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Strawberry cultivation in Brazil

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ABSTRACT

The strawberry is cultivated in different regions of the world. Their cultivation have shown demand larger family hand labor and highly profitable. The strawberry is a very old fruit. Wild species existed for more 50 million years, but the specie was tamed around the XIV century A.C. There are various types of cultivation, among them stand out traditional cultivation and organic cultivation. The more important factors affecting the strawberries are climate, pests and diseases. Know the types of cultivation and strawberry it is important for decision making in the future, such as use of lichens in cultivation. The aim of this work is to explain about conventional and organic agriculture with emphasis in lichens on strawberry crop to support scientific research in more depth character.

Keywords: strawberry crop, organic strawberry, strawberry production.

INTRODUCTION

The strawberry is cultivated in different regions of the world. Their cultivation have shown demand larger family hand labor and highly profitable.

The plant is attacked for several pests and diseases, mainly in regions of high climate. The pesticides are large used in strawberry crop occasioning very diseases in human, animals and environmental pollution.

Techniques in cultivation should be add how organic crop. Sustainable agriculture can be used how possibility to a large productivity and production without to be hurtful to human and environment.

In adding, the lichens use was tested in work of Coelho-Junior (2013) and was obtained great results.

To obtain in depth study about strawberry cultivation is necessary know all elements of the

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cultivation. Including conventional and organic agriculture. The aim of this work is to explain about conventional and organic agriculture with emphasis in lichens on strawberry crop to support scientific research in more depth character.

REVIEW

This review treat about origin, botanic aspects, nutritional value, cultivars, climate aspects and the procedures of strawberry cultivation

1. Origin, botanic aspects and nutritional value

The strawberry is a very old fruit. Wild species existed for more 50 million years, but the specie was tamed around the XIV century A.C. In this time, this species were taken of the wild state with medicinal and ornamental purpose (VIEIRA, 2001).

The commercial strawberry (*Fragaria x ananassa*) is a fruit belonging the *Rosaceae*, subfamily *Rosoidea* and genus *Fragaria* (SANHUEZA *et al.*, 2005). Your specie was origined by interspecific crossing of the two species: *Fragaria chiloensis and F. virgiana* (Figure 1 and 2) (ANTUNES *et al.*, 2010).

The genus Fragaria is classified according with a level of ploidy. The basic chromossome number is seven (x=7). This genus comprises seventeen wild species. The *Fragaria x ananassa* is octoploid (2n = 8x = 56) (COELHO-JUNIOR, 2013; LI *et al.*, 2010; CASTRO, 2002).

There is evidence that genetic improvement was started by Indians who inhabited the Chile, before your discovery. They selected wild plants with pseudofruits larger sizes. The first works with genetic crossing were realized by Duchesne in 1760, when studied and characterized the existing strawberry species (CASTRO, 2004).

Figure 1 – *Fragaria. chiloensis* specie.*Source:* http://www.laspilitas.com/nature-of-california/plants/312--fragaria-chiloensis

Figure 2 – *Fragaria virgiana* specie. Source: http://nyc.books.plantsofsuburbia.com/fragaria-virginianawild-strawberryrosaceae, 2016.

Figure 3 – *Fragaria ananassa specie.* Source: http://www. http://pt.aliexpress.com, 2016.

Characterized by being herbaceous and creeping plant, your radicular system show fasciculate and superficial roots (CASTRO, 2002). The roots is

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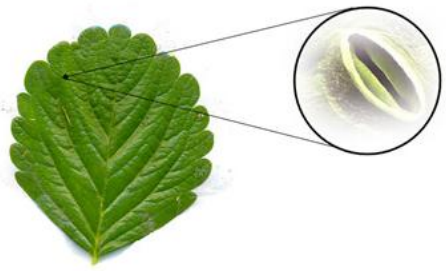
renewable and have size of 50 to 60 centimeters (FILGUEIRA, 2000), being that 90% from them are in 10 centimeters of soil surface (CASTRO, 2002). The roots show fibrous appearance and emerge of crown in the base of each new leaf and are divided in primary and secondary (BRAZANTI, 1989). When the plant gets older increases in (RONQUE, 1998 e ROSA *et al.*, 2013).

The part of plant the show above the soil is called of crown. Some species can have their crown mesuring up to 60 cm tall (BRAZANTI, 1989

The leaves are originated of crown. The leaves are formed for 3 foliole (FOLQUER, 1986). Some cultivars have 4 or 5 folioles (RONQUE, 1998) and your size may vary from 3 to 20 centimeters (FOLQUER, 1986). The folioles have great number of stomata, between 300 to 400 per mm^2. Therefore, the strawberry crop is very vulnerable to lack of water, low relative humidity, and temperatures above (SANHUEZA *et al.*, 2005). Each leaf is able to perspire 25 mL per day (RONQUE, 1998). The leaf blade has coloring between light green and dark green (Figure 4) (QUEIROZ-VOLTAN *et al.*, 1996).

Figure 4 – Stomata seen by microscope. Source: Coelho-Junior, 2013.



The strawberry show good taste and their known nutritional value. Indeed, have been shown to contain high amounts of vitamin C and phenolic compounds and help to protection against free radicals (CRESPO et al., 2010).

The fruit is rich in fructose, saccharose, vitamin C, vitamin B complex, riboflavin, pyridoxine , niacin, minerals (magnesium, manganese, calcium, iron, phosphorus and potassium) and poor in carbohydrates. When consumed in a balanced meal and due the presence of the Quando consumido numa refeição bem balanceada e devido à presença dos malic acid , salicylic acid and citric, increase the rates of iron absortion present in the vegetals, eggs and meat and neutralize free radicals (TACO 2006; BASON *et al.*, 2010; WASIM *et al.*, 2012; COELHO-JUNIOR, 2013).

The anthocyanin is other important substance responsible for strawberry color and human health. Environmental factors how light conditions, temperature, amount of irrigation, fertilization or cultivation systems can affect the concentration of anthocyanins and antioxidant activity in strawberries (CRESPO et al., 2009).

Considering the above information is important to farmer consider all essential factors (light conditions, temperature, amount of irrigation, fertilization or cultivation systems) to a good production.

2. Cultivars and climate aspects

In fuction of photoperiod, the cultivars are divided in three groups: neutral days, long days (june-bearing) and short days (everbearing). The varieties of short days are those wich the flowering start with a photoperiod smaller than 12 hours with low temperatures representing the autumm. The mainly short-days varieties in Brazil are: Dover, Oso Grande, Camarosa, Festival, Sweet Charlie, Tudla, Camino Real, Ventana, Toyonoka and Campinas. The neutra-day cultivars are Aromas and Diamante (Figure 5) (COELHO-JUNIOR, 2009; COELHO-JUNIOR et al., 2010; OLIVEIRA, 2005).

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Figure 5 – Leaves of Dover, Oso Grande, Camarosa, Sweet Charlie, Tudla, Camino Real, Ventana, Aromas, Diamante, Campinas and Toyonoka (From left to right and from top to bottom). Source: COELHO-JUNIOR, 2016.

The strawberry crop requires much care and a good planning to the cultivation. It is strongly influenced by temperature and photoperiod and this exerts smaller influence (VERHEUL *et al.*, 2007). Besides these two factors, other are also important, but smaller expressive how: precipitation, dew point, relative humidity and light intensity. These other are smaller expressive due the cultivation to be in tubes and drip irrigation (RESENDE, 2001).

The requeriment of photoperiod and temperature varies a lot according with each cultivar. Those variants influence directly the plant growth, how vegetative growth, seedling production, flowering and fructification (SONSTEBY e HEIDE, 2008; OPSTAD *et al.*, 2011). Each cultivar require a number of light necessary to obtain a good developing of strawberry and good productivity.

For the vegetative development is important to heat (RESENDE, 2001; ROSA *et al.*, 2013), while seedling production require temperatures above 25ºC with long days (VILELA JUNIOR *et al.*, 2004; KUMAR *et al.*, 2011). Favoring flowering and fructification is considered great in temperatures bellow 15ºC, while above 25ºC disfavoring the strawberry (RESENDE, 2001; ANTUNES *et al.*, 2006; COELHO-JUNIOR, 2013).

In temperatures above 25ºC favoring strawberry acidity, decreases taste, aroma and consistence (ANTUNES *et al.*, 2006). In regions with could temperatures the strawberry stay firm, good taste and aroma. (FILGUEIRA, 2000).

3. Conventional Cultivation

The strawberry is cultivated in two systems: conventional and organic cultivation.

3.1. Planting time, planting site and altitude

In Brazil the planting time is of January to May, depending of cultivation region. In places of high temperatures can plant from April to May (RESENDE, 2001).

Altitude is also a factor that affects the production and strawberry productivity, and Brazil, is planted at altitudes greater than 700 m in São Paulo and 800m in Rio Grande do Sul and Santa Catarina (SANTOS and MEDEIROS, 2003; RONQUE, 1998). The altitudes of these municipalities were correlated with temperature data for identification of municipalities with potential for cultivation of strawberry, for each month, generating information appropriate time to your planting. The information of precipitation and relative humidity, two factors also important, but less intense that temperature and photoperiod, were not considered, since the strawberry crop is done in greenhouses and controlled irrigation. The altitudes were also medium cities have also been raised from data from weather stations in Pernambuco collected in CAD (2015). the parameters created by snore were followed (1998), which were classified municipalities that were below 600 m, between 600 m and 700 m and above 700.

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In study realized by Crespo et al. (2010) in Swiss the strawberry cultivated in Conthey (approximately 500 meters of altitude) with average temperatures around 16.5ºC and obtained production bellow Bruson city (above 1000 meters) with average temperatures around 14.5ºC using the cultivars Antea, Asia Clary and Matis.

The strawberry produces on sand loam soils with a good drainage and good availability of water (RESENDE, 2001).

3.2. Seedling production

For a seedling, production is necessary to choose a secluded area more 500 meters of the strawberry commercial crops and in the place do not have strawberry cultivation in the last five years and use a spacing of 1 m x 2 m for plant. The seedling should be identified, certified, and free pests and diases (RESENDE, 2001).

3.3. Soil preparation and fertilization

The soil sould be well plowed with planty organic matter with depth of 25 to 30 centimeters. The crop spacing is 30 x 30 centimeters (RESENDE, 2001).

The strawberry it is demanding in organic and chemical fertilization (COELHO-JUNIOR, 2013). In the cultivation should occur foliar fertilization using boron, zinc, calcium, potassium and nitrogen and application of calcareous (RESENDE, 2001).

3.4. Irrigation

The strawberry crop need a large amount water per day (COELHO-JUNIOR, 2013). The irrigation should be for sprinkler or drip irrigation, mainly drip irrigation (RESENDE, 2001).

3.5. Harvest, Production and productivity

The strawberry is produced in various regions of the world (Oliveira et al., 2005) and a culture of great economic importance in many countries, especially countries with low temperatures (VIEIRA, 2001; ROSA et al , 2013) .

The larger producer in the world is China with 3,005,3304 tonnes followed by United States, Mexico, Turkey, Spain, Egypt and Republic Korea, Poland.

In the Europe Spain is the first position with 312,500 tonnes, followed by Poland, Russian, Germany, United Kington, Greece, Ukraine and France.

In South America Chile is in first position with 45,819 tonnes followed by Colombia, Venezuela, Peru and Argentina. Brazil is 56º position in the world with only 3,200 tonnes (Table 1) (Figure 6).

Table 1 – The best producers in the world in 2013.

Pos.	Country	Production (tonnes)
1	China	30053304
2	United States of America	1360869
3	Mexico	379464
4	Turkey	372498
5	Spain	312500
6	Egypt	254921
7	Republic of Korea	216803
8	Poland	192647
9	Russian Federation	188000
10	Japan	160237
11	Germany	149680
12	Morocco	145233
13	United Kingdom	94373
14	Greece	79700
15	Ukraine	70700
16	France	55754
17	Netherlands	51000
18	Chile	45819
20	Colombia	42448
21	Italy	40116
22	Venezuela	38911
23	Belgium	35900
24	Iran	33752
25	Australia	32405
26	Peru	30776
32	Sweden	13800
33	Finland	13184
34	Argentina	13095
35	Portugal	12800
40	Switzerland	8743
56	Brazil	3200

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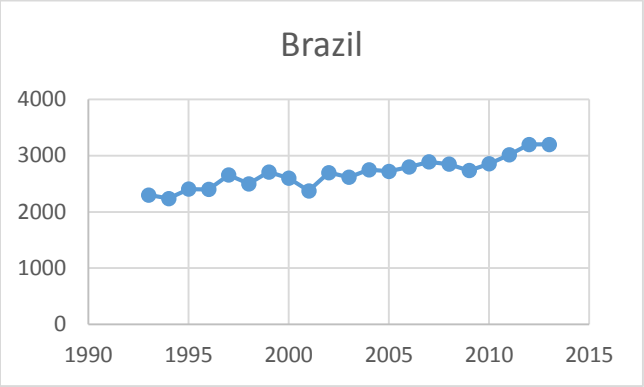
Figure 6 – Brazilian strawberry production (tonnes) in the years (1993-2013).



4. Organic production

Regarding the cultivation technical recommendations can be said that the soil preparation takes place in a similar way to conventional cultivation. The planting fertilizer must be specific to the organic compound used or any other material suitably decomposed, which should preferably be ' rich ' (i.e. good), because the strawberry plant nutrient is demanding. (SANTI & COUTO, 2012).

The producer who practices conventional system strawberry cultivation makes use of chemical inputs in the fertilization stage and the preventive and curative treatments against diseases and pests, without complying with the established technical rules. When the producer uses the integrated production system , it is concerned to conduct an economic production and high quality, obtained primarily with ecologically safer methods , minimizing the undesirable side effects of pesticide use to increase the protection of the environment and improve health human (SANTI e COUTO, 2012).

In the organic system the focus is directed to the establishment of ecologically balanced and stable agricultural systems, economically productive in large, medium and small-scale , high efficiency in the use of natural resources production and socially well-structured , resulting in healthy food , high nutritional value and toxic waste -free, and other agricultural products of superior quality, produced in full harmony with nature and with the real needs of humanity (SANTI and COUTO , 2012) .

According Madail (2007) the three different production systems, both in concept and in practice , it is of different systems and therefore technical and economic results different .

Other possibility to add organic agriculture, is the use of lichen in cultivation. Lichens are being resulting from a symbiotic association between fungi and algae (MARGULIS and SCHWARTZ, 2001).

In work realized by Coelho-Junior (2013), the lichen use in strawberry cultivation show great results. The lichens *Cladonia verticillaris* and *Cladonia salzmannii* decreased the amount of microorganism in the soil in strawberry crop.

CONCLUSION

The strawberry can be cultived in almost regions in the world, except very hot weather and few water. Because is a crop that receive great among of pesticides in necessary more studies for decrease among pesticides receive and to continue de larger production in the world.

Alternatives for the cultivation is possible and are studied to obtain best yield, the use of lichen is a great opportunity to develop of strawberries in the world.

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