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Strawberry cultivars: Knowing to expand and reduce the environmental impacts

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ABSTRACT

The cultivation of strawberry concentrates only in the states of the Southeast and South of the country, contributing to the generation of direct and indirect jobs. The opening of new boundaries, as in regions of higher temperatures has been indicated as an alternative to increasing the strawberry production in Brazil. In order to overcome this climate limitation, the aim of this work was to review on the characteristics of 11 strawberry cultivars for possible adaptation to hot climates, decreasing can escape the major diseases that affect the plant and the fruit and reduce the amount of pesticides that are part of day - to-day culture.

Keywords: strawberry descriptors, strawberry crops, strawberry cultivars.

INTRODUCTION

The strawberry belongs to the family Rosaceae, genus *Fragaria* and to the species *Fragaria x ananassa* Duch. It is an original hybrid by crossing two species, *chiloensis* *Fragaria virginiana* and *Fragaria* (SILVA, 2007). The strawberry is a fleshy and juicy pseudo intense red coloration. Has at its end the true fruits called achenes (CAMARGO, 1963). Strawberries are rich in fructose and sucrose

and low in carbohydrate. When the strawberry is consumed in a well-balanced meal, there is a chemical reaction that triples the iron absorption ratios present in vegetables, eggs and meat. It is also slightly laxative and diuretic. Supre the lack of minerals and vitamins B complex and has Quercetin, which is able to neutralize the action of free radicals responsible for the aging of cells (SANHUEZA, 2005). Moreover, it is rich in vitamin C, also containing riboflavin, pyridoxine, niacin,

magnesium, manganese, calcium, iron, phosphorus, potassium (TACO, 2006).

Currently, the strawberry is a crop of great economic and social importance in several countries, especially the United States and some European countries. However, in recent decades, there have been significant increases in production in some countries, including Latin American (VIEIRA, 2001). The cultivation of this vegetable in Brazil began in Rio Grande do Sul and was later taken to São Paulo, where it spread by their municipalities and other states.

The great interest in culture is its high profitability and high demand for hand labor, generating a significant increase for the economy and contributing to the social development process (VIEIRA, 2001). For the country, the culture of revenue is around 115 million. Net revenue of R \$ 41,500.00 per hectare, It is 39.3%, 43.9% and 16.8% involving the producer, partners and employees, respectively (Madaíl, 2008). Brazilian production in 2006 was 2,786 tons planted in 361 hectares (FAO, 2006). Brazil's main producing states are: Minas Gerais, São Paulo, Rio Grande do Sul, Parana and Espirito Santo, which together have 96% of all domestic production (REICHERT and MADAIL, 2003). No data on strawberry production in Pernambuco, only estimated harvest in 2000 in the town of Gravesend. This crop forecast was 20,000 kg (JC 1999).

One of the limiting factors of culture in regions of cold climates is the high susceptibility to disease. Currently known 51 species of fungi, three bacteria, nematodes eight and 24 viruses that affect the culture. Because of this large amount of illness that affect the strawberry pesticides are used

indiscriminately affecting human health (MASS, 1998).

The successful development of new combinations of characters to search open new frontiers can be limited by not knowing the available diversity of germplasm in breeding programs (GRAHAM et al., 1996). Additionally, the cultivars grown in Brazil are mostly from the United States, Japan and Spain. Therefore, a need exists for studies involving genetic breeding for the creation of new cultivars adapted to national higher temperatures (OLIVEIRA, 2008).

Currently, there has been the expansion of cultivation in areas distant from consumer markets, where producers have sought new farming techniques and new cultivars. Thus, it is necessary to characterize them as a means of avoiding germplasm cultivation with similar genomic constitutions, although with different denominations, and moreover, it is necessary mapping of the areas from which the strawberry cultivation and use of digital modeling of field may also be an alternative to identify the percentages of strawberry crops and their cultivars in Brazil (CALDAS, 2015; CALDAS 2016; CAHU, 2015a; CAHU, 2015b; SILVA, 2015a; SILVA, 2015b; VERSLYPE, 2015; VERSLYPE, 2016).

Due to the need to identify descriptors that have good response in plants subjected to hot and humid climates, as the State of Pernambuco Forest Zone, to incorporate the variety to be improved, the objective is that review, the determination of the properties of the cultivars obtained on the market to identify the best suited to hot weather conditions to avoid the use of agricultural products to combat diseases and pests reducing the environmental impacts (COELHO JUNIOR, 2016).

REVIEW

Descriptors in plant variety protection

Most strawberry cultivars few ancestors originated, domestication and genetic improvement itself has significantly narrowed the genetic basis of cultivated strawberry (SJULIN and Dale, 1987). The information on the diversity of the available germplasm in breeding programs are rather limited. Therefore, the successful development of new varieties of desirable characteristics for future cultivars strawberry may be limited by a lack of information and the low genetic diversity (Graham et al., 1996). The introduction of new cultivars and patenting them or other cultivars require identification system. The characterization of cultivars is the basis for estimating work on genetic similarity and for their identification (CONTI, 2002). For identification, verification and protection of a cultivar take into account uniformity and stability. For this the use of descriptors is required. These descriptors are genetically inherited characteristics that can be molecular, morphological, physiological or biochemical (MILACH, 2008).

These characteristics differ from species to species and are also commonly called varietal characters. These characters may be classified according to the degree of interaction with the environment, qualitative and quantitative traits.

The qualitative characters, called monogenic, are readily identified and characterized by lower influence of environment, so it is also called fixed character. As for the quantitative characters depend on the interaction of several genes, each contributing more and some less. They are easy to influence the environment, so called variable characters (Silva 2005).

Existing descriptors are morphological, isozyme, and molecular. The most commonly used descriptor is the morphological, but has many

limitations (MILACH, 2008), mainly related differentiation elite genotypes (Smith & Smith, 1992). Another major problem is when the character is variable, under great influence of the environment and must be obtained lot of characters and do several repetitions and in different locations to obtain more efficient results (JESUS, 2006).

Protein descriptors and enzymes came to meet some limitations of morphological ; Advantageously, enable the analysis of genetic distance (Smith & Smith , 1992) .

After a few years of the onset of enzymes and proteins they came descriptors DNA descriptors , allowing the individual's genotype access preventing the expression of the phenotype and the environment (MILACH , 2008) . Several techniques exist , making it possible to identify the genetic variability by DNA. These techniques are commonly known as molecular markers (MILACH , 2008). To obtain new cultivars need to years of research and testing , making it a very expensive activity. For this, prior to its disclosure and marketing responsible for developing them should seek resources for plant variety protection (MAGALHAES , 2006).

The cultivars protection law created on April 25, 1997 (MILACH , 2008) ensures the rights of any marketing of the protected cultivar (Magalhaes , 2006). One of the reasons is that the descriptors must present were homogeneous , stable and other of the various (MILACH , 2008).

In addition to this law , there is a body responsible for this, the National Service for Cultivar Protection (SNPC) , belonging to the Ministry of Agriculture,

Livestock and Supply. He is responsible for the spread of new cultivars and the requirement of the minimum requirements necessary for a new cultivar (SILVA, 2005).

The physicochemical characteristics of the strawberry are quite important due to three main factors, nutritional value, flavor and aroma. At cultivars should differ enough as to its content of ascorbic acid, pH, titratable acidity and soluble solids.

Cultivars

The strawberry cultivation is an important alternative for small farms. An important factor in achieving success in the production is the use of adapted cultivars for each region to plant health, and acceptance in the marketplace alternative to dry season (CASSIAN et al., 2002). In Brazil, the breeding work of strawberry started in 1941, the IAC - Agronomic Institute of Campinas, Campinas-SP, under the coordination of Leocadio de Souza Camargo researcher. Thanks to the cultivation of genetically improved clones developed in IAC, the strawberry production in São Paulo has increased about six times in the late 60. Another relevant factor to the progress of culture was the production and regular supply of basic matrices free viruses tested in the Section of Virology Fitotécnica IAC (CASTRO, 2004). Therefore breeding was considered a milestone in the strawberry culture awakening interest in researchers and producers (DUARTE FILHO et al, 2007).

From the 90 works have been intensified research and trials aimed at introducing new cultivars produced by institutions public and private companies. But mostly, there is no appropriate prior assessment, as the adaptation and

productivity of these crops in the regions for which they were developed (TACO 1999).

The use of appropriate cultivation for the production of strawberry plants is a very important point because the environmental conditions and handling determine productivity and product quality in the user table (DUARTE FILHO et al., 2007). The choice becomes a limiting factor, especially with respect to hours of light and cold, which varies according to the genetic material used. Another important point is the consumer choice that requires fruits with good appearance and no pesticide residues (DUARTE FILHO et al., 2007).

In recent years, the interest is focused on the search for yielding cultivars, early in showy fruits, coarse, sweetened and resistant to "black flower" disease caused by the fungus *Colletotrichum acutatum*. In fact, looking up genetic resources pest and disease resistance level, such that make possible cultivation with rational use of pesticides, since crops are made almost daily, for several months. The cultural techniques to reduce inoculum or decreasing the spread thereof, as crop rotation, soil solarization, soil disinfestation, greenhouse and drip irrigation, they are extremely valuable, since there is no availability of genotypes with favorable combinations of all the features of interest (PASSOS 1999).

Depending on the photoperiod, cultivars are divided into two groups: neutral days cultivars (Aromas and Diamante) and short day cultivars. Cultivars short day are those in which the flowering starts with the lowest photoperiod than 12 hours followed by representing the lowest temperature fall. The main varieties of short days used in Brazil are: Dover, Oso Grande, Camarosa, Sweet Charlie,

Tudla - Milsey , Camino Real, Festival, Ventana , Toyonaka and Campinas (Oliveira , 2005b).

Dover is a cultivar obtained at the University of Florida in 1973 , resulting from a cross between 'Florida Belle ' and ' Fla . 71-189 ' (Howard and ALBREGTS , 1980) . Plants have medium vigor , thick crown, early production and high productivity. The fruits are large , with conical - elongated shape , skin and firm flesh and red - intense color , flavor little acid and little evident aroma (GROPPPO et al . , 1997). The fruits show great variability in size , shape and flavor. The cultivar is susceptible to anthracnose . It was the most planted in the country in the years 1993-95 , and has been gradually replaced by other cultivars that have superior organoleptic characteristics (SANTOS, 2003) (OLIVEIRA et al . , 2005b) (Figure 1) .

Figure 1 - Leaf cultivar Dover.



Oso Grande is a cultivar of short days and great adaptability ; vigorous plant with large leaves and dark green ; median cycle and high production capacity . large fruits , firm texture of pulp at the beginning of production and average at the end of the harvest in a clear and aromatic red coloring ; light red skin ; subácido flavor , fit for consumption "in natura" . Tolerant gray mold (*Botrytis cinerea*) and susceptible to stain micosfarela (*Mycosphaerella fragariae*) and anthracnose (*Colletotrichum fragariae* and *Colletotrichum acutatum*) (ANTUNES, 2016) (Figure 2).

Figure 2 - Leaf cultivar Oso Grande.



Camarosa is its own farming for consumption "in natura" and industrialization . Cultivating short days ; vigorous plant with large leaves and dark green ; early cycle and high production capacity . large fruits ; dark red skin ; firm texture of flesh and bright red internal color , dark and uniform ; subácido , own taste for consumption "in natura" and industrialization . Susceptible to micosfarela spot anthracnose and gray mold (ANTUNES, 2016) (Figure 3).

Figure 3 - Leaf cultivar Camarosa.



Sweet Charlie was obtained at the University of Florida in 1992. Plants are compact , with medium sized leaves and a lot of hairiness . Production is late , and very productive . The fruits are medium sized , firm , red - light internal color , characteristic sweet flavor, low acidity and high content of vitamin C, suitable for fresh consumption . The cultivar is tolerant to anthracnose stem and fruit, and susceptible to micosfarela spot and gray mold (SANTOS, 2003; SHASTA NURSERY ., 2004; Oliveira et al , 2005b) (Figure 4)

Figure 4 – Leaf of cultivar Sweet Charlie.



Tudla - Milsey is a cultivar originated from Spain. Plants are compact , medium vigor, with large sheets of dark green and root system well developed . The production cycle is slow , and very productive , maintaining the size and firmness of the fruit by the end of the harvest. The fruits have cone-shaped or elongated wedge , large size, firm flesh of red - bright color, red skin , sub- acid flavor and very aromatic and is recommended for fresh consumption and industrialization . The cultivar is tolerant to gray mold , and susceptible to micosferela spot and anthracnose stem and fruit (SANTOS . 2003; OLIVEIRA et al , 2005b) (Figure 5)

Figure 5 – Leaf of cultivar Tudla-Milsey.



Camino Real is a very cultivate for consumption "in natura" . short- day plants , originating from the University of California, USA . It has high production capacity . The plants are smaller, more compact and erect and less vigorous than the cultivar Camarosa . The fruits are large , firm , with

skin and dark red flesh and good taste and is recommended for market fresh and industrialization (ANTUNES, 2016) (Figure 6).

Figure 6 – Leaf of cultivar Camino Real.



Ventana is a very cultivate for consumption "in natura" . Cultivating short day , originating from the University of California . It has a high yield per plant . The plants are large , strong , but not as straight . The fruits are large , moderately firm , with internal color and bright red skin , good looks and good taste , is recommended for market fresh and industrialization (ANTUNES, 2016) (Figure 7)

Figure 7 – Leaf of cultivar Ventana.



Cultivar own Festival for consumption "in natura" . Plant with excellent resistance to disease , both foliar and root . Keeps the shape and size during the entire production cycle . Good production in the second year.

Aromas is fit for consumption "in natura" . Originating from the University of California, USA . Cultivating neutral day for table fruit with good size

, early , bright red color, good flavor , medium vigor , suitable for summer cultivation (planting from September) . Cultivate for the Serra Gaucha region. It is relatively resistant to powdery mildew . The plants have an average force (Figure 8).

Figure 8 – Leaf of cultivar Aromas.



Diamante was obtained at the University of California in 1997. The plants are upright and compact , conducive to dense crops. It is very productive , producing large fruit , firm and of excellent quality and is recommended for fresh consumption . The coloring of the fruit inside is light red , so it is not suitable for industrialization , farming neutral days (ANTUNES, 2016) (Figure 9).

Figure 9 – Leaf of cultivar Diamante.



Campinas is a cultivar of short, rough days ; great fruit and good taste; tolerance to angular leaf spot (*Xanthomonas fragariae*) ; susceptible to Rhizoctonia sheath blight (Rhizoctonia) , anthracnose (Colletotrichum sp) and wilting Verticillium (Verticillium albo-atrum) (SANTOS, 2005) (Figure 10).

Figure 10 – Leaf of cultivar Campinas.



The cultivar was obtained in Japan. Toyonaka also known as Toyonoka is a cultivar that has great fruit, adapted to warm climates and very productive , producing large fruit , firm, excellent quality and is recommended for fresh consumption (Figure 11).

Figure 11 – Leaf of cultivar Toyonaka.



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