

EFFECTS OF GIBBERELLIC ACID, ACETYLTHIOPROLINE, AND A MIXTURE OF AMINO ACIDS + SHORT-CHAIN PEPTIDES ON SCALLION YIELD

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ABSTRACT

Scallion sets were soaked for 14 hours in aqueous solutions of gibberellic acid 3 (GA)(5, 10, 20, 30 mg·L⁻¹), acetylthioprolin (AP)(100, 200, 300, and 400 mg·L⁻¹), and a glycine-rich commercial complex of amino acids and short-chain peptides (APC)(1, 2, 3, and 4 g·L⁻¹). The same AP, APC, and GA rates were sprayed on the resulting plants 15 and 30 days after sprouting. As compared to non-treated control plants, scallion yield was significantly higher in scallions treated with GA, AP, and APC, regardless of rate. The highest yields were obtained with APC at the rate of 3 g·L⁻¹, AP at the rate of 300 mg·L⁻¹ and GA at the rates of 20-30 mg·L⁻¹.

Key words: Biostimulant; green onion; salad onion; shoot growth; specialty vegetables.

INTRODUCTION

Gibberellic acid, acetylthioprolin, and amino acid and peptide mixtures have been used to enhance crop growth and yield. Gibberellic acid 3 (GA) stimulates cell growth and stem elongation (Phinney, 1983; Yabuta and Sumiki, 1938), although in dry onion GA has been found to delay and/or reduce bulb enlargement (Russo, 2003), due to stabilization of bulb cell microtubules. Acetylthioprolin (AP) has been shown to affect the metabolism of sulfur, glutathione, and amino acids, and it has been found to increase nutrient uptake, mitochondrial activity, and antioxidant activity in several enzymatic systems in plants (Oeriu et al., 1969; Schmidt and Jäger, 1992; Wallsgrove, 1995). In coffee (*Coffea arabica*), AP enhanced germination and vegetative growth (Villacres Vallejo, 1992) as well as fruit yield (Bueno Soto, 1985). A commercial glycine-rich mixture of amino acids and short-chain peptides (APC) has been associated with increased mitochondrial activity, stress tolerance, nitrogen metabolism, and production of new plant tissue (Taylor et al., 2004; Wallsgrove, 1995). APC enhanced fruit set in olive (*Olea europea*), almond (*Prunus dulcis*), and pistachio (*Pistacia vera*) (Viti et al., 1989; Viti and Bartolini, 1998).

Green onion, salad onion, or scallion (*Allium cepa*) is a specialty crop grown throughout the world for its leaves and small bulb. While the effect of some growth regulators and biostimulants on dry and fresh onions (full-grown bulb crop) has been documented (Gonzalez, 1986; Russo, 2003; Yildirim et al., 2002), little is known about the effects of growth enhancing compounds on scallions. Since the marketable produce of dry and fresh onions is different from that of scallions, it is possible that growth promoting substances that do not increase dry and fresh onion yield may enhance scallion yield. The objective of this study was to determine the effect of set and foliar treatments of GA, AP, and APC on scallion yield.

MATERIALS AND METHODS

A greenhouse study was conducted in Gainesville, FL, during November 2003-January 2004. The treatments consisted on scallion set immersion in aqueous solutions of GA, AP, and APC, followed by sprays of the same products 15 and 30 days after crop emergence. The

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treatments were established in a randomized complete block design with six replications, where one container was an experimental unit.

'Sweet Spanish' scallion sets were soaked for 14 hours in GA (0, 5, 10, 20, 30 mg·L⁻¹), AP (100, 200, 300, and 400 mg·L⁻¹), and (APC)(1, 2, 3, and 4 g·L⁻¹). Immediately after treatment with AP, APC, and GA, scallion sets were planted onto plastic containers (10 cm diameter x 10 cm in height) filled with sandy soil from Gainesville, FL. The same AP, APC, and GA rates were sprayed on the resulting plants 15 and 30 days after sprouting.

One day prior to set transplanting, the crop was fertilized with N, P₂O₅, and K₂O at the rates of 100, 150, and 150 kg·ha⁻¹, respectively. Additionally, N was applied as a side dress at the rate of 100 kg·ha⁻¹ 20 days after emergence. The crop was irrigated daily, and no disease or insect control was necessary. Fresh weights for scallion bulb, leaves, and whole shoot (bulb + leaves) were determined at harvest (52 days after sprouting). Dry weights for scallion bulb, leaves, and whole shoot were determined by drying the plant portions in an oven for 36 hours at 90 C. Data were submitted to analysis of variance and regression at the 5% significance level.

RESULTS AND DISCUSSION

AP, APC, and GA rates did not affect scallion bulb yield (data not shown), but significantly affected the yield of leaf and whole shoot of scallion. The pattern of leaf and whole shoot yield response to a given stimulant was the same, and thus only whole shoot yield is presented (Figures 1-3).

When scallions were treated with GA, whole shoot yield tended to increase as GA rate increased in an exponential pattern. At the rate of 30 mg·L⁻¹, scallion whole shoot yield was approximately 17% higher than in control plants (Figure 1). In scallion plants treated with AP and APC, whole shoot yield tended to increase as AP and APC rates increased up to 300 mg·L⁻¹ and 3 g·L⁻¹, respectively, with a tendency to decrease at higher rates. (Figures 2 and 3).

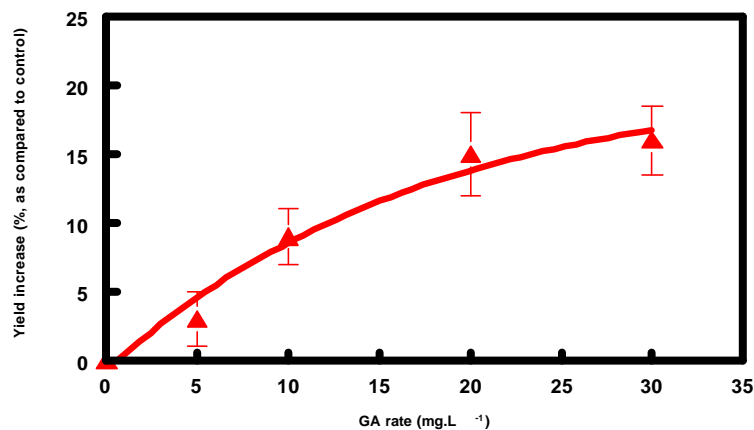


Figure 1. Response of scallion whole shoot yield to gibberellic acid rates.

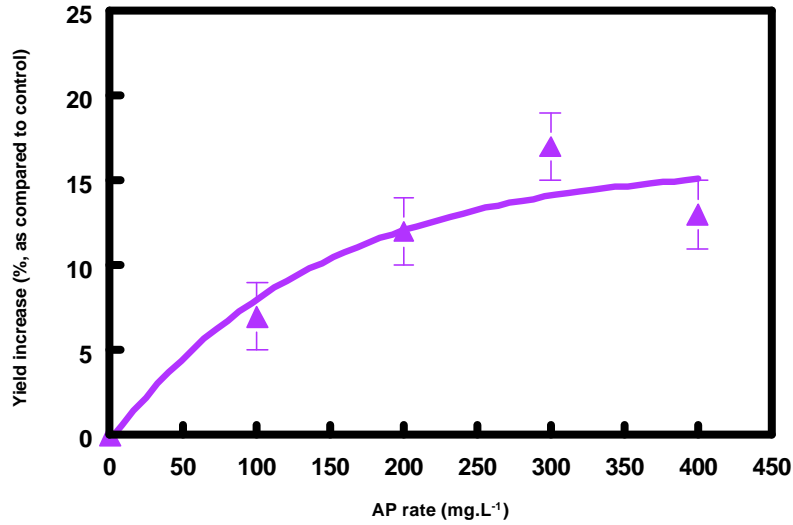


Figure 2. Response of scallion whole shoot yield to acetylthioprolin rates.

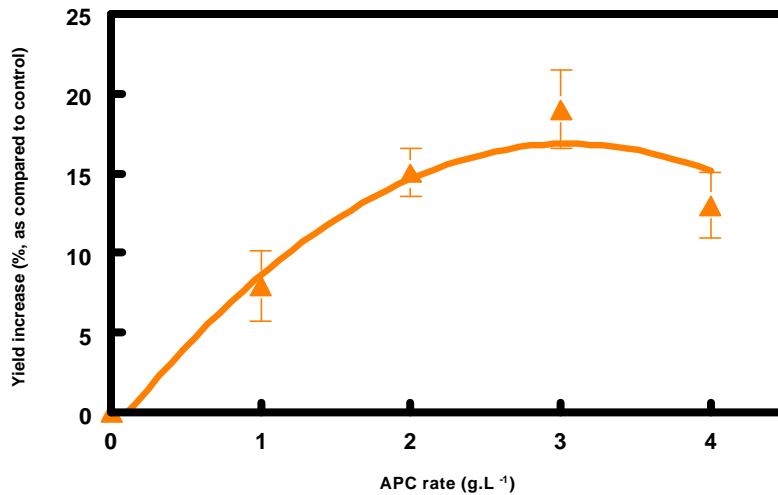


Figure 3. Response of scallion whole shoot yield to rates of a commercial mixture of amino acids and peptides.

Research by Russo (2003) showed that in dry onion GA applications did not increase bulb yield, which is consistent with our findings in scallion. In our research, whole shoot (bulb+leaves) yield increased as a function of increased leaf yield rather than increased bulb yield. Thus, GA-treated scallions were leafier than control plants, but were not different in bulb weight. Similarly, AP and APC did not significantly increase scallion bulb weight, and increased whole shoot yield by increasing AP and APC rates resulted from stimulating foliar growth. Taylor et al. (2004), Oeriu et al. (1969), and Villacres Vallejo (1992) found that AP and APC increased plant biomass in other crops such as coffee, corn (*Zea mays*), an effect attributed to enhanced nitrogen and sulfur metabolism and antioxidant activity.

This research showed that the leaf and whole shoot (leaf+bulb) yield of scallion may be increased by set immersion and foliar application of GA, AP, and APC. The extent of yield response to GA, AP, and APC was yield-dependent. For the three stimulants, the highest yield increase found was approximately 17% as compared to untreated scallion plants.

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