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

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Abstract — A randomized complete block design (RCBD) experiment with three replications was conducted at the Kabula 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 (6m²) with a 1m furrow between beds and 1.5m between replications. Three hybrids pepper (Chili-WASA-Chil-1, Chili-WASA-Chil-2 and Chili-WASA-Chil-3) designated as treatments (T₁, T₂ and T₃) were evaluated. T₃ (27.45 cm) and T₂ (42.52; 60.10 cm) had the tallest PH at 4, 6 & 8WAT with T₁ (20.34 & 34.23 cm) recording the shortest PH at 4 & 6WAT respectively. The largest SG was accounted for by T₂ (6.86; 8.72; 9.47 cm) at 4, 6 & 8WAT while T₁ & T₃ had the same values (4.79 cm) at 4 WAT and T₂ & T₁ recorded the least at 6 & 8 WAT. The widest CS at 4, 6 & 8WAT was observed in T₂ (17.11, 32.60 & 56.47 cm²) and T₃ had the least at 6 & 8WAT (25.63 & 35.76 cm²) respectively. Similarly, T₁ (54.00, 59.00 & 78.00) recorded the highest NB plant¹ at 4, 6 & 8WAT while T₃ (40.00 & 64.00) had the lowest at 4 & 6WAT. For LA and LAI, T₁ (9.49 & 13.83) and T₂ (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 T₁ (6.36, 12.00, 13.55; 6.26, 7.06 & 8.98) respectively. For yield and yield components, T₂ (66.00, 61.00, 63.87 cm & 51.00) recorded the highest values for NFS, NFH, FL and NMF plant¹ and the least were observed in T₁ (53.00 & 49.00) and T₃ (54.61 cm) 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.
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 (6m²) 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 °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 | T1 |
| HYB-CHIL-WASA-HY-CHIL-2 | T2 |
| HYB-CHIL-WASA-HY-CHIL-3 | T3 |

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 (T1, T2 and T3) was chosen for the experiment. Seeds were nurced on the 10th 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 10th 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 T1, T2 and T3 with respect to plant height (PH) at four and six weeks after transplanting (4WAT & 6WAT). T3 and T2 recorded the tallest plants (27.45; 26.08 cm) while T1 (20.34cm) had the shortest plants at 4WAT successively. At 6WAT, T2 accounted for the tallest PH (42.52 cm) followed by T3 (36.63 cm) and T1 had the
shortest plants (34.23 cm) respectively. Stem girth (SG) exhibited significant differences at 4 and 6 WAT but 8 WAT had no statistical differences. T2 accounted for the largest SG (6.86; 8.72; 9.47 cm) at 4, 6 & 8 WAT with T1 and T3 (4.79 cm) recording the same values at 4 WAT successively. The second and third largest SG at 6 WAT were observed in T1 (6.58 cm) and T3 (5.76 cm) correspondingly while at 8 WAT; T1 had the second highest (8.01 cm) and T1 (7.54 cm) the least SG. Number of branches (NB) and canopy spread (CS) had significant differences (P < 0.05) at 6 & 8 WAT. The highest NB was observed in T3 (9.00) while T2 (8.00) & T1 (6.00) recorded the least values and T2 (12.00) had the highest NB at 8 WAT followed by T3 (11.00) and T1 (9.00) the fewest. T1 exhibited the largest CS (17.11; 32.60 & 56.47 cm²) at 4, 6 & 8 WAT. T3 accounted for the second largest CS at 4 WAT (15.89 cm²) but the smallest at 8 WAT (35.72 cm²) respectively. Additionally, T2 had the second highest CS at 6 & 8 WAT (25.76; 42.75 cm²) but the least at 4 WAT (14.44 cm²).

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

| Character                  | Treatment | 4 WAT | 6 WAT | 8 WAT | 4 WAT | 6 WAT | 8 WAT | 4 WAT | 6 WAT | 8 WAT | 4 WAT | 6 WAT | 8 WAT |
|---------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Plant height (cm)         | T1        | 20.34 | 34.23 | 55.00 | 4.79  | 6.58  | 7.54  | 4.00  | 6.00  | 9.00  | 17.11 | 32.60 | 56.47 |
|                          | T2        | 26.08 | 42.52 | 60.10 | 6.86  | 8.72  | 9.47  | 5.00  | 8.00  | 12.00 | 14.44 | 25.76 | 42.75 |
|                          | T3        | 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 8 WAT respectively. With respect to NL, T1 recorded the highest NL at 4, 6 and 8 WAT (54.00, 59.00 and 74.00) followed by T2 (44.00; & 65.00) while T3 had the least mean values (40.00, & 64.00) at 4 & 8 WAT correspondingly. T3 (50.00) had the second highest NL plant⁻¹ and T2 the lowest at 6 WAT. The widest LA plant⁻¹ at 4 & 6 WAT was indicated by T1 (9.49 and 13.83 cm²) followed by T2 (8.17 & 13.64 cm²) and T3 which exhibiting the narrowest LA (6.36 & 12.00 cm²). T2 had the widest LA at 8 WAT (16.90 cm²) and T1 and T3 recording the narrowest values (15.35; 13.55 cm²) concurrently. For LAI plant⁻¹, T2 (8.83; 10.09; 12.47) recorded the maximum LAI at 6 & 8 WAT followed by T1 (7.39; 8.59; 10.70) and T3 with the minimum values (7.39, 9.21 & 11.20) respectively.

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

| Character                  | Treatment | 4 WAT | 6 WAT | 8 WAT | 4 WAT | 6 WAT | 8 WAT | 4 WAT | 6 WAT | 8 WAT | 4 WAT | 6 WAT | 8 WAT |
|---------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Number of Leaf plant⁻¹    | T1        | 54.00 | 59.00 | 78.00 | 9.49  | 13.83 | 15.35 | 7.39  | 8.59  | 10.70 |       |       |       |
|                          | T2        | 44.00 | 48.00 | 65.00 | 8.17  | 13.64 | 16.90 | 8.83  | 10.09 | 12.47 |       |       |       |
|                          | T3        | 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 (%)                   |           | 8.70  | 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 non-marketable fruit (NNMF) plant⁻¹ and number of seed (NS) fruit⁻¹ recorded no statistical differences among evaluated pepper hybrids. Regarding fruit length, T2 accounted for the longest (63.87 cm) FL followed by T1 (55.21 cm) with T3 (54.61 cm) recording the shortest respectively. The largest FD was observed in T1 (18.70 cm) followed by T3 (15.01 cm) and T2 (12.99 cm) the smallest. Conversely, with respect to
FFW plant\textsuperscript{1}, T3 and T2 recorded the heaviest FFW (43.10; 41.30 g) concurrently as opposed to T\textsubscript{1} (32.90 g) which recorded the least fruit weight. Moreover, the maximum and minimum NFS and NFH plant\textsuperscript{1} were recorded by T\textsubscript{2} (66.00; 61.00) and T\textsubscript{1} (53.00; 49.00) respectively. The highest NMF was indicated by T\textsubscript{2} (51.00) with both T\textsubscript{1} & T\textsubscript{3} recording the same lowest values (46.00) as in the case of NNMF plant\textsuperscript{1} (5.00) and T\textsubscript{2} (4.00) had the least. For NS fruit\textsuperscript{1}, T\textsubscript{3} &T\textsubscript{1} (30.00; 25.00) exhibited the highest and T\textsubscript{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\textsuperscript{1} | Number of fruit harvested plant\textsuperscript{1} | Fruit length plant\textsuperscript{1} (cm) | Fruit diameter plant\textsuperscript{1} (cm) | Fresh fruit weight (g) | Number of marketable fruit | Number of Nonmarketable fruit | Number of seed fruit\textsuperscript{1} |
|-----------|-----------|---------------------------------------------|---------------------------------------------|-------------------------------------------|-------------------------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
|           | T\textsubscript{1} | 53.00                                      | 49.00                                       | 55.21                                     | 18.70                                     | 32.90                      | 46.00                       | 5.00                        | 25.00                       |
|           | T\textsubscript{2} | 66.00                                      | 61.00                                       | 63.87                                     | 12.99                                     | 41.30                      | 51.00                       | 4.00                        | 22.00                       |
|           | T\textsubscript{3} | 56.00                                      | 50.00                                       | 54.61                                     | 15.01                                     | 43.10                      | 46.00                       | 5.00                        | 30.00                       |
|           | LSD p\textless0.05 | 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\textsuperscript{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\textsuperscript{1} might be accredited to effect of K\textsuperscript{+} 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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