observed when fruit were exposed for 220 min. Some of these fruit also failed to ripen. Heat treatment (especially for 160 min) delayed ripening of fruit, as measured with color and texture changes, compared to the control. Heat treatment changed the protein composition of the fruit and affected the activity of peroxidases.

27 ORAL SESSION 1 (Abstr. 401–405) Vegetable Crops: Crop Physiology

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Assessing Crop Canopy Development Using a Digital, Red/Near-infrared Band Ratioing Camera

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Current methods of making crop cover estimates are time-consuming and tend to be highly variable. A low-cost, digital, red/near-infrared band ratioing camera (Dycam Inc., Chatsworth, Calif.) and accompanying software (S. Heinold, Woodland Hills, Calif.) were evaluated for estimating crop cover. The camera was tested using a set of images having leaf areas of known sizes with different crop, soil, and lighting conditions. In the field, camera-based crop cover estimates were compared to light bar measured estimates. Results indicate that the camera and image analysis software are capable of estimating percent crop cover over a range of soil, crop, and lighting environments. Camera-based crop cover estimates were highly correlated with light bar estimates (tomato r^2 = 0.96, cotton r^2 = 0.98). Under the conditions tested, the camera appears to be a useful tool for monitoring crop growth in the field.

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Lettuce Seed Germination and Endo-mannanase Activity are Stimulated by Ethylene at High Temperature

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Temperatures above 30 °C may delay or inhibit germination of most of commercial lettuce cultivars. Ethylene enhances lettuce seed germination at high temperatures. Enzyme-mediated degradation of endosperm cell walls appears to be a crucial factor for lettuce germination at high temperature. The galactomannan polysaccharides in lettuce endosperm cell wall are mobilized by endomannanase. The role of endo-mannanase during germination of lettuce seeds at high temperature (35 °C) and the possible role of etlene in enzyme regulation were investigated. Seeds of thermotolerant ('Everglades'-EVE) and thermosensitive ('Dark Green Boston'-DGB) lettuce genotypes were incubated at 20 and 35 °C in water, 10 mM of 1-aminocyclopropane-1-carboxylic acid (ACC), or 20 mM of silver thiosulphate (STS). Also, seeds were primed in an aerated solution of polyethylene glycol (PEG), or PEG+ACC, or PEG+STS. Untreated seeds germinated 100% at 20 °C. At 35 °C, EVE germinated 100%, whereas DGB germinated only 33%. Seed priming or adding ACC during imbibition increased germination of DGB to 100% at 35 °C. Adding STS during imbibition led to a decrease in germination at 35%C in EVE and completely inhibited germination of DGB. Priming with STS led to reduced germination at 35%C of both genotypes. EVE produced more ethylene than DGB during germination at high temperature. Providing ACC either during priming or during germination led to an increase in endo-mannanase activity, whereas STS inhibited mannanase activity. Higher endo-mannana activity was observed in EVE than DGB seeds. The results suggest that ethylene might overcome the inhibitory effect of high temperature in thermosensitive lettuce seeds via weakening of endosperm due to increased endo-mannanase activity.

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Promotion of Germination and Seedling Development of Lima Beans (*Phaseolus* spp.) by Nickel Chloride

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Delaware is among the largest producers of lima beans in the United States, having more than 10,000 acres in this crop. The plants are raised from seeds, but seeds are notably prone to injury during handling. The seed has little or no endosperm and relies on reserve food materials in the cotyledons. Lima beans are legumes, and the seeds store nitrogenous compounds. Nickel is implicated in nitrogen metabolism, and nickel is now implicated as an essential mineral nutrient element. With the variable rate of germination of lima bean seeds, our objective was set to determine the effect of nickel on seedling development of the lima bean plant. Lima bean seeds were soaked for various periods in 10 solutions from 0 to 500 ppm nickel chloride. Soaking for 1 h in 100 ppm nickel chloride solution was determined to be the best treatment. The 100 ppm treatment then became the standard treatment for lima bean seeds. Hence, seeds were treated with distilled water of the 100 ppm nickel chloride. The results are that the nickel chloride significantly improved the rate of germination of lima bean seeds. Germination rates were improved from 60% ±5% to 76% ±3%. The total effect of treatments with nickel chloride varied from one batch of seeds to another; however, promotion of germiantion was significant. Osmoregulation and seed priming as well as stimulation of nitrogen metabolism by nickel are possible explanations of the positive effects of nickel chloride.

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Cyclic Cold Temperature Stresses Before Transplanting Influence Cantaloupe Seedling Growth and Earliness But Not Total Yield or Quality

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Cantaloupe seedlings may be repeatedly exposed in the field soon after transplanting to temperatures alternating between almost freezing and optimal temperatures. In the first year of a 2-year study, 'Athena' cantaloupe seedlings were exposed in walk-in coolers to temperatures cycling from 2 °C for 3, 6, and 9 hours daily to 25 °C for the rest of the 24-h period. Cold stress was repeated for 1, 3, 6, and 9 days before field planting. In the second year, transplants were exposed to 2 °C for 3, 6, and 9 hours for 3, 6, and 9 days before field transplanting. The objective of this study was to determine the long-term effect of early season cold temperature exposure on seedling growth, earliness, yield and quality by simulating the cold/warm alternations possible in the field in coolers. Cold-stressed transplants were planted in the field after all risk of ambient cold stress was negligible. In both years, exposure to cycling cold temperatures generally did not effect total productivity and fruit quality, although seedling growth characteristics were reduced in response to longer cold-stress treatments. In the second year, early yield was reduced by exposure to increasing hours of cold stress, but this was not significant in the first year. Therefore, cold temperature stresses occurring in the field at transplanting have negligible effect on yield potential of 'Athena' cantaloupe.

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Glycinebetaine Accumulation in Red Beet under Salinity

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Accumulation of glycinebetaine occurs in Chenopodiaceae members and is thought to assist in osmotic adjustment and protect cytoplasm from sodium toxicity. Red beet has an ability to tolerate high tissue sodium levels, which may result in increased glycinebetaine production. To test this hypothesis, two cultivars of red beet ['Scarlet Supreme' (SS) and 'Ruby Queen' (RQ)] were grown under nonsaline (4.75 mM Na) and saline (54.75 mM Na) conditions in a recirculating hydroponic system for 42 days at elevated CO_2 (1200 $\mu mol \cdot mol^{-1}$) in a growth chamber. Leaf glycinebetaine level, relative water content, and osmotic potential were measured at weekly intervals. Leaf glycinebetaine levels increased with plant age and reached a maximum of 67 $\mu mol \cdot g^{-1}$ dw under nonsaline and 101 $\mu mol \cdot g^{-1}$ dry weight (dw) under saline conditions at 42 days in SS; in RQ, the glycinebetaine levels reached a maximum of 91 $\mu mol \cdot g^{-1}$ dw under nonsaline and 121 $\mu mol \cdot g^{-1}$ dw under saline conditions by 26 days. The mean glycinebetaine levels were increased over two-thirds under saline conditions in both the cultivars. RQ accumulated significantly higher (37% more under nonsaline, and 46% more under salinity) glycinebetaine than SS. The turgid leaf osmotic potential of RQ was consistently higher than SS under nonsaline (2.23 MPa in RQ vs. 1.82 MPa in SS) and saline (2.48 MPa in RQ vs. 2.02 MPa in SS) conditions. The results indicate that higher glycinebetaine levels in the leaf could result in better osmotic adjustment, and glycinebetaine accumulation in red beet can vary among cultivars and is strongly affected by external salinity.