

RESPUESTAS DE LAS CERAS EPICUTICULARES DE MANZANA AL DAÑO POR SOL

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Palabras clave: Capacidad antioxidante, Embolsado, Fenoles, α -Farneseno, Minerales, Oxidación lipídica, Potencial hídrico.

Las ceras epicuticulares son la interfaz entre el medio ambiente y el fruto, jugando un importante rol en las relaciones hídricas de la planta y en la interacción de ésta con agentes bióticos y abióticos. Por otra parte, el daño por sol es un problema no resuelto en la producción de manzanas y que puede llegar a producir importantes pérdidas económicas. A fin de determinar las modificaciones inducidas por el daño por sol, sobre las ceras epicuticulares de manzana, se evaluaron algunas características físicas y bioquímicas de éstas.

En dos temporadas consecutivas, se evaluó las ceras epicuticulares de cuatro cultivares de manzana: Royal Gala, Granny Smith Pink Lady® y Fuji, y sobre este último se evaluó además, cera de fruta que creció embolsada. En cera de fruta con y sin daño por sol, de cada cultivar, se determinaron las variaciones en concentración y composición, concentración de fenoles, capacidad antioxidante, oxidación lipídica y concentración de α -Farneseno. Adicionalmente, se evaluó la acumulación de minerales en la epidermis de manzanas y el potencial hídrico del tejido subepidermal en frutos con y sin daño por sol.

En concentración, casi no se encontraron diferencias, entre fruta con y sin daño por sol. En cuanto a la composición química, no fue posible encontrar un patrón general de comportamiento frente al daño por sol, sólo respuestas particulares de los cultivares. En el caso de la concentración de fenoles, capacidad antioxidante y concentración de α -Farneseno también hubo comportamientos variables y particulares según el cultivar, mientras que la oxidación lipídica tendió a ser mayor bajo el efecto del daño por sol. Respecto de la concentración de minerales en la epidermis, sólo en Fuji y Pink Lady® fue posible establecer diferencias atribuibles al efecto del daño por sol, especialmente en la concentración de Mg y Ca. Estas diferencias se explicarían por el efecto generado por el daño por sol en el flujo transpiratorio y por ende en el movimiento de ciertos nutrientes. El potencial hídrico subepidermal fue menor en el tejido afectado por el daño por sol.

El embolsado en el cultivar Fuji, en general tendió a disminuir los efectos del daño por sol sobre las ceras epicuticulares. La concentración de nutrientes en la epidermis de fruta embolsada, con o sin daño por sol, disminuyó en comparación con la no embolsada. Esta práctica además indujo diferencias en los patrones de acumulación de los nutrientes evaluados.

Las evaluaciones realizadas permitieron establecer que existen respuestas de las ceras epicuticulares de manzana al daño por sol, las cuales son variables según el cultivar y en algunos casos pueden ir asociadas a la susceptibilidad de éste al daño por sol.

ABSTRACT

Epicuticular waxes become an interface between environment and the fruit, playing an important role in the hydric relations of the plant and its interactions with biotic and abiotic agents. On the other hand, sunburn or solar damage is an unsolved problem and has been reported as an important cause of economic loss in apple production. With the aim of determining the modifications to apple wax caused by solar damage, its concentration and some biochemical characteristics were evaluated.

Over two seasons, epicuticular waxes were evaluated in four apple cultivars: Royal Gala, Granny Smith, Pink Lady® and Fuji. Wax from bagged Fuji apples were also evaluated. Variations were determined in the concentration, composition, phenolic concentration, antioxidant capacity, lipidic oxidation and α -Farnesene concentration of the epicuticular wax of fruit with and without solar damage in those four cultivars. No significant differences were found in concentrations between fruit with and without solar damage. In terms of chemical composition, it was not possible to find a general pattern of behavior in response to solar damage, just particular responses from cvs. For the case of phenols concentration, antioxidant capacity and α -Farnesene concentration, there were also variable and particular behaviour according to the cultivar, while the lipidic oxidation tended to be higher under the solar damage effect. Regarding mineral concentration at the epidermis, just in Fuji and Pink Lady® it was possible to determine differences due to solar damage, especially in Mg and Ca concentration. Those differences would be explained throughout the solar damage effect in the transpiratory flux and therefore in the movement of some nutrients. The sub-epidermal water potential was lower in solar damaged tissues. Bagging fruit (Fuji apples) tends to decrease the solar damage effect over the epicuticular waxes. Nutrients concentration in epidermis of bagged fruit, with or without sunburn, decreased compared with non-bagged ones. On the other hand, this practice produced differences in nutrient accumulation patterns. The evaluations led to conclude that there are responses in apple epicuticular waxes due to solar damage, those are different according to the cultivar and in some cases are associated with cultivar susceptibility to sunburn.

EPICUTICULAR WAX CONCENTRATION AND COMPOSITION IN FOUR APPLE CULTIVARS AFFECTED BY SOLAR DAMAGE

ABSTRACT

Cuticular wax is an interface between the environment and the fruit, playing an important role in the hydric relations of the plant and its interactions with biotic and abiotic agents. With the aim of determining the modifications to apple wax caused by solar damage, wax concentrations were evaluated in four cultivars (cvs.): Fuji, Royal Gala, Granny Smith and Pink Lady® over two seasons. Variations were determined in the concentration and composition of the wax of fruit with and without solar damage in the four cvs, as well as bagged Fuji apples. The melting point of the wax and the water potential of sub-epidermal tissue were also measured.

Almost no differences were found in concentrations between fruit with and without solar damage. In Granny Smith, evaluations of wax thickness from the center of the lesion and healthy sectors determined that cuticle reduction is only produced at the center of the lesion. In terms of chemical composition, it was not possible to find a general pattern of behavior in response to solar damage. Only the particular responses of cvs. Royal Gala and Granny Smith show close compositions with little variation in their waxes. Unbagged Fuji presented the greatest differences in terms of wax concentration among fruit with and without solar damage, while among the bagged fruit the differences were less accentuated. In general, Pink Lady® had an erratic behavior.

Key words: bagged, melting point.

BIOCHEMICAL RESPONSES OF APPLE EPICUTICULAR WAX TO SUNBURN

ABSTRACT

Epicuticular waxes, as the outer barrier of plants, are the first to face the environmental factors. De esta manera, los agentes causales del daño por sol, estarían actuando primariamente sobre las ceras. Thus, the causal agents of sunburn, would be acting primarily on the wax. In order to know the sunburn effect on certain biochemical characteristics of apple wax, wax from fruit with and without sun damage was evaluated. Four apple cultivars (cvs.) were used (Fuji, Royal Gala, Granny Smith and Pink Lady®) during two consecutive seasons. Wax from fruit with and without sunburn was extracted and analyzed in terms of concentration of phenols, antioxidants, lipidic oxidation and concentration of α -farnesene. Expressing the results by area, there was practically no difference between wax fruit with and without sunburn. The concentration of phenols, antioxidants, α -farnesene showed particular behaviors depending on the cv. In conditions of greater damage severity and expressing the results based on the weight of wax: Fuji and Granny Smith had a lower concentration of phenols in damaged fruit; the concentration of antioxidants increased in Royal Gala and Pink Lady® with sunburn, while in Fuji was the contrary; meanwhile, the α -farnesene concentration decreased significantly only in Royal Gala affected by sunburn, whereas lipid oxidation was higher in wax from fruit with sunburn. These results show that wax responses to damage from sun are variable and dependent on the cultivar (cv.). Key words: antioxidants, bagged, α -Farnesene, lipidic oxidation, phenolics concentration.

**ESTABLECIMIENTO DE LAS TENDENCIAS EN CONCENTRACIÓN DE
MINERALES EN EPIDERMIS DE MANZANA AFECTADAS POR
DAÑO POR SOL**

ABSTRACT

With the aim of knowing the effect of sunburn on the accumulation of minerals in apple skin, its concentration was evaluated in fruits with and without solar damage. Four cultivars were used: Royal Gala, Granny Smith, Fuji and Pink Lady®, the effect of bagging was also evaluated on the latter. By means of using the principal component analysis, it was possible to differentiate between cultivars and within them. No changes associated with solar damage were found in Royal Gala and Granny Smith. In Fuji and Pink Lady® different behaviors under the effect of damage were possible to establish, especially in the concentration of Mg and Ca. These differences are explained by the effect generated by sun damage in the transpiration flux and therefore in the movement of certain nutrients. The combination of genetic and morphological conditions, the sensitivity to damage, the time in which this damage occurs and the intensity of agronomic practices such as thinning, would affect the response of Fuji and Pink Lady®, in terms of mineral concentration, to sun damage. Bagging of the cultivar Fuji reduced the concentration of nutrients in the fruit epidermis, with or without sun damage, compared to non-bagged fruit. Moreover, this practice induced different behaviors in the concentration of minerals under the effect of solar damage.

Palabras clave: componentes principales, embolsado.