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## EVALUATION OF A SPRAY FORMULATION OF CODLEMONE FOR MATING DISRUPTION OF CODLING MOTH (*CYDIA POMONELLA*) IN APPLE (*MALUS PUMILA* MILL.)

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Mating disruption of codling moth using codlemone pheromone-emitting twist-ties or cards has become a standard practice in many orchards. This study was initiated to determine the effectiveness of NoMate CM EC, a spray formulation of codlemone pheromone. Treatments were applied 20–21 Apr. 1995 to plots measuring 99 × 244 m of 15-year-old 'Golden Delicious' apple trees on seedling rootstock. Trees were spaced 3.7 × 5.5 m and treatments were made in a randomized complete block design replicated three times. Whole trees were sprayed to run-off using a handgun. Treatments were 20.2 g a.i. NoMate CM EC/h and a watered sprayed control. Two pheromone-baited, sticky traps were placed in each replicate to monitor codling moth activity. Moth counts were made 3 days after treatment and continued twice weekly for 4 weeks. Results indicated very little moth activity for the first 14 days of the study in plots treated with NoMate CM EC when compared to the control. However, after the first two weeks differences between treatments were not significant.

## LOW QUALITY, LOW QUANTITY WATER USED—CONTAINER PLANT PRODUCTION

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Since initiation of the research in 1990, diverse plants (92 genera from 47 families) have been grown in the closed, insulated pallet system (CIPS). Greater growth has occurred in various embodiments of the CIPS than in the open container system (OCS) controls. Branching of roots, and of shoots of some plants, is greater in CIPS. CIPS is a closed system; there is no circulation of irrigation solutions nor effluent discharge from CIPS. Water and fertilizer movement in CIPS is plant-driven, and use is 10% of that applied in overhead sprinkler fertigation of open containers. Tomato plants are more tolerant of saline irrigation water, and greenhouse tomato production is more profitable in CIPS than in the OCS. CIPS provides several pest management alternatives.

## MODELING WATER USE OF SHADE TREES IN FIELD PRODUCTION NURSERIES

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Supplemental watering of shade trees in field production nurseries is needed, even in summer-rainfall climates, to achieve maximum growth. Scheduling the timing and amount of supplemental watering makes more efficient use of financial and water resources while maintaining maximum growth. Methods of scheduling supplemental watering based on uniform canopy and rooting in production agriculture must be modified, however, for shade trees in a production setting. Nursery trees are non-uniform in canopy and rooting compared to an agricultural crop. Applying the water budget method can be effective

with sprinkler systems if tree water loss and rooting depth can be properly estimated. A measure of reference evapotranspiration and a species-specific multiplier are typically used to estimate water loss. Since species diversity in a field nursery is quite high, however, estimates of both tree transpiration and rooting depth must necessarily be simplified assumptions less accurate than for a uniform agricultural crop. If supplemental water is to be applied with drip irrigation, estimates of tree transpiration and soil water depletion need to be converted to volume units with information on total tree leaf area.

## EFFECTS OF HIGH-SULFATE IRRIGATION WATER ON BEAN AND BROCCOLI

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Groundwater, contaminated with sulfur (S) at concentrations higher than allowable for drinking water, may be suitable for irrigation. Our objectives were to determine the growth response and mineral uptake of two vegetables grown in high-S irrigation water. Bean (*Phaseolus vulgaris*) and broccoli (*Brassica oleracea* L.), grown in 8-L pots containing a calcareous sandy loam, were irrigated with waters containing from 58 to 582 mg S/L. Plants were harvested and growth was measured at 4, 8, or 12 weeks. Soil paste extracts and dry plant tissue were analyzed by inductively coupled plasma (ICP) spectroscopy at each harvest. Bean shoots and pod dry weight decreased by 32% and 28%, respectively, as S concentration increased. Although final pod number was not affected by the irrigation treatments, pod yields (4 weeks) decreased as S concentration increased. Broccoli growth was not affected by increasing S concentration at any of the harvest dates, though head diameter did decrease as S increased. Magnesium, sodium, and sulfur accumulated in shoot tissue (leaves and stems) of both species in proportion to their concentration in the irrigation water. It appears that high-S waters can be used to grow these vegetables without negative effects on growth.

## GROWTH AND SOIL RESPIRATION OF PEPPER INOCULATED WITH VAM FUNGI UNDER TWO TEMPERATURE REGIMENS

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Pepper (*Capsicum* sp. L.) seedlings were inoculated with either *Glomus* sp. AZ 112 (isolated from Wickman, Ariz.), *Glomus intraradices* Smith and Schneck (isolated from Santa Theresa, N.M.), a mixture of the two isolates, or a nonmycorrhizal control, and were grown for 8 weeks in a moderate (20.7 to 25.4C) or high temperature (32.1 to 38.0C) environment. Plants in moderate temperatures were larger and had lower specific soil respiration ( $R_{sp,soil}$ ) ( $\mu\text{mol CO}_2/\text{m}^2/\text{s}$  per gram root tissue dry weight) compared with those in high temperatures. In moderate temperatures, mycorrhizal plants were smaller and had higher  $R_{sp,soil}$  than nonmycorrhizal controls. In high temperatures, plants inoculated with the isolate mixture grew nearly twice as large and had lower  $R_{sp,soil}$  compared with plants inoculated

with the individual isolates or the nonmycorrhizal control. Results suggest an improved carbon economy and a synergistic enhancement of pepper growth caused by the mixture of VAM fungal isolates that was not achieved by inoculation with single isolates alone under conditions of high-temperature stress.

#### EVALUATION OF FUNGICIDES FOR CONTROL OF BOTRYTIS SOIL LINE ROT IN SEED ONIONS

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Fungicides, including Topsin M, Rovral, Ronilan, Ridomil/Bravo, TD 2350-1, CGA 219417, and a combination of Topsin M and TD 2350-1, were evaluated for control of *Botrytis allii* in a commercial field of hard, yellow, seed onions near Madras, Ore. The 10 × 25-ft split-plots were replicated three times in a randomized complete block design, with half the plot planted with Topsin M-treated seed prior to planting. Plots received a single fall fungicide application on 30 Sept. 1994, and two spring applications on 3 May and 13 May 1995. Stand counts were taken 4–6 Nov. 1994 and 21 Apr. 1995 to evaluate reduction in plant population over winter. Three row-foot of plants grown from untreated seed were removed and examined for lesions and sporulation 15–19 June 1995. Thirty-plant samples were taken from both plots with treated and untreated seed 17–21 July 1995. Botrytis was considered present if lesions plus sporulation were observed on the bulb at the time of sampling, or if sporulation developed on previously non-sporulating lesions within 3 days of storage in plastic bags at room temperature. A visual rating of plants that remained standing due to adequate root systems was conducted 24 July 1995. Bulb evaluation of non-seed-treated plots on 15–19 June indicated significant control of botrytis with TD 2350-1 over plots not receiving foliar fungicide application. Evaluation of non-seed-treated plots on 17–21 July indicated Topsin M, TD 2350-1, and a combination of the two fungicides provided significant disease control compared to plots without foliar application of fungicides. There were no significant differences between fall and spring stand counts, or between treated and untreated seed.

#### ADDRESSING LOCAL URBAN LANDSCAPING NEEDS THROUGH RESEARCH AND EXTENSION

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When comparing states with population percentages residing in major cities, Nevada is considered the third most urban state in the nation. It also has the distinction of being the driest, with less than 4 inches of precipitation annually in the Las Vegas Valley. Nevada is using 280,000 acre-feet of water from its 300,000 acre-feet allotment from the Colorado River annually. Approximately 60% of this is used for urban landscaping. With average water use at >300 gallons per person per day in the past, Las Vegans have been criticized as “water-wasters.” Rising water prices and an active research and extension education program begun in 1985 and supported by the local water utility has helped to contribute to changing water use patterns and a reduction in water use. Research, educational programs for commercial landscapers, and home horticulture programs conducted through Master Gardeners have helped to reduce water use in the Las Vegas Valley while providing information on sound horticultural practices.

#### PERFORMANCE OF SIX GROUND COVER SPECIES UNDER MINIMUM IRRIGATION

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The performance of six landscape groundcover species was evaluated in a field experiment with irrigation treatments of 50%, 40%, 30%, and 20% of real-time ET<sub>0</sub>. Analysis of seasonal plant performance ratings indicated that for *Baccharis pilularis* ‘Twin Peaks’, *Drosanthemum hispidum*, and *Hedera helix* ‘Needle point’ there were no season-long increases in plant appearance when irrigated more than 20% ET<sub>0</sub>. *Vinca major*, *Gazania* hybrid, and *Potentilla tabernaemontanii* exhibited no significant improvement in appearance when irrigated above 30% ET<sub>0</sub>. A marked decline in performance was apparent in *Gazania* and *Potentilla* at all treatments during the

study period, however, suggesting that their long-term minimum irrigation needs exceed 50% ET<sub>0</sub>. In a follow-up study, five of the above species and *Osteospermum fruticosum* received 30% ET<sub>0</sub> at irrigation schedules of three times/week, once/week, once/2 weeks, and once/4 weeks. *Potentilla* was not sustained in acceptable condition at any treatment, while there were no season-long differences in performance within the other species due to irrigation frequency.

#### WATER CONSERVATION IN CONTAINER PRODUCTION NURSERIES—IRRIGATION SCHEDULING

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Applying only the amount of water needed by a plant, when it needs it, is a simple concept that can conserve water and reduce runoff. Simple, that is, when managing a single crop that covers an extensive area under several irrigation zones. Container production nurseries grow a large number of plants and each irrigation zone usually has a diverse grouping of taxa in various stages of development. In 1989, a nursery crop project at Oregon State University began to investigate irrigation scheduling for container-grown woody landscape plants. Crop coefficients (kc), used to adjust irrigation to specific production practices and crop characteristics, vary greatly for woody landscape plants. Woody plant kc values range from <1.0 to >5.0 during the production cycle. Plant taxa, growth stage, spacing, and pruning significantly influence kc of container-grown plants. *Ilex crenata* ‘Green Island’ showed a reduction in water use (40%) immediately after pruning, but had similar kc values 60 days later. Grouping plants with similar kc values under the same irrigation zone is a very difficult task for a production nursery. It might be more practical to schedule irrigation for daily evapotranspiration, avoid placing new plantings next to mature crops, and only separate-out plants with very high or very low crop water requirements.

#### WATER USE BY THREE LANDSCAPE TREES UNDER LIMITING CONDITIONS

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Evergreen elm (*Ulmus parvifolia*), southern live oak (*Quercus virginiana*), and South American mesquite (*Prosopis alba*) were irrigated at 75%, 50%, and 33% of reference evapotranspiration for 2 years in Phoenix, Ariz. Each tree was irrigated with twenty-nine 3.8-L·h<sup>-1</sup> drip emitters to a depth of 90 cm. Initial trunk diameters were about 4 cm. Water use was monitored by heat balance sap flow gauges and related to canopy volume, projected canopy area, and total leaf area. Oak used more water than elm, and elm more than mesquite under all irrigation regimes. Irrigation regimes had a greater effect on oak and elm water use than on mesquite, but all trees maintained an acceptable canopy regardless of treatment.

#### THE ROLE OF WATER IN FLORICULTURAL CROP/INSECT INTERACTIONS

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Water stress and N fertilization can have a profound effect on populations of phytophagous insects. While species and cultivar selection can identify plants that are resistant to common insect pests, cultural practices may further decrease the susceptibility to insect attacks. Six poinsettia and six chrysanthemum cultivars were grown under well-watered or water-deficient conditions, and three fertilizer regimes with low, medium, or high concentrations of N. Vegetative plant growth and longevity and fecundity of various insect pests on these plants were determined. Host plant suitability to insects was estimated by the quantity of foliar soluble protein. Low irrigation reduced leaf area and leaf and stem dry weights 36% to 41% in poinsettias and 26% to 28% in chrysanthemum. Leaf area and leaf dry weight increased linearly in response to increasing fertilizer concentrations in poinsettia and chrysanthemum. Cultivar-specific differences were found for all variables of vegetative growth in poinsettias

and chrysanthemum. Cultivar also strongly affected insect preference, development, and fecundity. Low irrigation significantly reduced insect survivorship of the silverleaf whitefly on poinsettias. On chrysanthemum, leafminers, thrips, and melon aphids were unaffected by irrigation or fertilizer treatments. Chrysanthemum cultivar choice strongly affected the number of insects or development time.

#### EPIDEMIOLOGY OF PEPPER STIP

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Pepper stip is a physiological disorder manifested as gray-brown to greenish spots occurring on fruit of bell, pimento, Anaheim, and other types of peppers, most noticeably on red fruit produced under fall conditions. The spots,  $\approx 0.5$  cm in diameter, occur singly or in groups; marketability for either fresh market or processing use is severely affected. The factors controlling the occurrence or severity of the disorder are not well understood; to date, control has been achieved primarily by the use of resistant cultivars. In 1995 replicated plots of susceptible ('Yolo Wonder L' and 'Grande Rio') and resistant ('Galaxy' and 'King Arthur') cultivars were grown in seven commercial fields in central California. 'Galaxy' and 'King Arthur' were essentially free of symptoms, while 'Yolo Wonder L' and 'Grande Rio' showed significant damage at all sites, with 23% to 88% of fruits affected at the mature-red stage. Petiole tissue analysis showed that resistant cultivars consistently had lower N and K, and higher Ca concentrations than susceptible cultivars; the same trend was apparent in fruit tissue. Stip was most severe at sites with low soil Ca and/or very high N and K fertilization rates. It is hypothesized that Ca nutrition significantly influences stip expression.

#### THE EFFICACY AND COMPARISON OF TRAPS TO MONITOR ADULT WHITEFLY POPULATION DENSITIES IN CANTALOUPE

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A whitefly trap recently developed by Chu and Henneberry was tested in a cantaloupe field at the University of Arizona Maricopa Agricultural Center in 1995. The trap was compared with a  $3 \times 5$ -inch yellow sticky card trap, a commercial dome trap, and the leaf-turn sampling method. Results showed that the new whitefly trap effectively caught adults in cantaloupes. Numbers of adults increased as whitefly adult population densities increased during the season. Numbers of adults caught by the new whitefly trap were comparable to numbers of adults caught with the commercial dome trap and to a lesser extent the counts of adults determined by leaf-turn sampling method. Results with the new trap were not comparable to adults caught with yellow sticky card traps.

#### EFFECT OF GA<sub>3</sub> AND PBA ON GROWTH AND FLOWERING OF BOUGAINVILLEA

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Bougainvillea cuttings propagated in fall and winter often bloom profusely before putting out adequate shoot growth. These large flowers shade the small leaves, resulting in slow growth. In an attempt to solve this problem, rooted 'Juanita Hatten' cuttings were planted in 11.5-cm pots, clipped to 5 cm, and placed under natural short day or a 4-hour night interruption on 7 Dec. Plants were sprayed on 8 Dec. and again on 2 Jan. with 0, 50, 100, or 200 mg GA<sub>3</sub>/L or a combination of GA<sub>3</sub> and PBA at 200 mg·L<sup>-1</sup>. Data were taken on the uppermost new shoot of each plant. Under long-day conditions, the first inflorescence was produced on the first node of all control plants, whereas plants treated with GA<sub>3</sub> at 100 or 200 mg·L<sup>-1</sup> produced the first inflorescences on higher nodes. The number of inflorescences on this shoot was unaffected by any treatment. GA<sub>3</sub> treatment resulted in longer shoots (6.7–10.2 cm vs. 2.4 cm) and more leaves (13.4–16.2 vs. 7.5), with greater effects at higher concentrations. These shoots had several

inflorescences at the base, followed by many nonflowering nodes and additional flowers near the tip. The GA<sub>3</sub> + PBA treatment had no effect on the position of the first inflorescence. However, shoots had twice as many nodes and fewer inflorescences than the controls and were shorter than those treated with GA<sub>3</sub> alone. Plants under short day responded similarly to respective treatments under the long-day conditions. Tests will be conducted to determine if stock plants need to be treated in early fall and cuttings collected from the new growth to prevent early flowering.

#### SUPERDWARF WHEAT RESPONSES TO GRADIENT IRRADIANCE

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The objectives of this research were to mimic the gradient irradiances to which wheat (*Triticum aestivum* L. cv. SuperDwarf) plants were exposed aboard the Russian space station Mir, and to determine whether these irradiances inhibit growth and floral development. SuperDwarf wheat plants were exposed to irradiances of 20–40, 60–80, 100–120, and 140–180 (PPF =  $\mu\text{mol}\cdot\text{cm}^{-2}\cdot\text{s}^{-1}$ ) and grown to maturity. Twenty plants were randomly selected from each irradiance level and chlorophyll, total leaf area, shoot biomass, and total soluble leaf and plasma membrane (PM) proteins were recorded. Irradiance at increasing levels of intensity increased the fresh biomass, leaf area, chlorophyll content, and the total soluble PM and leaf proteins of wheat tissue. There were significant differences between the abaxial and adaxial sides of the wheat leaves in stomatal density, stomatal index, stomatal length and width, and number of stomata along 1-mm length of leaf. These data may be uniquely valuable for further studies of relationships between chlorophyll content, photosynthetic rate, and productivity of wheat grown aboard the Russian space station Mir, space missions of long duration, or future manned space stations to generate oxygen, purify water, remove carbon dioxide, produce food and recycle waste materials. (Supported by NASA Grant NCC 2-831 and the Utah Agr. Expt. Station.)

#### HISTOCHEMICAL ASSESSMENT OF GROUND-BASED AND MIR-GROWN WHEAT

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Our objectives were to ascertain whether wheat (*Triticum aestivum* L. cv. SuperDwarf) plants, grown aboard the Russian space station Mir in the microgravity of space, exhibited any plant structure and histochemical changes compared with those ground-based plants grown in Moscow, Russia, and Logan, Utah. Plants were harvested at stages of ontogeny corresponding to day 6, 14, 25, 35, and 55 post-emergence and placed in 4% formaldehyde: 1% glutaraldehyde (4F: 1G) fixative, adjusted to pH 7.2, and stored in Aclam plastic bags. Upon return to earth, samples were dehydrated and embedded in Spurr's resin. Use of differential chromophores on semi-thin sections (1  $\mu\text{m}$ ) suggests no major artifacts in cellular structure. Enzyme localizations for lignin, carbohydrate, starch, alkaline and acid phosphatase indicate that plants grown aboard Mir appeared to have less lignin than ground control plants. (Supported by NASA Grant NCC 2-831 and the Utah Agr. Expt. Station.)

#### COMPARISON OF LONG-TERM STORAGE IN CHEMICAL FIXATIVES ON MORPHOLOGY AND ANATOMY OF SUPERDWARF WHEAT

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Wheat (*Triticum aestivum* L. cv. SuperDwarf) plants grown in the microgravity of space aboard the Russian space station Mir and sampled for morphological and anatomical comparison to those ex-

posed to gravity on earth will be stored in chemical fixative for relatively long periods of time. Our objective was to examine, evaluate, and verify that the integrity of the vascular system and cellular components of wheat plants is maintained following storage in a chemical fixative. In ground-based studies, wheat seedlings were harvested on days 9, 28, and 68 and preserved in 4% formaldehyde : 1% glutaraldehyde (4F : 1G) fixative, adjusted to pH 7.2. Samples of leaves and/or stems were taken from these stocks after various times in storage (24 h, 1, 6, 12, and 24 months), dehydrated, and embedded in Spurr's resin. Semi-thin (1  $\mu$ m) and thin (50–70 nm) sections were examined by light and transmission electron microscopy. Overall, there seems to be no major artifacts in the cellular structure. The plasmalemma and other organelles appeared normal in this fixative. Use of differential chromophores suggests that enzyme localizations at both the light and electron microscopical levels are not adversely affected by long-term storage. (Supported by NASA Grant NCC 2-831 and the Utah Agr. Expt. Station.)

#### ALTERNATIVES TO SULFUR DIOXIDE FUMIGATION FOR TABLE GRAPE STORAGE

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Clusters of four varieties of table grapes were packed in TKV lugs and fumigated with 4, 6, or 8 Deccodione Smoke Tables (DST) for a period of 30 minutes in a fumigation chamber. After fumigation, inoculum of *Botrytis cineraria* was placed among the berries in the clusters in predetermined locations. Fruit was stored at 0C and high relative humidity for up to 16 weeks. Fruit was examined at 4, 8, 12, and 16 weeks of storage. Decay control index, freshness of stems, and bleaching of pigments around the capstem was recorded at each evaluation time. Size of aerosol particles was determined. Satisfactory control of decay was obtained with 8 DSTs. Lower doses failed to give satisfactory decay control. Bleaching of capstems typically seen with sulfur dioxide fumigation was not noticed with DST fumigation.