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Agroproductive Behavior of Four Onion Varieties (Allium cepa) in Suburban Arid Lands in Camalote, Camaguey, Cuba
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Agroproductive Behavior of Four Onion Varieties (*Allium cepa*) in Suburban Arid Lands in Camalote, Camaguey, Cuba

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ABSTRACT
Four onion varieties of onion (*Allium cepa*) were studied in order to evaluate their behavior in the edaphoclimatic conditions of Ignacio Agramonte CCS, Camalote Agricultural Company, municipality of Nuevitas, Camaguey, Cuba. A randomized block design with four treatments and three replicas was used on alluvial soil, between November 2013 and March 2014. For evaluation of the phenological behavior and the crop´s yield indicators, plant height, number of leaves, bulb diameter, bulb formation, and yields (t/ha), were evaluated. One-way variance analysis was made to the data collected. The Hybrid Yellow Granex had the best bulb formation (90%); Texas Early Granex 502 had the highest yield (17 t/ha).

KEY WORDS/: onion, agroproductive behavior, bulb formation, crop yields

INTRODUCTION

Onion (*Allium cepa* L.) is a biannual plant that can be found worldwide, it demands specific climatic conditions for proper vegetative cycle development, and it is very productive in temperate regions.
According to Estrada *et al.* (2012), it is considered a spice for its taste and nutritional properties. It helps with absorption and digestion of foods. And it is low in energy, but high in mineral salts and other features that make it a general tonic and a stimulant.
Most varieties do not form bulbs in tropical conditions, though the varieties with the best behaviors do not show their highest potential as a consequence of high temperatures and short days. However, there exists a wide number of varieties with different adaptation levels to climate differences (Lescay and González, 2011).
In Cuba, onions are cultivated in all the country with varied productive behaviors. The best yields are produced in the western part of the country (avg. 11.5 t/ha); followed by the central region (10.4 t/ha); and the eastern region (9.0 t/ha), according to the Technical Standards Manual for the crop (2012).
Several research centers in Cuba have made efforts to generate new varieties with proper agronomical characteristics, considering the country´s conditions and the capacity of seed production. As a result, varieties Jagua 9-72, CA-36, CB-42, and Caribe 71 were produced, but stable quality seed supply of these varieties and lines has fallen short (De la Fe and Cárdenas, 2014). Today, evaluation studies of imported varieties are taking place (Creole Synthetic, Red Creole, Hybrid Yellow Granex, Texas Early Granex, Granex F1, White Majestic, and others), to know their adapting capacity to Cuban conditions, and for seed production.

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The prospective general development project for the province of Camaguey includes the construction of new hotels in the northern keys; hence agriculture must respond by projecting the necessary actions of food supply to the new resorts. The idea is to import onions from nearby areas or increase onion production on local farms, based on tradition, potential and experience in the Camalote area, and more recently, in the municipalities of Vertientes and Najasa.
Technically, crop management at the Ignacio Agramonte Cooperative of Credits and Services (CCS) in Camalote has faced difficulty with bulb formation, which that causes weight loss, susceptibility to harmful agents, and premature rotting. The varieties used have been imported, so the farmers do not have any adaptability criteria from other regions in the country. Therefore, the aim of this paper was to determine the agroproductive behavior of four onion varieties (*Allium cepa* L) in suburban arid lands in Camalote.

MATERIALS AND METHODS

The study was developed at the Ignacio Agramonte CCS, Camalote Agricultural Enterprise, municipality of Nuevitas, in the province of Camaguey. It is located at 210 25l 40" north latitude and 770 08l 30" west longitude, 188 - 190 meters above sea level (El Carmen Topographic chart 4680-ll – 1:25 000).
The experiment was made in the period between November 2013 and March 2014. The trial was made on clay loam alluvial soil with high contents of organic matter, and predominance of calcium among cations; slightly saline (pH 5.5-6.5), highly humufied, not much eroded soil, with 30.0 cm effective depth. The soil is on a flat slope (1.1-2%), according to the soil genetic map, 1: 25 000 (second soil classification, Cuba, 1975).
The weather variables observed were relative humidity (%), precipitations (mm), and temperatures (maximum, minimum, and mean ºC), according to the provincial weather center in Camaguey.

Months	Temp. Mean (ºC)	Relative humidity (%)	Precipitations (mm)
November	26.5	79	13.2
December	25.9	77	15.6
January (2015)	29.4	82	34.00
February (2015)	29.6	80	22.7
March (2015)	30.0	73	53.8

A randomized block design with four treatments and three replicas was made.
Treatment 1 (T1) Hybrid Yellow Granex (control)
Treatment 2 (T2) Texas Early Granex 502
Treatment 3 (T3) Granex F1
Treatment 4 (T4) White Majestic

Sowing was directly made by hand, 1 cm deep, on November 22nd, using a 0.10 m x 0.50 m frame; the space between plants was 0.05 m^2.

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Below are the indicators evaluated and measured every 20 days.

- Plant height (cm): determined by measure tape, from the base to the top of the plant.
- Number of leaves (one): the number of leaves of each plant was counted.
- Diameter of bulbs (cm): determined by a caliper gauge after harvest.
- Yields (t/ha): by dividing the bulb weight by the lot area, then converting to t/ha.
- Bulb formation (%): determined through phenological observation of bulbs after harvest, by counting and dividing by the number of plants.

Agrotechnical labors were performed according to the Technical Instructions Manual for the crop (2010), and harvest was made by hand, when the bulbs were fully grown and developed, with 50% dry leaves and bent stems, coinciding with the date of harvest, on days 113 and 114. Then, the bulbs were dried and cured for 9 days in the sun; the onions were turned over every three days, and covered with their leaves to avoid sunburns. Later, also manually, the bulbs were cleaned, by cutting off the stems and roots, then the onions were classified according to their diameter and size (Technical Standards Manual (NC 226: 2002)).

SPSS 11.5 for Windows was used for data processing; the Duncan´s multiple range test was used to compare the means, error probability was 5%.

RESULTS AND DISCUSSION

Plant height (Table 1) showed that the best behavior in the three evaluations was observed in the Hybrid Yellow Granex; the lowest mean was measured in the White Majestic treatment (18.2cm, 36.2cm, and 48.0cm, respectively). The results of evaluation indicated that all the varieties were within the parameters set for plant physiology, with the highest value in bulb thickening (Carravedo and Mallor, 2007).

According to the Technical Instructions Manual (2010), the best temperature values for onions are 20-30 ºC, between sowing and days 55-60. During the experiment, temperatures ranged between 26 and 29 ºC, above the set up values, which may have caused the treatments not to reach the best heights. Accordingly, Huerres and Caraballo (1985) recorded 80-85 cm high plants, under optimum temperatures.

Similar results were found by Lescay and Moya (2006), upon evaluation of climatic factors on some morpho-agronomical variables, in four varieties of onion in the eastern region of Cuba. They claimed that plant height and the number of leaves are influenced somehow by climatic factors, such as temperature and precipitations.

Table 1. Plant height (cm)

Treatments	20 days I	40 days II	60 days lll
T1 Hybrid Yellow Granex	21. 7a	41.6a	66.0a
T2 Texas Early Granex 502	20.2ab	33.2b	54.1b
T3 Granex F I	20.4ab	41.6a	55.0b
T4 White Majestic	18.2b	36.2ab	48.0c
Esx	0.6385	1.5701	0.3986

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The number of leaves is shown in Table 2, where the Hybrid Yellow Granex treatment had the largest number of leaves in the evaluations; no significant differences were observed in treatments 3 and 4. Treatment 2 had the largest number of leaves, with significant differences from the other treatments. These results coincided with other results in the literature regarding growth and vegetative development of plants. As the plant showed the highest leaf number and development, the bulbs started to thicken during the initial stage of bulb formation. This parameter was essential for plant growth, with an after-effect on bulb formation and thickness. Guenkov (1983) established ranges for onions between 7 and 12 leaves, depending on the varieties.

The Technical Instructions Manual (2010) established temperatures of 20-23 ºC between sowing and days 55-60, as well as proper soil humidity, for optimal leaf development. Lescay and Moya (2006) indicated that a single environmental stimulus does not affect every organism the same way, it depends on the particular genetic build for each individual.

Table 2: Behavior of number of leaves

Treatments	20 days	40 days	60 days
T1 Hybrid Yellow Granex	3.6a	5.7b	10.8a
T2 Texas Early Granex 502	4.5a	7.8a	9.0b
T3 Granex F1	4.8a	8.0a	10.1a
T4 White Majestic	4.2a	8.1a	10.1a
Esx	0.35	0.43	0.29

The results of bulb diameter are shown in Table 3; the highest value for bulb diameter was observed in treatment 1 (T1) Yellow Granex Hybrid. This indicator was also influenced by temperature (Technical Instructions Manual, 2010). The requirement is 27 ºC after 60 days to achieve adequate bulb development, but during the experiment, the temperatures were around 30 ºC. For bulb formation and increased bulb diameter, the plant requires a combination of light-hours and temperatures, which is hardly produced in Cuba (12 light/hours) (Narayan and Mishra, 1989). In that sense, these authors stated that drought affects stem diameter considerably. According to Ruíz (2007), this parameter is an essential element for yields. Huerres and Caraballo (1996) reported larger bulb volumes for these varieties than for the red varieties.

The highest yields were accomplished in treatments 1 and 2 (12.0 and 17.0 t/ha, respectively), with a significant difference from the rest of the treatments. The results of the four treatments were above the national mean reported in the Technical Instructions Manual (2010) for the eastern Cuban provinces, but they were below the crop´s genetic potential. Treatment 2 had the best yields.

The soil pH was 5.5 - 6.5 was within the set parameters for good crop development, with set values of 6.0 - 7.9; higher or lower values may lead to serious yield drops. It coincided with authors like González and Ramírez (2002), Mesa (2003), who studied the effect of saline soils, and their utilization in agriculture; and Machado (2004), who noted that onions are resistant to salinity.

Bulb formation in the Hybrid Yellow Granex treatment was 90%, followed by treatments 4, 2, and 3, respectively. These results coincided with other authors like Estrada *et al.* (2012) who

reported Hybrid Yellow Granex as a variety with fully formed stem bulbs, and a single growing point.

Table 3. Bulb diameter (cm), weight (g), bulb formation, yields (t/ha).

Treatments	Bulb diameter (cm)	Bulb weight (g)	Bulb formation (%)	Yields (t/ha)
T1 Hybrid Yellow Granex	7.4a	30.6ab	90[a]	12.0ab
T 2 Texas Early 502	5.1b	50.1a	66[bc]	17.0a
T 3 Granex FI	4.6b	20.9b	57[c]	9.8b
T4 White Majestic	5.0b	30.1b	73[b]	10.1b
Esx	0. 44	0.42	0.38	0.39

CONCLUSIONS

Variety Hybrid Yellow Granex had the best agroproductive behavior and bulb formation under the conditions of the study.

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