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EVALUATION OF THE HEAT TOLERANT TOMATO (*Lycopersicon esculentum* Mill.) VARIETY 'CHRISTY'

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ABSTRACT

An evaluation of the heat tolerant tomato variety 'Christy' was conducted in a replicated small plot trial at the Gladstone Road Agricultural Centre during 2015. This study examined fruit quality and yield beyond the cooler growing season of September to March. The first harvest occurred on the 8th May, three months after planting, followed by harvests on the 18th and 26th of May. There were significant differences observed for the total number of fruit per plant, total weight of fruit per plant, number of marketable fruit per plant or weight of marketable fruit per plant, over the three harvest dates. Based upon the results obtained from this study, the variety 'Christy' proved to be very tolerant of the high temperature conditions during the onset of the summer season, comparing favourably to other investigated tomato varieties evaluated during the cooler months of the year. The 'Christy' tomato might be a useful variety to incorporate within the cropping systems of more local Bahamian farmers.

Heat tolerant 'Christy' tomato variety grown at the Gladstone Road Agricultural Centre during 2015.

Introduction:

The tomato (*Lycopersicon esculentum* Mill.) is undoubtedly the most important vegetable grown in the world, where it is cultivated in both tropical and temperate zones. It thrives best in moderate climates, but can adapt to a wide range of climatic conditions. The tomato can be grown in a variety of soil types, but does best on well-drained, fertile soils. It can be cultivated in the open under field conditions, or in a greenhouse under environmentally controlled conditions. The climate of The Bahamas is characterised by two distinct seasons: a cool and dry period from October to March and a hot and wet period from April to September. The cool season daily temperatures average a low of

18°C (64°F) and high of 25°C (77°F), while the warm season temperatures average a low of 26°C (79°F) and high of 32°C (90°F). The inability of vegetable crops to tolerate these high temperatures is a major constraint to the cultivation of tomatoes in The Bahamas during the summer months.

The vegetative and reproductive processes of the tomato are adversely affected by high temperature stress, resulting in a reduction in fruit quality and yield (Alsadon, *et al.*, 2006). Rick (1978) estimates that temperatures above 32°C (90°F) for more than three hours a day is sufficient to induce the abortion of flowers in the tomato. Several researchers (Abdul-Baki, 1991; Wessel-Beaver and Scott 1992; Sato, *et. al*., 2000; Abdelmageed and Gruda, 2009; Elsharief *et. al*., 2011) have identified heat tolerance in tomatoes by evaluating them for flowering and fruit set, since these two factors are sensitive to heat and relate directly to yield. High temperatures have been shown to affect not only the flowering and early fruiting stages, but also the later development and maturity of the fruit, resulting in reduced yields (Abdul-Baki, 1991; Wessel-Beaver and Scott 1992; Van Der Ploeg and Heuvelink, 2005; Abdelmageed and Gruda, 2009).

Bahamian farmers produce approximately 400 hectares (988 acres) of tomato each year, yielding about 11.0 tonnes/ha (4.9 tons/acre) (FAOSTAT, 2011). The tomato is consumed fresh, cooked or processed into various food products. In The Bahamas, it is an important ingredient in the daily diet of Bahamians throughout the islands and is perhaps the most commonly used vegetable. The tomato production season for farmers in The Bahamas could be extended beyond the cool season with improved flower and fruit set.

Recently, farmers in North Andros have been using heat tolerant, tomato yellow leaf curl virus (TYLCV) resistant varieties, including 'Christy', in their cropping systems with much success. When the average daily temperatures climb toward the end of the season, the farmers allow the weeds to grow among their tomato crop. This management practice helps to shade the developing fruit from the intense heat, resulting in improved fruit quality and yield. Accordingly, this practice corroborates work done by El-Gizawy *et al*. (1992), who reported an increase in yield of tomatoes when shade was provided to reduce temperatures and light intensities. For those North Andros farmers, the production season has now been extended beyond the month of May. This study is being conducted by the Department of Agriculture as it seeks to identify heat tolerant tomato varieties suitable for cultivation during the hot summer months.

Objective:

This present study was conducted to evaluate the heat tolerant tomato variety 'Christy' and document its performance under growing conditions of The Bahamas, beyond the winter vegetable growing season.

Materials and Methods:

Evaluation of the tomato variety 'Christy' was conducted at the Gladstone Road Agricultural Centre from February to May of 2015. The 'Christy' tomato is a product of the seed company Seminis. It is a determinate, heat tolerant variety producing a medium to large sized fruit and has very high resistance to tomato yellow leaf curl virus (TYLCV), tomato spotted wilt, Verticillium, Fusarium, and nematodes.

Tomato seeds were planted in a field seedbed during late February, 2015. After seven days, close to 100% germination was achieved. Healthy tomato plantlets were selected from the seedbed and planted to field plots in early March. The experiment was set out in a completely randomised design

with four replications. Each replicated plot consisted of ten plants with inter-row spacing of 1.5 m (5.0 ft), while within row spacing was 60 cm (2 ft) between plants.

The usual cultural practices were observed to ensure that an even stand of plants was maintained in the field plots. A drip irrigation system supplied water throughout the experimental period. The plants were not treated with insecticides or fungicides, in order to determine their resistance or susceptibility to insect pests and diseases.

Tomatoes were harvested when the first mature tomatoes, or crown set, were green ripened and of a marketable size. For this study, all observations and measurements were made on a set of three harvests of marketable tomatoes. A total of forty plants, ten plants for each of the four replications, were sampled for each harvest. Fruit displaying surface defects, uneven ripening, disease or insect damage were discarded.

The mean daily maximum and minimum temperatures for the trial period were 28.8^{o}C (83.8^{o}F) and 20.8^{o}C (69.4^{o}F), respectively. The total rainfall for the period was 313.5 mm (12.3 in). Mean monthly sunshine duration for the period was 9.0 h. Weather information (Table 1) was obtained from the Meteorological Department of The Bahamas.

Table 1. Weather data on rainfall, hours of sunshine and mean maximum and minimum temperatures for New Providence for the period of February 2015 to May 2015, courtesy of the Meteorological Department of The Bahamas.

Month	**Total rainfall (mm/**inches**)**	**Mean monthly radiation (h)**	**Mean maximum temperature (ºC/**ºF**)**	**Mean minimum temperature (ºC/**ºF**)**
February 2015	**46.0**/1.81	**8.5**	**26.1**/79.0	**18.2**/64.7
March 2015	**70.9**/2.79	**9.0**	**28.7**/83.7	**20.2**/68.3
April 2015	**80.0**/3.15	**9.5**	**30.3**/86.6	**22.4**/72.3
May 2015	**116.6**/4.59	**9.0**	**29.9**/85.8	**22.4**/72.4

Note: Monthly mean values have been rounded up to the nearest tenth.

Statistical Analyses:

All experimental results were analysed using Instat+™ v3.36. Instat is an interactive statistical package, copyright © 2006, Statistical Services Centre, The University of Reading, UK. All rights reserved.

Results and Discussion:

Results were based on the three harvests of the heat tolerant tomato variety. Over the three harvest dates there were significant differences observed for the total number of fruit per plant, total weight of fruit per plant, the weight of a single tomato fruit, the number of marketable fruit per plant and weight of marketable fruit per plant.

Table 2. Analysis of variance (ANOVA) for total number of fruit per plant, total weight of fruit per plant, weight of a single fruit, number of marketable fruit per plant and weight of marketable fruit per plant for the 'Christy' tomato variety. Standard error is for each treatment mean. Error mean square has 119 df. *, ** and *** denote statistical significance at 5, 1 and 0.1% level of confidence, respectively. NS indicates differences between means not significant.

		----------Significance levels----------				
Source	df	Total number of fruit per plant	Total weight of fruit per plant (g)	Weight of a single fruit (g)	Number of marketable fruit per plant	Weight of marketable fruit per plant (g)
Harvest date	2	**	**	**	**	**
Error	117					
Std. Err		0.14	30.4	4.21	0.13	27.8

The mean values for the yield components of the 'Christy' tomato variety, with respect to the total number of fruit per plant, total fruit weight per plant, average fruit weight, number of marketable fruit per plant and weight of marketable fruit per plant are presented in Table 3. These components are among the most important yield attributes in tomato (Pandey *et al*., 2006).

Table 3. Mean values of yield responses for the 'Christy' tomato variety, assessed during May, 2015

Harvest date	Total number of fruit per plant	Total weight of fruit per plant (g)	Weight of a single fruit (g)	Number of marketable fruit per plant	Weight of marketable fruit per plant (g)
8 May, 2015	3.58a	689.3a	195.3a	2.95a	579.9a
18 May, 2015	3.45a	601.7a	177.3b	2.98a	504.7a
26 May, 2015	2.85b	489.4b	172.4b	2.68b	457.4b
Mean	**3.29**	**593.5**	**181.7**	**2.87**	**514.0**

The t-test at a level of 5% probability was applied. For each variety, means within columns bearing different lowercase letters differ significantly at 5% level of confidence.

The 'Christy' tomato variety exhibited acceptable post-harvest quality characteristics, consistent with the basic requirements for the USDA standards for grades of fresh tomatoes (USDA-AMS, 1997). The tomatoes were medium in size, generally well formed and free of defects. There was some evidence of the catface disorder in a small number of fruit, however (Plate 1).

Plate 1. Catfacing on ripening fruit of 'Christy' tomato

At a mean weight of 514.0 g of marketable fruit per plant (Table 3), the 'Christy' tomato variety yielded less favourably than did the heat tolerant tomato variety 'Inbar', evaluated under similar climatic conditions (Richardson, 2013). However, these results compare favourably to those of four tomato varieties evaluated during the cool season (Richardson, 2012). Indeed, as temperatures rose during the month of May, there was a significant decrease in the yield responses by the end of the month. Of the three harvest dates in May, the final harvest resulted in a decrease in all parameters measured over the experimental period. It is clear that the higher temperatures during April and May, at the flowering and fruiting stages, did not have a totally negative impact on fruit development of the 'Christy' tomato variety.

The results of this study suggest that the heat tolerant variety 'Christy' could be cultivated in The Bahamas during the warmer month of May and can be used to extend the growing season. Its resistance to the TYLCV, Fusarium and Verticillium makes it an even more attractive tomato to incorporate within the cropping systems of local Bahamian farmers.

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