



Mini Review

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# Soils of Yucatan: Effect On The Growth Of The *Habanero chili* Plant (*Capsicum chinense*)



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## Mini Review

Leptosols are the most common soils in the world (12%). This is also the case in Mexico (24%) and in the state of Yucatán (80%) The high spatial heterogeneity of Leptosol areas complicates agricultural development, agronomic experimentation, and transfer of agricultural technology; among other things- The state of Yucatán, in southeast Mexico, has an extensive territory of undulating topography, forming a karstic plain developed on a deep sequence of Cenozoic limestone layers. Calcareous bedrock and the subhumid climate have contributed to the formation of soils showing differences in depth, stone content, Fe and Al as residual material, and other chemical and physical soil properties. The soil mantle, composed mainly of weakly developed protosols is highly variable [1].

The fruits of *Capsicum chinense* plants grown in the Yucatan Peninsula have a denomination of origin "Yucatán Peninsula habanero chili" from 2010 [2] based on their unique characteristics of flavor, aroma, pungency, color and shelf life; these are due to the special conditions in the region, which are suggested to be due to the particularities of the soils in which they are cultivated.

For cultivation of *C. chinense* three main types of soil are used (K'áankablu'um (red soils), Box lu'um (black soils) or ch'ich'lu'um (stony soils), this classification does not consider however, it is local knowledge that the stony soil is limited in micro and macronutrient contents, as well as poor water retention capacity. These soil properties can cause different types of stress to the plants, such as stress due to potassium (K) deficiency or water stress.

The interaction of the soil with the plant affects the development of the fruit, since the amount of nutrients, water and salinity in the soil has a significant effect on the quantity and size of fruit, whereas other studies have shown a direct

relation of the content of some secondary metabolites with the same factors. However, when plants are cultivated the variety of factors affecting development cannot simply be reduced to the presence or absence of a nutrient or lack of water, the soil structure is complex and variant, although nutrition can be corrected by chemical methods, other soil parameters do not.

In one study [3], Twenty-eight laboratory tests were performed on samples from 24 soils At least 50 % of the soils were silt loam, with low apparent density (0.58-0.82g cm<sup>-3</sup>), high porosity (71-74%), from neutral to moderately alkaline, very slightly saline, and very high OM contents (>6%). Of the soils, 54 % were rich in N (>0.25%), 67% in P (>11mg kg<sup>-1</sup>) and 92 % in K (>0.6 cmol(+)100g-1); in 88 % the CIC was high to very high (25-52meq 100g-1), 100 % were high in Ca (>10 cmol(+) kg<sup>-1</sup>) and 75 % were medium to high in Mg (1.3-5cmol(+)kg<sup>-1</sup> More than 60 % were marginal in Fe (2 and >1.0mg kg<sup>-1</sup>, respectively). These results suggest that the soils in the state of Yucatán are highly heterogeneous in their physical and chemical characteristics.

In another study [4], yields of habanero chili fruits showed the importance of applying high doses of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O to the soil and the availability of sufficient water in the soil solution for this species. Similar results were reported with red and green chilies [5]; with paprika [6] and with *C. chinense* sweet [7]; They indicate that the yield decreases as the nutrition or the usable moisture is reduced, this as a detrimental physiological response to stressful nutritional and water conditions, indicating that the translocation of assimilates towards the fruits decreases as the deficit of water.

Analyzing the two main types of soil in Yucatan (black and red), the relation between the edaphic characteristics and the bacterial and fungal community structures in these two kinds of Leptosol [8], the results revealed that Black Leptosol (BlaS) had

a higher content of calcium carbonates, organic matter, nitrogen, and phosphorus than Red Leptosol (RedS). The most outstanding difference in the bacterial community structure between BlaS and RedS was that while in BlaS Actinobacteria was the most abundant phylum (43.7%), followed by Acidobacteria (26.9%) and Proteobacteria (23.6%), in RedS the bacterial community was strongly dominated by Acidobacteria (83%).

Nitrogen, along with phosphorus, are the nutrients that most limit crop productivity. In addition, it is known that nitrogen, potassium and water deficit can affect the synthesis of capsaicinoids in the fruits of habanero chile [9,10]. The presence of different nitrogen sources in the three soil types of Yucatan can lead to significant changes in plant growth and development. For example, exogenous nitrate has been [11], and regulates transcript levels of a nitrate transporter of high affinity in this species [12]. Nitrate per se stimulates leaf cell expansion [13,14] and has a very significant effect on the metabolism of C, especially by stimulating the synthesis of acids.

On the other hand, the presence of an organic source of nitrogen in the soil, as in the case of amino acids, can lead to completely different morphological changes than those caused by the inorganic nitrogen source. For example, glycine inhibited the growth of the primary root of habanero chili, but stimulated the formation and elongation of root hairs and induced a significant accumulation of starch granules at the root apex [15].

According to the characteristics of the leptosols in interaction with the characteristics of the crop, that it does not tolerate excesses of moisture and does not present a high nutritional demand, is that partly the favorable adaptation can be explained, and consequently, the particular characteristics presented by the Habanero Chile from the Yucatan Peninsula.

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