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Pedological Characteristics of Cucumber (Cucumis sativus L) Cropsin Mediterranean Environment (Huete, Spain)

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Abstract

Substrate nutrient and moisture management are two major concerns in the cultivation of Cucumis sativus L cropsinHuete. Entisols (Soil Survey Staff) or Regosols (FAO-UNESCO-ISSS) are the main soil types in this area. These soils are characterized by being moderately deep, they have medium to moderately thick textures and they are on sandy subsoils or sandy loam. The soils are moderately permeable and are susceptible to saturation during periods of prolonged rainfall. The soils are generally fertile are susceptible to mechanized tillage and rarely contain a stony phase.

Keywords: Cucumber Sativus L; Adaptation; Pedological; Huete; Mediterranean Environment;

Introduction

Agro-ecological engineering approaches aimed at the design and exploration of alternative land use systems on different scales can support the identification of appropriate land use options [1]. According to Fresco and Kroonenber, the characteristics of the agro-ecological processes depend on the scale in question [2].

Cucumber is a native vegetable of the tropical regions of South Asia, from where it spread to Europe and America. The botanical name for cucumber is Cucumis sativus L As for melon, wátermelon and squash, cucumber belongs to the family Cucurbitaceae [3]. Cucurbitaceae is a reasonably large family of about 130 genera and 900 species [4,5]. Of these species, around 30 from 9 genera are cultivated. All Cucurbitaceae are frost-sensitive and the family is confined to the warmer regions of the globe. Cucumber is cultivated on around seven million hectares worldwide and more than half are produced in Asia, 26% in Europe and the rest in Africa and America [6]. Spain wasone of the first countries to produce cucumber in the European Union, with an estimated production volume of between 700,000 and 800,000 tonnes.

Castilla La Mancha (Central Spain) is one of the Spanish regions in which different cucurbetacea (melon, watermelon, cucumber)are produced. These areas are traditionally dedicated to irrigated farming. Cucumber (Cucumis sativus L) from Huete (Cuenca, Spain) is highly valued gastronomically and it is used in salads and entrees. The aim of the work described here wasto review the pedological characteristics and adaptability in the case of Huete cucumber.

Material And Methods

The Site

The area under investigation surrounds the village of Huete, a municipality in the Cuenca region of Alcarria (Castilla-La Mancha, Spain), located on the eastern and southern slopes of Castillo hill (Figure 1) between the courses of the rivers Borbotónand Major. The elevation of Huete is 809 msnm.

Figure 1: Location of the area

In geological terms, the tertiary that borders the soils of the meadow where the Huete cucumber is planted is represented by materials of the Paleogene and Neogene periods and it has continental environments and varied lithology (conglomerates, sandstones, clays, gypsum, limestone). The quaternary (where the crop is located) is formed by deposits of erosion and filling (basically alluvial deposits from the valley, although sometimes in conjunction with coluvions and hillside deposits).

The average annual temperature in Huete is 12.40C and precipitation has an average annual value of 451 mm. It can be seen from the climatic diagram that there is a period of water deficit that normally coincides with the period of cultivation of the cucumber.

Soil Sampling

The samples were taken from profiles opened with a caterpillar machine (approximately 1 × 1.5 meters in area and 2 meters in depth). In all cases the soil profile was conditioned using manual tools. The profiles (Table 1) were described according to FAO guidelines and samples were subsequently collected from each horizon for all the profiles and were air dried and sieved (< 2 mm) prior to analysis [7].

Table 1. Some characteristics of analyzed soil profiles.

PROFILE 1 (X-527.062.44 - 4.445.097, 8)							
Soil Type (FAO/ST)	**Morphology**	**Parent material**	**Vegetation/ Use**	**Topography**	**Slope**	**Drainage**	**Stoniness**
Haplic Regosol / Typic Xerorthent	Ap (0-36 cm) C1 (36-83 cm) C2 (>83 cm)	Fluvial material/ Marls	Irrigated farming	Botton valley	Flat (C-0)	Well drained (C-4)	No stoniness (C-0)
PROFILE 2 (X-527.057.81 – 4.446.008)							
Soil Type (FAO/ST)	**Morphology**	**Parent material**	**Vegetation**	**Topography**	**Slope**	**Drainage**	**Stoniness**
Haplic Regosol/ Typic Xerorthent	Ap (0-45 cm) C1 (45-68 cm) C2 (>68 cm)	Fluvial material/ Marls	Irrigated farming	Botton valley	Flat (C-0)	Well drained (C-4)	No stoniness (C-0)

Analytical Methods

Soil pH was measured in a 1:1 soil:water suspension (Peech, et al.) and electrical conductivity in a 1:5 soil: water suspension (Richards, et al.) [8,9]. The exchangeable capacity was measured by the method described by Thomas [10]. The soil organic matter was determined using the method described by Anne [11]. The total $CaCO_3$ content was determined by the Bernard calcimeter method using 4 M HCl. Finally, total nitrogen was measured by Kjeldahl's method and available phosphorus was measured by the Olsen method [12,13].

Results and Conclusions

The relevant data for the soil samples are summarized in figure 2. The organic matter content is moderate, tending to low (< 3%). Chemically, the pH is optimum (7.55 to 7.96) and the catión Exchange capacity (43.6 - 29.3 cmol/kg) is acceptable. The texture is sandy-loam with a low percentage of gravel, although within the study area deep pockets of clay-loam were frequently found. The texture of the analyzed soils reveals that they have a uniform texture, which is predominantly loam-loamy. The cation exchange capacity ranges from 29.3 to 43.6 cmol/kg and this is dominated by Ca^{2+}. The carbonate content (which is lower in profile 1 than in profile 2) ranges between 21.5 and 63.6%. The soil is deficient in phosphorus (varies between 5.4 and 14.6 ppm) and a similar trend was observed for the N content.

However, one of the most significant features of the soils of the area dedicated to cucumber cultivation is the presence of a certain level of salinity. The Huete cucumber seems able to tolerate greater levels of soil salinity than other species. Barage states that there are wild accessions of cucurbitaceae that are salt tolerants [14]. The cucumbers are irrigated with water that has moderate electrical conductivity and there is no appreciable decrease in yield. (Sanden, et al.) pointed out that a soil electrical conductivity up to 6 dS/m does not have a detrimental effect on the growth of pistachio and the scenario could be similar in Huete; in the case of pistachio only when the electrical conductivity of the soil exceeds 8 dS/m was a decrease in yield of approximately 50% observed [15]. In the soils under investigation the electrical conductivity values range between 1.7 and 2.2 dS/m and the values were slightly higher in profile 1 than in 2.Given the salinity data it is possible that this low level of salinity may be one of the characteristics that gives Huete cucumber its characteristic taste, an aspect that would need to be investigated more deeply.

The soils were developed from materials deposited by river currents and are generally identified as Entisols or Regosols (FAO-UNESCO-ISRI) [16,17]. As a consequence of their relatively low genetic development, these soils do not have clearly defined diagnostic horizons. However ,they are characterized as being moderately deep, they have medium and moderately thick textures and are on sandy subsoils or sandy loam. The soils are also moderately permeable and are susceptible to saturation during periods of prolonged rainfall. The soils are generally fertile, susceptible to mechanized tillage and rarely contain a stony phase.

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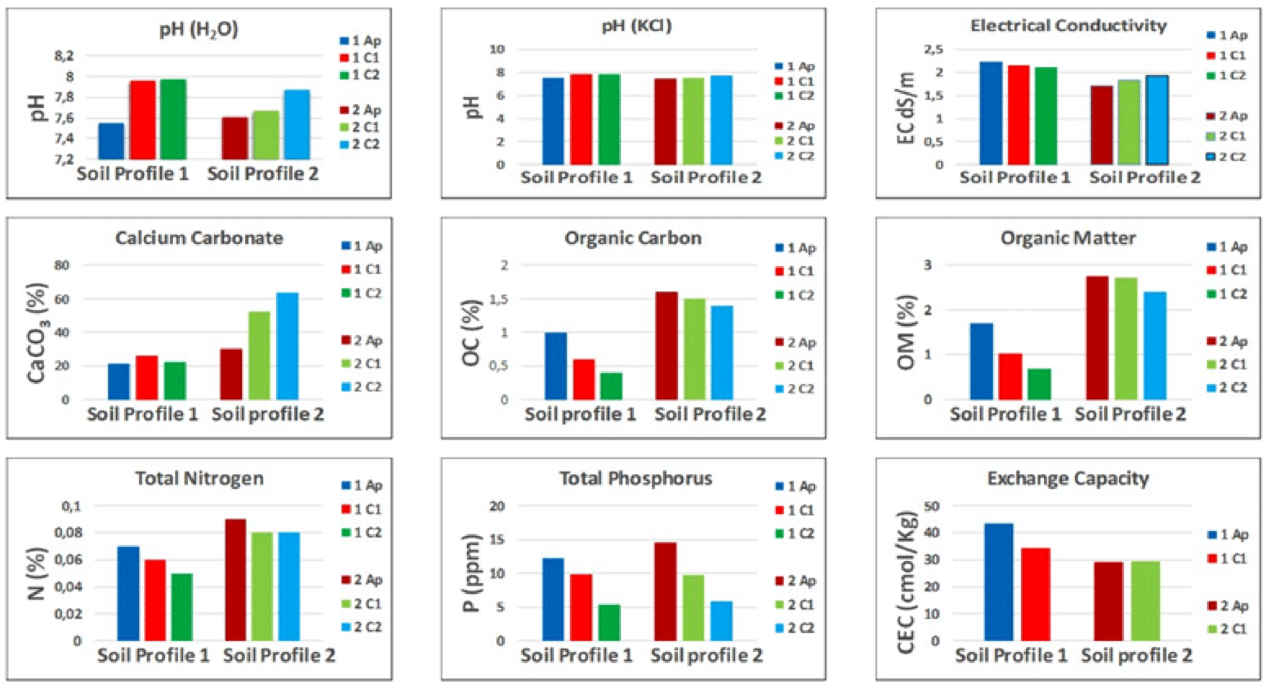

Figure 2: Selected properties measured in soil samples: pH, EC electrical conductivity (dS/m), OC organic carbon (%), OM organic matter (%), calcium carbonate (%), N total nitrogen, P total phosphorus, CEC exchange capacity (cmol/kg).

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