Effect of Foliar Application of Amino Calcium on Fruit Firmness and Storage life of Golden Delicious Apples

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Abstract: Apples are one of the oldest fruits known to mankind and have been cultivated for many years. In order to investigate the effect of foliar application of amino calcium on Golden Delicious apple trees a randomized complete block design with four repetitions was conducted in the city Abadeh, Fars Province, southern Iran. Apple trees were sprayed with different concentrations (0, 2.5, 5.0, and 7.5 mg/l) of amino calcium. After spraying the trees mature fruits were harvested and stored in cold storage houses for 3 months. After this period, traits such as amount of calcium, fruit weight, fruit firmness, and decay were assessed at the horticultural laboratory of Jahrom Azad University. We found that foliar application of amino calcium delayed and decreased the amount of fruit decay during storage. Fruit firmness was highest in apples that were sprayed with 7.5 mg/l amino calcium. Moreover, fruits that were sprayed with 7.5 and 5 mg/l amino calcium had lower weight reduction compared with fruits that were sprayed with other concentrations of amino calcium. We found no significant difference between different concentrations of amino calcium with respect to calcium levels.
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Introduction

Each year the quality of many agricultural and horticultural products deteriorate at different stages, especially after harvest. The amount of fruit decay is more evident in third world countries because of disregarding the principles of storing agricultural products, lack of development and expansion of proper storage methods, and damage caused by storage pests. If we also consider the damage to crops in farms and gardens, the amount of agricultural waste rises considerably (Fathi, 1371). Increased production and excess supply of fruits during the harvest season along with the low fruit prices has led to fruit processing as well as its storage in cold houses. Although fruit storage has succeeded to reduce fruit respiration and prevented weight reduction and physiological disease contraction by decreasing the temperature, fruits such as apples still experience decay during storage. To reduce waste and decay as well as maintain the best quality, management is essential (Pourazarang, 1373). (This reference should be written according to its English abstract and the year changed.) Apples are among the initial plants known to mankind with the scientific name of *malus pumila* of the rosaceae family (Saboury and Karbassi, 2000). Recent studies have shown that spraying diluted chelated calcium on apples near harvest season reduces the risk of bitter pit disease during storage (Scott et al, 1985). This element is an intercellular boding agent and is found in the pectates of the medial septum of plnts.

We aimed to assess the effect of foliar application of amino calcium on the after-harvest quality of Golden Delicious apples.

Material and Methods

In order to investigate the effect of foliar application of amino calcium on Golden Delicious apple trees, a randomized complete block design with four repetitions was conducted in the city Abadeh, Fars Province, southern Iran. In this experiment, different concentrations (zero, 2.5, 5.0, and 7.5 mg/l) of amino calcium were sprayed on the apple trees.

The study was done in one of the young gardens of Imam Khomeini Relief Committee in Abadeh that cultivated East Malling-Merton 106 apple rootstocks. The trees were five years old and the garden comprised Golden Delicious apples. The initial stage of foliar application was done in September 2012. Other stages of foliar application were done every other week. Each tree was sprayed with 1 liter of solution in all stages.

After foliar application, mature fruits were separately harvested from each tree and collected. The fruits were labeled based on the type of treatment, repetitions, and solution concentrations and transferred to the horticultural laboratory of Jahrom Azad University. After measuring fruit traits, they were transferred to the cold storage house and stored at ±1 [c] and 85-90% humidity. The fruits were taken out of storage three months later and their traits were measured once again. The measured

characteristics included fruit firmness, calcium level, weight reduction percentage, and percentage of fruit decay.

Data were analyzed using SAS software. Duncan test was used for comparing different treatments. $P<0.05$ was considered as significant.

Results and Discussion

We found that the amount of decay after storage was higher in the apples that were not treated with the amino calcium. The foliar application of amino calcium on apples reduced their amount of decay during storage. The lowest percentage of decay was related to apples treated with 7.5 mg/l of amino calcium (figure 1). Sensitivity to decay also depends on the concentration of ascorbic acid, polyphenol oxidase activity, and the amount of phenol compounds; however some researchers have stated that a weak relationship exists between these variables and the amount of decay (Weller et al, 1997). Shear (1995) found that fruit decay was related to calcium deficiency.

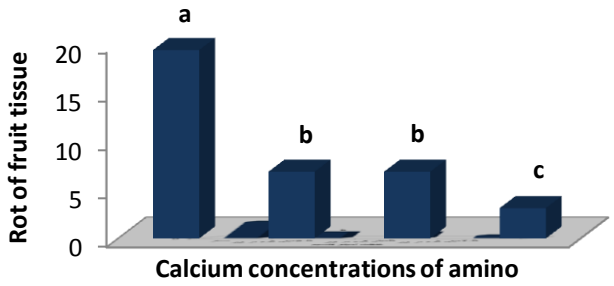

Figure 1: Effect of different concentrations of amino calcium on the amount of decay in Golden delicious apples

The highest amount of fruit firmness was related to apples treated with 7.5 mg/l of amino calcium. We found no significant difference in this regard in apples sprayed with 2.5 mg/l treatments of amino calcium (figure 2). The fruit firmness of apples that were not treated with amino calcium (control) reduced drastically after storage (figure 2).

When the surface cell walls are saturated, calcium probably turns into solution in the intercellular space of surface cells and gradually moves towards cell walls with less calcium. Ultimately, calcium's bond with cell walls leads to more firmness (REF).

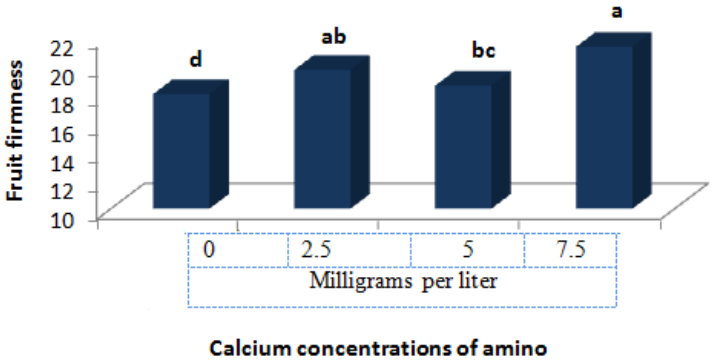

Figure 2: Effect of different concentrations of amino calcium on the firmness of Golden Delicious apples

Different concentrations of amino calcium affected the percentage of weight loss in fruits after storage. Fruits that were sprayed with concentrations of 5 and 7.5 mg/l of amino calcium experienced lower weight loss. Fruits that were not treated with amino calcium experienced the highest amount of weight loss (figure 3).

Evapotranspiration naturally reduces fruit weight. Weight reduction during dehydration is due to changes that occur in water vapor pressure resistance during respiration from the fruit's surface (REF). During storage, amino calcium covers fruit surfaces and leads to lower water loss and maintains water in fruits and as a result maintains fruit weight.

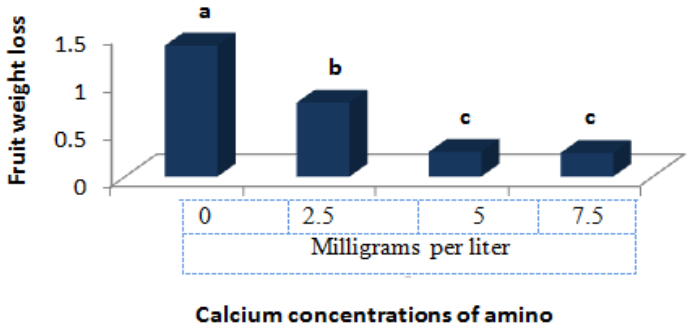

Figure 3: Effect of different concentrations of amino calcium on the amount of weight loss

Based on variance analysis results, no significant difference was found between apples sprayed with different concentrations of amino calcium and the control group with respect to calcium levels (figure 4). In order to successfully store fruits in cold houses, calcium levels should be higher than a critical level which cannot be supplied only by soil because calcium moves in plants with transpiration and thus transfers to places that have higher levels of transpiration. Since fruits experience less transpiration, the flow of calcium containing to the fruit also decreases. On the other hand, the flow of calcium in the phloem is slow and the leaf's calcium cannot be transferred to the fruit (REF).

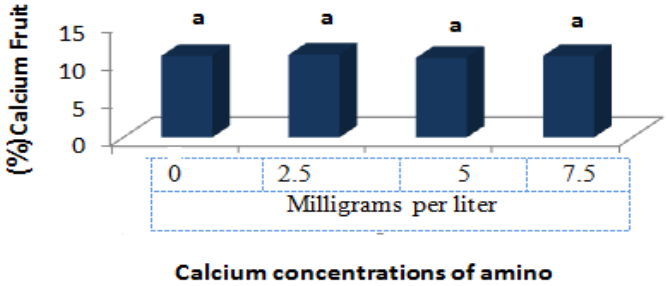

Figure 4: Effect of different concentrations of amino calcium on calcium levels in Golden Delicious apples

Conclusion

In general, any factor that prevents or inhibits ethylene production, delays fruit decay, because ethylene affects and facilitates ripeness and decay. Foliar application of amino calcium was effective in maintaining fruit firmness and weight, and delayed fruit decay during storage.

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