oil (>90%) notably linolenic and linoleic acids. In this study we investigate the effect of Zn deficiency on the production of Free Fatty Acids (FFA) and Superoxide Radicals (SR) and the resulting effect on nut quality and rancidity.

Levels of FFA in walnut oil increased dramatically with increasing Zn deficiency, Zn deficiency also markedly decreased the SR content of nuts. These responses were most marked at tissue Zn levels of less than 17 ppm a value which coincides with the appearance of symptoms of Zn deficiency in leaves of walnut. The low level of peroxide in Zn deficient plants most likely is the result of 'consumption' of peroxides in the process of formation of FFA's. This cycling of FFA and peroxide values is typical of nut crops. Results are discussed in relation to known effects of Zn deficiency on superoxide formation as well as possible effects of Zn deficiency on stability of membrane bound liposomes within the walnut kernel.

STABY

722

NITROGEN DEMAND AND UPTAKE CAPACITY OF ALTERNATE-BEARING PISTACHIO TREES

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The nitrogen (N) requirements and uptake capacity of mature, alternate-bearing pistachio (*Pistacia vera* L.) have not been determined. This study was conducted to obtain this information using 25-year-old 'Kerman' trees on *P. atlantica* seedling rootstocks. Three "on" trees were deflorated in 1984 to permit fertilization of both "on" and "off" trees in the same year. Three "on" and 3 "off" trees were fertilized with ^{15}N-depleted $(NH_4)_2SO_4$ in Jan. 1987, and annually thereafter with non-labelled N. Trees were excavated in Jan. 1991, separated into various organ fractions, and analyzed for total and labelled N. Preliminary evidence indicates that N loss from "off" trees is only 20-30% of the N removed from "on" trees, and that "off" trees have an increased capacity for fertilizer N recovery.

178 ORAL SESSION (Abstr. 723–730)
Postharvest Physiology: Floriculture

723

POST-PRODUCTION STORAGE REDUCES CARBOHYDRATE LEVELS IN EASTER LILIES

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Easter lilies may be held in cool (2-4° C) storage for one or more weeks if not properly timed during forcing. In addition, most lilies are sleeved, packed into boxes and shipped 4 or more days without temperature control. Since these plants do not photosynthesize, stored reserves are utilized for plant maintenance. Post-production characteristics of these plants are often poor due to these accumulated stresses. A time course study was conducted to document changes in carbohydrate (CHO) pools in Easter lily leaves, stems and flower buds during dark storage of 0 to 3 weeks at 4°C or 0 to 6 days at 21°C. Storage at both temperatures resulted in losses of CHOs from the whole plant. Warm storage caused more rapid CHO loss than cool storage. Stems lost 6% of the total CHO over a 1 week period at cooler temperatures, but lost 43% of total CHO after 6 days of 21°C. Leaves lost 67% or 57% of leaf CHO when stored at 21°C or 4°C, for 6 days or 3 weeks, respectively. The average loss of total CHO in the buds was 42% at 21°C, whereas buds of plants stored at 4°C for three weeks lost only 0 to 8% CHO.

724

EVALUATION OF POINSETTIA CULTIVARS GROWN IN CENTRAL FLORIDA.

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Seventeen poinsettia cvs and 3 seedlings were grown in a mesh shade house and a glass house during 1990. Cube-rooted cuttings were potted on 8/31, pinched to 6 nodes on 9/17, and treated with pgrs on 10/5 and 10/12. Lighting was provided at night from 9/15 through 10/5. Data collected included number of days to first bract color, days to marketability, plant ht. and diam, inflorescence diam, no. of laterals, and no. of bracts in color on 12/12. Seedlings were compared to 6 cvs in a post-production room for 4 weeks. Days to marketability ranged from 51.2 (Ecke's sdlg 490) to 67.8 (Peace Frost), compared to Gutbier V-10 Amy (44.9), Gross Subjibi (45.7), Gutbier V-14 Glory (52.2), and Annette Hegg Dark Red (53.7). Tallest plants were Ecke's sdlg 441 (46.6 cm) and Eckespoint Lilo (45.8 cm) while V-10 Amy plants were the shortest (27.4 cm). Laterals of V-10 Amy were weak and often collapsed at flowering. The remaining cvs ranged in height from 27.7 to 39.4 cm. Sdlg 490 produced inflorescences similar in diam to Supjibi, had more bracts, but had slightly smaller individual bracts. Sdlg 490 exhibited leaf retention intermediate to Supjibi and V-14 Glory.

725

POTTED CHRYSANTHEMUM LONGEVITY AFFECTED BY FLOWER RESPIRATION AND CARBOHYDRATES.

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Chrysanthemum cultivars vary in longevity under interior conditions. Four chrysanthemum cultivars ('Iridon', 'Jade', 'Jasmine' and 'Tip') with different postproduction longevities were grown to flowering and moved to interio conditions (12 μmol s^{-1} m^{-2} of cool white fluorescent light for 12 hr daily and 21±1C) to determine interior longevity (senescence of the inflorescence). Also, carbon exchange rates (CER), dry matter (DM) and nonstructural carbohydrates were determined at flowering and after 17 days postproduction.

Whole plant dark respiration, flower and root respiration, whole plant light compensation point, flower and stem nonstructural carbohydrates, root soluble sugars and total root nonstructural carbohydrates decreased from flowering to 17 days postproduction. Flower respiration after 17 days postproduction was negatively correlated with postproduction longevity. No correlation was found between whole plant or plant part DM or carbon partitioning to the flower and plant longevity. Stem nonstructural carbohydrates at flowering, stem starch and root soluble sugars after 17 days postproduction, were positively correlated with postproduction longevity. The percent of leaf starch in total leaf nonstructural carbohydrates after 17 days postproduction was negatively correlated with postproduction longevity. These results indicate that flower respiration and carbohydrates may serve as valuable physiological indicators of potted chrysanthemum longevity.

726

DIFFERENCES BETWEEN ROSE CULTIVARS IN SUSCEPTIBILITY TO INFECTION BY *BOTRYTIS CINEREA*

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Differences in susceptibility of rose flowers (*Rosa hybrida*) to grey mold, caused by *Botrytis cinerea*, were investigated. 'Supra' and 'Royalty' rose flowers were inoculated with various concentrations of *B. cinerea* conidia and stored in humidified chambers at 21C. Disease severity was quantified 2 days later as the number of lesions that had developed on each flower. The slope of the inoculum concentration - disease severity (IC-DS) regression line was used as a measure of susceptibility. In five separate experiments 'Supra' was consistently more susceptible than 'Royalty', although the susceptibility of each cultivar and the difference in susceptibility changed over the growing season. In experiments using isolated petal disks there was no difference between the cultivars in the germination of *B. cinerea* conidia on the petal surfaces, but fewer of the germinated conidia penetrated into the 'Royalty' petals. The site of inhibition of penetration is being investigated.

727

DIFFERENTIAL TEMPORAL AND TISSUE EXPRESSION OF AN APPARENT LOW ACTIVITY ISOFORM OF CARNATION CATALASE

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Sim-type carnation (*Dianthus caryophyllus* L., cv Elliot's White) apical petal tissue contains two distinct catalase isoforms which differ in Mr and in temporal accumulation of immunoreactive protein. Both Native and SDS-PAGE/western analyses using cross reactive antiserum raised against a subunit of a low specific activity catalase from tomato pericarp tissue showed that accumulation of the most prevalent, lower apparent Mr isoform increased beginning shortly following harvest, reaching a peak at 6-8 d postharvest. A second catalase isoform of higher apparent

Mr declined initially then increased coincident with the respiratory climacteric. Northern blot hybridization analysis performed using a heterologous 1.7 kb cDNA clone corresponding to a low specific activity catalase from tomato indicated cross-hybridization to a 2.8 kb carnation mRNA. Hybridization of the clone to poly $(A)^+$ mRNA preparations from apical petal tissue generated a weak signal relative to mRNA obtained from stem internode tissue. Abundance of catalase mRNA determined by northern hybridization was in agreement with the amount of protein recovered by immunoprecipitation /SDS-PAGE of ^{35}S–labeled *in vitro* translation products.

179 ORAL SESSION (Abstr. 731–735)
Cell and Tissue Culture: Transformation

STABY

728
VOLATILES PRODUCED BY CARNATION FLOWERS TREATED WITH 2,4-D
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It has previously been demonstrated that exceedingly high concentrations of 2,4-D, when taken up by cut carnations, inhibit petal senescence, while application of low concentrations of this synthetic auxin promote petal senescence. The mode of action of such high concentrations of 2,4-D has not been elucidated.

In previous work, it was observed that significant amounts of volatiles always emanated from those flowers treated with high 2,4-D, and which displayed inhibition of ethylene synthesis as well as petal senescence. In the present work, the headspace of treated flowers was therefore tested by gas chromatography after enclosure for a short period of time. Two of the major constituents of the volatiles produced by the treated flowers were found to be ethanol and acetaldehyde.

Since ethanol has formerly been shown to delay senescence in carnation flowers, and since 2,4-D has been shown to induce alcohol dehydrogenase, it is suggested that the mode of action of 2,4-D in this case is by means of the ethanol produced as a result of the 2,4-D treatment.

729
ETHYLENE PRODUCTION PATTERNS OF CARNATIONS AFTER TREATMENT WITH NORBORNADIENE
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'White Sim' carnations were harvested and placed in 2000 to 3000 µl/l norbornadiene (NBD) in air. Successive groups of flowers were removed from NBD every two days and exposed to laboratory air. Regardless of the duration of exposure to NBD, flowers produced virtually no C_2H_4 at the point of removal from NBD. Control flowers (no exposure to NBD) exhibited a typical climacteric-like burst of C_2H_4 production about 6 days after harvest. Flowers held for 2, 4, or 6 days in NBD and then transferred to air showed a climacteric-like pattern of C_2H_4 production, but the maximum rate was reduced by about 33% when compared with the control. Flowers held in NBD for 8 days showed an even smaller burst in C_2H_4 production (reduced by about 75%). C_2H_4 production by flowers held for 10 or 12 days in NBD was reduced by about 90%, and no climacteric-like burst of C_2H_4 production was evident. Flowers showed minimal loss in fresh weight while they remained in NBD, but they rapidly lost fresh weight immediately upon removal from NBD. The expression of senescence-related genes after removal from NBD is currently under investigation.

730
ETHYLENE-INDUCED FLORET ABSCISSION IN SNAPDRAGON
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Postharvest quality of snapdragon (*Antirrhinum majus*) is limited by the abscission of florets. Ethylene has been implicated as a causal agent of floret abscission. I have investigated the role of ethylene in floret abscission and genotypic variation in this response. Floret abscission was induced by exposure to 2 µl/L ethylene for 48 hr or longer. Returning inflorescences to air following 24 hr or less of ethylene treatment prevented ethylene induced abscission. Ethylene-responsiveness was found to increase with floret age in sensitive genotypes. Several inbred lines were identified which did not abscise in response to 2 µl/L ethylene. Reciprocal crosses were made between ethylene sensitive and insensitive lines. All of the F_1 progeny responded to ethylene by floret abscission similar to the sensitive parent. The F_1 progeny have been selfed and backcrossed to both parents for segregation analysis.

731
AGROBACTERIUM-MEDIATED TRANSFORMATION OF PLUM (PRUNUS DOMESTICA L.) WITH THE PAPAYA RINGSPOT VIRUS COAT PROTEIN GENE
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Hypocotyl slices from ungerminated plum seeds were co-cultivated with A. tumefaciens EHA101 (Hood et al., 1986. J. Bact. 168:1291-1301) containing the plasmid pGA482GG/cpPRV-4. This plasmid carries the papaya ringspot virus (PRV) coat protein gene construct and chimeric NPTII and GUS genes (Fitch et al., 1990, Plant Cell Repts. 9:189-194). Shoots were regenerated from hypocotyl slices cultured on shoot regeneration medium consisting of Murashige and Skoog (MS) salts, vitamins, 2% sucrose, 2.5 µM indolebutyric acid (IBA), 7.5 µM thidiazuron, 300 mg/liter carbenicillin, 200 mg/liter cefotaxime and 75 mg/liter kanamycin. Regenerated shoots were rooted on half strength MS salts with vitamins, 1% sucrose, 2.5 µM IBA, and 75 mg/liter kanamycin. These plants tested positive for both NPTII and GUS activity. The expression of PRV coat protein is being tested as well as the reaction of transgenic plants to plum pox virus infection.

732
TECHNIQUES FOR RUBUS TRANSFORMATION AND REGENERATION
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Based on Southern and ß-GUS analysis, Rubus somatic tissues were successfully transformed and plantlets were regenerated from disarmed Agrobacterium tumefaciens-infected tissue. Model studies were used to determine several procedural requirements for this system. For example, internodes were used instead of leaves or petioles because they were more susceptible to A. tumefaciens and were equally regenerative. Thidiazuron was more effective than benzyl adenine for shoot organogenesis. Coincubation time was increased to 4 days. The C58 strain, with the same chromosomal compliment as the disarmed GV3101 strain, was almost as virulent as wild strains isolated from Rubus. Cefotaxime, used to stop coincubation, increased the number of shoots regenerated from petioles and internode pieces.

733
IMPROVED TRANSFORMATION OF TOBACCO CELL SUSPENSION CULTURES AS A MODEL FOR PLANT BIOLISTICS RESEARCH
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The biolistics process uses high velocity microprojectiles to carry foreign DNA into cells. Though biolistics has already proven to be useful for a wide range of species, improvements are still needed, and many of the factors which affect transformation efficiency have not been defined. In our experiments, cell suspensions of *Nicotiana tabacum* (NT1 line) were used as a model to identify these factors. The most critical factors for high efficiency transformation were: cell age, microprojectile type & size, DNA construct, osmoticum in the bombardment medium, use of a new helium-driven biolistic device, and the handling and growth environment of the cells after bombardment. By optimizing these factors, an average of 7,000 transiently expressing GUS cells and 800 kanamycin resistant colonies were obtained per bombarded plate. The high efficiency and rapid results (2 days transient/4 weeks stable) of the NT1 model system make it useful for cell biology studies and for testing DNA constructs.