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"Phyllophaga ssp. damage to jicamas roots during development. Effect on saccharides content"

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Abstract

Pachyrhizus erosus (jicama) is a tuberous root cultivated around the world and commonly used as food. Different authors report on their nutraceutical properties, such as the hypoglycemic effect of jicama aqueous extract, which helps in the prevention of type 2 diabetes mellitus, and enhances the growth of *Lactobacillus L. plantarum* due to the presence of prebiotics. The aforementioned functional properties have been related to their saccharides, mainly fibers and oligosaccharides. The aim of this work was to follow the changes in starch, pectin, inulin and other simple saccharides in jicama roots during their growth that were damaged by *Phyllophaga* spp. Regarding the content of reducing sugars, it was observed that during the first two jicama collections (100 and 140 days), these increased (11.12%-18.63% control jicama and 11.98%-28.66% stress jicama), with a significant difference between the development periods ($p>0.05$) and stress. Regarding the percentage of total sugars, the presence of beetles did not affect the synthesis of the component, observing the minimum values at 100 days of development (11.67%). In the determination of starch, no significant differences ($p>0.05$) were observed between control jicama and with biotic stress at 100 days, but at 140 days, while by development time the sample that presented the highest content was jicama, at 180 days. An effect of sample growth development was also observed. Regarding specific components, damaged jicama show smaller starch yield values (50%) than clean samples, while in most other cases, the biocomponents increased their concentration, most of them at 140 days of development, with sucrose being the most noticeable component (250 mg/g-350 mg/g). According to the chromatograms for inulin, nystose, kestose, sucrose, glucose, and fructose were found. In the case of pectin, the following compounds were found: galacturonic acid, glucose, xylose, and arabinose. Some other components only appear in damaged jicama (inulin). This behavior must be triggered by the presence of the parasite promoting different metabolic pathways. More studies are needed in this area.

Introduction

Pachyrhizus erosus is a tuberous legume that belongs to the genus Pachyrhizus, which is cultivated around the world due to its edible roots, composed mainly of water (87%), starch (10.7%), protein (1.3%) and fiber (1.4%), and is commonly used as food, cosmetic or for medical purposes. Jicama roots are consumed at different stages of development, probably having different compositions of polysaccharides such as starch, pectin, cellulose, xyloglucans, heteromannes, heteroxylans, data that have not yet been reported in the growth of jicama. However, despite having a high yield and nutraceutical properties, this plant is exposed to attack by pests and diseases, thus generating a large amount of agricultural waste whose use has not been determined. Furthermore, these agro-industrial wastes can be a good source of polysaccharides such as starch, pectin or inulin that are involved in the direct defense of plants.

Aim

Determine changes on starch, pectin, inulin and other saccharides on jicama roots damaged by *Phyllophaga spp.* during development.

Materials and methods

Planting plan: The material was sown, following the commercial practice in Apaseo el Grande, Guanajuato, Mexico in clay soil, applying a double row of seed and placing a medium flow irrigation hose. 6 furrows were sown 100 meters in length with 14 to 16 jicama seeds per linear meter. Of these furrows, the second and fifth corresponded to the experimental treatment of control or healthy jicama (T1). Irrigation was carried out from east to west, taking advantage of the natural slope of the land, carrying out 10-12 irrigations in total. The deflowering was chemical during the first three months, and no fertilizers were added. It is worth mentioning that, on this land, the white grub was sown in a controlled manner. However, the concentration used did not generate any effect, so only healthy samples were considered for the study and were decided to repeat the experiment in a biotically compromised field in order to evaluate the effect of infestation stress.

Sample preparation: The tuberous root was cleaned by removing soil with a brush and then washed with enough water. Once clean, the sample was photographed, cut into slices of approximately 0.3 cm and dried for 48 h (AFOS MINI KLIN, England) at 30°C. Finally, the jicama was ground (Hamilton Beach 80350 China) for 10 min in 30 s periods and sieved through a 0.5 mm Monyl mesh. The material was stored in plastic bags with Ziploc closure in a desiccator at room temperature until its subsequent use. For the determination of sugars by spectrophotometric and HPLC, Miller, 1959; Dubois, *et al*., 1956 and Gonzalez-Vazquez *et al*., 2022 were followed.

Results

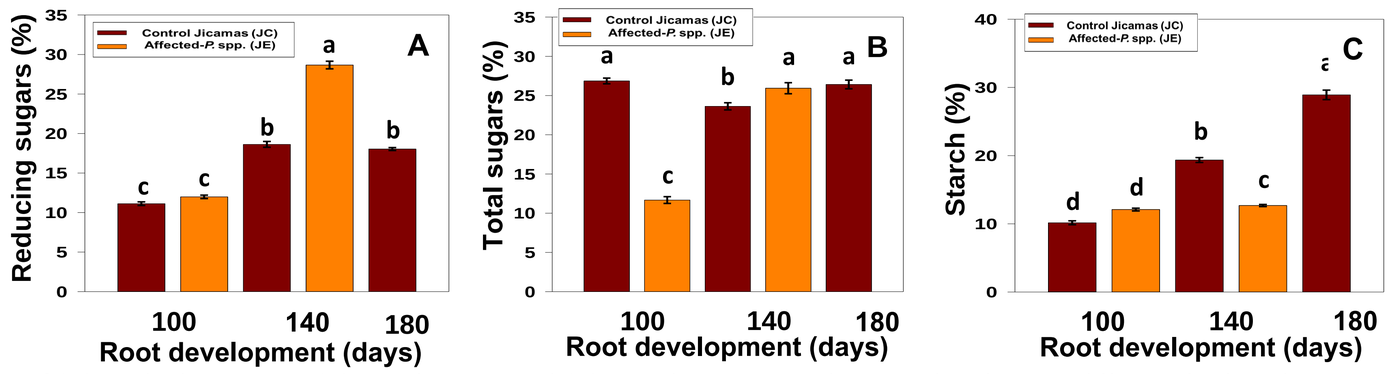

Figure 1: Spectrophotometric determination of (A) Reducing sugars, (B) Total sugars and (C) Starch percentage in control and stressed jicama in the 3 harvest periods.

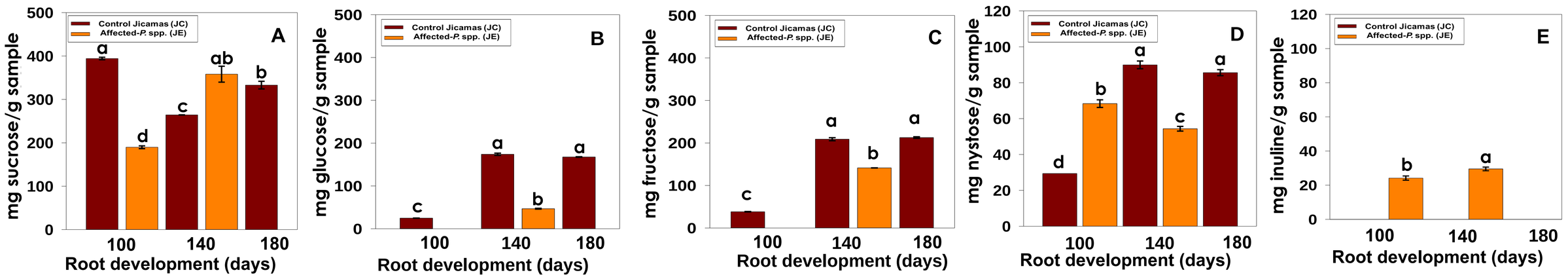

Figure 2: Determination of sugars by HPLC-inulin. (A) Sucrose, (B) Glucose, (C) Fructose, (D) Nystose and (E) Inuline concentration (mg/g) in control and stressed jicama in the 3 harvest periods.

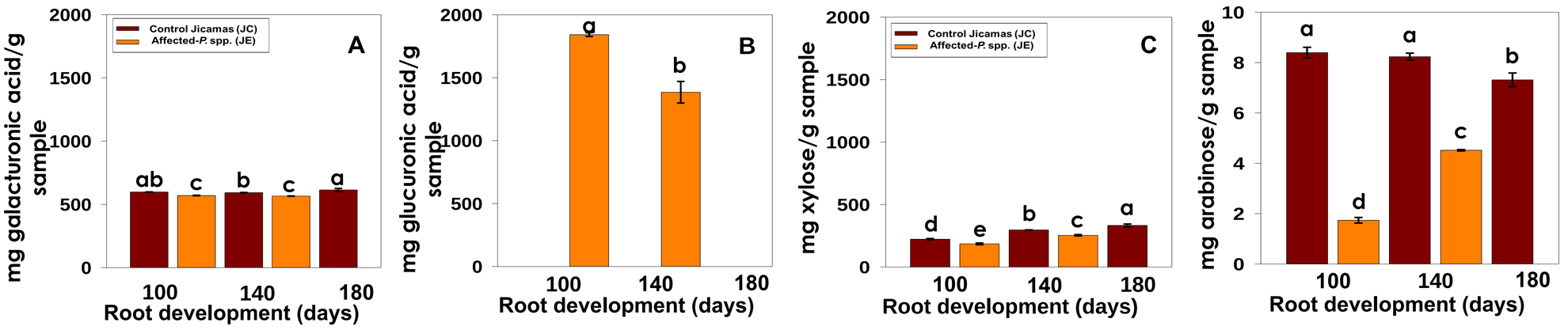

Figure 3: Determination of pectins by HPLC. (A) Galacturonic acid, (B) Glucoronic acid, (C) Xylose and (D) Arabinose concentration (mg/g) in control and stressed jicama in the 3 harvest periods.

Conclusions

- The total starch content increased during development.
- The highest concentrations of glucose, fructose and nystose occur after 140 days of development.
- It has been reported that the cell walls of undamaged jicama are chemically composed of cellulose, lignin, pectin and hemicelluloses and are composed of neutral and acidic sugars such as arabinose, rhamnose, xylose, mannose, galactose, glucose, galacturonic acid and glucuronic acid, some of which have been found in this study.
- Finally, these results provide extensive knowledge about jicama by knowing the polysaccharide changes during the tuberization process.

References

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