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GROWTH ACCELERATION OF QUENEPA (*MELICOCCUS BIJUGATUS*) ROOTSTOCK WITH AN EXTRACT OF THE BROWN ALGA *ASCOPHYLLUM NODOSUM* AND A BLEND OF AMINO ACIDS, PEPTIDES AND RELATED COMPOUNDS

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ABSTRACT: Research was conducted in Mayagüez, Puerto Rico, to determine the effect of two biostimulants on the in-nursery growth of 'Martinez' quenepa grown for rootstock. A brown alga (*Ascophyllum nodosum*) extract (Stimplex®) and a commercial blend of amino acids and related compounds (Macro-Sorb Radicular®) were applied to the rootstock container substrate as drench every three weeks until the plants reached the adequate grafting stage. Plants treated with the biostimulants were ready for grafting earlier than control plants. In general, 'Martinez' quenepa response to the amino acid blend was somewhat greater than its response to the (*Ascophyllum nodosum* extract, but the extent of growth response depended on biostimulant rate. Both biostimulants may be useful to accelerate the growth of quenepa seedlings for rootstock.

Keywords: Biostimulants, Physiological regulators, Tropical fruits

INTRODUCTION

The economic importance of quenepa, Spanish lime, limoncillo or mamoncillo (*Melicoccus bijugatus*) has been increasing in Puerto Rico, where quenepa accounted sales were approximately $620,000 in fiscal year 2007-2008 (PR Department of Agriculture, 2009). The amount of quenepa demanded by consumers has been increasing; therefore, more commercial orchards need to be established. In Puerto Rico, several superior trees have been identified, named and described as selections for grafting to establish organized orchards (Cabrera and Brunner, 2000 and 2007; Sierra Gomez, 2006). Grafted quenepa trees are true to the selection grafted and reach the production stage in three to five years, at least three years earlier than in non-grafted trees (Cabrera and Brunner, 2000 and 2007).

Quenepa seedlings take nine to 10 months to reach the adequate grafting stage (0.7 cm in stem diameter, at 20 cm above the soil). Transplant growers would benefit from practices that shorten the time for seedlings to be ready for grafting, hence reducing the need for labor, management and protection, thereby freeing resources to be used to produce other transplants.Acceleration of quenepa seedling growth may be achieved by using appropriate exogenous physiological regulators, but there is scarce documentation on the effect of exogenous regulators on quenepa growth. In quenepa seedlings, gibberellic acid 3 has been shown to increase height, but not necessarily stem diameter (Morales-Payán and Santos, 1997).

In other crops such as tangelo (*Citrus reticulata* x *C. paradisi*), Tahiti lime (*Citrus latifolia* Tanaka), grapefruit (*Citrus paradisi*) and in orange (*Citrus sinensis*), applications of a commercial mixture of amino acids, peptides, and nucleotides (Macro-Sorb Radicular®) and a commercial extract of the brown alga *Ascophyllum nodosum* (Stimplex®) were shown to reduce the time necessary to achieve adequate transplanting size after budding (Morales-Payán, 2008; Morales-Payán and Santiago, 2008; Santana et al., 2006). Stimplex® is an extract of the brown alga *Ascophyllum* nodosum, reported to contain auxins, betains, cytokinins, oligosaccharides, organic acids and polysaccharides that appear to trigger hormonal responses in plants (Blunden, 1991; Crouch et al., 1992; Sanderson & Jameson, 1986; Sanderson et al., 1987; Tyihák et al., 1994). Macro-Sorb Radicular® is a biostimulant derived from enzymatic hydrolysis of animal membranes, containing (weight/volume) 2% plant-available nitrogen, 21.3% free amino acids, peptides, nucleotides, and fatty acids, and 14.8% unidentified organic matter.

The objective of this research was to determine the effect of a commercial extract of the brown alga *Ascophyllum nodosum* (Stimplex®), and a commercial blend of free amino acids, peptides, nucleotides, and fatty acids (Macro-Sorb Radicular®) on the growth of quenepa for rootstock.

MATERIALS AND METHODS

Container experiments were conducted in the fruit crops nursery of the Alzamora Teaching and Research Farm of the University of Puerto Rico in Mayagüez, Puerto Rico, in 2007 and 2008. 'Martinez' quenepa seedlings were grown in 2-L bags filled with a top soil+sand substrate and were managed following local practices, except for the application of the biostimulant treatments.

The treatments were established in a randomized complete block design with 10 replications per treatment, where one seedling equaled one replication. The treatments consisted of soil applications (drench) of aqueous solutions of a commercial extract of the brown alga *Ascophyllum nodosum* (Stimplex®) (liquid formulation, 0.01% active ingredient based on kinetin-like biological activity) and a commercial mixture of amino acids, peptides, nucleotides and fatty acids (Macro-Sorb Radicular®)(liquid formulation with 20% weight/weight solids with putative active ingredients). The rates of both products were 0, 0.25, 0.5, 0.75, and 1.0 ml of commercial product per liter of water per application. Each quenepa seedling received 150 ml of biostimulant aqueous solution per application, starting 30 days after seedling emerged in the substrate bags, and repeated every 21 days thereafter until seedlings attained adequate grafting size (AGS). Rootstock seedlings were considered at the AGS when their stems reached 0.7 cm in diameter at 20 cm from the soil surface. Stem diameter at 20 cm from the soil surface was measured every 21 days after the first application of the treatments. Regression analysis (5% level) was conducted on resulting data.

RESULTS AND DISCUSSION

Stem diameter was significantly affected by the treatments, with the time necessary to attain AGS decreasing as the rate of the kelp extract and the amino acid blend increased (Figure 1). In general, 'Martinez' quenepa seedlings grew faster when treated with the amino acid blend than when treated with the *Ascophyllum nodosum* extract. Time to AGS was reduced by as much as 15% and 21% when treated with the *Ascophyllum nodosum* extract and the amino acid and peptide blend, respectively, as compared to untreated seedlings (Figure 1). In other words, in the process of growing quenepa rootstock for grafting, using the *Ascophyllum nodosum* extract and the amino acid and peptide blend represented an acceleration of approximately 41 and 57 days, respectively, in time to AGS.

The acceleration of growth found in Tahiti lime in this research is similar to that of the effects reported when an *Ascophyllum nodosum* extract and blends of amino acids, peptides and related compounds were applied in nursery to plants such as Tahiti lime, tangelo, grapefruit, and orange (Morales-Payán 2007; Morales-Payán and Santiago, 2008; Santana et al., 2006). The biostimulant effect of the *Ascophyllum nodosum* extract tested in this research may be attributed to the content of growth-promoting substances such as cytokins, auxin, betaines, oligosaccharides, polysaccharides, and organic acids, among others, all of which may enhance growth by themselves and/or may trigger hormonal responses in plants (Blunden, 1991; Crouch et al., 1992; Sanderson & Jameson, 1986; Sanderson et al., 1987).

The effect of the amino acid and peptide blend might be due to its reported auxin-eliciting activity (Kaufman et al., 2005), tolerance to stress, and enhancement of photosynthetic activity, production of roots and nutrient uptake in plants (Kaufman et al., 2007; Rai, 2002), all of which in turn would enhance biomass accumulation and accelerate growth. Our results show that, aside from their specific modes of action in quenepa plants, both biostimulant formulations tested in this research may be useful to accelerate the growth of quenepa seedlings for

rootstock; the extent of growth promotion depended on the rate applied. Future research will include evaluation of other rates of these biostimulants separately and in tank-mixing, as well as other growth promoting exogenous substances.

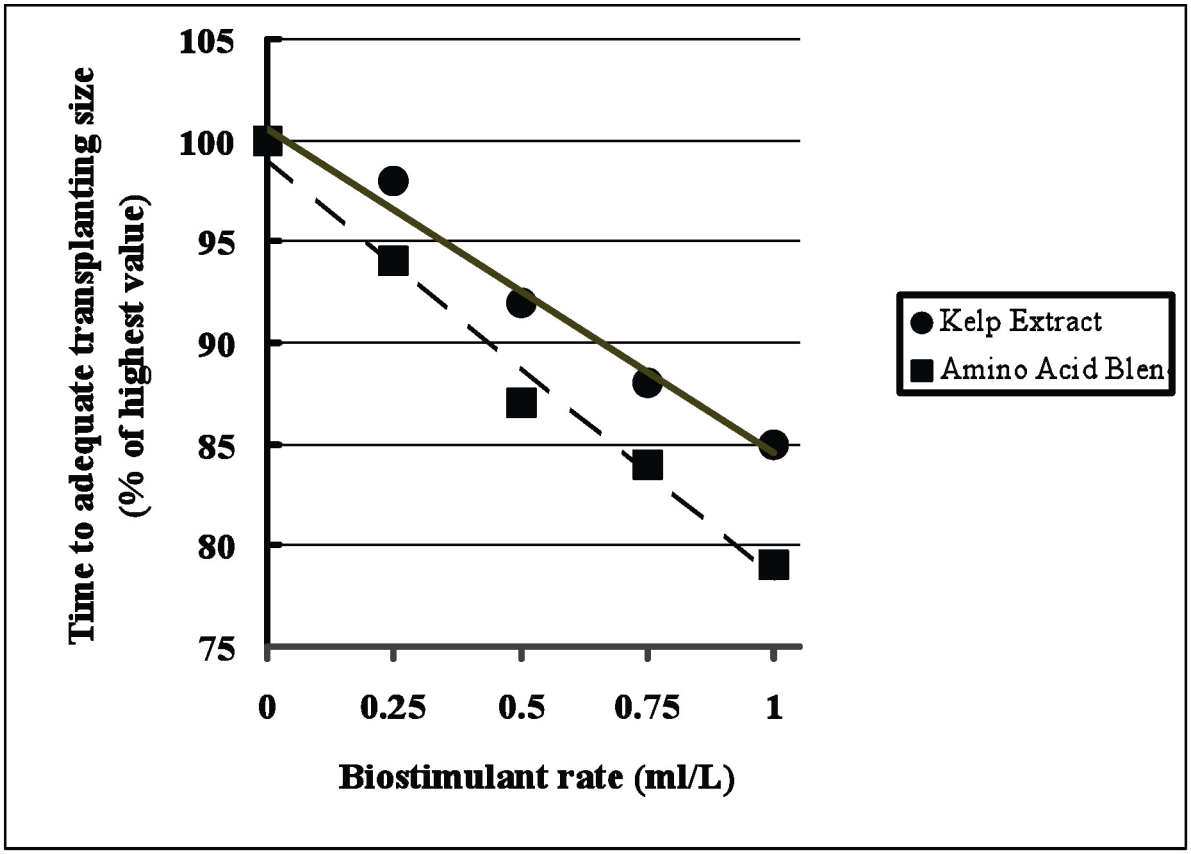

Figure 1. Effect of a kelp (*Ascophyllum nodosum*) extract and an amino acid mixture on the time to adequate grafting stage of 'Martinez' quenepa seedlings for rootstock in Mayagüez, Puerto Rico. Data averaged from experiments in 2007 and 2008.

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