2015 2nd International Conference on Geological and Civil Engineering
IPCBEE vol. 80 (2015) © (2015) IACSIT Press, Singapore
DOI: 10.7763/IPCBEE. 2015. V80. 16

Introduction and Participatoryevaluation of Exotic Cultivars of Pepper (Capsicum Spp.) among Small Holder Farmers in South-Western Nigeria

Akin Omotayo [1 +], Claudia Ribeiro [2], Anthony K. Oluleye [3] and Ayodele Fajinmi [4]

[1] IFSERAR, Federal University of Agriculture, Abeokuta,Nigeria

[2] EMBRAPA vegetables Research Program, in EMBRAPA Brazil

[3] Department of Soil Science, Federal university, Oye, Ekiti, Nigeria

[4] Department of Horticulture and Crop Science, Federal university, Oye Ekiti, Nigeria

Abstract. Pepper (Capsicum spp.) production by farmers in southwestern Nigeria is limited by low yield due to poor genetic potentials of most cultivars available, use of poor quality seeds, disease infestation, and poor managment practices among others. To overcome the constraints, some varieties of pepper developed at Embrapa Brazil and NIHORT Nigeria, were introducedfollowed bytraining of 100 small scale farmers . Participatory field demonstrations of the improved varieties of pepper were carried out to determine acceptability some of these pepper varieties among farmers. The two Brazilian sweet bell peppers (Z105, Z103) singificantly outyielded the local variety (F102). Two of the Rhombus shaped vaireties introduced (Z106 and Z107) also recorded sifgnificantly higher yield than the local varieties. Famers' ranking of the varietiesindicates preference for all the exotic lines on all paramters. Based on the results, four Brazillian vareities, Z103, Z105, Z106 and Z107 were selected for widespread promotion.

Keywords: Introduction, Participatory, Evaluation, Exotic Pepper, Small Holder Farmers.

1. Introduction

Pepper (*Capsicum spp.*) is an essential element of Nigerian diet. Apart from its use in the preparation of stew and for garnishing meals, pepper is useful as a preservative and in the treatment of illnesses. Nearly all small holder farmers particularly women produce pepper for both household consumption and the local market particularly in South-Western Nigeria. It has been estimated that between 100 – 200 thousand hectares of land are devoted to the cultivation of pepper by small holder farmers in Nigeria annually [1]. Thus, Nigeria is the largest producer of pepper in Africa, accounting for about 50 per cent of total production. More recent estimates indicate that Nigeria produced about 700,000 metric tons of pepper from a total land area of about 77,000 hectares [2], [3]. Consumption of pepper in Nigeria accounts for a substantial portion of the average daily food intake either in soup or as condiments for flavouring and colouring and preservation of meat, fish, and some staple food items.

In most farming communities in Nigeria, three cultivars of *Capsicum annum* and *Capsicum frutescens* are grown. These cultivars of *Capsicumannum* includes sweet bell fruit shaped pepper, the medium corrugated rhombus shaped fruit hot pepper, and the long cayenne fruit pepper, while one cultivar of the *Capsicum frutescen*,known as hot pepper, is cultivated. Each of these however, varies in terms of fruit shape, size, maturity period, and pungency [4]. Pepper production by farmers is constrained by low yield due to poor genetic potentials of most cultivars available to farmers, poor fruit quality due to lack of modern

+ Corresponding author.
E-mail address: akinjuly@yahoo.co.uk.

technical production skills, use of poor quality seeds, disease infestation [5], restriction of production to a single farming season, low income and pervasive poverty among small holder farmers [6].

To overcome this situation, it is crucial to introduce to farmers improved pepper cultivars for critical evaluation and adoption. Adoption stimulating features of such improved cultivars of pepper should include high yielding potential, disease resistance, good quality and wide acceptability of fruit shape, size, colour and taste. The high and regular market demand for pepper makes it imperative for enhancing farmers' production capacity through introduction and promotion of improved varieties.

EMBRAPA Brazil (Brazilian Enterprise for Agricultural Research) is one of the leading research centers in the world where research into tropical species of crops are carried out. Research into different varieties of pepper has led to the development of high yielding, disease resistant and tropically adapted pepper varieties that could perform well in South-Western Nigeria. Consequently, some cultivars of pepper developed at Embrapa Brazil and the National Horticultural Research Institute (NIHORT) Nigeria, were obtained and introduced to farmers in Ekiti State, Nigeria between September 2012 and April 2014. Adoption of these cultivars by farmers depends on a combination of access, physical appeal, perceived market value, objective assessment and careful analysis of the varietal characteristics through participatory on-farm trials [6]. This study therefore sets to determine farmers' evaluation of these pepper varieties using participatory on–farm adaptive research and some selected mass media channels.

1.1. Objectives

The objectives of the study are to:

1. identify, describe and evaluate the selected pepper cultivars;
2. conduct participatory on-farm trials and field demonstrations on production of these cultivars;
3. Comparatively assess the performance of the exotic and local breeds of pepper on farmers' field
4. Suggest recommendations for wide scale adoption of improved pepper varieties in the area.

2. Materials and methods

2.1. Description of the Study Area

The study was carried out in Ekiti State, southwestern Nigeria. Ekiti State is located between Latitude 7^0 15' to 8^0 51' North and Longitude4^0 45' to 5^0 45' East.The State is mainly upland, rising over 250 meters above sea level. It lies on an area underlain by metamorphic rock. It is generally undulating country with a characteristic landscape that consists of old plains broken by step-sided out-crops that may occur singularly or in groups or ridges. The State has tropical climate with two distinct seasons. These are the rainy season (April–October) and the dry season (November–March). Temperature ranges between 21 ° and 28 ℃ with high humidity. The south westerly wind and the northeast trade winds blow in the rainy and dry seasons respectively. Tropical forest exists in the south, while derived savannah occupies the northern peripheries.

MV resistant pepper genotypes from Brazil (Embrapa) were made available directly to 100 small holder farm households in Ekiti State, Nigeria. These cultivars of pepper together with some local varieties obtained from National Horticultural Research Institute Ibadan (NIHORT) were introduced and jointly evaluated by farmers, scientists, extension workers and other actors in the pepper value chain. The production of some cultivars of these pepper favored by the majority of small holder farmers and other value chain actors were then promoted widely. The pepper value chain including, production, processing, drying, storage, market access and input supply system were analyzed to determine the areas of strengths and weaknesses for precise development intervention. However, only a part of the results were reported in this paper. Local landraces and improved cultivars from Nigeria (National Horticultural Research Institute - NHRI) were evaluated side by side with cultivars from Brazil (Embrapa Vegetables) in 2013 with specific focus on identification, description and evaluation of plant and fruit characteristics of selected improved pepper cultivars.

A total of 11 cultivars of *Capsicum* spp. (rhombus fruit shaped "RODO", bell fruit shaped "TATTASSAI" from Nigeria and commercial cultivars from Brazil (three bell peppers, BRS Moema, BRS Seriema and BRS Mari) were introduced to farmers. Plant characterization based on plant height and

diameter, leaf number, yield/plant/ hectare were determined. Fruit characterization included fruit width and length, pericarp thickness; seed number/fruit and seed weight. Correlation was run between leaf number and fruit yield per plant and per hectare. Plants were monitored weekly for disease symptom expression and evaluated for disease incidence and diseases severity (DS).

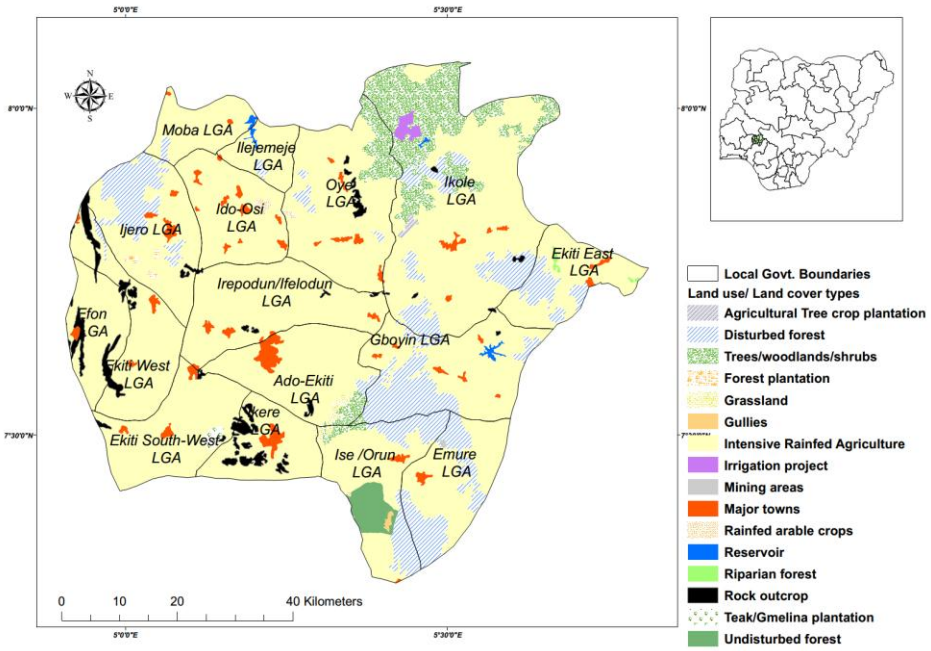

Fig. 1. Land use map of Ekiti State, Nigeria showing the study area.

On station trials were conducted to determine the performance of the exotic varieties before the commencement of on farm demonstration and eventual introduction to farmers and training of the farmers on their cultivation and management. On-station evaluation of selected pepper cultivars was carried out at the Federal University Oye-Ekiti, research farm, in the wet and dry season seasons of year 2013.

On-farm trials were established in October 2013, in three locations: Erio (N 07^0 43', E 05^0 00', Elevation 496m), Emure (N 07^0 23', E 05^0 29', Elevation 337m) and Aba Fatunla(N 07^0 48', E 05^0 29', Elevation 563m) in Ekiti State (Fig. 1). Seeds of selected improved cultivars screened from the on-Station trials were raised along with the local farmers' landraces, using farmers' methods and seedling raising beds. The experiment also monitored disease infestation incidence. Disease severity and yield per hectare were determined at the end of the experiment.

3. Results and Discussion

3.1. Socioeconomic Characteristics of Farmers

Four categories of socioeconomic characteristics of the farmers were considered in this study. These are sex, age, farm size devoted to pepper cultivation and farmer's income from pepper production. Table 1 below indicates that 64% of the farmers surveyed for the study are male while 34% are female. Pepper in the communities is traditionally a women's crop. However because of the increasing commercial value of the crop and its flexible income potential, men appear to be taking over the cultivation of pepper in these communities as additional source of cash crop. Data in Table 1 show that farmers' age ranged between twenty one and over sixty years with over 60% of the farmers aged between 40 years and above. This is typical of the age categorization of farmers generally in this part of the country. Very few young people are typically involved in farming in South-Western Nigeria. Pepper in particular is a crop that could encourage young people to go into farming because of its possibility of providing ready cash to farmers in less than three months after planting. Pepper also has and the characteristic of repeated harvests for up to a period of three to five months which should make it attractive to young people as a commercial farm enterprise.

Over 66 percent of the farmers devoted less than one hectare to the cultivation of pepper. This is a common practice in South-Western part of Nigeria where pepper is still not considered as a major

commercial crop. This small farm size devoted to cultivation of pepper also corresponds with the income levels from pepper cultivation according to the data in Table 1. The income from pepper ranged between N5,000 and N25,000(Nigerian Naira) or US$30 –US$152 United States Dollars during the trial season, with the average income recorded at N25,000 or US$150.

3.2. Agronomic and Performance Characteristics of Pepper Varieties Introduced

Plant and fruit traits evaluated varied significantly (P<0.05) among all cultivars tested ("RODO", "TATTASSAI" and "SOMBO" peppers). Fruit yield of BRS Mari was the highest in the "RODO" group. In the bell sweet pepper group ("TATASSAI"), highest yields were obtained by the hybrids "Impacto", "Magna Super" e "Magali R", and in the group long cayenne ("SOMBO"), the cultivar Grisu had the highest yield. The leave number per plant had nosignificant negative correlation with fruit yield.

Table 1: Socioeconomic characteristics of farmers

Sex	Frequency	Percentage
Male	66	66
Female	34	34
Total	100	100
Age Range (Years)		
20-30	8	8
31-40	24	24
41-50	50	50
51-60	12	12
61 and above	8	8
Total	100	100
Mean Age	43	
Farm Size (Ha)		
<1	66	66
2	28	28
3	06	06
Total	100	100.0
Mean	2	
Income range from pepper	Frequency	Percentage
<50000	28	28
5000-10000	20	20
10001-15000	10	10
15001-20000	2	2
20001-25000	6	6
>25000	30	30

Agronomic characteristics showed growth and yield for Rhombus Fruit shaped ("RODO") pepper**,**with significant difference in plant height (P< 0.05). It ranged from 34.8cm for Z107 and Z108 cultivars to 49.7cm for NHVI-RL. Differences in leaf number and stem girth were also significant (P< 0.05). Leaf number (See Fig. 2 below) and stem girth, which averaged 72 and 3.5cm ranged between 81 and 104 and 3.7cm and 4.4cm, respectively. Fruit yield, girth and length, pericarp thickness, seed number and weight, varied significantly (P<0.05) among cultivars (Fig. 2)

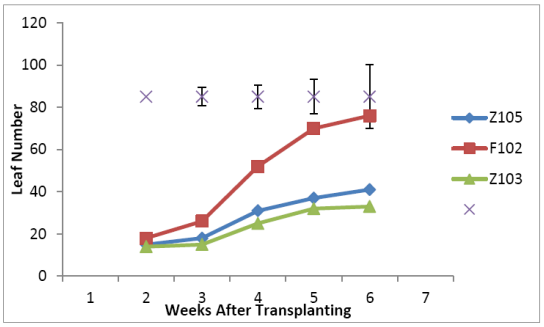

Fig. 2. Chart showing development of physiological characterists of three cutivars of Sweet bell peppers

Result of yield of Sweet bell fruit shaped ("TATTASSAI") pepper showed that the best fruit yield was obtained during the rainy season from Z105 cultivar (5086.7 kg/ha). Yield response for long cayenne ("SOMBO") pepper result showed that the best fruit yield was obtained during the rainy season from Z104 variety (4151.7 kg/ha). This was followed by Z101 (1662.5 kg/ha), while the least was obtained from F107

(1128.4 kg/ha).The leaf number for rhombus fruit shaped 'RODO' pepper cultivar had no significant correlation (r =0.29, P>0.05)with fruit yield/ha as shown in Table 2. The leaf number for sweet bell shaped 'TATTASSAI' pepper cultivar had no significant correlation(r=0.11, P>0.05) with fruit yield/ha (Table 2). The leaf number for long cayenne 'Sombo' pepper cultivar had none significant positive correlation (r=0.30,P>0.05) with fruit yield/ha as shown in Table 2.

The two Brazilian sweet bell peppers (Z105) **(6,219kg/ha)**(Z103) **(6,339kg/ha)** singificantly outyielded the local variety (F102) **(2,780kg/ha)** as shown in Fig. 3. Similarly, two of the Rhombus shaped vairety (Atarodo) introduced from Brazil (Z106 and Z107) recorded sifgnificantly higher yield than the local varieties and varieties introduced from NIHORT Nigeria as indicated in Fig. 4

Viral diseases were the most predominant followed by *Cercospora* leaf spot. *Anthracnose*, bacteria, soft rot of the fruit and *Phytophtora* fruit rot. There was a high significant (P<0.01) difference in the response of all the varieties to disease incidence. Some varieties exhibited resistance to some diseases while some exhibited tolerance. The improved varieties (NHVI-IA and NHVI-AB) obtained from (NIHORT) National Horticultural Research Institute, Ibadan Nigeria, exhibited resistance to *Phytophtora* rot, also tolerance to viral diseases and Bacteria soft rot. All the local land races were susceptible to all the observed diseases except F106 and F107 that exhibited tolerance to *Phytophtora*

Table 2: Correlation matrix showing the relationship between agronomic characteristics of crop growth and yield for rhombus fruit shaped pepper cultivar.

	SG	PH	LN	Y/p	Fgirth	Flenght	Pthick	Sno	Swt	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	-0.23	-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.

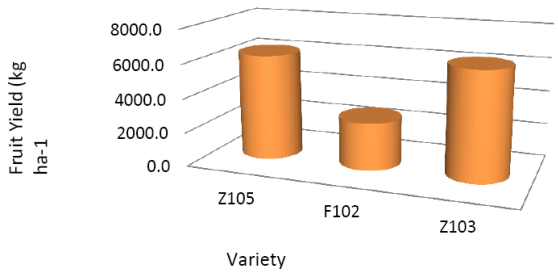

Fig. 3. Fruit yield of three varieties of Sweet bell peppers "Tatase"

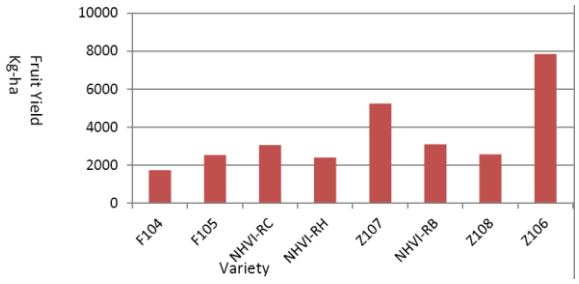

Fig. 4. Fruit yield of eight varieties of rhombus (Atarodo) pepper

Table 3: Farmers scoring/ranking of performance of the varieties

Variety	Origin	Rank		
		Yield	D/R	AP
F102	Local landrace	2	8	2
F104	Local variety	1	3	3
F105	Local variety	3	1	1
NHV1 –RC	NIHORT, Nigeria	4	11	4
NHV1 – RB	NIHORT, Nigeria	6	5	5
NHV1 –RH	NIHORT, Nigeria	7	6	6
Z103	EMBRAPA, Barazil	8	10	8
Z105	EMBRAPA, Brazil	11	9	9
Z106	EMBRAPA, Brazil	10	7	11
Z107	EMBRAPA, Brazil	9	4	10
Z108	EMBRAPA, Brazil	6	2	7

D/R Disease resistance, **AP** – Percieved adoption potential; Farmers were requested to rank all the varieties on the three parameters on a scale of 1 – 11 with 1 as lowesrt rank and 11 highest.

3.3. Farmers' Ranking of Pepper Varieties

Following the approach by Russell [7] famers were requested to rank all the pepper varieties introduced on three paramters which are yield, disease resistance and adoption potential (Table 3) after training the faemrs on idenrtiifcation of all these parameters. On all parameters, famers who were trained show preference for all the exotic varieties for disease resitiance of Z108 variety. The ranking of all the varieties appear consistent among famrers based on percieved yield except for that same variety Z108 which was ranked low and this appears to affect farmers ranking of its adoption potential. Farmers who were trained differed singinicantly from those who were not trained in their ranking of some of the paprameters particularly on determination of disease severity (DS).

4. Conclusion and Recommendations

These results are based on two levels of trials during a period of 14 months. The trials continue and more inferences and confirmation of results are expected to follow after 24months of trial. Famers perception and assessment of performance of the varieties are also expected to crystalize more precisely after the studies are concluded. Based on the results so far, four Brazillian vareities, Z103, Z105, Z106, Z107 are being promoted among famrers 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 particluarly important because most of the vareities introduced from Brazil are usually grown under greenhouse conditions and disease infestation are 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.

5. Acknowledgement

This study was financed by the Africa-Brazil Agricultural Innovation Marketplace project. We gratefully acknowledge the support.

6. References

[1] Ado S. G. (1998) Evaluation of Capsicum in Nigeria- Quantitative Caharacteristics of pepper. Paper presented at the 12th Annual Conference – Horticultal Society of Nigeria Pp 16 -17

[2] Ado. S. G.: (1990) Pepper production guide , Extension Guide 10: 47-48 Horticultural Research Programme, Institute for Agricultural Resaerch, (IAR) Ahmadu Bello University,Zaria, Nigeria.

[3] Omotayo A.M., C. Ribeiro, Oluleye A, K. and Fajimi A (2012) Particpatory evaluation of improved pepper (Caspicum Spp) among small scale farmers – Research Pre-proposal submitted to the Africa Brazil Agricultural innovation Marketplace Project, EMBRAPA Brazil 5Pp.

[4] Denton A. O, K.D. Alason, M.A. Adegoro (Editors) 2000. NIHORT twenty five years of research into horticultural crops development in Nigeria (1975-2000)

[5] Fajinmi, A. A. (2006). Incidence spread and possible control strategies of pepper veinal mottle Potyvirus (PVMV), Yield and agronomic parameters of pepper (Capsicum annum) in Nigeria .Ph.D. Thesis. Department of botany and microbiology. Faculty of science, University of Ibadan. pp 1-13

[6] USAID/IITA 2002 Growing pepper in Nigeria: Commercial Crop Production Guide Series:Research to Nourish Africa, International Institute of Tropical Agriculture, (IITA), Ibadan, Nigeria.

[7] Russell (1997). Pair wise ranking made easy. In: PLA notes No 28, Methodological Issues: International Institute of Environment and Development (IIED). London UK