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# Evaluation of Three Hybrids Pepper for Adaptation and Yield Attributes in Western Urban Sierra Leone

Patrick M. Ngegba[1], Salia M. Kanneh[2], Dan D. Quee[3] & Peter D. Musa[4]

[1, 2 & 3] Sierra Leone Agricultural Research Institute, PMP 1313 Tower Hill, Freetown, Sierra Leone
[4] Department of Horticulture, School of Natural Resources Management, Njala University, Njala,, Sierra Leone
Corresponding author: patdousnges@yahoo.com

***Abstract*—** *A randomized complete block design (RCBD) experiment with three replications was conducted at the Kabala Horticultural Crops Research Centre (KHCRC) cropping site, Ogoo Farm of the Sierra Leone Agricultural Research Institute (SLARI), Freetown, Sierra Leone. The research was carried out from April to July, 2016 using a plot size of 6m x 1m ($6m^2$) with a 1m furrow between beds and 1.5m between replications. Three hybrids pepper (Chil-WASA-Chil-1, Chil-WASA-Chil-2 and Chil-WASA-Chil-3) designated as treatments ($T_1$, $T_2$ and $T_3$) were evaluated. $T_3$ (27.45 cm) and $T_2$ (42.52; 60.10 cm) had the tallest PH at 4, 6 & 8WAT with $T_1$ (20.34 & 34.23 cm) recording the shortest PH at 4 & 6WAT respectively. The largest SG was accounted for by $T_2$ (6.86; 8.72; 9.47 cm) at 4, 6 & 8WAT while $T_1$ & $T_3$ had the same values (4.79 cm) at 4 WAT and $T_3$ & $T_1$ recorded the least at 6 &8 WAT. The widest CS at 4, 6 & 8WAT was observed in $T_1$ (17.11, 32.60 & 56.47 $cm^2$) and $T_3$ had the least at 6 & 8WAT (25.63 & 35.76$cm^2$) respectively. Similarly, $T_1$ (54.00, 59.00 & 78.00) recorded the highest NB plant$^{-1}$ at 4, 6 & 8WAT while $T_3$ (40.00 & 64.00) had the lowest at 4 & 6WAT. For LA and LAI, $T_1$ (9.49 &13.83) and $T_2$ (8.83, 10.09 & 12.47) indicated highest values at 4 & 6WAT; 4, 6 and 8WAT. The lowest values for LA and LAI at 4, 6 & 8WAT were observed in $T_3$ (6.36, 12.00, 13.55; 6.26, 7.06 & 8.98) respectively. For yield and yield components, $T_2$ (66.00, 61.00, 63.87 cm & 51.00) recorded the highest values for NFS, NFH, FL and NMF plant$^{-1}$ and the least were observed in $T_1$ (53.00 & 49.00) and $T_3$ (54.61cm) correspondingly. Generally, it could be concluded that all three exotic pepper are adaptable to the climatic conditions of Sierra Leone (Western area). Hence further evaluation required across vegetable growing zones.*

***Keywords*— adaptation, hybrids, attributes, evaluation, solanaceae.**

## I. INTRODUCTION

Chilli pepper (*Capsicum annum L.*) is a member of Solanaceae family and is one of the most important vegetables in the world. This genus emanated from Central and South America and consists of approximately 30 species (Dagnoko, 2013). The crop plant has duration of 90 to 150 days and is grown widely in rain-fed environments with very high yields when the rainfall is about 600 to 1250 mm (FMRL, 2016). Chilli pepper thrives well in climate with temperatures ranging between 18 to 27°C during the day and between 15 to 18°C during the night. According to FMRL (2016) the fruits vary in shape, color, pungency, texture and are an important vegetable fruit for the fresh market and processed products. It is widely used as food and medicine (FMRL, 2016). In addition to its economic importance, nutritional and medicinal values its fruits is an excellent source of natural colours and antioxidant compounds. It provides a rich source of vitamins A and E. Both hot and sweet peppers contain more vitamin C to prevent flu colds than any other vegetable crop. Moreover, pepper is used as a spice in many dishes, as decoration in food, adds flavor and colour, provides relief for several ailments, reduces muscle pain, inflammation and itching, act as a heart stimulant which regulates blood flow and strengthens the arteries and perhaps with the potential to reduce heart attacks (http://database.prota.org, 2016). In the sub-region, the yield of pepper is relatively low hardily exceeding 6.78 – 14 t/ha. However, according to Grubben and El Tahir (2004) Chili pepper has the potential to yield up to 18 t/ha and sweet pepper up to 30 t/ha in open-fields. Harvests exceeding 20 t/ha have been reported in Mali for introduced C. *annuum* chili varieties (AVRDC/Mali; 2008, unpublished). This average regional yield of pepper is not able to meet the regional market demand for pepper because it is very low. This indicates that there is high need for further improvement of pepper yield in West Africa. Yield is dependent on the genetic background of the plant and the

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environment therefore focus should be on varieties with high yielding potential and moderate to high tolerance to the prevailing biotic and abiotic environmental conditions in which they are grown.

In Sierra Leone, the production of exotic vegetables is increasingly becoming a livelihood strategy as unemployment level reaches 70% (SLARI, 2011). Chill pepper can contribute significantly to the country's economy with production dominated by women which are concentrated in urban and peri-urban areas. Vegetable growers are faced with the problems of accessing and identifying high yielding exotic vegetable seeds including chilli pepper from a reputable seed dealers or companies that are adaptable to Sierra Leone climatic conditions. Therefore, exploring the adaptive and yield potential of exotic Chilli pepper to climatic condition of Sierra Leone is imperative to breeders, growers, and seed producers. The study was hence carried out to evaluate two pepper hybrids for adaption and yield.

## II. MATERIALS AND METHODS

The experiment was laid out in a randomized complete block design (RCBD) with three replications. Flat beds measuring 6m x 1m ($6m^2$) with a 1m furrow between beds and 1.5m between replications and four treatments during the dry season from May to July, 2016 in the Inland Valley Swamp (IVS) of the Kabala Horticultural Crops Research Centre (KHCRC) Site, Ogoo Farm, of the Sierra Leone Agricultural Research Institute (SLARI), Freetown, Sierra Leone. Sierra Leone is bordered by Guinea to the north and northeast, Liberia to the south and southeast, and the Atlantic Ocean to the west. The research field area of Ogoo Farm lies between latitudes 7° and 10°N and longitudes 10° and 14°W along the West Coast of Africa and is characterized by a monomodal rainfall pattern, with the rainy season extending from May to September with an average annual rainfall of 2000-3000 mm and temperature of 28-31 $^0$C. The soil is of dark alluvial and the total rainfall and means sunshine recorded during the experiment was 331.0 mm and 26.15 h, respectively while maximum and minimum mean temperatures were however, 27.7 and 25.7EC, respectively. The three treatments of hybrids pepper used in trial are indicated in Table-1.

*Table.1: Experimental treatment*

| Exotic Chilli pepper | Treatment code |
|---|---|
| HYB-CHIL-WASA-HY-CHIL -1 | $T_1$ |
| HYB-CHIL-WASA-HY-CHIL -2 | $T_2$ |
| HYB-CHIL-WASA-HY-CHIL -3 | $T_3$ |

An exotic pepper variety of HYB-CHIL-WASA-HY-CHIL-1, HYB-CHIL-WASA-HY-CHIL-2 and HYB-CHIL-WASA-HY-CHIL-3 designated treatments ($T_1$, $T_2$ and $T_3$) was chosen for the experiment. Seeds were nursed on the 10$^{th}$ April, 2016 on a 2 m x 3 m well prepared sunken nursery bed supplied with 20 Kg of chicken manure. The incidence of pests and diseases were minimal, however, insecticides (Delthametrine) at the rate of 250g/l and fungicides (Carbendazim) at the rate of 500g/l respectively were used to control insects (white flies) and diseases. Prior to transplanting, NPK 15:15:15 (80g) and urea (100g) was mixed in one full watering-can using clean water to do liquid feeding to strengthen vigorous growth of seedlings for field planting. To enhance permanent field conditions for seedlings, shade, quantity and frequency of watering were gradually reduced during the last one week preceding field transplanting. Each plant stand was supply with NPK 15: 15:15 throughout the growth period on fortnightly basis. Inter and intra row spacing of 60cm x 50cm with two rows per bed with two seedlings per stand and later thinned to one seedling per hill was transplanted 10$^{th}$ May, 2016. During the growing period standard agronomic practices were fully observed as and when necessary. For data collection, five randomly selected plants were tagged.

Parameters scored include; plant height at four weeks after transplanting (WAT) at 4, 6 and 8, stem girth at 4, 6 and 8, number of branches at 4, 6 and 8, canopy spread at 4, 6 and 8, number of leaf plant$^{-1}$ at 4, 6 and 8, leaf area plant$^{-1}$ at 4, 6 and 8, leaf area index plant$^{-1}$ at 4, 6 and 8, number of fruit set plant$^{-1}$, Number of fruit harvested plant$^{-1}$, fruit length plant$^{-1}$ (cm), fruit diameter plant$^{-1}$(cm), fresh fruit weight (g), number of marketable fruit and number of nonmarketable fruit plant$^{-1}$. Harvesting commenced six weeks after transplanting with an interval of 3-4 days between harvests. Data recorded were subjected to Analysis of Variance (ANOVA) using the Genstat (12th edition) Statistical package. The LSD at 5% was used to separate significant treatment means.

## III. RESULTS

**Growth performance of exotic Chilli pepper**

Table-2 & 3 display vegetative performance of chili-1 and 2. Vegetative performance is one of the most important adaptive characteristics measured for any introduced plant materials. Analysis of variance showed significant differences between mean values of vegetative parameters evaluated. The result showed significant differences at ($P < 0.05$) among $T_1$, $T_2$ and $T_3$ with respect to plant height (PH) at four and six weeks after transplanting (4WAT & 6WAT). $T_3$ and $T_2$ recorded the tallest plants (27.45; 26.08 cm) while $T_1$ (20.34cm) had the shortest plants at 4WAT successively. At 6WAT, $T_2$ accounted for the tallest PH (42.52 cm) followed by $T_3$ (36.63 cm) and $T_1$ had the

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shortest plants (34.23 cm) respectively. Stem girth (SG) exhibited significant differences at 4 and 6WAT but 8WAT had no statistical differences. $T_2$ accounted for the largest SG (6.86; 8.72; 9.47 cm) at 4, 6 & 8WAT with $T_1$ and $T_3$ (4.79 cm) recording the same values at 4 WAT successively. The second and third largest SG at 6WAT were observed in $T_1$ (6.58 cm) and $T_3$ (5.76 cm) correspondingly while at 8WAT; $T_3$ had the second highest (8.01cm) and $T_1$ (7.54 cm) the least SG. Number of branches (NB) and canopy spread (CS) had significant differences ($P < 0.05$) at 6 & 8WAT. The highest NB was observed in T3 (9.00) while $T_2$ (8.00) &$T_1$ (6.00) recorded the least values and $T_2$ (12.00) had the highest NB at 8WAT followed by $T_3$ (11.00) and $T_1$ (9.00) the fewest. $T_1$ exhibited the largest CS (17.11; 32.60 &56.47 $cm^2$) at 4, 6 & 8WAT. $T_3$ accounted for the second largest CS at 4WAT (15.89 $cm^2$) but the smallest at 8WAT (35.76 $cm^2$) respectively. Additionally, $T_2$ had the second highest CS at 6 &8WAT (25.76; 42.75 $cm^2$) but the least at 4WAT (14.44 $cm^2$).

*Table.2: Mean values of growth performance of exotic Chilli pepper*

| | Character | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treatment** | **Plant height** (cm) | | | **Stem girth** (cm) | | | **Number of branches plant$^{-1}$** | | | **Canopy spread plant$^{-1}$** ($cm^{-2}$) | | |
| | 4 WAT | 6 WAT | 8 WAT | 4 WAT | 6 WAT | 8 WAT | 4 WAT | 6 WAT | 8 WAT | 4 WAT | 6 WAT | 8 WAT |
| $T_1$ | 20.34 | 34.23 | 55.00 | 4.79 | 6.58 | 7.54 | 4.00 | 6.00 | 9.00 | 17.11 | 32.60 | 56.47 |
| $T_2$ | 26.08 | 42.52 | 60.10 | 6.86 | 8.72 | 9.47 | 5.00 | 8.00 | 12.00 | 14.44 | 25.76 | 42.75 |
| $T_3$ | 27.45 | 36.63 | 49.50 | 4.79 | 5.76 | 8.01 | 5.00 | 9.00 | 11.00 | 15.89 | 25.63 | 35.76 |
| Lsd p<0.05 | 3.38 | 3.78 | 13.67 | 1.430 | 1.67 | 1.65 | 2.20 | 1.20 | 1.51 | 4.72 | 4.17 | 4.44 |
| CV (%) | 6.00 | 4.40 | 11.00 | 11.50 | 10.50 | 8.70 | 20.30 | 7.00 | 6.40 | 13.20 | 6.60 | 4.40 |

Number of leaf (NL), leaf area (LA) and leaf area index (LAI) plant$^{-1}$ statistically ($P < 0.05$) showed significant differences at 4, 6 and 8WAT respectively. With respect to NL, $T_1$ recorded the highest NL at 4, 6 and 8WAT (54.00, 59.00 and 74.00) followed by $T_2$ (44.00; & 65.00) while $T_3$ had the least mean values (40.00, & 64.00) at 4 & 8WAT correspondingly. $T_3$ (50.00) had the second highest NL plant$^{-1}$ and $T_2$ the lowest at 6WAT. The widest LA plant$^{-1}$ at 4 & 6WAT was indicated by $T_1$ (9.49 and 13.83 $cm^2$) followed by $T_2$ (8.17 &13.64 $cm^2$) and $T_3$ which exhibiting the narrowest LA (6.36 &12.00 $cm^2$). $T_2$ had the widest LA at 8WAT (16.90 $cm^2$) and $T_1$ and $T_3$ recording the narrowest values (15.35; 13.55 $cm^2$) concurrently. For LAI plant$^{-1}$, $T_2$ (8.83; 10.09; 12.47) recorded the maximum LAI at 6 & 8WAT followed by $T_1$ (7.39; 8.59; 10.70) and $T_3$ with the minimum values (7.39, 9.21 & 11.20) respectively.

*Table.3: Mean values of growth performance of exotic Chilli pepper*

| | Character | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Treatment** | **Number of Leaf plant$^{-1}$** | | | **Leaf area plant$^{-1}$** | | | **Leaf area index plant$^{-1}$** | | |
| | 4 WAT | 6 WAT | 8 WAT | 4 WAT | 6 WAT | 8 WAT | 4 WAT | 6 WAT | 8 WAT |
| $T_1$ | 54.00 | 59.00 | 78.00 | 9.49 | 13.83 | 15.35 | 7.39 | 8.59 | 10.70 |
| $T_2$ | 44.00 | 48.00 | 65.00 | 8.17 | 13.64 | 16.90 | 8.83 | 10.09 | 12.47 |
| $T_3$ | 40.00 | 50.00 | 64.00 | 6.36 | 12.00 | 13.55 | 6.26 | 7.06 | 8.98 |
| Lsd p<0.05 | 9.15 | 11.43 | 11.66 | 1.20 | 3.429 | 1.76 | 2.689 | 1.46 | 2.53 |
| CV (%) | 8.700 | 9.70 | 7.50 | 6.60 | 11.50 | 5.10 | 15.80 | 7.50 | 10.40 |

**Yield and yield components of exotic Chilli pepper**

Yield and yield components are presented in Table 3. Of the evaluated yield and yield component parameters, fruit length (FL), fruit diameter (FD) and fresh fruit weight (FFW) plant$^{-1}$ had significant differences. Number of fruit set (NFS), number of fruit harvested (NFH), number of marketable fruit (NMF) and number of nonmarketable fruit (NNMF) plant$^{-1}$ and number of seed (NS) fruit$^{-1}$ recorded no statistical differences among evaluated pepper hybrids. Regarding fruit length, $T_2$ accounted for the longest (63.87 cm) FL followed by $T_1$ (55.21 cm) with $T_3$ (54.61 cm) recording the shortest respectively. The largest FD was observed in $T_1$ (18.70 cm) followed by $T_3$ (15.01 cm) and T2 (12.99 cm) the smallest. Conversely, with respect to

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FFW plant$^{-1}$, T3 and T2 recorded the heaviest FFW (43.10; 41.30 g) concurrently as opposed to $T_1$ (32.90 g) which recorded the least fruit weight. Moreover, the maximum and minimum NFS and NFH plant$^{-1}$ were recorded by $T_2$ (66.00; 61.00) and $T_1$ (53.00; 49.00) respectively. The highest NMF was indicated by $T_2$ (51.00) with both T1 & $T_3$ recording the same lowest values (46.00) as in the case of NNMF plant$^{-1}$ (5.00) and $T_2$ (4.00) had the least. For NS fruit$^{-1}$, $T_3$ &$T_1$ (30.00; 25.00) exhibited the highest and $T_2$ (22.00) the least.

*Table.4: Mean values of yield and yield components of exotic Chilli pepper*

| | Character | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Treatment** | Number of fruit set plant$^{-1}$ | Number of fruit harvested plant$^{-1}$ | Fruit length plant$^{-1}$ (cm) | Fruit diameter plant$^{-1}$ (cm) | Fresh fruit weight (g) | Number of marketable fruit | Number of Nonmarketable fruit | Number of seed fruit$^{-1}$ |
| $T_1$ | 53.00 | 49.00 | 55.21 | 18.70 | 32.90 | 46.00 | 5.00 | 25.00 |
| $T_2$ | 66.00 | 61.00 | 63.87 | 12.99 | 41.30 | 51.00 | 4.00 | 22.00 |
| $T_3$ | 56.00 | 50.00 | 54.61 | 15.01 | 43.10 | 46.00 | 5.00 | 30.00 |
| Lsd p<0.05 | 12.91 | 16.37 | 6.69 | 1.94 | 10.80 | 17.61 | 3.54 | 12.87 |
| CV (%) | 9.80 | 13.50 | 5.10 | 5.50 | 12.20 | 16.40 | 34.30 | 22.10 |

## IV. DISCUSSION

**Growth performance of exotic Chilli pepper**

Generally, peppers tremendously hold high potential in the Africa in relationships to health and nutritional enhancement and poverty reduction. Evaluation and identification of exotic varieties with high adaptive and yield potential is equally important to growers, breeders, and seed producers and marketers in Africa. From the result obtained, it could be stated that all three evaluated exotic pepper are adaptable to agro-ecological environment (Western area) of Sierra Leone. The differences observed among evaluated pepper hybrids with respect to growth parameters including; PH, SG, NB, CS, NL, LA and LAI plant$^{-1}$ could be ascribed to genetics differences among hybrids pepper. Furthermore, it could be attributed to the availability applied N and that of the inherent soil during the experimentation. The result is in conformity with Kanneh *et al*, (2017) who reported similar results for the above parameters when two local varieties of pepper were evaluated for growth and yield using different rates of NPK fertilizer. They attributed the significant differences for PH, NL, NB, diameter of stem and LA to genetic differences, rate of fertilizer and likely soil fertility. Moreover, result further corroborates with the findings of Abd El-Aziz (2007). According to Godia (2014) SG is one of the potential storage sites for food material for photosynthesis and could be influenced by nutrients in the soil. Hence, findings are in accordance with Egharevba (2010) and Adebayo *et al*. (2009) who reported significant differences with respect to SG and stated that the differences was as result fertilizers applied and that in the soil were readily available in the best form for easy uptake by plant roots increasing the morphological growth of the plants. According to Adebayo *et al*, (2009), nutrient availability especially N determines plant vegetative development.

**Yield and yield components of exotic Chilli pepper**

Yield and yield components are very much important in evaluating introduced cultivars. Significant differences observed among the three hybrids of Chilli pepper for NFS, NFH, FL, FD, NMF and NNMF plant$^{-1}$ might be accredited to effect of $K^+$ which is linked with fruit formation, development and quality of fruits and seed. The result from the investigation is generally similar to the findings of Kanneh *et al*, (2017) and Zaki *et al*, (1999) who stated that yield differences in crop cultivars maybe attributed to plant stomata ability in the allocation of photosynthetic material to economic yield. In spite of the above, the average NFS, FL and FD were not in conformity to what was recorded by Kanneh *et al*, (2017) suggesting that the hybrids used in the experimentation do not produce plenty fruits, but have long FL and larger FD than the local pepper varieties evaluated.

## V. CONCLUSIONS

The study shows that all three hybrids of pepper evaluated are adaptable to Sierra Leone climatic conditions and have yield potential if favourable conditions exist. However, there is need for further evaluation of material across agro ecological zones of Sierra Leone especially predominantly vegetable growing areas.

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