$\mu_3 = 11.696 - 2.162(y_3) + 1.421(y_1)$	75.4	$\mu_3 = 27.150 - 0.829(y_3) + 0.047(y_2)$	77.0	$\mu_3 = 0.739 - 2.894(Y_3) + 1.902(Y_1) + 0.389(Y_2)$	79.3
Wk 46	$\mu_3 = -1.161 - 1.356(y_3) + 0.690(y_1)$	72.9	$\mu_3 = 8.023 - 0.930(y_3) + 0.246(y_2)$	74	$\mu_3 = -5.516 - 1.516(Y_3) + 0.688(y_1) + 0.243(y_2)$	71

Table 4: Prediction equations of yolk weight (μ_4) from pre-broken traits at different ages in small-sized Japanese quails

	Egg weight (y_3) + length (y_1)	R^2 (%)	Egg weight (y_3) + width (y_2)	R^2 (%)	Egg weight (y_3) + length (y_3) + width (y_3)	R^2 (%)
Wk 6	$\mu_4 = 53.060 - 4.822(y_3) + 4.554(y_1)$	40.30	$\mu_4 = 10.149 - 1.429(y_3) + 1.416(y_2)$	62.9	$\mu_4 = 29.588 - 3.137(y_3) + 1.996(y_1) + 1.080(y_2)$	73.2
Wk 10	$\mu_4 = -1.720 + 0.901(y_3) - 0.938(y_1)$	47.90	$\mu_4 = -3.869 + 1.162(y_3) - 1.370(y_2)$	66.80	$\mu_4 = -8.608 + 2.163(y_3) - 1.043(y_1) - 1.402(y_2)$	72.3
Wk 14	$\mu_4 = 11.456 - 1.621(y_3) + 1.177(y_1)$	42.1	$\mu_4 = 6.785 - 0.745(y_3) + 0.366(y_2)$	65.1	$\mu_4 = 48.769 - 6.632(y_3) + 8.942(y_1) - 3.739(y_2)$	69.9
Wk 18	$\mu_4 = 6.254 - 0.917(y_3) - 0.119(y_1)$	47.8	$\mu_4 = 6.422 - 0.972(y_3) - 0.090(y_2)$	67.6	$\mu_4 = 4.879 - 0.505(y_3) - 1.037(y_1) + 0.742(y_2)$	77.1
Wk 22	$\mu_4 = 0.831 + 0.966(y_3) - 0.487(y_1)$	43.3	$\mu_4 = 0.485 + 0.969(y_3) - 0.305(y_2)$	64.3	$\mu_4 = 0.608 + 0.709(y_3) - 1.275(y_1) + 0.974(y_2)$	78.2
Wk 26	$\mu_4 = 21.605 - 6.103(y_3) - 6.231(y_1)$	42.3	$\mu_4 = 1.909 - 0.174(y_3) + 0.392(y_2)$	62.4	$\mu_4 = 21.030 - 6.024(y_3) + 6.093(y_1) + 0.097(y_2)$	77
Wk 30	$\mu_4 = -0.138 - 0.381(y_3) + 1.013(y_1)$	47.3	$\mu_4 = -3.011 - 0.295(y_3) + 0.858(y_2)$	64.4	$\mu_4 = 0.780 - 0.367(y_3) + 1.208(y_1) - 0.219(y_2)$	72.6
Wk 34	$\mu_4 = -1.574 + 0.222(y_3) + 0.845(y_1)$	45.1	$\mu_4 = -1.227 + 0.661(y_3) + 0.652(y_2)$	63.3	$\mu_4 = -1.57 + 0.209(Y_3) + 0.871(Y_1) - 0.023(Y_2)$	70.3
Wk 38	$\mu_4 = 0.783 - 1.522(y_3) + 0.606(y_1)$	40	$\mu_4 = 6.711 - 1.664(y_3) - 0.808(y_2)$	62.6	$\mu_4 = 6.711 - 1.664(y_3) - 0.808(y_2)$	73.2
Wk 42	$\mu_4 = -39.842 - 0.022(y_3) + 0.881(y_1)$	47.8	$\mu_4 = -17.572 + 1.166(y_3) - 0.493(y_2)$	61.4	$\mu_4 = -23.925 + 0.788(y_3) + 0.348(y_1) - 0.431(y_2)$	75.7
Wk 46	$\mu_4 = -6.252 - 0.514(y_3) + 1.289(y_1)$	48.3	$\mu_4 = -0.154 + 0.392(y_3) + 0.294(y_2)$	61.4	$\mu_4 = -7.815 - 0.705(y_3) + 1.286(y_1) + 0.288(y_2)$	75.2

Conclusion

1. Egg length and width can individually be used for prediction of egg weight but the prediction was better when egg length and width were used as regressors.
2. Each of albumin and yolk weight was predictable with enough accuracy from egg weight, length and width.
3. Also, egg shell weight was predictable with enough accuracy from egg weight, length and width.
4. Using the predictors jointly was more accurate in predictions compared to using them individually

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Evaluation of Improved Hot Pepper Cultivars (*Capsicum* spp) in Ekiti State, Southwestern Nigeria

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Abstract

The agronomic features of nine (9) hot pepper (*Capsicum annuum*) varieties obtained from EMBRAPA, Brazil (3); NIHORT, Ibadan (4) and local landraces (2) were evaluated in 2013 at the Teaching and Research Farm, Federal University, Oye-Ekiti, Nigeria. The experiment was laid out as a factorial split-plot design with fertilizer as main plot and the varieties as sub-plots in three replicates. Growth indices: plant height, stem girth and number of leaves; yield and fruit parameters: fruit length, fruit girth and pericarp thickness were measured. The agro-economic indicators calculated were incremental yield, net returns and benefit-cost ratio. The varieties differed significantly ($P<0.05$) in the growth and fruit parameters. Two varieties (Z106 and Z107) from Brazil gave significantly ($P<0.05$) higher yields than the local varieties (F104 and F105) and those developed in NIHORT. The profitability of Z106 was the highest followed by Z107 while F104 gave the least due to the low yield recorded as a result of severe disease infection. The study shows that Z106 and Z107 varieties could be adopted for profitable pepper production in Ekiti State.

Keywords: Pepper cultivars, 'Atarodo', cost of production, growth indices, economic analysis

Introduction

Peppers (*Capsicum* spp) are widely cultivated in Nigeria, especially in the savannah agro-ecological zones during the rainy season and in the dry season under irrigation. The popularity is on account of the spicy nature and high nutritional value as pepper supplies large portions of vitamins A and C and minerals in many Nigerian diets. Kelley and Boyhan (2009) had emphasized this high nutritional value as one medium green bell pepper would provide up to 8% of the recommended daily allowance of vitamin A, 180% of vitamin C, 20% of calcium (Ca), 2% of iron (Fe) and substantial amounts of vitamin A and B. *Capsicum annuum* and *Capsicum frutescens* L. are the two pepper species cultivated commonly in Nigeria and other parts of humid to semi-arid tropics where the fruits have widespread use in the culinary, pharmaceutical and beverage industries (Aliyu, 2000).

The average national productivity for Nigeria was 3.85 tons (t).hectare $(ha)^{-1}$ in 2009 (FMARD, 2010) which is low compared to the world average capsicum pepper fruit yield at 13.4 $t.ha^{-1}$ (FAO, 2013). This low productivity on the predominant smallholder farms conforms with reports that pepper yield in the developing countries is probably 10-30% of yield obtained in developed countries due to the local low-yielding varieties being grown, unfavourable weather conditions and production constraints which include the problems of pests and diseases, low soil fertility and poor weed management (Galanihe *et al.*, 2004; Grubben and El-Tahir, 2004; Idowu-agida *et al.*, 2010; Idowu-agida and Ajayi, 2011). Capsicum suffers from a myriad of pests and diseases. The most important pests are mites, thrips, aphids, white flies and caterpillars (*Heliothis* spp, *Spodoptera* spp). The pepper fruit fly (*Coratitis capitata*) feeds on the fruit flesh

leaving the skin. Scale insects and mealy bugs occur mainly on the stems of older plants while the other insects are cutworm, aphids, grasshoppers, leaf miner, seed corn maggots, and pepper weevils (Green *et. al.*, 1991; AVRDC, 2004; Agrios, 2005; Fajimi, 2010). Bacterial wilt is a very serious disease as the infected pepper plants show wilting and death of the growing point and upper leaves. The virus diseases transmitted by aphids, white flies and thrips or by mechanical means and fungal diseases (anthracnose or fruit rot caused by *Colletotrichum gleosporioides* and blight caused by *Phytophthora* spp) cause extensive losses (Fokunang *et al.,* 2001; Grubben and El-Tahir, 2004).

The use of integrated pest management technologies involving many biological products and natural enemies to produce healthy crops with minimal chemical residues is the rule in the developed countries but less applicable in Nigeria. Besides, the chemicals for spraying to control diseases and pests are beyond the reach of the resources-poor farmers. The major step in the control is to identify and use local varieties that have broad general field tolerance to the most important pests and diseases as those with absolute resistance are rarely available (Grubben and El-Tahir, 2004). Attention would be paid to assessing the performance of hot pepper varieties in the production season. EMBRAPA, Brazil and the National Horticultural Research Institute (NIHORT), Ibadan, Nigeria with mandates for vegetable improvement have developed some cultivars of pepper which can be evaluated for performance. The objective of this study was to compare the agro-economic performances of pepper cultivars from Brazil and the local landraces developed by NIHORT with the view to making recommendations on the best varieties for the adoption under the conditions of Ekiti State, Nigeria.

Materials and Methods

Nine (9) cultivars of hot pepper consisting of three developed at EMBRAPA, Brazil: Z106, Z107 and Z108; four from the National Horticultural Research Institute, Ibadan: NHVI-RBig, NHVI-RHBig, NHVI-RC and NHVI-RL; and two local varieties: F104 and F105 were used for the study. The seeds were obtained from the institutions while selected naturally-ripened fruits of local 'Atarodo' pepper varieties were macerated to extract the seeds which were air-dried, bulked and packaged. The seeds were sown in 10-litre trays filled with 1:1 mixture of topsoil and compost to 1.5 cm depth and covered with soil. Watering was done daily and the seedlings were nursed in a 7 4 3 m growth chamber for about six weeks. The seedlings were transplanted to the prepared field at the Teaching and Research Farm (7º48′N and 5º29′E, 530 m above sea level) of Federal University, Oye-Ekiti, Nigeria on the 8th of March 2013. The site is predominantly forest with hydromorphic soil and the land use pattern that showed cultivation of cassava/maize, vegetables, yam in many cycles for a period of 15 years and without history of fertilizer use.

Surface (0-15 cm) soil samples were randomly collected from the plot area, bulked for a composite sample, air-dried and sieved (<2 mm). The sample was analyzed for soil physical and chemical properties using standard laboratory procedures described in Udo *et al.* (2009): particle size distribution using the hydrometer method, soil pH (1:1 soil/water) with a glass electrode pH meter, organic matter by dichromate oxidation, extraction of exchangeable cations with neutral normal ammonium acetate and determination of Na, K and Ca with flame photometer while the Mg was read on an Atomic Absorption Spectrophotometer; exchangeable acidity extraction with 0.01M KCl and titration with 0.01M NaOH; total N by the macro-Kjeldahl method; and available P extraction with Bray P-1 extractant and the molybdenum blue colour read on a spectrophotometer.

The trial was laid out in a split-plot design with three replications. The main plot was the fertilizer treatment (0 and 100 $kg.ha^{-1}$ of NPK 20-10-10) and the sub-plots were the varieties. The size of each plot measured 2 3 m and separated by 1 m path. The seedlings

were transplanted at 0.6 0.5 m. The fertilizer was applied in two splits at 4 and 12 weeks after transplanting by banding while manual weeding operations were carried out as necessary. Plants were monitored weekly for disease symptom expression and evaluated for disease incidence and disease severity. Data were collected on plant height, stem girth and number of leaves weekly. Ripe fruits were harvested twice weekly to determine yield.plant^{-1} and yield.ha^{-1} while fruit parameters: fruit length and girth, pericarp thickness, number of seed.fruit^{-1} and seed weight were measured. Data were subjected to Analysis of Variance (ANOVA) using Statistical Analysis System (SAS) and the means were separated using Least Significant Difference (LSD). Correlation analysis was carried out between number of leaves and fruit yield.plant^{-1} and yield.ha^{-1}.

Gross margin analysis model was used to determine the profitability of each cultivar based on estimated input cost and total revenue. The inputs were valued at farm gate prices at the time of production while the labour cost component consisted of nursery management, land preparations, transplanting, weeding and application of fertilizer and pesticides.

Results

The physical and chemical characteristics of the soil are shown in Table 1. The soil was a neutral (pH=7.0) clay loam with total N (2.10 g.kg^{-1}) and available P (34.61 mg.kg^{-1}). The exchangeable bases were abundant in the order: Ca (21.50)> Mg (1.57)> K (0.67)>Na (0.08 cmol.kg^{-1})

The nature of pepper plant height development over the period of observation is shown in Fig. 1. Plant height increased with time and at 2 WAT, F104 and NHVI-RL produced the tallest plants which differed significantly from Z106. The trend in plant height was Z106>F105>Z107>Z108. At 3 and 4 WAT, F104, NHVI-RL and Z106 gave plants which were significantly taller than Z107 and Z108 while F104 gave the highest value at 5 WAT which differed from F105, NHVI-RH, Z107 and Z108. The tallest plants were from Z106 which did not differ from F104 and NHVI-RC at 6 WAT but Z107 and Z108 were the shortest. NHVI-RL and Z106 were tallest followed by F104 and NHVI-RC at 7 WAT. Fig 2 shows the stem girth of pepper cultivars with time (in weeks). F104 gave the best stem girth over 2-4 WAT during which it was significantly different from Z106, NHVI-RB, Z107 and Z108. The trend was the same at 5 WAT but the varieties were not significantly different. At 6 WAT, F104 and NHVI-RL gave the highest values which differed only from Z107. At 7 WAT, NHVI-RL produced the thickest plants which did not differ from the other varieties.

Table 1: Characteristics of the soil in the experimental site

Properties	Values
pH (H_2O) (1:1)	7.0
Organic matter (g.kg^{-1})	46.03
Total N (g.kg^{-1})	2.10
Available P (mg.kg^{-1})	34.61
Exchangeable cations (cmol.kg^{-1})	
Calcium, Ca	21.50
Magnesium, Mg	1.57
Potassium, K	0.67
Sodium, Na	0.08
Exch. Acidity	0.00
Effective CEC	4.47
Particle size (g.kg^{-1})	
Sand	560
Silt	210
Clay	220
Textural Class	Clay loam

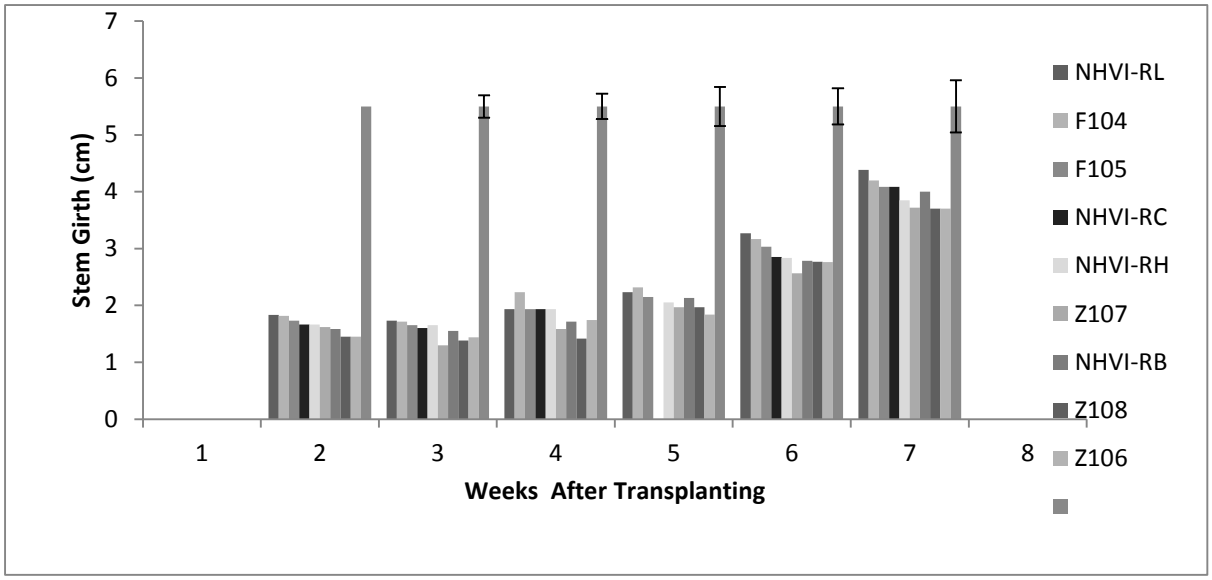

Fig 1: Stem girth development over weeks of 'atarodo' varieties

The number of leaves produced with time is shown in Fig. 3. At 2 WAT, F104 produced higher number of leaves than the other varieties with Z108 least. At 3 WAT, the highest number of leaves was produced by F104 and NHVI-RL while the Z107 and Z108 produced the least. At 4 and 5 WAT, F104 and NHVI-RL produced the highest number of leaves while Z108, NHVI-RH and Z106 produced the least. At 6 WAT, NHVI-RL and F104 produced the highest number of leaves which differed from Z108, NHVI-RH and F105 but Z106, Z107 and NHVI-RB were not different. At 7 WAT, NHVI-RL produced the greater number of leaves than F104 and Z106 while the least were produced by NHVI-RC, Z108 and NHVI-RB.

Fruit yield per plant, fruit length and stem girth, pericarp thickness, seed number and weight in the varieties are shown in Table 2. The parameters significantly differed among the varieties. The highest fruit yield at 235.2 g.plant^{-1} produced by Z106 was significantly different from other varieties. NHVI-RB, NHVI-RC and NHVI-RL gave similar values and were superior to NHVI-RH while F105 was better than F104 at 52.2 g.plant^{-1}. The fruit girth was highest in NHVI-RB which did not differ from NHVI-RC and Z107 while Z104 and Z106 were least. Fruit length was highest in Z106 which was similar to Z104. The pericarp thickness was not different among the varieties. The number and weight of seeds per fruit were least in F104 and Z106 to the highest values in F105.

The ripe fruit yields of the different pepper varieties at 0 and 100 kg.ha^{-1} are shown in Fig. 4. The varieties differed significantly ($P<0.05$) at 0 and 100 kg.ha^{-1} of NPK fertilizer application. At the 0 kg.ha^{-1} rate, Z106 produced the highest yield followed by NHVI-RB, NHVI-RH and Z107 while the least were F104, F105, NHVI-RC and Z108. The pattern was the same at 100 kg.ha^{-1} NPK fertilizer application for Z106 which gave the highest yield but was followed by Z107, NHVI-RC and F105. The effect of fertilizer increased fruit yield slightly in NHVI-RH and NHVI-RL but decreased in NHVI-RB.

Table 2: Fruit yield characteristics in nine varieties of hot pepper

Accession Number	FY/PT(g)	FG(cm)	FL(cm)	PTH(cm)	SN	SW(g)
NHVI-RBig	93.0	7.0	5.3	0.20	73	1.3
NHVI-RHBig	72.0	8.9	4.6	0.20	68	1.4
NHVI-RC	91.8	8.6	5.3	0.20	71	1.3
NHVI-RL	89.4	7.2	5.3	0.19	67	1.4
F104	52.2	5.8	5.5	0.19	57	1.0
F105	76.2	7.5	4.7	0.20	82	1.7
Z106	235.2	4.0	6.2	0.20	57	1.1
Z107	157.2	8.6	3.9	0.20	72	1.4
Z108	77.4	6.9	3.6	0.20	66	1.4
LSD (5%)	6.7	0.9	0.7	0.01	7.5	0.7

FY/PT= Fruit yield per plant, FG= Fruit girth, FL=Fruit length, PTH= Pericarp thickness, SN= Seed number, SW= Seed weight

The pooled average pepper yields of the varieties over the treatments and replicates are presented in Table 3. The highest (7,839 kg.ha^{-1}) fruit yield was obtained from Z106 cultivar followed by Z107 (5,239 kg.ha^{-1}) while the least was obtained from F104 (1,739 kg.ha^{-1}). NHVI-RB produced 3099 kg.ha^{-1} which was slightly higher than NHVI-RC (3059 kg.ha^{-1}) and NHVI-RL (2979 kg.ha^{-1}).

The correlation coefficients of the relationships between plant growth parameters and yield attributes are shown in Table 3. Plant height had significant correlations with stem girth and number of leaves. The fruit yield correlated significantly with only yield.plant^{-1} while fruit girth with number of seeds and number of seeds with seed weight showed significant correlations

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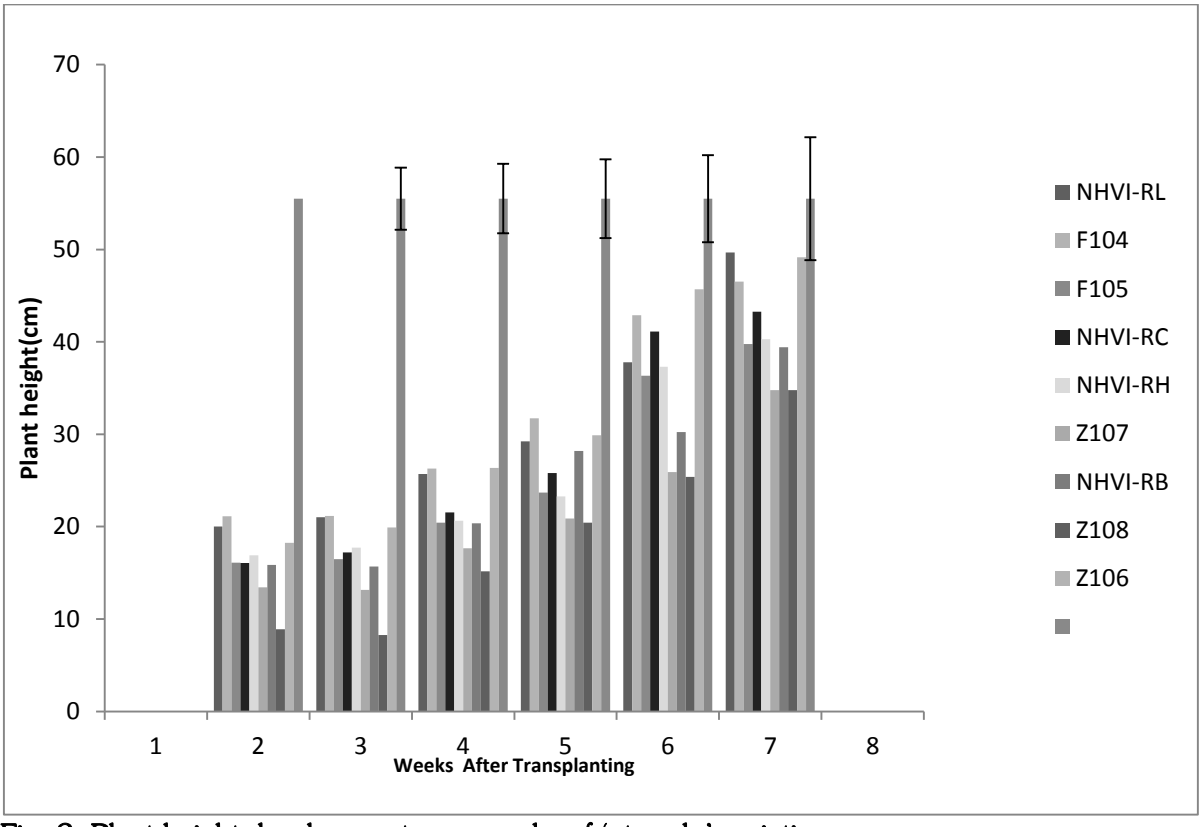

Fig. 2: Plant height development over weeks of 'atarodo' varieties

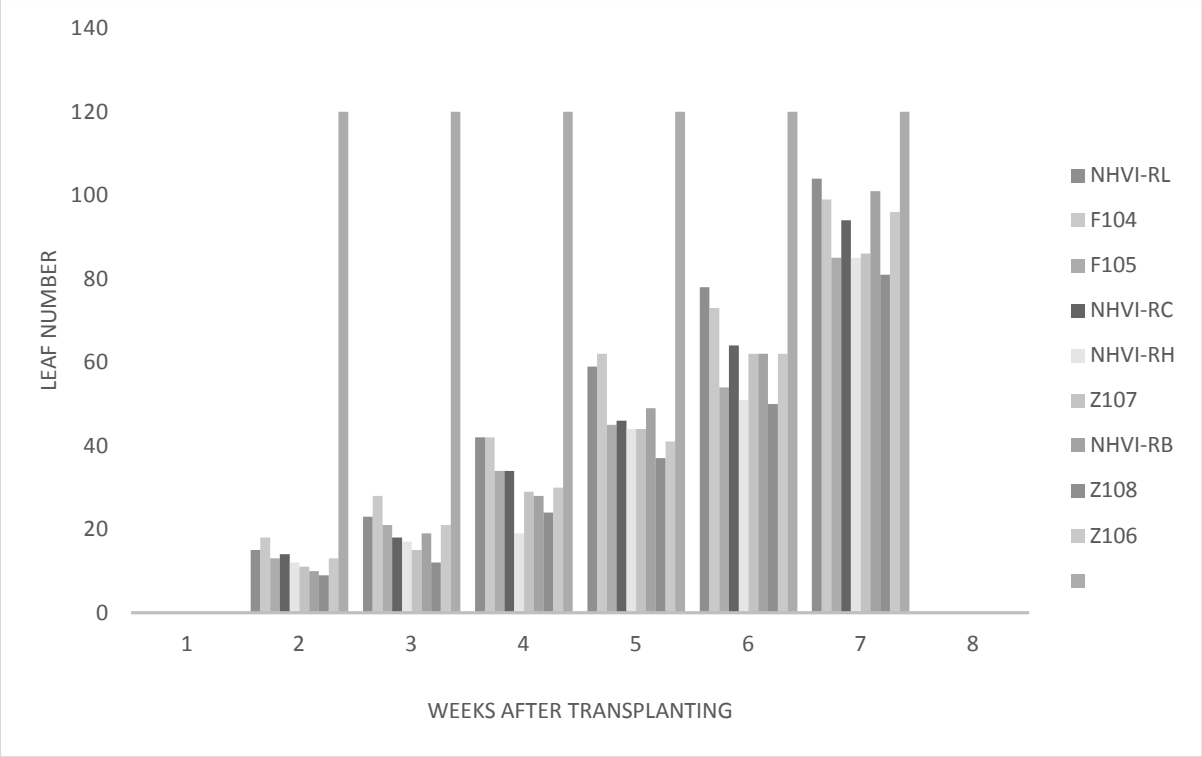

Fig 3: Leaf number development over weeks of 'atarodo' varieties

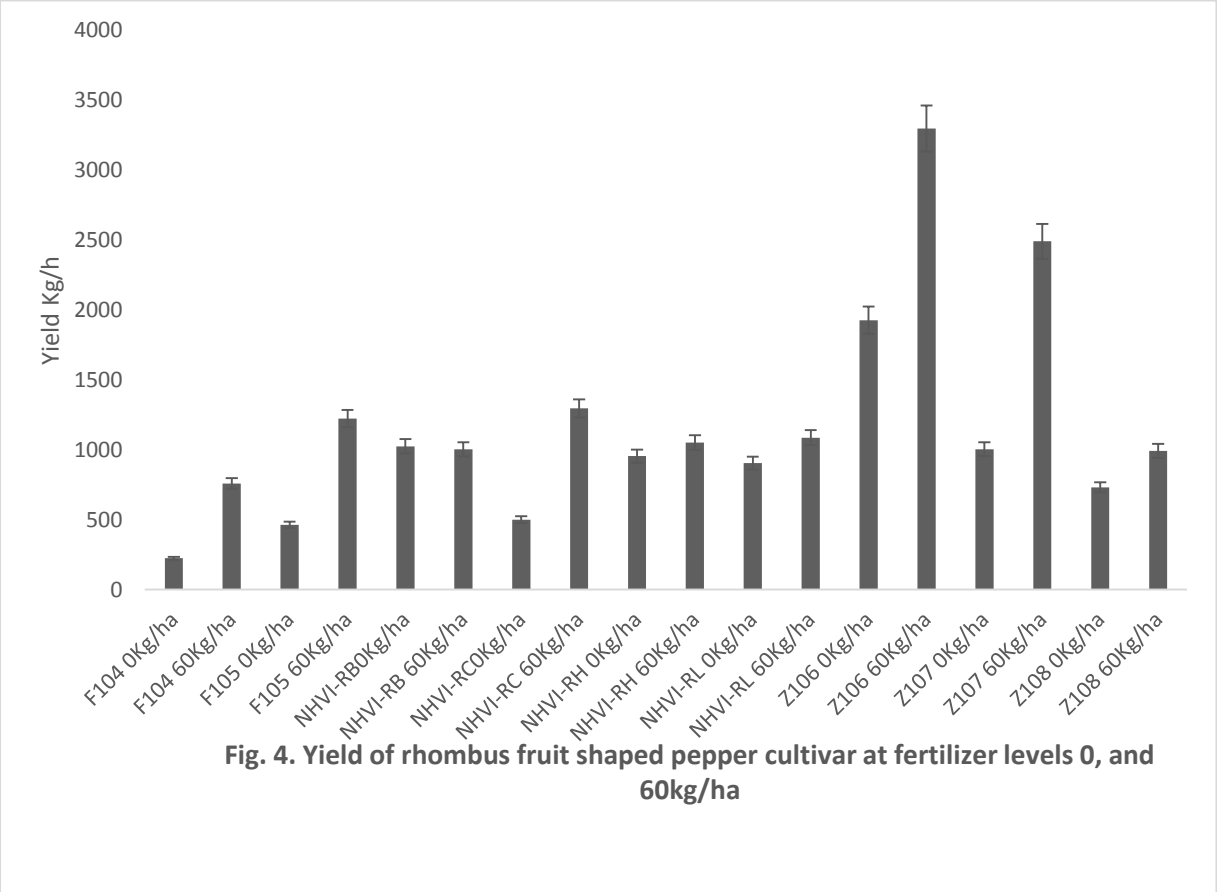

Fig. 4. Yield of rhombus fruit shaped pepper cultivar at fertilizer levels 0, and 60kg/ha

Table 3: Correlation matrix of the relationships between crop growth parameters and fruit yield of hot pepper cultivars

SG	PH	LN	Y/p	F girth	F length	P thick	S no	S wt	Y/ha
Stem girth	-	0.57**	-0.68**	-0.32	-0.03	0.03	-0.04	-0.12	-0.01	-0.01
Plant height		-	0.63**	-0.13	-0.37	0.36	-0.09	-0.32	-0.28	0.03
Leaf number			-	-0.16	-0.19	0.18	-0.17	-0.21	-0.19	-0.03
Yield/plant				-	-0.22	-0.19	-0.04	0.06	-0.02	0.49*
Fruit girth					-	-0.22	0.06	0.46*	-0.02	0.07
Fruit length						-	-0.08	-0.2	-0.25	0.07
Pericarp thickness							-	-0.05	0.07	-0.09
Seed number								-	0.65**	0.21
Seed weight									-	0.12
Yield/ha										-

*, ** = Significant at 5 and 1% respectively.

All the varieties were susceptible to viral diseases and Cercospora leaf spot but with varied degrees of disease severity. The local accessions of the three *Capsicum annuum* cultivars (rhombus fruit shaped, 'RODO' responded poorly with high disease incidence and severity compared with the exotic accessions.

The average cost of pepper production for the pepper varieties is presented in Table 4. It has assumed the same costs for all the items especially seed, fertilization and harvesting. Table 5 shows the economics of producing the pepper varieties. The average price of fresh pepper fruits was ₦400.kg^{-1} used to calculate the revenue which gave Z106 the highest gross returns (₦3,135,600/ha), net returns (₦2,923,800/ha) and benefit cost ratio 13.8:1. The highest profit (₦13.8) for every ₦1.00 invested was recorded by planting Z106 followed by Z108 with ₦8.8 benefit from the ₦1.00 investment. The benefit-cost ratio was least for F104 at ₦2.2 for every ₦ spent in producing the variety

Table 4: Average cost of production of pepper during the season

Variable	N/ha
Nursery	6,000
Land preparation	20,000
Transplanting	30,500
Weeding	75,600
Fertilizer application	10,200
Insecticide	11,500
Harvesting	40,000
Fertilizer	8,000
Seed	10,000
TOTAL	211,800

Source: Field Data, 2013

Table 5: Economic production of rhombus fruit shaped pepper cultivar

Accessions Number	Yield kg/ha	Gross returns/ha	Cost of production/ha	Net returns N/ha	Benefit to cost ratio
NHVI-RL	2979	1,191,000	211,800	979,800	4.6
F104	1739	695,600	211,800	483,800	2.2
F105	2539	1,015,600	211,800	803,800	3.7
NHVI-RC	3059	1,223,600	211,800	800,000	3.7
NHVI-RH	2399	959,600	211,800	747,800	3.5
Z107	5239	2,095,600	211,800	1,883,800	8.8
NHVI-RB	3099	1,239,600	211,800	1,027,800	4.8
Z108	2579	1,031,600	211,800	819,800	3.8
Z106	7839	3,135,600	211,800	2,923,800	13.8

Farm gate price of pepper was N400/kg
Source: Field Data, 2013

Discussion

The soil in the experimental site was high in total N, available P and exchangeable K when compared with 1.0 g kg^{-1}, 8-15 mg.kg^{-1} and 0.18-0.2 cmol.kg^{-1} critical levels respectively established for the soils in Nigeria (Adepetu *et al.*, 2014). Also, the soil organic matter content was high considering that the established critical level beyond which most arable crops would not respond to fertilizer is 20 g.kg^{-1}. This high fertility status is due to the nature of the soil. It is located in the valley bottom and benefitted from sediments eroded from the upper parts of the topography as well as the effects of seasonal hydromorphic conditions. The clay loam texture, also a result of the soil formation process, is suitable for pepper production.

Although the experiment involved fertilizer main plots, the means of the 9 pepper varieties were presented for growth parameters. All the pepper varieties showed increase in the growth parameters as the plants aged. The local varieties F104 and NHVI-RL produced the tallest plants initially (2-4 WAT) after which Z106 and NHVI-RL became prominent. F104 and NHVI-RL produced plants with the highest stem girth and number of leaves throughout the period of observation. The development indicates the early vegetativeness of some local pepper varieties and agrees with Idowu-Agida *et al.* (2010) that local varieties of pepper had greater values for stem height and girth compared to some improved pepper cultivars. The varieties that gave the least values for the growth parameters were Z107 and Z108.

The fruit yield.$plant^{-1}$, fruit length and fruit girth, pericarp thickness, seed number and weight were significantly different among the varieties. The exotic variety Z106 gave the highest fruit yield.$plant^{-1}$ and was followed by Z107 which differed from three out of the NIHORT varieties (NHVI-RB, NHVI-RC and NHVI-RL) that gave similar values while F104 produced the least yield. The pattern of performance in fruit yield.$plant^{-1}$ was the same with the yield.ha^{-1} which showed that the initial vegetative growth advantage of F104 and NHVI-RL did not reflect in greater fruit production. The low yield of F104 and F105 could be due to the severity of viral infection, anthracnose and cercospora leaf spot diseases. Fokunang *et al.* (2000) and AVRDC (2004) had noted the negative correlation between disease traits and yield on various crops. Also, Fajinmi (2013) observed that the growth and yields of pepper genotypes grown in Nigeria are hindered by the high incidence and severity of diseases, especially those caused by viral infections due to the tropical vegetation that supports many alternative hosts and the rapid multiplication of insect vectors that transmit the virus.

The varieties differed in fruit yield at 0 and 100 kg.ha^{-1} NPK 20-10-10 treatments. The highest yields of Z106, Z107, NHVI-RB and NHVI-RH at 0 kg ha^{-1} are indicators of the potentials of these varieties. Only Z106 and

Z107 still showed the high yields at 100 kg ha^{-1} NPK but included NHVI-RC and F105. The yields indicate the highest responses to the NPK fertilizer in F104, F105, NHVI-RC and Z107; medium in Z106 and Z108; and low in NHVI-RL, NHVI-RH and NHVI-RB. The responses are not expected in this soil whose total N, available P and exchangeable K contents exceed the established critical levels for the soils in Nigeria (Adepetu *et al.*, 2014) which emphasize the need to conduct systematic studies to determine the nutrient and fertilizer needs of pepper based on soil test correlation and calibration in various pepper growing zones.

With regard to economic performance, Z106 and Z107 gave the highest revenue, net returns and benefit cost ratio while Z108 was not different from some of the local varieties in terms of low profits on account of poor yields. The lowest yields recorded, especially in F104, could be attributed to severity of disease infections. Thus, Z106 (Pimenta BRS Mari) and Z107 (Pimenta Moema) which out-yielded the NIHORT and local varieties (F104 and F105) are considered better suited for cultivation and should be promoted among famers in Ekiti State, Nigeria. However, further research should be conducted on the adaptability of the exotic pepper varieties, including Z108 (Pimenta BRS Seriema) to the agro-ecological environment in Southwestern Nigeria and especially for resistance/tolerance to the viral, fungal and bacterial diseases identified during the field trial. This is particularly important because the exotic varieties are usually grown under cover and controlled environment in greenhouses

Conclusions

Considering the yield response and the cost of production, Z106 (Pimenta BRS Mari) cultivar was considered better suited for cultivation. Results showed that the two of the Rhombus shaped varieties introduced, Z106 (Pimenta BRS Mari) and Z107 (Pimenta Moema) significantly ($P<0.05$) out-yielded the local varieties (F104 and F105). The result also revealed that the profitability of Z106 has the highest (BCR 13.8:1) profit, followed by Z107 (BCR 8.8:1), with the least (BCR 2.2:1) recorded in F104. The low yields recorded in F104 could be attributed to disease infestation. The study recommends that for profitable production Z106 and Z107 varieties could be adopted.

Based on the results so far, Z106 and Z107 are being promoted among famers in Ekiti State, Nigeria. It is recommended that further research be conducted to adapt the exotic varieties of pepper to the environment in Southwestern Nigeria for resistance to viral and bacterial diseases which were much evident on the field during the trials. This is particularly important because the varieties introduced from Brazil are usually grown under greenhouse conditions and disease infestation is closely controlled. Since pepper production takes place in open field conditions in Nigeria, efforts should be made to minimize disease infestation through further adaptation and breeding for resistance to diseases.

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