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## EFFECTS OF GAS COMPOSITION DURING PRIMING OF *sh2* MAIZE SEEDS

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Sweet corn with the *shrunken-2* (*sh2*) gene is characterized by poor seed emergence and low seedling vigor. Also, this variety is sensitive to flooded conditions. Our objective was to determine the effects of aeration, during priming treatment, on germination and vigor. Priming consisted of aerating *sh2* maize seed during soaking then drying on a lab bench overnight under a fan. Fifty seeds at a time were soaked ( $25 \pm 2C$ ) in 100 ml deionized water. During this time they received either 75% O<sub>2</sub> : 25% N<sub>2</sub>, pure N<sub>2</sub>, pure CO<sub>2</sub>, or no gas (soak control) for up to 6 hours. The flow rates ranged from 0.35 to 2 standard liters per minute for 75% O<sub>2</sub> : 25% N<sub>2</sub>, 0.8 to 2.5 for N<sub>2</sub>, and 0.5 to 1.3 for CO<sub>2</sub>. Pressure was held constant at 1 psi. All samples were weighed before soaking, immediately after soaking, and again upon partial drying. Germination was counted after 7 days using the rolled paper towel method ( $25 \pm 1C$ ). Radicle lengths were measured after 72 hours. Oxygen (75%) increased vigor. Also, O<sub>2</sub> permitted greater water absorption ( $P < 0.02$ ). Carbon dioxide and N<sub>2</sub> both decreased vigor. Data suggest that aeration conditions (75% O<sub>2</sub>) during the hydration treatment has beneficial effects.

## INVESTIGATION OF *LEWISIA TWEEDYI* SEED ANATOMY AND SEEDCOAT-IMPOSED DORMANCY

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*Lewisia tweedyi* (A. Gray) Robinson is an endangered, herbaceous perennial native to the Cascade Mountains of northern Washington state and southern British Columbia. It is highly valued as an ornamental, but has a reputation for being challenging to grow and is only cultivated by alpine specialists. The better known *Lewisia* species, *L. cotyledon*, is a minor commercial crop in some areas of Europe and western North America. *Lewisias* are members of the Centrospermae; a linear peripheral embryo surrounds centrally located perisperm. *Lewisia tweedyi* seed is distinct from all other *lewisias* in having a fleshy appendage, or caruncle. Germination practices include stratification for an unspecified period in a garden cold frame. In addition to a long germination period, percent germination is characteristically low. A number of tests, including sowing under axenic conditions, and combinations of prechill periods and liquid N scarification were conducted. Seedcoat-imposed dormancy and germination requirements have been determined.

## NUCLEAR DNA CONTENT OF *DENDROBIUM* ORCHID SPECIES AS DETERMINED BY LASER FLOW CYTOMETRY

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Flow cytometry (FC) has proven to be an efficient and reliable method to estimate nuclear DNA content (genome size) in quantifiable units useful for genetic and molecular biology studies. This method also makes possible determination of the variation in nuclear DNA

content between related taxa, which gives insights into the process of speciation. In this study, DNA content was determined in nuclei isolated from leaves of 21 *Dendrobium* species representing each of the major taxonomic groups used in the Univ. of Hawaii breeding program. Nuclei were mechanically isolated, stained with the nucleic acid-specific fluorochrom propidium iodide, and DNA content determined using a Coulter Epics 753 laser flow cytometer. Chicken erythrocyte nuclei ( $2C = 2.33$  pg DNA) were used as an internal standard for direct comparative measurement. The mean diploid genome ( $2C$ ) values for *Dendrobium* species ranged from 3.36 to 5.06 pg. Genome sizes were evaluated for possible use as discrete characters for taxonomic group assignment and compared to previous data on breeding compatibility and evolutionary relationship between species.

## IN VITRO SCREENING FOR ANTHURIUM TOLERANCE TO BURROWING NEMATODE, *RADOPHOLUS SIMILIS*

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Burrowing nematode, *Radopholus similis*, reduces flower-yield-infected anthurium fields. Genetic resistance is one alternative to chemical control of the disease in anthurium. Seventeen commercial anthurium varieties, established in vitro on anthurium nutrient medium, were inoculated with burrowing nematodes to screen for tolerance. Three months after inoculation, plant responses were compared by number of nematodes recovered and by symptom index and plant weight loss with respect to non-inoculated plants. Results show that 'Mauna Kea' and 'Flamingo' anthuriums are among the most tolerant, while 'Ozaki' is one of the most susceptible. These results are consistent with grower field evaluation. Nematode count is positively correlated with symptom index and weight loss. The mechanism of tolerance or resistance of anthurium toward burrowing nematode is unclear. However, due to the fact that burrowing nematode is a migratory endoparasite, a preinfectious resistance or tolerance mechanism is more likely to take place.

## COMMUNITY-DERIVED GREEN WASTE COMPOST USED TO GROW WATERMELONS, SWEET CORN, AND TOMATOES

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Under heavy pressure to prolong the life of landfills, cities have been asked to reduce the amount of trash deposited in them. Yard grass clippings and prunings contribute greatly to filling up local landfills. Since green waste can be easily composted, municipalities are looking into agriculture as a potential candidate in disposing of composted material. It is common knowledge that compost is good for plants. However, most information seems to be anecdotal or testimonial. Therefore, the need for scientific-based information is highly needed if compost is to be used successfully in agricultural lands. To generate hard data, replicated test plots were conducted in watermelons, sweet corn, and tomatoes in which 10 and 20 tons per acre of community-derived, green waste, composted material was used in addition to a commercial fertilizer rate and nontreated check. Soil and tissue analyses were run three times during the season to check nutrients in plants

(N, P, and K). Organic matter, electrical conductivity, and pH were analyzed from soil samples. Yields and quality determinations also were taken from all crops for comparisons. Organic matter from compost treatments increased significantly in corn and tomatoes. Electrical conductivity was lower in the composted treatments, and K increased as well. Trials are being funded by the California Integrated Waste Management Board, and it will continue for at least 1 more year.

#### IMPROVING SWEET CORN FERTILIZER-NITROGEN EFFICIENCY

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Improving sweet corn fertilizer-N efficiency promotes a more vigorous and healthy crop, rewards the grower with greater profits, and protects our water resources from nitrate-N pollution. Two areas of research that have the potential to improve the efficiency of fertilizer-N applications are the Minolta SPAD 502 chlorophyll meter and the presidedress soil N test. The SP meter is a rapid and nondestructive technique for assessing sweet corn leaf levels, and SP readings have been correlated to leaf N concentration. A presidedress soil N test measures the amount of soil N that will be available to the plant during the remainder of the growing season. SP meter readings combined with presidedress soil N analyses may be used to determine crop N needs and fertilizer-N sidedress application rates. Basing fertilizer-N sidedress application rates on actual crop N needs will reduce excess fertilizer-N applications and the resulting leaching of nitrates.

#### A NEW APPROACH TO VEGETABLE VARIETY EVALUATIONS FOR THE HOME GARDEN

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Conducting varietal evaluations for the home vegetable garden are time-consuming, labor-intensive, and costly. As a result, most are done on an observational basis only. In 1991, a horticultural training program modeled after the highly successful Master Gardener program began at the Utah State Prison, Draper, for the prison inmate population. In 1994, 12 broccoli, 20 pepper, and 30 tomato varieties commonly used in the home garden were evaluated for growth and yield at the Prison Farm. Inmates raised, tended, harvested, and compiled the trial's data and participated in all evaluations of the varieties. Extension personnel provided the instruction and regular visits to conduct the trial. The project provides instruction on vegetable production and cultivar evaluations to the inmates while providing the public with needed cultivar information for the home garden. In addition, the partnership with the inmate population limits the time inputs necessary to conduct the trials by extension staff. This project will continue and greatly expand in 1995.

#### EVALUATING CARROT CULTIVARS IN WASHINGTON THROUGH ON-FARM TRIALS AND IN-MARKET TASTING

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Carrots are among the most important commercial vegetable crops in Washington state. Over the past decade, production by both large-scale and small-scale growers has steadily increased. To assist these growers, a variety of carrot cultivars for fresh market and processing have been evaluated in on-farm trials and in-market tasting conducted by Washington State Univ. Cooperative Extension. In 1994, 116 entries from 16 seed companies and the U.S. Dept. of Agriculture were planted for evaluation. Imperator-, Chantenay-, Nantes-, and Kuroda-type carrots were planted in separate sections of this on-farm trial. Foliage and roots of all entries were scored at 120 days after planting. Customers at the Pike Place Market were asked to evaluate the appearance, flavor, and texture of 22 of these carrots. A majority of evaluators expressed a preference for Kuroda-type carrots. Some Nantes-type carrots also received high scores. The suitability of carrot cultivars for new products, including carrot juice and carrot chips, and nutritional levels were analyzed in a related study.

#### RESOURCE CONSERVATION AUDITS AND OUTDOOR CLASSROOMS DECREASE WATER USAGE

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The San Pedro River has been impacted by continued growth of Fort Huachuca Military Base. The San Pedro River, a riparian-migratory area, has had continuous water flow but now has intermittent water flow. The cause is cones of depression in the aquifer due to domestic well pumping. The aquifer is recharge with water from the river. Cooperative Extension has implemented Resource Conservation Audits for landowners in the lower San Pedro Valley. Also, outdoor classrooms are being constructed at three schools to educate children and community members. The goal of these programs is to educate landowners on water conservation through the use of native and adapted drought-tolerant plants, xeriscaping, irrigation efficiency, water harvesting, soil erosion, and composting. Site visits help landowners identify opportunities to reduce water use. Research-based informational brochures have been produced so landowners can plan and implement water-saving techniques on their properties. This program has been implemented using six members of the Border Volunteer Corp., part of Americorp program.

#### INHERITANCE OF PANSY-LIP IN *DENDROBIUM*

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A peloric form of the labellum or lip of *Dendrobium* appeared in a hybrid registered by D'Bush Nursery of Australia as *Dendrobium* D'Bush Pansy in 1988. Unlike the typical lip of *Dendrobium*, the lip of D'Bush Pansy is similar to the two lateral sepals, and the flat petals and sepals resemble those of the pansy, hence the name D'Bush Pansy. A few seedlings of D'Bush Pansy were obtained from Australia through Bangkok Flowers in 1989. D'Bush Pansy crossed to several *Dendrobium* plants with normal lip produced offspring with normal lip, indicating that pansy-lip is recessive to normal-lip. Three F<sub>1</sub> offspring backcrossed to the pansy-lip parent produced 1:1 ratios, and one F<sub>2</sub> progeny segregated into 3 normal-lip : 1 pansy-lip. Thus, pansy-lip is controlled by a single recessive gene pair.

#### IN VITRO CONSERVATION OF THE NORTHERN GENOME OF *LUPINUS LEPIDUS*

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*Lupinus lepidus* is a dwarf perennial lupine native to British Columbia. It possesses high horticultural potential, but the only known population in British Columbia averages 70 plants and is under constant threat of destruction. *Lupinus lepidus* is variable from seed and very difficult to propagate from cuttings. To protect the northern genome of *L. lepidus*, and to help introduce this plant to the nursery trade, we have investigated the feasibility of micropropagation for expansion of the supply of plant material. A regeneration procedure has been developed that enables multiple *L. lepidus* plantlets to be obtained directly from cotyledon explants of 10-day-old seedlings. More than 40 microshoots per explant were induced from cotyledonary node explants after placing them on MS medium containing BAP at 1 mg·liter<sup>-1</sup> and NAA at 0.05 mg·liter<sup>-1</sup> for 3 weeks. The regenerated shoots grew vigorously on a hormone-free, half-strength MS medium and could be multiplied on the same medium every 2 weeks. This micropropagation cycle has been used continuously for 9 months. Alternatively, 15 to 20 plantlets can be forced to develop from the axillary buds on the stems of 5-month-old seedlings by withholding sucrose from half-strength MS medium. The induced plantlets could be further propagated on the same medium, but they displayed less vigor than those obtained from the cotyledonary node explants.

#### DNA FINGERPRINTING IN *RHODODENDRONS* USING RANDOM AMPLIFIED POLYMORPHIC DNA

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Random amplified polymorphic DNA (RAPD) markers were evaluated for use in DNA fingerprinting of commercial *Rhododen-*

*dron* cultivars. DNA was isolated from *Rhododendron* leaves and subjected to PCR amplification with single primers, 10 nucleotides in length, and of arbitrary sequence. Amplification products were visualized by agarose gel electrophoresis and ethidium bromide staining. Fingerprints were readily identifiable for a number of cultivars, and a high level of polymorphism was observed among clones of 10 rhododendron varieties. The technique was consistently reproducible in different trials using the thermocycler, between different thermocyclers, and using different DNA isolation from the same plant. This method will be applied to large-scale fingerprinting of *Rhododendron* cultivars and for distinguishing material propagated in tissue culture.

#### SYSTEMATICS OF *TRILLIUM OVATUM* L. FORMA *HIBBERSONII* TAYLOR & SZCZAWINSKI

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The forma now known as *Trillium ovatum* L. forma *hibbersonii* Taylor & Szczawinski (Liliaceae) was first discovered on the west coast of Vancouver Island, B.C., in 1938 by Jack Arthur Hibberson (Holotype UBC 73131). The obvious morphological differences that characterize the forma *hibbersonii* from *T. ovatum* are the dwarfing of all its parts, pink not white flower color at anthesis, and narrow lanceolate leaves. Although it has gained popularity as a garden plant, it has received very little attention in the scientific community. A description and designation as a distinct species (*T. hibbersonii*) was published by L. Wiley in 1968 but was considered invalid. The 1975 valid publication by T.M.C. Taylor and A.F. Szczawinski designated this taxon at the intraspecific level of forma. The present study was initiated to provide a comprehensive reevaluation of the taxonomic status: forma, separate species, subspecies, or variety? A change in taxonomic status from forma to species would elevate the taxon from rare to endangered status. This study considers morphological differences and flavonoid analysis of samples from both natural populations and cultivated plants. Habitat, dormancy requirements, and breeding strategy also were considered. Initial investigation using random amplified polymorphic DNA (RAPD) indicates this method is another valuable tool for distinguishing between the taxa.

#### MICROPROPAGATION OF *FICUS BENJAMINA* L. 'VARIEGATA' L. Agus Sukamto, Dept. of Horticulture, Univ. of Hawaii at Manoa, Honolulu, HI 96822

Shoot tip culture of *Ficus benjamina* L. 'Variegata' produced multiple shoots on Murashige and Skoog (MS) medium with 1  $\mu\text{M}$  2,4-dichlorophenoxy acetic acid (2,4-D), 1  $\mu\text{M}$  naphthalene acetic acid (NAA), 1  $\mu\text{M}$  benzylaminopurine (BAP), L-proline at 2 mg·liter<sup>-1</sup>, and L-glutamine at 1 mg·liter<sup>-1</sup> without previously producing callus. Multiple shoots were more profuse on one-half MS medium with 4.44  $\mu\text{M}$  BAP. Single shoot of multiple shoots produced roots on one-half MS medium with NAA at 2.69  $\mu\text{M}$ . Leaf culture of the plant produced profuse calli on same media without plant regeneration. Calli subcultured on one-half MS or MS media with 1.7  $\mu\text{M}$  indole-3-acetic acid (IAA) and 150  $\mu\text{M}$  6-(y,y-dimethylallylamino)-purine (2iP) did not induce plant regeneration.

#### FRAGRANCE IN ANTHURIUM

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Flowers emit volatile compounds that attract pollinators. In ornamental plant breeding programs, fragrance is a significant character that adds value to flowers for its consumer appeal. In Hawaii, anthurium (Araceae) is an important crop used for cut flowers and flowering potted plants. Unlike other ornamentals, fragrance is not presently associated with commercial anthuriums. However, several anthurium species are known to have distinctive scents. To obtain the novelty trait of fragrance in anthurium, an understanding of anthurium scent genetics, physiology, and chemistry is required. Scented anthurium species and hybrids in the Univ. of Hawaii germplasm collection have been studied. Fragrance emission among species varies with time of day—some species being scented only in the morning, only at night,

or all day long. Fragrance emission also varies with stage of spadix development, with some species having scent as pistillate and/or staminate flowers. The species sampled comprise five categories: *A. amnicola*, *A. formosum*, and *A. lindenianum* are minty; *A. armeniense* is sweet; *A. gracile* is floral; *A. bicollectivum*, *A. cerrobaulense*, *A. folsomii*, and *A. harleyii* are fruity; and *A. supianum* is fishy. Some of the chemical components are illustrated.

#### DNA FINGERPRINTING TECHNOLOGY FOR PLANT BREEDER'S RIGHTS

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DNA fingerprinting is a potentially powerful molecular genetic technique that can be used to distinguish subtle differences in genome structure among closely related genotypes, such as many horticultural varieties. A DNA fingerprinting project is currently in progress at the Univ. of British Columbia (UBC) Biotechnology Laboratory to produce a set of DNA markers and an easy, reliable, and legally recognized analysis protocol that will enable the UBC Botanical Garden Plant Introduction Scheme (PISBG) to unambiguously identify any of their released varieties, even in dormant or juvenile form, wherever it is being propagated or sold. High-quality genomic DNA was isolated from the leaf samples of six PISBG species (*Anagallis monellii*, *Artemisia stelleriana*, *Clematis*, *Genista pilosa*, *Microbiota decussata*, and *Penstemon fruticosus*) using a modified CTAB DNA isolation protocol, and further purified by cesium chloride/ethidium bromide gradient. Samples of these genomic DNA preparations (10 ng) were then amplified by a 45-cycle polymerase chain reaction (PCR) protocol using 1.5- $\mu\text{M}$  10-nucleotide primers of arbitrary nucleotide sequence that amplify a variety of sites distributed across the genome. Following the amplification, PCR products [random amplified polymorphic DNA (RAPD) markers] were separated by agarose gel electrophoresis and visualized by ethidium bromide staining. More than 70% of the 51 primers tested so far generated distinctive banding patterns (2–11 bands) with DNA samples from each species. Subtle changes in the genome or differences between genotypes can be detected by screening a series of such primers against DNA samples from the genotypes in question. Once a RAPD primer has been identified that consistently generates a different banding pattern between genotypes, it can be used as an identification tool for discriminating between those genotypes at any time in the future.

#### EVALUATION OF HUP<sup>+</sup>, HUP<sup>-</sup> AND A TRANSCONJUGANT *RHIZOBIUM* ON YIELD, NITROGEN FIXATION, AND UPTAKE HYDROGENASE ACTIVITY IN SELECTED CHICKPEA CULTIVARS

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Evolution of hydrogen gas (H<sub>2</sub>) during N<sub>2</sub> reduction in root nodules results in inefficient use of energy needed for N<sub>2</sub> fixation. Cultivars of chickpea (*Cicer arietinum* L.) were inoculated with *Rhizobium* strains with and without genes for uptake hydrogenase (Hup) activity. H<sub>2</sub> evolution, acetylene reduction activity, and uptake hydrogenase (Hup) activity were assayed on the resulting nodules. The Hup<sup>-</sup> strains produced higher plant yields than the Hup<sup>+</sup> strains. The +N controls produced significantly higher yields than the -N controls and plants inoculated with *Rhizobium* strains. Hydrogen uptake activity by *Rhizobium* strains was influenced by the cultivar characteristics. Expression of the plasmid-borne *hup* genes (pHU52) of *Bradyrhizobium japonicum* was modified by the host cultivar. The average nodule fresh weight and shoot and root dry weights of the cultivars significantly increased following inoculation with the transconjugant Hup<sup>+</sup> *Rhizobium* strain. Thus, biological N<sub>2</sub> fixation may be enhanced by selecting *Rhizobium* strains that are appropriately matched to the particular cultivar. Incorporation of transconjugant Hup<sup>+</sup> genes can increase rhizobial activity.

## EFFECTS OF REGENERANT WASTEWATER IRRIGATION ON GROWTH AND ION UPTAKE OF LANDSCAPE PLANTS

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The effects of regenerant wastewater irrigation and high concentrations of  $\text{Ca}^{2+}$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ , and  $\text{Cl}^-$  on growth and ion uptake of nine species of landscape plants were studied. Significant differences in chloride tolerance were detected among the species. Generally, the species that had greater uptake of chloride grew less than species that took up less amounts of chloride. Lace fern (*Athyrium filix-femina* Roth.) had the highest tissue Cl concentration and was the most affected. Hydrangea (*Hydrangea macrophylla* Ser.) also had high tissue Cl concentration, but showed no growth reduction. Its tolerance was attributable to a high tissue Ca concentration. The data suggest that in the species tested, higher tissue Ca concentrations were positively correlated with plant tolerance to Cl. Overall, the  $\text{Cl}^-$  concentration in the wastewater seems to be the factor most likely to create problems for the landscape plants. However, severe negative effects will probably be noticed only for very sensitive plant species, but it is important to determine this before applying regenerant irrigation water.

## GROWTH OF FOUR SOUTHWESTERN LANDSCAPE TREES IN CUPRIC-HYDROXIDE-PAINTED NURSERY CONTAINERS

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Seedling liners of sweet acacia (*Acacia smallii*), shoestring acacia (*Acacia stenophylla*), palo brea (*Cercidium praecox*), and Chilean mesquite (*Prosopis chilensis*) were potted on 1 June 1993 into 27-liter (#5) black polyethylene containers filled with a 70% ponderosa pine forest mulch, 15% sand, and 15% silt (by volume) rooting medium. Just before potting, the inner wall of one-half of the containers of each species was painted with a latex paint impregnated with cupric hydroxide; the remaining containers were unpainted as a control treatment. Trees were then grown for 5 months in an outdoor container production nursery at a spacing distance of 45 cm. All trees were irrigated and fertilized according to standard nursery practices. The effect of cupric-hydroxide-painted containers (CHPC) on tree growth was species specific. Compared with nonpainted controls, CHPC caused roots to become more branched and decreased shoot lateral branch number and extension lengths of sweet acacia and shoestring acacia. CHPC also decreased height of shoestring acacia, but did not affect height of sweet acacia or root and shoot dry weight of sweet acacia and shoestring acacia. Shoot and root dry weight, height, and shoot lateral branch number and extension lengths of Chilean mesquite in CHPC were all increased compared with nonpainted controls. CHPC did not affect root branching of Chilean mesquite. Also, CHPC did not affect any measured growth variable of palo brea.

## TRAINING LANDSCAPE MANAGERS VIA SATELLITE TELECONFERENCE

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The fabled "wide open spaces" of the west make travel an integral, though expensive, part of most extension programs. As an alternative, Utah State Univ. has been successful in targeting a major extension audience for service via satellite teleconferences. The audience we have worked with consists primarily of landscape managers at institutional facilities, such as schools, cities, churches, hospitals, and parks, who do not have formal training in horticulture. The primary impetus and key to the success of this program is a collaboration between the university (provides content material and production) and an outside institution (provides satellite broadcasting and receives employee training). As a result, the program simultaneously reaches three main audiences: employees of the partnering institution, county extension audiences throughout the state, and any private party with a satellite

who watches. Keys to the success of this program include a statewide system of satellite dishes at all county extension offices, close collaboration between content and distance-learning specialists, marketing assistance to county agents, endorsement of the program for employee training by employers, a workbook to supplement broadcast material, administrative support, and careful identification of the target audience. Concepts we are struggling with include bridging regional to national audiences and improved marketing.

## AVENUES OF DISTANCE EDUCATION: HIGHWAYS, BIWAYS, AND DEAD ENDS

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In 1992 and 1993, we taught the course "Landscape Management in the Interior West" by satellite in four states in the mountain west. The broadcast originated from an on-campus studio without students present, but with a two-way audio link. About one-third of the students viewed the course for credit and were located both on and off campus, while the remainder were not on campus and took the course for personal knowledge. In 1992, the course was broadcast live, but in 1993 it was restructured in a modular format and videotaped before broadcast. In 1994, videotapes from the previous year were used to offer the course on a semi-independent study basis on the Utah State Univ. campus. Videotaping the course in discrete content modules substantially improved the quality of the course by eliminating production problems and creating better content flow. The videotapes in turn provided a readily usable off-the-shelf course. Student response, however, varied with location and degree of involvement. On-campus students were critical of a perceived lack of face-to-face contact with faculty. Positive responses came from viewers in remote locations where access to college-level courses is otherwise limited. Distance education through studio-produced, videotaped lectures provides a visually engaging format that is easily disseminated. Such courses will less likely succeed on client campuses, however, unless there is an on-site individual mediating between the tapes and students.

## SELF-LEARNING: CD-ROM INSTRUCTION AND AUTHORING

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A fundamental concern of agricultural education is innovation within the teaching process. In dealing with high technology, increasing subject complexity, and rising costs, educators (including plant managers and training personnel) must look to alternative methods of training and teaching. Educational multimedia software can effectively present a new dimension to traditional computer-assisted instruction (CAI) by adding sound, animation, high-resolution graphics, and live-action video. Multimedia software is not difficult to program; however, the ease of programming depends on the authoring language or languages that are used. A traditional language such as C++ can take extended periods of time to program, possibly hours per minute of program. A program developed specifically for multimedia development can facilitate the interactions between sound, videos, and animation more readily, and reduce the programming time required significantly. The use and development of multimedia software using Toolbook (Asymetrix Corp.) will be presented with copies of the developed software available.

## LIFE IN THE WORLD WIDE WEB—SPIDER OR FLY?

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The Internet is a computer network phenomenon with no center and no circumference. It is a vast interconnected WEB of information resources. Historically, finding data in this WEB has been difficult, but things are improving rapidly. In this session, we will find out how to safely get around in this network of information. We will find repositories of relevance to the horticultural discipline. We will also discuss how to contribute to the information resources found on the Internet.