

**Symposium 11 (S11): Asian Plants with Unique Horticulture Potential: Genetic Resources, Cultural Practices and Utilization**

**Monday · August 12**

**Location: Metro Toronto Convention Centre, Room 205CD**

**1100–1140**

**S11-0-1**

**ORIENTAL VEGETABLES—HISTORY AND STATUS OF VEGETABLE INDUSTRY IN CHINA**

Dongyu Qu\*

Institute of Vegetables and Flowers, Chinese Academy of Agricultural Sciences, Beijing, China 100081

China is largest vegetable production in the world, which accounted for 75% vegetable output in Asia. The sharing production per capita in a year reached as high as 330 kg (net consumption per capita is about 200 kg). The sustainable increase is due to economical reform, expanding growing area, popularization of F<sub>1</sub> hybrids and improvement of production condition. The establishment of vegetable seed industry helped to speed up this process. The institute based enterprises played key role in the marketing new technology and their efforts brought the booming of vegetable industry. The future priority for vegetable technology development should focus on the quality enhancement, applied research for creation of desirable breeding materials and post harvest technology. Breeding environment friendly vegetables is important topic in the future. China has tremendous potential for vegetable industry not only supplying for Chinese market but also other countries, which can contribute the food security for this planet. Let us share the Chinese history and share horticultural diversity to improve the vegetable basket in other part of world.

**1140–1200**

**S11-0-2**

**EFFECTS OF CHITOSAN OF DIFFERENT MOLECULAR WEIGHT ON RESPIRATION, GROWTH, AND NUTRITIONAL QUALITY OF SOYBEAN SPROUTS**

Sung-Bae Kim, Young-Sang Lee\*, Young-Sook An, Soon-Ryang Park, Seung-Hun Lee

Div. of Life Sciences, Soonchunhyang Univ., Shinchang-Myon Eupnae-Ri, Asan, Chung-Nam, South Korea, 336-745

To clarify the molecular weight-dependent chitosan effects on production of soybean sprouts, soybean seeds were soaked with 1,000 ppm chitosan of low (LMW: 2,000 < M.W. < 10,000), medium (MMW: 50,000 < M.W < 100,000), and high (HMW: M.W. > 1,000,000) molecular weight. Sprouts treated with HMW exhibited significant increment in respiration rate by 5% within 1 day after soaking. Chitosan effectively increased soybean sprout growth in that harvested sprouts treated with HMW resulted in 3%, 3%, 1%, and 12% increase in total length, hypocotyl length, root length, hypocotyl thickness and fresh weight, respectively. These growth enhancing effects of chitosan were proportional to its molecular weight. Chitosan treatment caused no adverse or promotive effects on vitamin C contents, and chlorophyll formation in sprout cotyledons, an important factor on quality of soybean sprouts, was slightly reduced by chitosan soaking. In conclusion, soaking soybean seeds with chitosan, especially high molecular weight, seems to be an effective way to enhance productivity of soybean sprouts.

**1200–1220**

**S11-0-3**

**THE IMPORTANCE OF PHOTOPERIOD IN CULTIVAR AND SITE SELECTION FOR PRODUCTION OF MYOGA (*ZINGIBER MIOGA* ROSCOE)**

K. Stirling\*, R. Clark, S. Wilson, P. Brown

TIAR, School of Agricultural Science, Univ. of Tasmania, Hobart, Tasmania, Australia, 7001

Myoga (*Zingiber mioga* Roscoe) is a potential new crop in Australia. Flower buds are harvested for fresh market sales. Consequently, identification of prin-

cipal environmental stimuli for flowering in myoga was required to aid in selection of suitable production locations. Initial crop evaluation trials have established that there are two apparently different cultivars, one of which produced few flower buds at 42°S latitude, deeming it unsuitable for further commercial production. Photoperiod was therefore considered to be a potentially important factor regulating flowering in the commercial production of myoga. Both cultivars were used in this trial. Plants grown under long day conditions (16 h) and short day conditions (8 h) with a night break produced flower buds, while those under short day conditions (8 h) did not. The failure of plants under short day conditions to produce flower buds was due to abortion of developing floral primordia rather than a failure to initiate inflorescences. It was concluded that for flower development in myoga a qualitative long day requirement must be satisfied however flower initiation is day-neutral. Short day conditions resulted in abortion of flower primordia, premature senescence of foliage and reduced foliage dry weight in both cultivars. Early senescence and low flower bud yield of the Inferior cultivar but not the Superior cultivar have been observed in crop evaluation trials in Southern Australia and New Zealand. Differences in critical photoperiod between the two cultivars may explain this observation and a second trial was designed to confirm this. Both cultivars were grown under three daylength treatments; 10, 12 and 14 hour daylengths and were destructively harvested on three separate occasions to determine if initiation had occurred. From this data the critical daylength for each cultivar was established and may be used as an important consideration in site and planting date selection for specific cultivars.

**1220–1240**

**S11-0-4**

**NEW LETTUCE PRODUCTION SYSTEM USING AUTOMATIC REAPING HARVESTER AND RAIL SYSTEM**

Toru Maruo\*, Shigehiko Akimoto\*, Noriko Wada\*, Michiko Takagaki\*, Yutaka Shinohara\*

Faculty of Horticulture, Chiba Univ., 648, Matsudo, Chiba, Japan, 271-8510

New production system using rail system and automatic reaping harvester was developed for lettuce. With this system labor-saving and better efficiency of harvest works should be achieved in lettuce production. In the meantime, the harvested leaves could be distributed directly as cut vegetables and packing process might also be simplified. Leaf lettuce (*Lactuca sativa* L.) was cultivated under protected conditions. A rail system developed for tea plantation was introduced in the plastic house and set up along the cultivation bed. This rail system was used not only for harvest but also for soil and planting bed preparation. The harvesting system we used was automatic reaping harvester developed from the tea harvester moving on the rail system. With this system, upper leaves were reaped off at a specific height precisely, allowing the plants to regenerate new leaves for successive harvest. Lettuce plug seedlings were planted two times (14 Sept. and 19 Nov. 2000) at 3 planting densities. The influences of the planting density and reaping height of the lettuce plant on the yield and quality of the products were examined. The efficiency of this harvest system was also evaluated by the time used for harvest. As far as planting density, higher yield was obtained with higher density planting. About reaping height, reaping at 13 cm from the soil surface resulted in higher yield than at 8 cm. With this system, total yield was higher in comparison with conventional system and about 15 reaping could be executed. The time required for harvesting 1 m<sup>2</sup> area of lettuce with this system was only 15 seconds and this means almost 1/100 harvesting time reduction as compared with conventional culture. We concluded this production system should be feasible for leaf vegetables with high harvest efficiency. More advanced research should be conducted for this system about application to other vegetables for the process of washing, sterilization, packing.

**1340–1440**

**S11-P-5**

**GENETIC DIVERSITY OF AN EUROPEAN COLLECTION OF LOQUAT [*ERIOBOTRYA JAPONICA* (THUMB) LINDL.]**

María L. Badenes\*, Teresa Canyamas, Carlos Romero, G. Llácer

Instituto Valenciano de Investigaciones Agrarias, Apartado Oficial, Moncada, Valencia, Spain, 46113

Loquat [*Eriobotrya japonica* (Thumb) Lindl.] was introduced in Europe in 18th century. It was first introduced as an ornamental tree. Later, when types with

larger fruits were selected, it was grown for its fruits. In Europe, the plant was grown in regular orchards at the beginning of the 20th century. At present, this species is an interesting alternative into the European fruit industry. A germplasm collection from a survey made in Spain and accessions introduced from Japan, Italy and Portugal was studied by means of RAPD markers. Among 46 accessions, 34 highly reproducible markers were selected. The polymorphism detected allowed to distinguish 39 accessions. Two groups of accessions, that shared the same combination of RAPD markers, could not be distinguished. One group included five accessions known as budsports from 'Algeri', the most important cultivar grown in Spain. A second group included two accessions surveyed in the same local area of Spain. Our results suggested that, although a large number of new accessions were identified, the genetic diversity of loquat introduced in Europe is very low. It seems that a few forms were introduced from Japan. The species was propagated by seeds and developed many budsport, however the genetic base is narrow. For the future breeding and improvement of the crop, it is necessary to broaden the collection by means of introduction of new plant material from Japan or China.

#### 1340-1440

##### S11-P-6

#### EFFECT OF RAIN-SHELTERED CULTIVATION ON SOIL MOISTURE, SAP FLOW, AND FRUIT QUALITY OF PEACH (*PRUNUS PERSICA*)

Dong-Chil Choi\*, Dong-Geun Choi, Dong-Hyun You, Hyeung-Gook Kim, Jeong Ryu

Dept. of Horticulture, Jeollabuk-do Agricultural Research and Extension Services, IKSAN, Jeollabuk-do, Korea, 570-704

Effects of rainfall interception (RI) on soil moisture, sap flow, and fruit quality of peaches were analyzed in order to find out the factors deteriorating fruit quality by rain. RI plots were mulched with black polyethylene film on soil surface. Peach cultivars tested were 'Changbang' as an early maturing variety, 'Taekubo' as a medium maturing variety, and 'Yumyeong' as a late maturing variety. Change of soil water was little and slow in treatment of rainfall interception than control. When the change condition of soil water was occurred, rainfall interception was delayed the increasing effect of soil water. Soil water content in RI plots was 80% lower than the control after small rain and 40% lower after heavy rain. Amount of sap flow was little for raining in all treatment. It was higher in rainfall interception during the stable soil water condition than control and was lower during unstable soil water condition. Maximum of sap flow in the daytime was 0.4–0.7 g·h<sup>-1</sup>·cm<sup>-2</sup> in shoot and 0.4–0.5 g·h<sup>-1</sup>·cm<sup>-2</sup> in 2-year-old branch. This result indicated that sap flow of new shoot was more than old one. Fruit shape was same in different treatment. Pit splitting rate was 57% in control and 5% in rainfall interception in 'Chang bang' cultivar, 20% in control and no appearance in rainfall interception in 'Taeku do' cultivar, and it did not appear in all treatment in 'Yumyeong' cultivar. Fruit hardness was higher in rainfall interception than control. And sugar content of fruit was higher in rainfall interception than control as much as 0.5 Bx in 'Changbang', 0.4 Bx in 'Taekubo', and 0.7 Bx in 'Yumyeong'. Taste of fruit produced in rainfall interception was better than those from the control.

#### 1340-1440

##### S11-P-7

#### CHROMOSOME STUDIES ON WILD AND CULTIVATED POMEGRANATE (*PUNICA GRANATUM L.*) FROM IRAN

Seyed Mahmood Ghaffari\*

Institute of Biochemistry and Biophysics, Univ. of Tehran, P.O. Box: 13145-1384, Tehran, Iran

Punicaceae, with one genus and two species, is one of the small families in the Flora of Iran. The important species in this family is pomegranate (*Punica granatum L.*). Pomegranate is endemic to Iran because it is distributed in Northern slopes of Elborz mountains (near the Caspian sea) in form of a pure-stand forest. Many years ago, Pomegranate was introduced from Iran to Europe by the Greeks. Meiosis in wild and cultivated plants was regular and showed eight bivalents at first metaphase. Because of the difficulty in spreading the meiotic chromosomes, the pairing analyses could be conducted in only limited number of cells. Chromosome segregation at first anaphase was 8-8. In diakinesis stage one bivalent of chromosome was associated with nucleolus. Occasionally in some cells laggard chromosomes at first anaphase were observed. Ac-

ording to our information, this is the first report for this species from Iran.

#### 1340-1440

##### S11-P-8

#### BOLTING AND FLOWERING IN LATE-BOLTING RADISH AS INFLUENCED BY GA<sub>4+7</sub> AND GA<sub>3</sub>+PDJ TREATMENT

Chung-Kil Kang\*<sup>1</sup>, Seung-Ho Kim<sup>2</sup>, Ki-Hwan Jung<sup>2</sup>

<sup>1</sup>Bioregulator Lab., Dept. of Crop Protection, NIAST, RDA, Suwon, Kyung-gi Do, Korea, 441-707; <sup>2</sup>Breeding Research Institute, Seed Div., Dongbu Hannong Chemicals, Ansong 456-933, Korea

This experiment was conducted to evaluate the bolting and flowering response in late-bolting radish as influenced by several plant growth regulator treatments from 2000 to 2001. Spray application of bioregulators at different concentrations was made in a greenhouse near Yangsung-myun, Ansong-si, Korea. First of all, we selected 3 late-bolting radish lines based on the degree of sensitivity to bolting. In addition, we evaluated several plant growth regulators to promote the bolting and flowering in the selected late-bolting radish genotypes. Among the tested chemicals, GA<sub>4+7</sub> and GA<sub>3</sub>+PDJ were effective for the stimulation of bolting and flowering. The most effective treatment was GA<sub>4+7</sub> at 80 ppm based upon the inflorescence length of late-bolting radish lines, even though the bolting response was also influenced by date of measurement and chemical concentrations. Two repeated treatments were more effective than a single treatment. GA<sub>3</sub>+PDJ treated twice significantly decreased the percentage of flower bud abscission, but GA<sub>4+7</sub> with twice treatment increased the percentage of flower bud abscission. In general, the higher the concentrations, the higher the percentage of flower bud abscised. It can be concluded that GA<sub>4+7</sub> treatment at 80 ppm stimulated the bolting and flowering in late-bolting radish genotypes and significantly increased the yield and quality of seeds harvested.

#### 1340-1440

##### S11-P-9

#### NATIVE FRUIT TREES: A SOLUTION FOR MALNUTRITION AND POVERTY IN DRY REGIONS OF INDIA

Ram Avtar Kaushik\*, Naresh Kumar Kaushik

Haryana Agricultural Univ., Regional Research Station, Bawal, Bawal, Haryana, India, 123501

India, supporting about 16% of the world population, inhabits a large proportion of malnourished and poor people. Among them, About one third are children. This problem is more acute in dry regions (12% of the total land surface of the country). Malnutrition is not only because of inadequate supply of food but also because of imbalance of diet. Deficiency of minerals and vitamins is the main cause of many fatal diseases. Fruits are rich source of minerals and vitamins. If fruits are included in daily diet, they can help a lot to combat these deficiency diseases. However, these fruits are out of reach of poor people in this region because of skyrocketing prices. Fortunately this dry region has some indigenous fruit species (*Ziziphus*, *Grewia*, *Cordia*, *Capparis*, *prosopis*, *Carissa*, *Emblica*, *Aegle*, *Feronia*, *Ficus*, *Phoenix*, *Syzygium*, etc), which are drought tolerant and yield products rich in nutritive and medicinal value. Some of these indigenous fruits have been found to possess immense nutritional and medicinal importance. These are known for their curative and ameliorative properties in several human ailments such as dysentery, diarrhea, vomiting, piles and blood pressure. These fruit trees can survive to the harsh conditions of the region and yield are also reasonably good as compared to seasonal crops. Although these fruit trees are easy to grow with little cost, they can solve the problems of malnutrition and poverty to a large extent.

#### 1340-1440

##### S11-P-10

#### EFFECT OF GRANULAR SILICATE APPLICATION ON THE QUALITY AND SHELF LIFE OF TOMATO GROWN BY PEARLITE CULTURE

Young-Chul Kim\*<sup>1</sup>, Kwang-Yong Kim<sup>1</sup>, Kuen-Woo Park<sup>2</sup>, Hyung-Kweon Yun<sup>1</sup>, Tae-Cheol Seo<sup>1</sup>, Ji-Won Lee, Young-Mi Yu, Sang-Gyu Lee

National Hort. Res. Inst., RDA, Suwon, Kyonggi-do, Korea

#### ABSTRACT UNAVAILABLE

**1340-1440**

**S11-P-11**

**AGROBACTERIUM-MEDIATED TRANSFORMATION OF *CUCUMIS SATIVUS* EXPRESSING THE COAT PROTEIN GENE OF ZUCCHINI GREEN MOTTLE MOSAIC VIRUS (ZGMMV)**

Gung Pyo Lee\*<sup>1</sup>, Chung Sun Kim\*<sup>1</sup>, Ki Hyun Ryu\*<sup>1</sup>, Kuen Woo Park\*<sup>2</sup>

<sup>1</sup>Inst. of Natural Science, Seoul Women's Univ., 129, Kongnung-dong, Nowon-gu, Seoul, Republic of Korea, 139-774; <sup>2</sup>Dept. of Horticultural Science, Korea Univ., 5-1, Anam-dong, Sungbuk-gu, Seoul, Korea

Plasmid DNA containing the zucchini green mottle mosaic virus coat protein (ZGMMV-CP) and NPTII genes was introduced into the explants of cucumber (*Cucumis sativus* var 'Chungjang') by the *Agrobacterium*-mediated transformation procedure. The binary vector pGA748-ZGMMV consisted of a kanamycin-selectable modification of pGA748, which the GUS gene was replaced with the ZGMMV-CP (485 bp). Putative transformants were selected for kanamycin resistance conferred by the introduced NPTII gene. PCR was performed on all ZGMMV-CP+ shoots regenerated to confirm the presence of either the NPTII and/or CMV-CP gene in the genomes of putatively transformed cucumbers. PCR analysis showed that 3 out of 20 putatively selected R0 plant lines contained the ZGMMV-CP gene. Nine putative transgenic lines out of 20 lines were investigated with the PCR analysis, and 5 regenerants produced a 450 bp DNA band with NPTII primer set and 3 regenerants showed a 485 bp DNA band with ZGMMV-CP primer set. This demonstrates that the *Agrobacterium*-mediated transformation of cucumber is established, and the transformation of the plant with the newly constructed plasmid vector containing ZGMMV-CP gene is in progress to make the virus-resistant transgenic cucumber.

**1340-1440**

**S11-P-12**

**EFFECTS OF CHITOSAN OF DIFFERENT MOLECULAR WEIGHT ON RESPIRATION, GROWTH, AND NUTRITIONAL QUALITY OF SOY-BEAN SPROUTS**

Sung-Bae Kim, Young-Sang Lee\*, Young-Sook An, Soon-Ryang Park, Seung-Hun Lee

Div. of Life Sciences, Soonchunhyang Univ., Shinchang-Myon Eupnae-Ri, Asan, Chung-Nam, South Korea, 336-745

To clarify the molecular weight-dependent chitosan effects on production of soybean sprouts, soybean seeds were soaked with 1,000 ppm chitosan of low (LMW: 2,000 < M.W. < 10,000), medium (MMW: 50,000 < M.W < 100,000), and high (HMW: M.W. > 1,000,000) molecular weight. Sprouts treated with HMW exhibited significant increment in respiration rate by 5% within 1 day after soaking. Chitosan effectively increased soybean sprout growth in that harvested sprouts treated with HMW resulted in 3%, 1%, 3%, 1%, and 12% increase in total length, hypocotyl length, root length, hypocotyl thickness and fresh weight, respectively. These growth enhancing effects of chitosan were proportional to its molecular weight. Chitosan treatment caused no adverse or promotive effects on vitamin C contents, and chlorophyll formation in sprout cotyledons, an important factor on quality of soybean sprouts, was slightly reduced by chitosan soaking. In conclusion, soaking soybean seeds with chitosan, especially high molecular weight, seems to be an effective way to enhance productivity of soybean sprouts.

**1340-1440**

**S11-P-13**

**EFFECT SALT STRESS CAUSED BY SODIUM CHLORIDE ON MINERAL ELEMENTS AND SOLUBLE SUGARS IN THREE COMMERCIAL OF POMEGRANATE**

M.R. Naini\*<sup>1</sup>, H. Lessani<sup>2</sup>, A.H. Khoshgoftar<sup>3</sup>

<sup>1</sup>Soil and Water Research Division, Agricultural Research Center, Saheli Street, Qom, Iran, 195; <sup>2</sup>Dept. of Horticulture, Faculty of Agriculture, Tehran Univ., Karaj, Iran; <sup>3</sup>Dept. of Soil Science, Faculty of Agriculture, Isfahan Univ. Technology, Isfahan, Iran

The effects of salinity stress in cuttings of three commercial cultivars 'Alak Torsh', 'Malas Torsh', 'Malas Shirin' of pomegranate were investigated to determine salt resistance. After rooting of cuttings, they were planted in the plastic pots containing sand: perlite (1:1) medium and irrigated with complete Hoagland's

solution immediately. After three weeks of growing, the plants were treated with sodium chloride solutions of different concentration (0, 40, 80 and 120 meq/L). These treatments continued during 80 days with irrigation water. Finally, uptake and transport of ions (Na, K, Ca, Mg, N and Cl) and soluble sugars in three cultivars were measured. The amounts of Na, Cl, and K in the tissues increased but amount of Ca, Mg and N of the tissues decreased with the increase in sodium chloride concentration in irrigation water, and the differences among uptaking and transporting of ions in three cultivars were not significant. The amount of soluble sugars decreased with the increase in sodium chloride concentration in irrigation water.

**1340-1440**

**S11-P-14**

**THE GHANA VEGETABLE SEED INDUSTRY: ORGANIZATION AND MANAGEMENT**

Nana Sakyiwa Olympio\*

Dept. of Horticulture, Kwame Nkrumah Univ. of Science and Technology, Kumasi, Ghana

It is recognized that a good seed industry is necessary and very essential for the development of any agricultural sector of a country. Ghana, being a developing country, needs supplies of quality seeds for the development of agricultural sector. Quality seeds are often the least expensive input for crop production, thus it represents an affordable way for farmers of poor countries. A well-organized seed distribution program should be in place so that the quality seeds can be planted in fields. The vegetable crop industry is among the least developed sector in the agricultural department of this country. The seed sub-sector of vegetable industry seems to have been overlooked in the past. The lack of well-established vegetable seed industry has therefore led to increase in imports of vegetable seeds. However much of the imported seed are not well adapted to the local environment, thus often leading to crop failure. This paper examines the vegetable seed industry in Ghana with emphasis of the production and improvement, management, conservation, the national seed policy, the role of the private sector and the assessment of the supply of vegetable seeds.

**1340-1440**

**S11-P-15**

**PHYLOGENETIC ANALYSIS OF ASIAN PEARS USING AFLP AND DNA SEQUENCES OF NUCLEAR RIBOSOMAL INTERNAL TRANSCRIBED SPACERS AND CHLOROPLAST GENES**

Zengguang Pan\*, Shoko Hikosaka, Saneyuki Kawabata

Lab. Horticultural Science, Univ. Tokyo, 1-1-1 Yayoi, Bunkyo-ku, Tokyo, Japan, 113-8657

The most popular pears (*Pyrus* spp.) are originated from China, which include White pears (*P. bretschneideri*), Chinese Sand pears (*P. pyrifolia*), Ussurian pears (*P. ussuriensis*), and Xinjian pears (*P. sinkiangensis*). Xinjian pears, which are cultivated in western China, has many morphological relationships to European pears (*P. communis*). There are also Japanese pears (*P. pyrifolia* var *culta*), of which the origin and the relation to Chinese pears are unclear. In this study, phylogenetic relationships among these Asian and European pears were investigated by determining partial sequences of nuclear and chloroplast DNAs as well as by AFLP in 3-4 cultivars for each species or variety. Fresh young leaves were desiccated in well-dried silica gel at room temperature. In several days, the samples became completely dry, being suitable for DNA extraction. The internal transcribed spacer of nuclear ribosomal DNA (ITS) and chloroplast aptH, petB, and psbA genes were amplified by PCR. Polymorphism were found in the length of amplified ITS region: DNA fragments of about 650 bp were amplified in all the cultivars investigated, but additional larger fragments of about 750 bp were also found in all Ussurian, Xinjian and European pears and one of Chinese Sand pears, but not found in White pears and Japanese pears. However, the sequences of the 650 bp DNA fragments showed little polymorphism among the species. The DNA sequences of aptH, petB, and psbA also did not show sufficient polymorphism for molecular phylogenetic analysis. These results showed that *Pyrus* species are genetically close to each other and thus DNA sequencing of genes is not powerful tool to classify *Pyrus* species. On the other hand, AFLP analysis showed many informative polymorphous fragments. Phylogenetic analysis showed that European pears are different from other Asian pears and that Xinjian pears had the closest relationship to European pears.

1340-1440

S11-P-16

**EFFECTS OF PRIMING ON SEED GERMINATION IN CARROT (*DAUCUS CAROTA* L.)**Suhyoung Park\*<sup>1</sup>, Jin Young Yoon<sup>2</sup>, Hyo Guen Park<sup>3</sup>

<sup>1</sup>Natl. Hort. Research Institute, Vegetable Breeding Division, Tap-dong 540-41, Suwon, Kyounggi, Republic of Korea, 441-440; <sup>2</sup>Choong ang Seed Co., Ltd. 461, Doojung Cheonan Choongnam, Korea, 330-170; <sup>3</sup>Vegetable breeding Lab., Seoul Natl. Univ., Suwon, Korea 441-744

Commercial seeds of carrot (*Daucus carota* L.) show low germination speed\* and need a long time for germination, thus resulting in poor germination uniformity. Therefore, farmers are urged to sow much more seeds than really required and thin out the extra seedlings several times. Series of experiments were carried out to determine the priming conditions of carrot seeds. The germination speed of 45 seed lots collected in 1996-97 ranged from 05 to 68%. Most of them showed very low germination speed of about 20%. To determine effective priming condition, we selected seed lots showing considerable differences between germination speed and germination percentage as experimental materials during 1996-99. Ca(NO<sub>3</sub>)<sub>2</sub> was most effective osmoticum among Ca(NO<sub>3</sub>)<sub>2</sub>, K<sub>3</sub>PO<sub>4</sub>, K<sub>2</sub>HPO<sub>4</sub>, KNO<sub>3</sub> and PEG for improving germination speed under both optimum and low temperature conditions. The effective concentration of Ca(NO<sub>3</sub>)<sub>2</sub> was 0.4 M, and priming period and temperature were 6 days and 15 °C, respectively. The germination speed was elevated as 70.5% compared to that of untreated seed was 4.7%. We added 9 kinds of pesticides and 2 kinds of GAs to Ca(NO<sub>3</sub>)<sub>2</sub> solution. 'Hymexazol' at 1,000 ppm was most effective in improving germination speed. That of control, simple Ca(NO<sub>3</sub>)<sub>2</sub> and 'Hymexazol' treatment was 13.8%, 31.5% and 44.0%, respectively. When primed seeds were dried at RH 55% and 20 °C until 10% moisture contents, T50\*\* of primed wet seeds was shortened from 5.1 days to 1.6 days. We concluded that the method of drying was as important as soaking method on improving seed germination in carrot. \*Germination speed: The percentage of germinated seeds 72 hours after sowing \*\*T50: (time for 50% of final germination).

1340-1440

S11-P-17

**THE CHARACTERISTICS OF MINERAL NUTRIENT ABSORPTION OF CUCUMBER (*CUCUMIS SATIVUS* L.) GROWN HYDROPONICALLY IN WINTER SEASON**Ji-Weon Lee\*<sup>1</sup>, Tae-Cheol Seo<sup>1</sup>, Young-Chul Kim<sup>1</sup>, Kwang-Yong Kim<sup>1</sup>, Byoung-Yil Lee<sup>2</sup>

<sup>1</sup>Veg. Cult. Div., Natl. Hort. Res. Inst., RDA, Suwon Korea, Suwon, Kyonggido, Korea, 440-706; <sup>2</sup>Dept. of Hort., Seoul Natl. Univ., Suwon 441-744, Korea

This experiment was conducted to clarify the absorption pattern of mineral nutrients in cucumber (*Cucumis sativus* L.) grown hydroponically during winter season in Korea. Environmental condition of greenhouse during winter season is frequently unfavorable enough to give low temperature stress to the growth of cucumber. Supplied nutrient solution showed constantly stable pH values for several days after solution replacement. Electric conductivity (EC) of nutrient solution was relatively stable until 30 days after transplanting and then increased. NO<sub>3</sub>-N absorption rate of cucumber plant increased until 75 days and then decreased. Cucumber plant absorbed high amount of NH<sub>4</sub>-N in a short period. Therefore, NH<sub>4</sub>-N in nutrient solution was completely consumed within 25 days in the beginning, 10 days in the middle, and 7 days in the late stage of cucumber growth after solution replacement. Nitrogen content in plant decreased with growing. Phosphorus absorption rate was higher than the supplied concentration at the early growing stage. Phosphorus content of the plant was stable through growing period. K absorption pattern and the change of K content in the cucumber plant were similar to those of NO<sub>3</sub>-N. Calcium and Mg absorption rate of the plant were lower than the supplied concentration during the growing period. Calcium content increased in the leaf and the stem and Mg content increased in the leaf and the fruit throughout the growing period.

1340-1440

S11-P-18

**DONGZAO JUJUBE AND ITS FRUITS STORAGE**

Jiping Sheng\*, Jianrong Ye, Lin Shen

College of Food Science, China Agricultural Univ., No 2 Westroad Yuanmingyuan

Street, Beijing, P.R. China, 100094

Dongzao jujube is a type of fresh consumed fruit that originated in China. Because of its delicious flavor, tenderness, juiciness, and high nutritional value, it is widely recognized as a promoting fruit in the future. Since the Dongzao jujube fruit normally ripens in early October, it is difficult to maintain storage for this plant at room temperature. In order to prolong the storage life and to be able to provide the fresh Dongzao jujube to markets for New Year's Day and Spring Festival, different methods have been used for long-term storage of Jujube. Under 0 °C and RH 90%-95% storage conditions, large box packages with plastic bags and small packages with PE films have proven to prolong the storage life of Dongzao jujube up to 80 days. But under lower temperature conditions of -2 °C and RH 90%-95%, plastic boxes covered with PE showed the best results at the end of storage. The fruits could be stored for 100 days with good fruits rate of 90% or higher and no chilling injury. Some fungicides such as plant extraction, Deccoziol 289-EC, were good for Dongzao jujube fruit storage. High oxygen pretreatment could prohibit the production of alcohol and the storage time can be prolonged further. This showed that the storage temperature is the most important factor in long term storage of Dongzao jujube fruit.

1340-1440

S11-P-19

**FIRST REPORT OF OCCURRENCE AND CONFIRMATION OF A NATURAL ABBB TETRAPLOID BANANA (*MUSA* SPECIES) FROM INDIA**S. Uma\*<sup>1</sup>, S. Sathiamoorthy<sup>1</sup>, Nicolas Roux<sup>2</sup>, R. Selvarajan<sup>1</sup>, A. Ramesh Kumar<sup>1</sup>

<sup>1</sup>National Research Center for Banana, 17, Ramalinga nagar South extension, Vayalur Road, Trichy, Tamilnadu, India, 620017; <sup>2</sup>IAEA, Vienna, Austria

South and Southeast Asia is believed to be the center of origin and diversification of banana and plantains. Though Thailand, Malaysia and Myanmar are rich in *Musa acuminata* and other *Musa* species, India harbours much diversity for *M. balbisiana*. Close proximity and natural tendency for introgression have resulted in speciation and diversification in North Eastern and peninsular India. Explorations conducted by National Research Center for banana in the interior forests of Arunachal Pradesh (N-E state) adjoining China and Myanmar has resulted in the identification of a unique accession. Evaluation and field assessment for 3 years in the NRCB field genebank using Shepherd and Simmond's 15 character classification chart and modified score card of Singh and Uma (2000) has classified this accession to be a tetraploid with ABBB genomic constitution. Flow cytometry studies at IAEA, Vienna have confirmed its tetraploidy status. In nature triploid bananas are preferred over the diploids and least, the tetraploids. Natural selection has slowly wiped out natural tetraploids which have played a key role in the evolution of triploid bananas. This accession has been evaluated for its yield, quality, reaction to biotic and abiotic traits and most importantly for its male and female fertility status. The paper deals with its superior traits which contributed for its possible survival against selection pressure in nature.

1340-1440

S11-P-20

**SEM STUDIES ON POLLEN MORPHOLOGY OF SOME LOCALLY GROWN VEGETABLES IN CHIANG MAI**

Pheravut Wongsawad\*, Chalobol Wongsawad, Sobchai Suwattanacupta, Thipmani Paratasillipin

Dept. of Biology, Faculty of Science, Chiang Mai Univ., Amphur Muang, Chiang Mai, Thailand, 50202

SEM studies on the pollen morphology of locally grown vegetables in Chiang Mai showed characteristic similarities and differences. *Buahinia purpurea* Linn. and *B. variegata* Linn. showed similarities in polar and equatorial shapes (inter-subangular to circular and prolate spherical, respectively), and aperture (tricolpate). A difference was observed in the exine structure. *Buahinia purpurea* Linn. had finger print, were reticulate, and had a single hole inside, but *B. variegata* Linn. had only finger print. *Buahinia purpurea* Linn., having a more red flower color and locally grown in Amphur Muang, differed from the others in that it had 1-3 holes inside the reticular structure. *Broussonetia kuzii* Corner. were spherical polar and equatorial shape, in aperture and knobby exine structure. *Tupistra albiflora* K. Larsen pollen were circular-lobate in polar shape, suboblate in equatorial shape, dicolpate in aperture and had fine-knobby exine structure. *Melientha suavis* Pierr. were circular-lobate in polar shape, perprolate-prolate in equatorial shape,

tricolpate in aperture and had net structure in exine structure. These studies on pollen morphology are one of the methods that would be useful in plant taxonomy.

**1340-1440**

**S11-P-21**

**PCR-RFLP OF CHLOROPLAST GENE FOR THE IDENTIFICATION OF CYTOPLASMIC MALE STERILE FACTOR IN ONION (*ALLIUM CEPA* L.)**

Kwang-Soo Cho<sup>\*1</sup>, Tae-Jin Yang<sup>2</sup>, Young-Seok Kwon<sup>1</sup>, Jong-Gyu Woo<sup>1</sup>

<sup>1</sup>Dept. of Horticulture, National alpine agricultural experiment station, Pyeongchang-gun, Gangwon-province, Korea, 232-955; <sup>2</sup>Clemson Univ. Genomic Institute, Clemson Univ. SC 29634-5708 USA

For the identification of cytoplasmic male sterile factor in onion, PCR-RFLP profiles of chloroplast genes were analyzed. After amplification of *psbA* gene, digestion with *MspI* enzyme could distinguish N and S-cytoplasm. Sequencing of *psbA* gene in S and N-cytoplasm onion revealed that there was no recognition site in S-cytoplasm plants, but N-cytoplasm plants had CCGG sequence within *psbA* gene. The results implied that the existence of single nucleotide polymorphism at 468 bp in *psbA* gene occurred and, which could be used in the application of genetic bit analysis for the identification of cytoplasmic factor. Digestion with *MspI* after *psbA* gene amplification of 34 onion varieties and open-pollinated variety Daekwallyung No. 1 was coincided with PCR marker. Results suggest that the PCR-RFLP method is useful for the identification of cytoplasmic male sterile factor in breeding lines of onion.

**1340-1440**

**S11-P-22**

**INVESTIGATION ON THE VARIATIONS OF WILD *MALUS HUPEHENSIS* VAR. *PINYITIANCHA***

Xiang Shen<sup>\*</sup>, Jiabao Wang, Qinpi-ng Wei, Huairui Shu

Collage of Hort., Shandong Agr. Unvi., P.R.China, Tai An, Shandong, P.R. China, 271018

The distribution center of *Malus hupehensis* var. *pingyitiacha* is in Mt. Mengshan in Pinyi and Feixian county, Shandong Province. The field exploration concluded that *Pingyitiacha* has very unusual adaptability. The variety distributes in many areas which have a wide range of mountainous environments. The botanical characteristics have not shown significant variations under the different environmental conditions because of their apomixis nature. The main distinction characteristic can be found in its leaf area, where it could be divided into two groups larger or smaller than 35 cm<sup>2</sup>. Isozyme analysis indicated that small-leaf group tree had 3 bands which did not exist in large-leaf group. Their Rf's were 0.26, 0.33, and 0.37. In addition, small-leaf group failed to show bands (Rf = 0.57) existed in the large-leaf group. The percentage of small-leaf group was only about 5% of the entire population.

**1340-1440**

**S11-P-23**

**EFFECTS ON FLOWER BUD DIFFERENTIATION AND BOLTING IN SEEDLING UNDER DIFFERENT TEMPERATURE AND DAYLENGTH TREATMENTS IN CHINESE CABBAGE (*BRASSICA CAMPESTRIS* VAR. *PEKINENSIS*)**

Yansong Ao<sup>\*1</sup>, Jinfang Zhao<sup>2</sup>, Kai Pan<sup>3</sup>

<sup>1</sup>Dept. of Plant Science, Shanghai Jiaotong Univ., Qixin road No. 2678, Shanghai, China, 201101; <sup>2</sup>Dept. of Horticulture, Beijing Agricultural College, Zhuxinzhuan, Beijing, China, 102208; <sup>3</sup>Dept. of Horticulture, Northeast Agricultural Univ., Mucai Street No. 59, Harbin, Heilongjiang, China, 150030

Using Chinese cabbage 'Huangdianxin' as experimental materials, the flower-inducing effects of seedling at different developmental stages exposed under different temperature and daylength in chamber was reported in this paper. It was shown that the flower bud differentiation and floral stalk formation were induced orderly, and the inducement of floral stalk formation began at the stage of flower buds largely formed. The lowest limited temperature was nearly the same as that of the highest in flower bud differentiation. If the flower bud was treated under 18 °C for 7 days, the reversion of flower bud differentiation would occurred. Before large amount buds exposed, the higher temperature was and the longer it lasted, the later the flowers exposed. Even though the reversion had not occurred, the

branches began to form the vegetative stage. Low temperature and short day light could inhibit the formation and extend of the floral stalk.

**1340-1440**

**S11-P-24**

**EFFECT OF SEEDCOAT PARTIAL EXCISION TREATMENT ON GERMINATION IN BOTTLE GOURD (*LAGENARIA SICERARIA* STANDL.)**

Eun-Ha Yoo<sup>\*1</sup>, Kwan-Dal Ko<sup>1</sup>, Hyo-Geun Park<sup>2</sup>, Jung-Myung Lee<sup>3</sup>

<sup>1</sup>Natl. Hort. Res. Inst., RDA, Suwon, Kyunggi-Do, 441-440, Korea, Suwon, Kyunggi-Do, Korea, 441-440; <sup>2</sup>Dept. of Horticulture, Seoul National Univ., Suwon, Kyunggi-Do, 441-744, Korea; <sup>3</sup>Dept. of Horticulture, Kyung Hee University, Yongin, Kyunggi-Do, 449-701, Korea

Bottle gourd has been widely used as rootstock for grafting in watermelon that is one of the most important vegetables in Korea. But there is a problem in the use of bottle gourd as rootstock because of its poor germination. Seedcoat of bottle gourd has been assumed to attribute to causes of poor germination. This study was carried out to investigate the reason of poor germination in bottle gourd with the varieties of 'Partner' and 'Renshi' through seedcoat partial excision. In 'Partner', germination of partially decoated seeds (a 2.5-mm length of seedcoat was excised at the micropylar end of the seeds) from 60 DAP (days after pollination) fruits was as high as 100%. Percent germination of intact seeds was as low as 47%. The treatment of 2.5-mm excision at chalazal end increased percent germination to 92%, 1-mm excision at micropylar end was 80%, and 1-mm excision at chalazal end was 65%. It showed significant differences between the excision part and length of decoating treatment. After-ripening of intact seeds in dry storage for 30 days resulted in germination of 85%. It was noted that germination was still inhibited by seedcoat. Through analysis of variance for the effect of seedcoat partial excision and the storage period on germination, it was known that seedcoat treatment improved the germination much more than after-ripening in seed storage. In 'Renshi', there was a similar tendency, but no significant difference between the percent germination of seeds from non-storage and storage treatment. As the result of comparison of imbibition behavior with intact and decoated seeds, the reason for poor germination was found out that water didn't enter into embryo, still remained in the part of seedcoat, which was assumed to restrict the entry of gases into the embryo.

**1340-1440**

**S11-P-25**

**OBSERVATION OF HISTOLOGICAL STRUCTURE ACCORDING TO SEED DEVELOPMENT IN BOTTLE GOURD (*LAGENARIA SICERARIA* STANDL.)**

Eun-Ha Yoo<sup>\*1</sup>, Hyo-Geun Park<sup>2</sup>, Jung-Myung Lee<sup>3</sup>

<sup>1</sup>Natl. Hort. Res. Inst., RDA, Suwon, Kyunggi-Do, 441-440, Korea, Suwon, Kyunggi-Do, Korea, 441-440; <sup>2</sup>Dept. of Horticulture, Seoul National Univ., Suwon, Kyunggi-Do, 441-744, Korea; <sup>3</sup>Dept. of Horticulture, KyungHee Univ., Yongin, Kyunggi-Do, 449-701, Korea

Seedcoat of bottle gourd has been assumed to be various causes of poor germination, including low permeability of the coat to water or gases, mechanical suppression of germination and release of dormancy-inducing substances. This study was conducted to examine the histological changes of seedcoat and to utilize the knowledge about seedcoat for germination improvement. The seedcoat of seed at 15 DAP (days after pollination) in bottle gourd 'Partner' differentiated into epidermis, hypodermis, sclerenchyma, parenchyma, and aerenchyma. And then cotyledons were formed, and the endosperm was seen. In seeds from 20 DAP, sclerenchyma became compressed and thicker markedly with the development of seeds, and granules were formed in the cells of sclerenchyma. This change was observed continuously in seeds from 30 and 40 DAP, the cell lumens of sclerenchyma were clogged with granules completely at 60 DAP. As the result of this change, seedcoat hardness had increased with DAP from 0.3 N of 10 DAP to 7.6 N of 60 DAP. As the hardness increased, seedcoat color darkened. It was assumed that phenolic compounds were oxidized and polymerized, and which was considered to be one of barriers in seedcoat, which might restrict water and gases into the embryo. In the case of seeds from fruits of 40 DAP with after-ripening treatment for 10, 20, and 30 days, the seedcoat hardness increased and color of seedcoat darkened with after-ripening period. Especially hypodermis of dry seed was thinner compared with that of wet seed, since it remained in being folded. While seed imbibed water, hypodermis was unfolded and formed mucilage layer, which resulted in hypodermis expansion. The mucilage formed on

hypodermis of imbibed seed, and cellulose microfibril in hypodermis strengthened the mucilage layer, which was assumed to restrict the entry of water and gases into the embryo.

**1340-1440**

**S11-P-26**

**IMPROVEMENT OF SEED GERMINATION IN BOTTLE GOURD (*LAGENARIA SICERARIA* STANDL.) CULTIVARS**

Eun-Ha Yoo\*,<sup>1</sup> Hyo-Geun Park<sup>2</sup>, Jung-Myung Lee<sup>3</sup>

<sup>1</sup>Natl. Hort. Res. Inst., RDA, Suwon, Kyunggi-Do, 441-440, Korea, Suwon, Kyunggi-Do, Korea, 441-440; <sup>2</sup>Dept. of Horticulture, Seoul National Univ., Suwon, Kyunggi-Do, 441-744, Korea; <sup>3</sup>Dept. of Horticulture, KyungHee Univ., Yongin, Kyunggi-Do, 449-701

Fifty-one seed lots of 28 cultivars were surveyed for seed characteristics and percent germination to learn the causes of low germination. The range of germination percentage varied widely, from 27% to 100%. The germination percentage of 25 seed lots was below 80%. A large difference was noted in seed characteristics and percent germination among the seed lots in a cultivar, and as well as among the cultivars. And the correlation coefficient between germination and immaturity was as high as -0.796. Between germination and proportion of mature seeds it was 0.663. Germination was negatively correlated with seed mechanical damage and with seed infection. Sixteen seed lots out of all, which showed poor germination, were tested with several seed treatment (SMP-solid matrix priming, Brushing, dry heating, seedcoat partial excision), and compared with the percent germination of intact seeds and seeds of partial decoated at micropylar end. Consequently, SMP treatment was the most effective in improving germination. Thirteen seed lots (80% of all) showed significant increase in percent germination after SMP treatment. Especially, SMP treatment much improved the percent germination of 'FR-100', 'CA SL-B', and 'FR 1000-B' which had high portions of immature seeds per seed lot, from 27%, 27%, and 29% into 97%, 82%, and 89%, respectively. This was much more effective than decoating treatment which showed the germination percentages of 50%, 58%, and 56%. Brushing also had the tendency of improvement in 13 seed lots out of 16 seed lots. Dry-heat treatment, commonly used to disinfect seeds in international trade, showed variable results while it enhanced germination in several seed lots, many seed lots showed a sharp decrease in germination. As this result, SMP is recommended as the most effective and safest treatment that can be applied commercially, and there is a necessity of much more research in SMP treatment such as detail condition of treatment and storage after treatment.

**1340-1440**

**S11-P-27**

**INVESTIGATION OF FRUIT GERMLASM RESOURCES WITH COLD RESISTANCE IN JILIN PROVINCE CHINA**

Bing-bing Zhang\*, Hu-itaio Liu, Hong-wei Song, Yan-buo Zhang

No. 6 West Xing Hua Street, Institute of Pomology, Jili Province Academy of Agriculture, GongZhuling, Ji lin, China, 136100

Jilin Province is located in the central part of Northeast China, where the yearly average temperature ranges from 2 to 6 °C and it may drop to 42 °C below zero in the winter. There are plenty of germplasm resources of hardy fruit trees in this location. Studies from the exploration, collection, preservation, characteristic identification and utilization of germplasm resources of hardy fruit trees have been carried out in the Pomology Institute of Jilin Provincial Academy of Agricultural Sciences for 50 years. Fruit trees belonging to 13 families, 25 genera, 2 subgenuses, 63 species, 7 varieties and 1 forma were identified and the National Fruit Tree Germplasm Gongzhuling Hardy Fruit Nursery was launched active research on these germplasm. Important traits, ecological distribution and utilization of germplasm resources of hardy fruit trees will be presented in this paper. Based on investigation of problems in the utilization and studies of germplasm resources of hardy fruit trees in Jilin Province China, several suggestions will also be provided.

**1340-1440**

**S11-P-28**

**REGULATION OF ABSCISIC ACID AND ITS BIOSYNTHESIS INHIBITOR ON POMEGRANATE POLLEN GERMINATION AND TUBE GROWTH**

Hong-Qiang Yang\*, Yu-Ling Jie, Lai-Xin Liu, Wang-Yun Tang

Horticulture College, Shandong Agriculture Univ., Taian, P.R. China 271018

The effects of abscisic acid (ABA) on pollen germination and tube growth were studied in pomegranate (*Punica granatum* L.). Results showed that ABA inhibited pollen germination and tube growth significantly at higher concentrations, over 50 mmol/L, while low ABA concentration, 0.05–5 mmol/L, improved the growth of pollen tube evidently. The rate of germination did not change, but both tube growth and the effects of ABA on tube growth were inhibited by 10 mg/g cycloheximide treatment. The inhibitors of ABA biosynthesis, NDGA (nordihydroguaiaretic acid) and fluridone, inhibited pollen germination and tube growth evidently. The degree of inhibition increased gradually along with the raise of concentration from 20–100 mmol/L, and the inhibiting degree to tube growth was more significant. ABA (1 mmol/L) could abate the inhibition degree of NDGA and fluridone to tube growth, but could not change the inhibition to germination. The result indicated that low ABA concentration was necessarily to pollen's natural growth.

**1340-1440**

**S11-P-29**

**DONGZAO JUJUBE AND ITS FRUITS STORAGE**

Jiping Sheng\*, Lin Shen

College of Food Science, China Agricultural Univ., No 2 Westroad Yuanmingyuan Street, Beijing, P.R. China, 100094

Dongzao jujube (*Ziziphus jujuba* Mill. cv. Donzao) is a type of fresh consumed fruit that originated in China. Because of its delicious flavor, tenderness, juiciness, and high nutritional value, it is widely recognized as a promoting fruit in the future. Since the Dongzao jujube fruit normally ripens in early October, it is difficult to maintain storage for this plant at room temperature. In order to prolong the storage life and to be able to provide the fresh Dongzao jujube to markets for New Year's Day and Spring Festival, different methods have been used for long-term storage of Jujube. Under 0 °C and RH 90%–95% storage conditions, large box packages with plastic bags and small packages with PE films have proven to prolong the storage life of Dongzao jujube up to 80 days. But under lower temperature conditions of -2 °C and RH 90%–95%, plastic boxes covered with PE showed the best results at the end of storage. The fruits could be stored for 100 days with good fruits rate of 90% or higher and no chilling injury. Some fungicides such as plant extraction, Deccoziel 289-EC, were good for Dongzao jujube fruit storage. High oxygen pretreatment could prohibit the production of alcohol and the storage time can be prolonged further. This showed that the storage temperature is the most important factor in long term storage of Dongzao jujube fruit.

**1340-1440**

**S11-P-30**

**MULTIPLICATION OF CHINESE DATE (*ZIZIPHUS JUJUBA* MILL.) USING CONVENTIONAL AND IN VITRO TECHNIQUES**

F. Stanica\*

Dept. of Pomology, Univ. of Agronomic Sciences and Veterinary Medicine, B-dul Marasti, 59, Bucuresti, Sector 1, Romania, 71331

Chinese date (*Ziziphus jujuba* Mill.) is a new entry in the Romanian fruit species assortment. Researches made at the Pomology Dept. of the Bucuresti Faculty of Horticulture studied different multiplication methods applied to Romanian selections and Chinese varieties of *Ziziphus jujuba*. Seeds from 2 varieties and 3 rootstocks were treated for 24 hours with concentrated sulfuric acid (H<sub>2</sub>SO<sub>4</sub>). After the treatment, the seeds weight reduced with 50% and the germination rate was minimal. 77.0% of the seeds germinated when the duration of the H<sub>2</sub>SO<sub>4</sub> treatment was 12 hours. The treatment duration influenced also the germination time. Different grafting methods were tested. The best one was the bark method applied in May. Scions were taken from Nine Chinese date varieties in January. After that they were individually waxed and preserved in polyethylene bags at 3–4 °C till the grafting moment. As rootstock, two Romanian selections, J1 and J2, were used. The grafting success was not influenced by the varieties and varied between 92.5% and 100%. When two years old, vigorous rootstocks were used, scions grew fast and started to bare fruits in the first year after grafting. For in vitro propagation, two culture media: Murashige & Skoog and Quoirin & Lepoivre, modified by Standardi and four hormonal balances were tested. The increase of the BAP concentration from 0.0 to 3.0 mg/L didn't have a visible effect on the multiplication rate. The percentage of clustered buds was low. Shoots' rooting was obtaining on MS culture media without hormones after one subculture with low auxin concentration (IBA 0.1 mg/L). The results obtained showed that for

rootstock multiplication it is possible to use seed treated with sulfuric acid. To obtain grafted plants the best method is the bark method on vigorous rootstocks. In vitro propagation method can be using both, for rootstock and varieties multiplication.

**1440–1510**

**S11-0-31**

**FRUIT TREE GENETIC RESOURCES NATIVE TO TEMPERATE ZONE IN ASIA**

T. Sanada\*, Y. Sato

Dept. of Breeding, National Institute of Fruit Tree Science, National Agricultural Research Organization, Fujimoto 2-1, Tsukuba, Ibaraki, 305-8605 Japan

According with De Candolle (1884), Vavilov (1951), etc., Asia, including China, Central Asia, Asia Minor, is thought to be the important region for the origin of many major cultivated fruit trees. Temperate-zone fruit trees such as apple, pear, peach, plum, cherry, grape, kiwifruit, orange, mandarin, etc., are included. Tremendous numbers of the wild species related to those fruit trees have been observed in Asia and the distributions of these wild species are elucidated. They are very useful for further improvements of the major fruit trees. For example, we will explain the apple breeding programs for resistance to diseases and for rootstocks. Many selected clones in different genera and species from major fruit trees have been cultivated in Asian countries and most of those fruits are usually used for processed foods. The following temperate zone fruit trees native to Asia are illustrated by the photographs of the fruits and the processed foods: maidenhair tree (*Ginkgo biloba*), yuzu (*Citrus junos*), hawthorn (*Crataegus pinnatifida*), Japanese apricot (*Prunus mume*), Chinese quince (*Chaenomeles sinensis*), Japanese quince (*Chaenomeles speciosa*), sarunashi (*Actinidia arguta*), honeysuckle (*Lonicera edulis*), bayberry (*Myrica rubra*), jujube (*Zizyphus jujuba*), akebia (*Akebia trifoliata*), sea buckthorn (*Hippophae rhamnoides*), etc. For the improvement of fruit trees, it is very important to establish the genebank. Therefore, we will introduce the activities in the fruit tree out of MAFF (Ministry of Agriculture, Forestry & Fisheries of Japan) Gene-bank Project. Introduction including exploration, inspection, preservation, evaluation and utilization of genetic resources have been performed, and about 8,600 materials have been preserved in our Institute under the Project.

**1510–1540**

**S11-0-32**

**NATIVE TROPICAL ASIAN FRUITS**

Prasert Anupunt\*

Horticulture research Institute, Dept. of Agriculture, Chatuchak, chatuchak, Bangkok, Thailand, 10900

The Asian region is rich in diversity of tropical fruit species, particularly in South and Southeast Asia. Fruits are very important for the well being of the populations in the region. Over 400 edible tropical fruit species are found in Asia. There is an wide range of production systems in Asian fruits, varying from simple collection of wild fruits to intensive commercial plantations. Over 55% of Asia's fruit species are not cultivated. Home gardens are the most prevalent production systems for cultivated fruit in Asia. Native species, including citrus, mango, durian, rambutan, langsat, and jackfruit are the most commonly found. Intensively managed orchards and commercial plantations are mainly non-branching fruit including banana, papaya and pineapple. In Thailand, intensively grown fruits are durian, mango, longan, mangosteen, pummelo, rambutan, lychee, tamarind, sugar apple, sapodilla, santol and tangerine. In addition, many related species of existing crops are important for breeding purposes, use as rootstocks, processing, and diets etc. For example, *Durio lowianus*, *Durio mansonii* and *Durio* spp. were used for breeding program and rootstocks; young leaves of *Garcinia cowa* are used as food additives in main Thai foods, Fruit of *G. schomburgkiana* could be used as a fine preserve, Gum resin of *G. hanburyi* is used as a medicine and for coloring. Hence, conservation of diversity and utilization in these species and selection of superior types for cultivation plays a major role in realizing economic gains in Asia.

**1540–1600**

**S11-0-33**

**THE DIVERSITY OF *CASTANEA* (L.) AND POPULATION DIFFERENTIATION IN CHINA**

W. Ling Qin\*, Younian Wang

Beijing Agricultural College, Dept. of Horticulture, De Sheng Mei Wai, Beijing,

China, 102206

Chestnuts (*Castanea* spp.) are widely distributed in the temperate zones of the Northern Hemisphere. Because of long history of cultivation and evolution, there are tremendous wealth diversity and genetic variations. Variations between genotypes and different populations are very high for virtually every trait. China is considered to be the main center of plant diversity. The wide range of diversity and populations supports the hypothesis that chestnuts are originated in China. At least three species and more than 300 cultivars, thousand and thousand of clones (from seedling variation) distributed in different climate zones and formed different populations. Species from China contain resistant germplasms which have been used to breed hybrids with increasing resistance in America and in Europe. This paper discussed the diversity of *Castanea* L. and populations in China in detail, analyzed the origin of chestnut in terms of diversity. Finally, the genetic solutions to problems were addressed.

**1600–1620**

**S11-0-34**

**TO BE ANNOUNCED**

**1620–1640**

**S11-0-34-A**

**TO BE ANNOUNCED**

**1640–1700**

**S11-0-34-B**

**TO BE ANNOUNCED**

**Tuesday · August 13**

**1100–1140**

**S11-0-35**

**BIODIVERSITY OF GERMLASM NATIVE TO ASIA-CHINA, JAPAN, AND KOREA**

Mark S. Roh\*<sup>1</sup>, H.J. Cho<sup>1</sup>, K. Gross<sup>1</sup>, Y.H. Joung<sup>1</sup>, A.K. Lee<sup>1</sup>, J. Slovin<sup>1</sup>, H. Ikeda<sup>2</sup>, S. Kurita<sup>3</sup>, J.K. Suh<sup>4</sup>, Z. Zhao

US Dept. of Agriculture, Agricultural Research Service, 10300 Baltimore Ave., Beltsville, MD 20705 USA; <sup>2</sup>National Institute of Floricultural Science, Tsukuba, Japan, Lab. of Phylogenetic Botany, Faculty of Science, Chiba Univ., Chiba, Japan; <sup>3</sup>College of Natural Resources, Dept. of Ornamental Horticulture, Dankook Univ., Cheonan, Korea; <sup>4</sup>Dept. of Landscape and Gardening, Beijing Agricultural College, Beijing, China

Biodiversity is mostly considered in terms of species, and it is commonly used as a synonym of species diversity. Species can not be recognized by systematists with total precision and information on genetic diversity which represent the heritable variation within and between populations of organisms can compliment the study of biodiversity of germplasm as a whole organism. This presentation will cover the germplasm collection, characterization, and evaluation of floral and woody plants in the Floral and Nursery Plants Research Unit (FNPRU) since 1980. The program of the Woody Landscape Plants Germplasm Repository (WLPGR) as a part of the National Plant Germplasm System maintains numerous germplasms collected from Asia and other part of the world will be explained. Seeds or cuttings of germplasm maintained at WLPGR are freely available to research communities all over the world. Many germplasm native to Asia, mainly from China, Japan, and Korea, were collected, preserved, characterized, and evaluated. Characterization of *Acer griseum*, *Ardisia*, and *Pinus sylvestris* forms, *Lycoris*, *Dendranthema*, and *Curcuma* based on the molecular markers and phenotypic morphology will be presented.

**1140–1200**

**S11-0-36**

**DENDRANTHEMA SPECIES AS CHRYSANTHEMUM GENETIC RESOURCES**

Seiichi Fukai\*

Faculty of Agriculture, Kagawa Univ., Miki-cho, Kida-gun, Kagawa, 761-0795

Japan

Many Asian plants including chrysanthemum have been used as ornamental plants. Some wild chrysanthemums had already appeared in the literature in China by 1 B.C. Chrysanthemum has been used as an ornamental plant since 5 A.C, but the origin is still unclear. Genetic resources of chrysanthemum include core species of the genus *Dendranthema* and cultivated chrysanthemum varieties (I), partially compatible related species (II), and other related species (III). The core species, genus *Dendranthema*, consists of about 50 species distributed mainly in East Asia, with about 20 species being native to Japan. Intra- and interspecific variation in cpDNA, detected by PCR-RFLP, in the genus *Dendranthema* has been reported. Some morphological and physiological characteristics of *Dendranthema* species native to Japan will be discussed. Each species shows a special plant form due to unique branching and flowering habits. All species flower under daylengths of 10 and 12 hours, but not 14 hours, at 25 °C. Each species requires a specific minimum temperature for flowering in winter. The reciprocal crosses between chrysanthemum and *Dendranthema* species are possible when the appropriate genotype is carefully chosen. The progenies of summer–autumn flowering type chrysanthemum flowered earlier than those of autumn flowering type in all combinations. Genetic erosion of wild chrysanthemum is serious in Japan. Investigation and conservation of wild chrysanthemums is an urgent issue.

**1200–1220****S11–0–37**

#### **CHARACTERISTICS OF RHIZOMES AND THEIR PROPAGATION IN *DENDRANTHEMA ZAWADSKII***

Ki Sun Kim\*, Chang Hee Lee

Dept. of Horticulture, College of Agriculture &amp; Life Sci., Seoul National Univ., Suwon, Kyeonggi-do, Rep of Korea, 441-744

*Dendranthema zawadskii* Herb. is a wild flower native to Korea, which is known as one of the origin of cultivated chrysanthemum. Their seed propagation has some problems because of heterogeneous plant shape and delayed time for flowering (at least 2 years). Vegetative propagation using shoot-tip cuttings in cultivated chrysanthemum is limited due to rosette form. Therefore, their long leptomorphic rhizomes were studied for mass production, in which the main axis of the plant grows horizontally below the ground surface, different from short winter suckers in *D. grandiflorum*, *D. boreale*, and *D. indicum*. The final objective of this study is to develop the mass production technique of rhizomatous plants. We investigated the problems of seed propagation, the physiological characteristics of rhizome, and selection of superior strains or varieties in rhizome production on this paper. Heterogeneous progenies (21.8%–55.5%) were produced from seeds of *D. zawadskii* ssp. *coreanum* (21.8%), and heterogeneous progenies (60%–72.7%) from seeds of *D. zawadskii* ssp. *latilobum* (64.8%) using leaf area percentage [(leaf width x leaf length) x 100/leaf area]. Shooting and rooting of rhizomes did not require cold treatment (4 °C, 4 weeks) and were influenced by the maturity of rhizome. As newer rhizomes were planted, the higher frequency of shooting in rhizomes appeared. Effect of removing sheath at the node of rhizomes did not facilitate bud sprouting from each node. Effect of apical dominance according to the position of node strongly appeared. Also, regardless of the nodal position, light condition triggered shooting of latent buds from rhizomes; in other words, apical dominance was broken by light. Finally, selection of superior strains was evaluated using 5 cm cut rhizomes from 6 subspecies and 12 local strains at 100 days after planting. *Dendranthema zawadskii* ssp. *yezoense* collected from south coastal region showed the highest productivity of rhizomes.

**1220–1240****S11–0–38**

#### **BREEDING OF ORNAMENTAL CROPS AT NHRI, KOREA**

Hyang Young Joung\*, Jae Yeong Kim

National Horticultural Research Institute, RDA, 475 Imokdong, Jangangu, Suwon, Kyunggido, Republic of Korea, 440-706

The floriculture industry in Korea had been developing since the Seoul Olympic Games in 1988. Cut flowers, as the major commodity, occupy 45% of the overall ornamental crop production. Potted plants follow with 40%. Main cut flowers are roses, chrysanthemums, lilies, perennial gypsophilas, carnations, gerberas, freesias, and gladioli. Breeding of these crops except gypsophila started in 1992. Since private companies are not interested in ornamental breed-

ing because they consider it as a small-scale industry, the NHRI took the sole responsibility for breeding different floral plants in Korea. Breeding targets include flowers to be colorful and its adaptability to the Korean environment. Important traits for selection include: for chrysanthemum—white rust-resistance and tendency to be not to produce branch (branchless); carnation—fusarium wilt resistance and heat resistance; gerbera—sturdy stem; lily—bulb rot resistance and good blooming with small bulbs; and gladioli and freesia—simultaneous blooming and enhanced fragrance. Cross-breeding was commonly used. Incompatibility of interspecific hybrids was overcome through embryo and ovule culture. Comparable genes were cloned and transformed into cultivars for colorful flowering in lily and tendency to be branchless in chrysanthemum. Transformation research was also improving with early flowering-gene in chrysanthemum. One hundred seventy one varieties out of the 16 ornamental crops were released recently from NHRI. Most of them are under the multiplication phase to study the demand of domestic growers for new varieties. The numbers of cultivars released are: for chrysanthemum—43, carnation—14, gerbera—8, roses—5, and graft-cactus—40. Also released are 21 varieties in Asiatic and LA hybrids of lilies, and 14 varieties in gladioli. Moreover, freesias are under the final selection stage. Future breeding targets may include improvement of cut flower's export quality.

**1340–1440****S11–P–39**

#### **THE GENETIC RESOURCES AND DIVERSITY OF *PRUNUS MUME* SIEB. ET ZUCC. IN CHINA**

Manzhu Bao\*, Yongchun Zhang, Junwei Zhang

Dept. of Forestry, Huazhong Agricultural Univ., Wuhan, Hubei, China, 430070

The Chinese flower and fruit plant, *Prunus mume* Sieb. et Zucc is one of the most renowned plants in both Southern and Central China. Natural populations of the species were found in areas of southwestern and central China, specifically in Yunnan, Sichuan, Hubei Provinces and the Tibet Autonomous Region. Through intensive exploration, samples from a variety of wild populations were collected and the genetic diversity among the populations was analyzed using pollen morphology, iso-enzymes and RAPD markers. Among the iso-enzyme markers, 24 out of 50 loci were polymorphic. The peroxidase, EST, GOT and SOD are all polymorphic iso-enzymes. RAPD markers showed 241 usable loci, 170 of which were polymorphic. Based on the comparison of pollen structures and markers, *Prunus mume* has a wide genetic diversity among the populations. The origin and development of these populations, as well as the strategies for protection and preservation of the genetic resources of the species, will be proposed.

**1340–1440****S11–P–40**

#### **EFFECT OF POT SIZE ON CUT FLOWER YIELD AND QUALITY OF GERBERA GROWN IN CONTAINER CULTURE FOR THREE YEARS**

Kyongju Choi\*<sup>1</sup>, Hongjae Kim<sup>1</sup>, Sunkook Kim<sup>1</sup>, Soonju Chung<sup>2</sup><sup>1</sup>Jeollanamdo Agricultural Research, and Extension Services, 206-7 Sanjei, Sanpomyeon, Naju, Jeollanamdo, Korea, 520-715; <sup>2</sup>Chonnam National Univ., Kwangju 500-757, Korea

Gerbera can be cultured for 3–4 years after planting, but in successive cropping soil, 20% to 30% of the plants were damaged by soilborne disease and pest every year. Therefore, this study was carried out to investigate the potential of hydroponics on pot for a safe cultivation and the pot size for increasing flower yield and quality. On 12 Aug. 1998, Gerbera 'Picaso' were planted using one tissue culture young plant per 1.8, 2.4 and 3.4-L pot which was filled with perlite + cocopeat (50: 50). Nutrient solution was sprayed 10 times a day from November to February, and 12 times a day from March to October. Flower yield and quality had been examined from planting date to 28 June 2001. Inflorescence length and flower diameter were reduced with the duration of culture, but showed positive correlation with pot size. Number of cut flowers which were cultured at 3.4, 2.4 and 1.8-L pot were 1,054 thousand, 972 thousand and 934 thousand/330 m<sup>2</sup> for three years respectively. Therefore, The plants at 3.4-L pots produced highest yield and best quality of cut flower with peduncle 48.5 cm long on the average. The results indicated that flower yield and quality in gerbera can be improved by culturing them by hydroponics on 3.4-L pot, that would also suppress the soil disease and pest injuries.



**1340-1440**

**S11-P-41**

**COLD TOLERANCE OF WILD *CAMELLIA JAPONICA* IN KOREA**

Sang-Tai Choi\*, Seung-Tae Kim, Hyun-Gun Park, Sam-Taek Cheong  
Horticulture Dept., Kyungpook National Univ., 1370, Sankyuk-Dong, Puk-Ku, Puk-Ku, Daegu, Korea, 702-701

The authors studied on cold tolerance of wild camellia growing at Cheju-island (33.06', winter minimum temp, -1 °C), Geoje-island (34 40', winter minimum temp, -6 °C), Ullung-island (37 29', winter minimum temp, -8 °C) in Korea. Camellia growing at ullung-island had several distinctive tree characteristics such as one trunk type, narrower leaf area, thicker leaves with serrate and more numerous stomata per unit area, higher content of protein and fat in the overwintering leaf than the ones growing in other islands. Leaf abscission pattern can be divided into the following 3 ways; leaf emerged at the same time were abscised after one year, two years and three years later. Camellia growing at Ullung-island shed their leaves after 2 or 3 years while camellias growing at Cheju and Geoje-island shed their leaves after one year. Former showed higher cold tolerance than the latter. Thus it is possible to grow camellia in DaeGu district (35 80' winter minimum temp, -13 °C).

**1340-1440**

**S11-P-42**

**DIFFERENTIATION OF PLANTLETS FROM CALLUS AND SUBSEQUENT FLOWERING IN GLADIOLUS**

Dae Hoe Goo<sup>1</sup>, Hyang Young Joung\*<sup>1</sup>, Kiu Weon Kim<sup>2</sup>

<sup>1</sup>Dept. of Herbaceous and Bulbous Floriculture, National Horticultural Research Institute, 475 Imok-dong, Suwon, Kyeonggido, Korea, 440-706; <sup>2</sup>Dept. of Horticulture, Yeungnam Univ., Kyongsan 712-749, Korea

Differentiation of plantlets from callus cultures induced from the shoot tip of gladiolus and subsequent transplanting of differentiated plantlets were observed. MS medium supplemented with NAA 1.0 mg·L<sup>-1</sup> without BA was most effective for callus induction from the shoot tip. Day length of 8 hours per day and concentrations of 4% sucrose and 2,4-D 0.5 mg·L<sup>-1</sup> were most effective for callus subculture. Differentiation ratio of plantlets was higher on calli cultured on MS medium supplemented with kinetin 1.0 mg·L<sup>-1</sup> and NAA 0.01 mg·L<sup>-1</sup>. Organ formation ratio (shoots with roots) was 90%. The optimum planting time of cormlet produced in vitro was found to be March for corm enlargement. Diameter and height of corms produced in greenhouse were 1.6 and 1.5 cm. Cormlets from plantlets differentiated from callus were planted in the greenhouse and the subsequent plants flowered in the next year with no variations.

**1340-1440**

**S11-P-43**

**THE EFFECT OF REMOVING SCALES FROM BULB ON FLOWERING AND GROWTH OF *LILIUM* SPP.**

Dong-Chil Choi\*, Hee-Jun Kim, Jeong-Man Kim, Sang-Young Seo, Jung-Sil Choi, Yeong-Geun Choi

Dept. of Horticulture, Jeollabuk-do Agricultural Research and Extension Services, Iksan, Jeollabuk-do, Korea 570-704

This study was carried out to investigate the effect of the removing scales from the bulb on flowering and growth of *Lilium* spp. The lily cultivars used for this experiment were *L. Oriental* hybrid 'Casa Blanca', *L. Asiatic* hybrid 'London' and *L. longiflorum* 'Gerlia'. The degree of removing scales from basal plate was consisted of 4 treatments; all-removed (removing all scales from the basal plate), 1/2 removed, 1/3 removed, and none-removed (control). The days required for sprouting was 21 days in all-removed treatment, 20 days in 1/2 and 1/3 removed treatments, and 18 days in the control in *L. Oriental* hybrid 'Casa Blanca'. Height of the plant in 'Casa Blanca' was 29.0 cm in all-removed, 61.7 cm in 1/2 removed, 68.2 cm in 1/3 removed, and 77.6 cm in the control. Similar results were also obtained in 'London' and 'Gerlia'. Days required for flowering was 110 in all-removed, 109 in 1/2-removed, 107 in 1/3 removed, and 104 days in control for 'Casa Blanca' (110-109-107-104); 73-69-67-64 for 'London', and 85-81-80-72 for 'Gerlia', respectively. The more the degree of scale removal, the longer the days for flowering. The rate of flowering was 100% in 1/3-removed and control in all cultivars used in this experiment, but it was quite low in lilies with 1/2 or all the scales removed. The number and

width of floret became smaller with the increase in the degree of removing scale. Chlorophyll content of 'Casa Blanca' was the highest in the control and lowest in all-removed treatment. The contents of fructose, glucose, and sucrose in 'Casa Blanca' leaves were the highest in the control and the lowest in all-removed treatment. Similar results were obtained with 'London, and 'Gerlia'.

**1340-1440**

**S11-P-44**

**IN VITRO PROPAGATION BY SHOOT TIP AND AXILLARY BUD CULTURE OF *DICENTRA SPECTABILIS* DC.**

Su-Young Hong\*, Jong-Taek Suh, Dong-Lim Yoo, Chun-Woo Nam, Su-Jeong Kim

National Alpine Agricultural, Experiment Station, RDA, Pyeongchang-Gun, Gangwon-Do, Korea, 232-955

In vitro shoot tip and axillary bud culture techniques were established in Korea native bleeding heart (*Dicentra spectabilis* DC.) in relation with plant growth regulators. Bleeding heart was cultured on MS media supplemented with 0, 0.1, 1.0 mg/L NAA and 0, 0.1, 0.5 mg/L BA, 3% sucrose and 0.8% agar and then cultured at 25 °C; with a photoperiod of 16 hours daylight for 30 days. Shoot formation was higher on only BA added to MS medium. And fresh weight was the most heavy on MS medium supplemented with 0.5 mg/L BA. Shoot proliferation experiment was carried out on MS media supplemented with 0.1, 0.5 mg/L BA and kinetin. Supplement of 0.5 mg/L kinetin to MS medium was most effective in shoot proliferation.

**1340-1440**

**S11-P-45**

**THE GERMPLASM PRESERVATION OF ORNAMENTAL PEACH CULTIVARS**

Dongyan Hu\*, Zuoshuang Zhang

Beijing Botanical Garden, Wofosi Road, Xiangshan, Hai Dian District, Beijing, Beijing, P.R. of China, 100093

The Ornamental peach (*Amygdalus persica* L. f. duplex Rehd.) is native to China and has plenty of natural resource diversity. There is urgent need for further research in the areas of germplasm collection and preservation. In the survey conducted in Japan and in over 30 cities in China, ornamental peaches were divided into 2 branches, 5 groups, and 12 forms based upon the criteria of stem and flower form. By means of in-situ and ex-situ, Beijing Botanical Garden has 55 cultivars and more than 5000 ornamental peach trees, thus becoming the largest ornamental peach cultivars and quantities holder in China. Beijing Botanical Garden is characterized by its ornamental peach and gained popularity with the Ornamental Peach Festival in 1989. To preserve the ornamental peach cultivars, research on the uses of this peach have been conducted. In the meantime, studies on morphological anatomy and the number of the chromosome and karyotypes of ornamental peach cultivars should have been carried out. Based on so many resources, two new early maturing cultivars are bred by using three early-flowering parents.

**1340-1440**

**S11-P-46**

**LIGHT LEVELS AND GROWTH INHIBITORS ON GROWTH OF SHADE TOLERANT JAPANESE SPURGE (*PACHYSANDRA TERMINALIS*).**

Jeong Sik Lee\*<sup>1</sup>, Sun Jin Jeong<sup>1</sup>, Jin Ah Heo<sup>1</sup>, Hee Jung Kang<sup>1</sup>, Yong-Koo Kim<sup>2</sup>

<sup>1</sup>Dept. of Environ. Hort.. The Univ. of Seoul, Zeonngdong Dongdaemungu, Seoul 130-743, Korea; <sup>2</sup>Dept. of Hort.. Kyung Hee Univ., Kiheung Yongin, Suwon 449-701, Korea

Japanese spurge (*Pachysandra terminalis*) is one of the evergreen ground cover plants adapted to the shade environment. The objective of this study was to investigate optimum shade environment and appropriate growth inhibitors for the growth and nutrient contents of the plant. The plant height was increased by shading. Ancymidol treatment with 30% shading resulted in the shortest plant height which is a useful characteristic for the covering plant. Dikegulac with 60% shade at 4 weeks after application showed the widest plant canopy. The number of branches were decreased along with the increasing degrees of shading. Dikegulac showed the largest number of branches at 30% and it also exhibited superior quality by developing larger number of branches than the other growth inhibitors in all shade levels. The fresh and dry weight of top part

in Japanese spurge was the greatest in 30% shade, and the weight was heavier for trees. The heaviest dry and fresh weight of Japanese spurge was achieved by dikegulac treatment with 30% shading. However, the fresh and dry weight of root parts demonstrated detrimental effects by increased degrees of shading, demonstrating opposite effect on weight difference compared with top part. Therefore, the top (T) and root (R) ratio was increased by increasing shading degrees. Photosynthetic activities, chlorophyll contents and nutrient levels in the leaves of Japanese spurge were positively increased by increased degrees of shading compared with non-shading.

**1340-1440**

**S11-P-47**

**MORPHOLOGICAL DIFFERENCE IN AFTER-GENERATION IN VITRO OF BULBLETS REGENERATED IN VITRO IN KOREAN NATIVE LILIES**

Jeong-A Kim<sup>1</sup>, Sun Jung Eum<sup>1</sup>, Jeong Doo Choi<sup>1</sup>, Dae Hoe Goo<sup>2</sup>, Kiu Weon Kim<sup>\*1</sup>

<sup>1</sup>Dept. of Horticulture, Yeungnam Univ., Daedong 214-1, Kyongsan, Kyungbook, Korea, 712-749; Dept. of Floriculture Div. I, National Horticultural Research Institute, RDA, Suwon 440-310, Korea

Long period is required from bulblet regenerated in vitro to flowering bulb. Enlargement of bulb is more advantageous in occurrence of a shoot compared to scaly leaves because of larger leaf area. This study was conducted to compare morphological differences by different size of bulblets and light and dark condition during culture in after-generation of *Lilium* bulblets regenerated in vitro. *Lilium concolor* var. *partheneion* and *L. dauricum* were used as plant materials. Basic medium was MS(1962)-solidified medium containing 90 g·L<sup>-1</sup> sucrose. Bulblets were obtained and subcultured by scaling in vitro. Sprouting percentage of the bulblets was over 93% in after-generation in vitro by cold treatment at 4 °C for 8 weeks regardless of species and light or dark condition during culture. Most of the bulblets formed scaly leaves in sprouting, and bulblets with a shoot were only about 3%, so it was similar between two species. However, ability of shoot occurrence was promoted in bulblets cultured under dark condition in vitro for both of species. It was improved from 0% to 4.0% in *L. concolor* var. *partheneion* and from 0.6% to 7.9% in *L. dauricum* compared to light condition during culture. Shoot formation ability was greatly affected by bulblet size from 0.3 to 1.0 g in FW and differed according to species. The shoot of *L. concolor* var. *partheneion* occurred from over 0.4 g of bulblet and *L. dauricum* was from over 0.7 g of that obtained through dark culture, and shoot appearance percentage was increased with bulblet's size in both species. Sprouting to days were also shortened in bulblet cultured under dark condition for both of species. The rate of sprouting was faster in bulblets of *L. dauricum* compared to *L. concolor* var. *partheneion*.

**1340-1440**

**S11-P-48**

**EFFECTS OF BULB MATURITY, SIZE AND CHILLING DURATION ON PHYLLOTACTIC TRANSITION IN *LILIIUM ORIENTAL* 'CASA BLANCA'**

Kwang Jin Kim<sup>\*1</sup>, Young Jin Kim<sup>1</sup>, Hye Kyung Rhee<sup>1</sup>, Dae Hoe Gu<sup>1</sup>, Ki Sun Kim<sup>2</sup>

<sup>1</sup>National Horticultural Research institute, 475 Imok-dong, Jangan-ku, Suwon, Kyunggi do, Korea, 440-706; <sup>2</sup>Seoul National Univ., Suwon 441-744, Korea

This study was conducted to identify phyllotactic transition according to bulb maturity, size and chilling duration in *Lilium Oriental* 'Casa blanca'. The bulbs were harvested at the intervals of 10 days after flowering, and then stored for 40, 50, 60 and 70 days at 4 °C ± 1. The bulbs with 6–8, 10–12 and 14–16 cm in circumference were used. The immature bulbs harvested at flowering, showed 100% alternate pattern regardless of bulb size, but in the mature bulbs of large size (14–16 cm) harvested 60 days after flowering, the rate of phyllotactic transition from spiral (2/5) to alternate pattern decreased to 16.7%. As chilling duration became shorter and shorter, the rate of phyllotactic transition increased and the phyllotaxis shifted to alternate pattern at the lower nodes of plant shoot. The plant of phyllotactic transition usually showed spiral 2/5 pattern in low nodes, and the flower differentiated in the shifted nodes to alternate pattern, and then began vegetative growth again, and terminal flower buds differentiated in shoot apex. The rate of phyllotactic transition increased in immature or smaller bulb, and shorter chilling.

**1340-1440**

**S11-P-49**

**EFFECT OF LOW TEMPERATURE ON GROWTH AND FLOWERING OF *CIRSIIUM JAPONICUM* DC.**

Yasuhiko Koike\*, Shigetoshi Suzuki

Faculty of Agriculture, Tokyo Univ. of Agriculture, 1737 Funako, Atsugi, Kanagawa, Japan, 243-0034

*Cirsium japonicum* DC., native to Japan, has beautiful red flowers. The plant has a great potential for the year-round growing ornamental plant. To force the plant, seedlings of *C. japonicum* with more than four expanded leaves were placed under the low temperatures at 1, 5 or 10 °C for 0, 2, 4, 6, 8 or 12 weeks. Initiation of leaf expansion after planting was promoted and days to flowering decreased with increasing weeks of low temperature at 1 or 5 °C. The strong promotive effect was obtained at 1 or 5 °C compared with 10 °C. Flowering was also accelerated when seedlings were grown at 27/20 °C (day/night) and under long daylength (16 hours) after the low temperature treatments. These results revealed that low temperature treatment resulted in rapid leaf growth, earlier flowering and long flower stalk with excellent flower quality.

**1340-1440**

**S11-P-50**

**GIBBERELIC ACID INFLUENCES BREAKING DORMANCY, NUMBER OF SPROUTS, AND ENZYME ACTIVITY OF *HANABUSAYA ASIATICA* (KOREAN ENDEMIC PLANT)**

Ho-Sun Lee\*, Dong-Lim Yoo, Seung-Yeol Ryu, Jeong-Eun Jang, Myoung-Soon Yiem

Horticulture Res. Div., Natl. Alpine Agr. Expt. Sta., RDA, Pyongchang-Gun, Kangwon, Korea, 232-955

Artificial breaking dormancy is important for year-round production of the marketable pot-plant. Well-branched plants are aesthetically important for the sale of many potted flowering plants. Gibberellic acid (GA<sub>3</sub>) is used to break dormancy of plant or seed, and often to stimulate sprouting. The objective of this study was to determine the effects of GA<sub>3</sub> application on breaking dormancy, sprouting and changing of abscisic acid contents, peroxidase, and catalase activity in pot culture of *Hanabusaya asiatica* (Korean endemic plant). Two weeks after leaf abscission, roots of Hanabusaya were transplanted to 17-cm pots. The pot plants were grown in a glasshouse maintained at a 20 ± 2.5 °C DT and 15 ± 2.5 °C NT. Ten milligrams active ingredient (a.i.) of GA<sub>3</sub> per pot was applied 6 weeks after transplanting to two plant ages (two and three years old). At 4 weeks after treatment, 3-year-old plants showed 90% dormancy breaking GA<sub>3</sub> application accelerated dormancy breaking as compared with the control and decreased days to sprouting (by 83 days) and flowering (by 72 days). In addition to the artificial dormancy breaking, the number of sprouts in 2- and 3- year-old plants were increased by GA<sub>3</sub> application (by three and five times of control, respectively), resulting in more well-branched plants. Compared with the control, GA<sub>3</sub> treatment decreased abscisic acid contents in roots. Peroxidase and catalase activities were increased after dormancy breaking by GA<sub>3</sub> treatment. However, GA<sub>3</sub> application resulted in somewhat longer plant height than control. Therefore, GA<sub>3</sub> application at 10 mg a.i. per pot could be used to break dormancy for year-round production and to produce well-branched pot plants of *Hanabusaya asiatica*. However, more researches are needed to reduce the height of the plant treated with GA<sub>3</sub>.

**1340-1440**

**S11-P-51**

**VASE LIFE AND QUALITY OF CUT *POLYGONATUM ODORATUM* VAR. *PLURIFLORUM* FOR. *VARIEGATUM* STEMS AS AFFECTED BY PRETREATMENTS AND HOLDING SOLUTIONS**

Jong Suk Lee\*, Young A Kim, Jong Su Park, Sun Ae Hwang, Poong Ok Lee

Dept. of Horticulture, College of Agriculture, Chungnam National Univ., Daejeon 305-764, Korea

*Polygonatum odoratum* var. *pluriflorum* for. *variegatum* is usually used as cut foliage for flower arrangement. However, the foliage yellowing of the stems occurs easily when dipped in water without postharvest treatments. Postharvest foliar spray of 500 mg/L 6-benzylaminopurine (BA) or 1000 mg/L gibberellic acid (GA<sub>3</sub>) markedly extended vase life of cut stems of *Polygonatum odoratum*

var. *pluriflorum* for. *variegatum*. Foliage yellowing did not occur in these treatments until 30 days after treatments. Postharvest pretreatment with 3% sucrose + 200 ppm 8-hydroxyquinoline sulfate (HQS) + 250 ppm BA for 16 hours also extended vase life of cut stems three times as long as nontreated control. Holding solution of 2% sucrose + 200 ppm HQS + 20 ppm BA extended vase life of cut stems by more than 30 days.

**1340-1440**

**S11-P-52**

**EFFECT OF BA, THIDIAZURON AND AGNO<sub>3</sub> ON IN VITRO REGENERATION IN *CYCLAMEN PERSICUM***

Seung Woo Lee\*, Hae jin Jung, Geun Won Choi, Young-Doo Park  
Dept. of Horticulture, Kyung Hee, Univ., Yongin, Kyunggi-Do, Republic of Korea, 449-701

Experiments were conducted to investigate the effect of BA, thidiazuron (TDZ) and AgNO<sub>3</sub> on in vitro regeneration in *Cyclamen persicum*. Petiole and bulb tissues from seedlings germinated and grown in vitro for 90 days were collected and cultured on MS media supplemented with NAA and BA or NAA and TDZ at concentrations of 0, 0.5, 1.0 or 1.5 mg·L<sup>-1</sup>, respectively. AgNO<sub>3</sub> at concentration of 0, 2, 4, 8 or 16 mg·L<sup>-1</sup> was added to MS media containing 0.5 mg·L<sup>-1</sup> NAA and 1.0 mg·L<sup>-1</sup> TDZ. In combination with 0.5 mg·L<sup>-1</sup> NAA and TDZ, both petiole and bulb explants showed higher capacity for the regeneration of leaflet as compared with other concentrations tested. However, explants collected from bulb tissue gave the highest leaflet regeneration at concentration of that combination. Callus formation tended to increase by using NAA in the medium. In contrast, BA in the medium did not show a great difference of leaflet regeneration in both petiole and bulb explants and at all concentration tested. One and 1.5 mg·L<sup>-1</sup> NAA hastened callus formation in combination with BA. At concentration of 2, 4, 8 and 16 mg·L<sup>-1</sup> AgNO<sub>3</sub>, petiole explant produced 2.0-3.2 leaflets but no leaflet was regenerated from bulb explant. These results suggest that the in vitro regeneration in cyclamen is greatly affected by various culture conditions.

**1340-1440**

**S11-P-53**

**INHERITANCE OF SEVERAL CHARACTERS AND RAPD BANDS IN INTERSPECIFIC HYBRIDS BETWEEN *DIANTHUS GIGANTEUS* AND *D. CARTHUSIANORUM***

Su Young Lee\*<sup>1</sup>, Ki Sun Kim<sup>2</sup>

<sup>1</sup>Biotechnology Research Team, National Horticultural Research Institute, 540 Tap-dong, Suwon, Kyonggi, Korea, 441-440; <sup>2</sup>Dept. of Horticulture, Seoul National Univ., Suwon 441-744, Korea

Hereditary phenomena of 8 qualitative and 16 quantitative characters was elucidated through analyzing segregation ratio, broad-sense heritability, and correlation between characters on the basis of morphological characteristics in 55 interspecific hybrids between *D. giganteus* and *D. carthusianorum* and their parents. Also random amplified polymorphic DNA (RAPD) markers were analyzed using the same material. Concerning the segregation of characteristics of 8 qualitative characters including flower color, fragrance, color of blade and stigma, and arrangement of individual flowers, 55 interspecific hybrids showed either the characteristics of female parent or male parent. Heritability of corolla height was highest among 16 quantitative characters, whereas that of stem width and the number of flowers were lowest. Using 35 primers, we scored a total 215 different fragments on the basis of their presence/absence. As a result of analyzing hereditary phenomena of 215 polymorphic RAPD bands interspecific hybrids were divided into 4 types: AB type (dominance or parental type), Ab type (female type), aB type (male type), ab type (recessive type) which both parent did not show. The number of AB, Ab, aB, and ab type bands was 34 (15.8%), 53 (24.6%), 51 (23.2%), and 77 (35.8%), respectively. Therefore, it was confirmed that segregation ratio of AB:Ab:aB:ab was 2:3:3:4. As a result of chi-square test, it was confirmed that segregation ratio of absent to present in bands of Ab, aB, and ab type except AB type corresponded to expected ratio. And we presumed that AB type bands were linked to the locus controlling stem length, height of corolla, and calyx length and aB types were linked to the locus controlling pink color of petal, purple color of stigma, and clustered in arrangement of individual flower. Ab types were linked to the locus controlling length and width of leaf and petal length and ab types were linked to the locus controlling stem width, style length, and number of flowers.

**1340-1440**

**S11-P-54**

**IDENTIFICATION OF RAPD MARKERS LINKED TO THE LOCUS CONTROLLING FLOWER CENTER COLOR IN CARNATION**

Su Young Lee\*<sup>1</sup>, Ki Sun Kim<sup>2</sup>

<sup>1</sup>Biotechnology Research Team, National Horticultural Research Institute, 540 Tap-dong, Suwon, Kyonggi, Korea, 441-440; <sup>2</sup>Dept. of Horticulture, Seoul National Univ., Suwon 441-744, Korea

DNA markers tightly linked to the locus controlling a useful character were identified for marker-assisted selection to increase the efficiency of plant breeding. Flower center color (FCC) is an important trait in spray-type carnation (*Dianthus caryophyllus*), of which production area is increasing recently. To identify DNA markers linked to the locus controlling the trait, random amplified polymorphic DNA (RAPD) analysis with bulked segregant analysis (BSA) was performed using 340 primers with *D. giganteus* (female parent), *D. carthusianorum* (male parent) and 55 interspecific hybrids. Only the female parent had this trait. The hybrids were segregated between white and colored. Hybrids were divided into five groups according to scores given to them from 1 to (no FCC) to 5 (the same FCC intensity as the female parent). DNA bulks were made from each group using 5 to 7 plants samples. We confirmed that two RAPD markers, OPQ20-1400 and OPX12-400, were linked to the locus controlling FCC in carnation. The intensity of OPQ20-1400 band depended on the intensity of FCC, and OPX12-400 was only expressed in plants of which FCC was strongly expressed.

**1340-1440**

**S11-P-55**

**RESISTANCE TO *FUSARIUM OXYSPORUM* IN LILIUM**

Jin Hee Lim\*<sup>1</sup>, Hye Kyung Rhee<sup>1</sup>, Young-Jin Kim<sup>1</sup>, Ki-Byung Lim<sup>2</sup>, Jaap M. van Tuyl<sup>2</sup>

<sup>1</sup>Dept. of Herbaceous and Bulbous Floriculture, Natl. Hort. Res. Institute, RDA, 475, Imok-Dong, Jangan-Gu, Suwon, kyonggi, Korea, 440-310; <sup>2</sup>Plant Research International, Wageningen P.O. Box 16, The Netherlands

The soilborne fungus *Fusarium oxysporum* f.sp. *lilii* causes bulb rot of lily, which endangers its bulb production worldwide. The resistance to fusarium of 44 species under standardized conditions was tested in hybrids and breeding lines from National Horticultural Research Institute (NHRI) and PRI by using the scale bulblets from each genotype. The Asiatic cultivars 'Orlito' and 'Connecticut King' was observed to be highly resistant, while 'Pirate' was observed to be highly susceptible. The resistance level of the Oriental hybrids (Acapulco, Stargazer) and *L. longiflorum* (Snow Queen, Gelria) was lower compared with the resistance of the Asiatic hybrid lilies and ranged from moderately resistant to susceptible. Based on the species, *L. regale* and *L. dauricum* were observed to be highly resistant, while *L. davidii* and *L. hansonii* were highly susceptible. Three of the 10 LA-hybrid lilies from NHRI were highly resistant while the others were observed to be moderately resistant, and the LO-hybrid lilies from NHRI were susceptible. The variation in resistance level of the four interspecific hybrids from PRI range from moderately resistant (LA and OA) to susceptible (2 OA).

**1340-1440**

**S11-P-56**

**HUNAN (CHINA) FLORA WITH RICH ORNAMENTAL PLANTS**

Kewang Liu\*<sup>1</sup>, Donglin Zhang<sup>2</sup>

<sup>1</sup>Dept. of Forestry Botany, Central South Forestry Univ., 1, Zhuzhou, Hunan, China, 412006; <sup>2</sup>Dept. of Horticulture, Univ. of Maine, Orono, Maine 04469-5722 USA

Hunan (China) is located in transition zone between subtropical and temperate forests. The special locality and variable topography enrich the diversity of plant species. More than 4,300 species of vascular plants have been documented. Since no plant exploration in Hunan occurred for the purpose of ornamental plants, we have studied its ornamental plant potential in recent years. By comparing with cultivated ornamental plants in Asia, Europe, and North America, Hunan has more than 2,000 native plants that can be cultivated as ornamental plants. Some endemic species to Hunan, such as red loropetalum, already brought the worldwide attention in the ornamental field. Others, such as red-flower mu-lian and dong-an tea, have great ornamental potential and for

their breeding. The special ornamental groups, such as native fern (about 300 species), conifers (46), camellia (33), holly (63), magnolia (31), orchid (66) and rhododendron (46), had been addressed at species level. The potential for further breeding work and cold hardiness had been investigated. These data and distribution maps will enhance the plant exploration and utilization for Hunan and bring more beautiful plants in our daily gardens.

**1340-1440**

**S11-P-57**

**THE STUDY ON POLLINATION METHOD FOR THE INTERGENERIC HYBRIDIZATION BETWEEN *HEMEROCALLIS* SPP. AND *LILIAM* SPP.**

Dong-Chil Choi\*, Min-Sil Ahn, Hoi-Chun Lim, So-Ra Choi, Jeong Ryu, Jung-Sik Choi, Yeong-Geun Choi

Dept. of Horticulture, Jeollabuk-do Agricultural Research and Extension Services, Iksan, Jeollabuk-do, Korea, 570-704

In general, *Hemerocallis* has been called as a daylily because one ball of the flower blooms only one day although the total flowering period is for ten to twelve days. The intergeneric crossing between *Hemerocallis* and *Lilium* was performed in order to increase the commercial value of the floriculture plant with extended flowering period and variations in flower color and its shape. *Hemerocallis dumortieri*, *Hemerocallis thunbergii* and *Hemerocallis minor* were used as a seed parents. Casablanca of oriental hybrid type and London of Asiatic hybrid type were used as pollen parents. The capsule-setting rate of intrastylar pollination was obtained as 50%–80% while the capsule-setting rate of stigmatic pollination was less than 5%. Growth regulator applications markedly increased capsule-setting rate; 84% by GA<sub>3</sub>, 38% by IAA, and 15% by NAA respectively as compared to 5% in the control. Under the natural conditions, the capsule usually fell down in 10–12 days after pollination. Therefore, embryo rescue was performed within 10 days after pollination. To increase the rate of intergeneric hybridization and overcome an obstacle to embryo growth, the general process of in vitro pollination was also performed. In the case of in vitro pollination, the intrastylar pollination has showed higher capsule rate than the stigmatic pollination. When young capsules were excised and cultured in vitro, the ovule growth initiated after 7 days and showed pigment development after 20 days, and the seed was formed after thirty days. In the case of placenta culture, seeds were formed after 60 days from pollination.

**1340-1440**

**S11-P-58**

**EFFECT OF GIBBERELLIN ON SOME PROPERTY OF *FRITILLARIA IMPERIALIS* L.**

Masomeh Meamar Moshrefi\*

Dept. of Horticulture, College of Agriculture, Tarbiat Modares Univ., P.O. Box 14155-4838, Tehran, Iran

A general increase in interest and use of ornamental and medicinal plants as natural products for food and pharmaceutical applications has swept in Iran. Cultivation of ornamental and medicinal plant is a frequently suggested option to protect depletion of wild habitat. The bulbs were selected and marked in native habitat and they were taken out of the soil when their upper foliages dried out. The bulbs were treated with different concentrations of gibberellin (0, 1000, 3000 and 4000 ppm). This experiment has done in research field of Tarbiat Modares Univ., Faculty of Agriculture. The experiment was conducted in completely randomized block design with three replications with four bulbs per each treatment. Data were evaluated by analysis of variance and different between means were analyzed by DMRT. The results indicated that 3000 ppm was the best treatment for the improvement of the quantitative and qualitative vegetative and reproductive characteristics. In conclusion, *Fritillaria* can be successfully grown as bedding plants by use of gibberellin for bulb treatment.

**1340-1440**

**S11-P-59**

**EFFECT OF CHEMICAL TREATMENT AND PLANT GROWTH REGULATORS ON POSTHARVEST OF *FRITILLARIA IMPERIALIS* L. CUT FLOWERS**

M. Meamar Moshrefi\*

Dept. of Horticulture, College of Agriculture, Tarbiat Modares Univ., P.O. Box 14155, Tehran, Iran, 4838

Although bulb flowers make up a substantial proportion of the cut flowers trade, there are comparatively few studies on the senescence of these flowers. *Fritillaria imperialis* is a native Iranian plant. In this experiment, we investigated the effects of treatments of silver-containing chemicals such as AgNO<sub>3</sub>, Ag<sub>2</sub>SO<sub>4</sub>, Ag<sub>2</sub>N<sub>2</sub>O<sub>3</sub>, and growth regulators such as NAA, IBA and GA<sub>3</sub> on vase life of *Fritillaria imperialis* with factorial design. Comparison of mean was performed with DMRT at 1% and 5% level. Fresh weight of cut flowers increased initially and then decreased. Treatments with GA<sub>3</sub>, NAA and IBA resulted in the lowest flower quality. Abscission was minimized by NAA and IBA treatments. Mesophyll cells in petal of flowers treated with growth regulators influenced the vase life. One month after harvest, the cells maintained their original size as compared to the control. In the control plants, the intracellular space between the mesophyll cells expanded enormously and only the cells surrounding the vascular tissue remained small and closely packed. In this region there remains good contact between the mesophyll cells and other mesophyll cells, many of which appeared to have collapsed.

**1340-1440**

**S11-P-60**

**THE EFFECT OF PLANT GROWTH REGULATORS ON THE VEGETATIVE AND REPRODUCTIVE GROWTH OF BEDDING *FRITILLARIA IMPERIALIS***

M. Meamar Moshrefi\*, A. Khalighi, A. Talaie

Dept. of Horticulture, College of Agr., Tarbiat Modares Univ., P.O. Box 14155-4838, Tehran, Pol Gisha, Iran

*Fritillaria imperialis* L. is one of the most attractive Iranian plants native to central and west mountain of different provinces of Iran but not used as ornamental plant, and little information exist on cultural methods. Development of a novel product increase the possibility of success in world market because novelty is an important component of marketing strategy. The bulbs were selected and marked in their natural site when their above soil level foliage were dried, pulling up the bulbs from nature. The bulbs were treated with different concentrations of gibberellin (GA<sub>3</sub>), 2-naphthalen acetic acid (2-NAA), indol 3 butyric acid (IBA), indol-3-acetic acid (IAA), and naphthalene acetic acid (0, 250, 500, 1000, 2000 and 4000 ppm) prior to planting. Treatments were arranged in a randomized complete block design with 3 replicates, each with four bulbs at Agricultural Research Farm of Tarbiat Modares Univ. and the effects of plant growth regulators on the vegetative and reproductive growth of *Fritillaria imperialis* L. were thoroughly examined. Treated plants showed improved quality and quantity characteristics than the control and 2-NAA at a concentration of 1000 ppm produced longest length of stem and flower inflorescence and increases in the number of flowers.

**1340-1440**

**S11-P-61**

**EFFECT OF TEMPERATURE ON DEVELOPMENT OF EMBRYO AND SEED GERMINATION IN *HEPATICA NOBILIS***

Toshikazu Nomizu\*, Yoshiji Niimi

Niigata Univ., Faculty of Agriculture, Ikarashi 2-8050 Niigata, Niigata, Niigata, Japan, 950-2181

Seeds of *Hepatica nobilis* var. *japonica* 'Yukiwarisou' shed from receptacle during a period of late April to early May in Niigata, Japan, at which they had globular embryo and endosperm. Seeds with globular embryo cultivated under a non-heated polyethylene house developed into torpedo embryo until early June. However, embryo development was retarded temporarily from June to middle September as temperature rose, resumed with a fall in temperature and cotyledonary embryos were observed in seeds at around early November. Afterwards, radicle emerged and then cotyledons expanded before March. Based on these observations, seeds were cultivated in thermostatic chambers at 5, 15 or 25 °C in order to clarify effect of temperatures on development of globular embryo, resulting in that radicle appeared from only seeds cultivated at 15 °C 21 weeks after sowing. Histological observation showed that when seeds were cultivated at 25 °C, globular embryos developed into torpedo ones for about 7 weeks but not developed any more, whereas embryos in seeds cultivated at 15 °C developed into cotyledonary ones with growing slowly. It was found that germination of seeds of *H. nobilis* could be accomplished efficiently for a short period by a following way: seeds were incubated in the dark at 25 °C for 7 weeks, followed by at 15 °C for 7 weeks and then transferred to a 12-hour

illuminating condition at 4 °C to develop hypocotyl and cotyledons.

**1340–1440**

**S11–P–62**

**CROSS COMPATIBILITY IN THE INTERSPECIFIC HYBRIDIZATION AMONG SEVERAL PLOIDIES OF *ROSA* SPP.**

Yong Nam Oh\*<sup>1</sup>, Kwang Seek Lee<sup>1</sup>, Ki Sun Kim<sup>2</sup>, Sun Kyoung Chung<sup>3</sup>

<sup>1</sup>Woody & Specialty Crop Flor. Div., National Hort. Research Institute, Rural Development Administration, Suwon, Kyongki-Do, Korea, 441-440; <sup>2</sup>Dept. of Horticulture, Seoul National Univ., Suwon, Kyongki-Do, 441-744 Korea; <sup>3</sup>Citrus Experiment Station, National Jeju Agricultural Experiment Station, Namjeju, Jeju-Do, 699-807 Korea

The interspecific crossing ability was studied in selfings and interspecific hybridizations between 2x *Rosa multiflora* and one of 8 cultivars under 6 species that possessed different ploidies. Interspecific hybridization effects differed significantly within their reciprocal crosses, respectively. That is, crossing ability was very high when *R. multiflora* was used as pollen parents in (2x) x (2x) and (5x) x (2x) cross combinations. The ability of self-fertilization was also high in *R. multiflora*. However, when *R. rugosa* (2x) and all of 5x species were used as pollen parents, cross-compatibility (crossing ability) in interspecific hybridizations was low, which also showed low self-compatibility in their selfings. The 4x and 6x species showed incompatibility or very low compatibility in selfing as well as interspecific hybridizations. Their fertility of gynoecious organs were comparatively normal, but pollen fertility was low and pollen tube growth was very weak in all rose species tested except *R. multiflora*, which resulted from abnormal microsporogenesis, low pollen vitality, and incompatibility between pollen and pistil in pollen germination or pollen tube growth procedure. These characters were thought to differ among species with different ploidies.

**1340–1440**

**S11–P–63**

**GENETIC ANALYSIS OF THE INTERSPECIFIC HYBRIDS IN *ROSA* SPP. IN RELATION TO PLANT RESISTANCE TO NORTHERN ROOT-KNOT NEMATODE (*MELOIDOGYNE HAPLA* CHITWOOD)**

Yong Nam Oh\*<sup>1</sup>, Myoung Rae Cho<sup>1</sup>, Ki Sun Kim<sup>2</sup>, Young Ho Kim<sup>2</sup>

<sup>1</sup>Woody & Specialty Crop Flor. Div., National Hort. Research Institute, Rural Development Administration, Suwon, Kyongki-Do, Korea, 441-440; <sup>2</sup>Dept. of Horticulture, Seoul National Univ., Suwon, Kyongki-Do, 441-744. Korea

Genetic analysis in relation to plant resistance to northern root-knot nematode was studied in the self-progenies and interspecific hybrids among 2x *Rosa multiflora*, 2x *R. rugosa* and 5x *R. corymbifera*. In susceptible 2x *R. multiflora* 'Chilewonye#1', their self-progenies were segregated into resistant and susceptible groups (resistant: susceptible = 7: 9) in the first selfed generation. The 2x *R. rugosa* was determined as resistant species to northern root-knot nematode (*Meloidogyne hapla*) in these experiments. In resistant species such as 5x species and 2x *R. rugosa*, their self-progenies were resistant to *M. hapla* in the first selfed generations, respectively. *Rosa multiflora* (2x) x *R. corymbifera* (5x) and *R. multiflora* (2x) x *R. rugosa* (2x) interspecific hybrids seemed to be segregated into resistant and susceptible groups in approximate ratio of 1:1 or 5:3, respectively. Thus, it was assumed that the susceptible species such as *R. multiflora* 'Chilewonye #1' and 'Burr' may have heterozygous alleles, and the resistant species such as *R. corymbifera* 'Laxa' and *R. rugosa* 'Rubra' have homozygous alleles in relation to plant resistance to northern root-knot nematode. It also could be hypothesized that the resistant alleles are not dominant but recessive alleles, which were supported by segregation patterns of self-progenies and interspecific hybrids. The resistance expression pattern could be explained best by double recessive epistasis within two homozygous recessive genes, when hypothesis was tested statistically.

**1340–1440**

**S11–P–64**

**NARCISSUS TAZETTA VAR. CHINENSIS: CAN DNA ANALYSIS REVEAL ITS ORIGIN?**

Shizuka Ohki\*, Atsuko Tanaka, Utako Suzukawa

Fukui Prefectural Univ., Dept. of Bioscience, Matsuoka-cho, Yoshida-gun, Fukui, Japan, 910-1195

*Narcissus tazetta* L. var. *chinensis* ROEM. is a triploid variety found in eastern end of Asian continent. In Japan and China, this variety is used for cut flower production and ornamental display. The descriptions of this plant can be found in the documentations of Tang Dynasty (618-907), probably brought through Silk Road as a medicinal plant from the Mediterranean region. In Japan, this variety is found in coastal regions where hot ocean current from South China Sea is passing, and is cultured for cut flower production. Therefore, it is said that bulbs floated on this hot current and reached to Japan. We tried to reveal this hypothesis by analyzing DNA sequence of this plant in China and in Japan. *N. tazetta* var. *chinensis* was collected from semi-wild colony in Fukien Pref., China and four different regions in Japan; Fukui, Hyogo (Awaji Isl.), Shizuoka, and Chiba Pref. Diploid *N. tazetta* was also used. The internal transcribed spacer (ITS) 1 and 2 regions in 18S-26S nuclear ribosomal DNA were amplified by PCR using genomic DNA extracted from young leaves. The sequence data were aligned and cluster analyzed by Genetyx-Win 5.0 to generate the genomic tree. The sequence of the plants from four different Japanese regions was very similar and belonged to the same clade. However, in Chinese plants 7 bp deletion was detected in ITS2 region and belonged to outgroup. The diploid *N. tazetta* was found to be the most recent common ancestor of Japanese clade. From these results we consider that *N. tazetta* var. *chinensis* in Japan is not the same origin of that in Fukien, China. This variety might be brought to Japan through different route passing other region of China. We are now analyzing chloroplast gene to reveal cytoplasmic evolution of this variety.

**1340–1440**

**S11–P–65**

**VIABILITY AND STORAGE OF LILY POLLEN**

Hye Kyung Rhee\*<sup>1</sup>, Jin Hee Lim<sup>1</sup>, Hae Ryong Cho<sup>1</sup>, Ki Sun Kim<sup>2</sup>, Jaap M. van Tuyl<sup>3</sup>

<sup>1</sup>National Horticultural Research Institute, 475 Imok-dong, Jangan-ku, Suwon, Korea, Suwon, Kyunggi do, Korea, 440-706; <sup>2</sup>Seoul National Univ., Suwon 441-744, Korea; <sup>3</sup>Wageningen UR, P.O. Box 16, 6700AA Wageningen, The Netherlands

The study was conducted to estimate the pollen viability of eight lily genotypes and to identify their optimum storage conditions. Pollen viability was assessed by in vitro germination, FCR (fluorochromatic reaction) test, and in vivo assays. Pollen grains were stored in the dark chamber where the room temperature was maintained at 4, -20, or -70 °C for 1 year. The highest percentage of pollen germination in *L. henryi*, *L. lancifolium*, *L. Oriental* 'Casa Blanca', *L. formolongi* 'F1 August' and 'Raizan' was observed when pollen grains were stored at temperatures lower than -20 °C from FCR test and in vitro study. On the other hand, the lowest percentage was found in pollen of 'Connecticut king', 'Barbaresco', and 'Kissproof'. These cultivars have shown poor germination rate of 10% or lower under four storage conditions. The best storage condition seemed to be low temperature of -20 °C or lower. Pollen grains of 'Raizan', 'Casa Blanca', and *L. lancifolium*, after 1 year storage (except for room temperature) still had sufficient capacity for fruit set after cross-pollinations. Highly significant correlations were found among the FCR test, in vitro germination, and fruit set test.

**1340–1440**

**S11–P–66**

**IDENTIFICATION OF PRE-FERTILIZATION BARRIERS IN INTERSPECIFIC HYBRIDIZATION OF LILY**

Hye Kyung Rhee\*<sup>1</sup>, Yong Jin Kim<sup>1</sup>, Kwang Jin Kim<sup>1</sup>, Ki Sun Kim<sup>2</sup>, Jaap M. van Tuyl<sup>3</sup>

<sup>1</sup>National Horticultural Research Institute, 475 Imok-dong, Jangan-ku, Jangan-ku, Suwon, Korea, Suwon, Kyunggi do, Korea, 440-706; <sup>2</sup>Seoul National Univ., Suwon 441-744, Korea; <sup>3</sup>Wageningen UR, P.O.Box 16, 6700AA Wageningen, The Netherlands

To identify pre-fertilization barriers, pollen tube growth in style and its penetration into the ovules have been studied in intraspecific and interspecific crosses among cultivars from *L. formolongi* (F), Asiatic (A), and Oriental (O) hybrids. Based on the cross combination, pollen tube growth stopped growing at the stigma or the style, or continued growing to the ovary. In intraspecific crosses (e.g. F x F, O x O, A x A), pollen tubes passed through the end of style only a few days after pollination, where the percentage of pollen tube penetration into ovules was higher than 60%. In contrast, in interspecific crosses (e.g. F x A, F x O, O x A, O x L, A x O, A x L), the pollen tubes did not pass through the style or only a few percent reached the end of style. Pollen tube penetration into the ovule was observed with lower than 7% (e.g., F x A, O x A, O x L). However, in interspecific F x O (*L. formolongi* 'Raizan' x Oriental 'Kissproof') crosses, the percentage of pollen tube penetration into ovules was more than 25% in stigmatic pollination. In interspecific hybridization of Lily,

pre-fertilization barriers were arrest of pollen tube growth in the stigma or style and failure of pollen tubes to penetrate into the ovules.

**1340-1440**

**S11-P-67**

**GENETIC DIVERSITY OF *DENDRANTHEMA PACIFICUM* (NAKAI) KITAM. NATIVE TO JAPAN**

Mark S. Roh\*<sup>1</sup>, Hiroshi Ikeda<sup>2</sup>

<sup>1</sup>USDA Agricultural Research Science, B-010A, Rm 238, 10300 Baltimore Ave, Beltsville, MD 20705 USA; <sup>2</sup>MAFF, National Institute of Floricultural Science, 2-1 Fujimoto, Tsukuba, Ibaraki 305-8519, Japan

*Dendranthema pacificum* (Nakai) Kitam is native to the south eastern shore of Honshu, Japan. A major characteristic of *D. pacificum* is that flower has only disc florets. However, in the United States, one *D. pacificum* with very small white ray florets (accession no. 1-7) is in the trade. Therefore, two accessions of *D. pacificum* in the United States and 19 accessions from Japan were collected to investigate genetic diversity, to evaluate as a new potential ornamental crop, and to identify *D. pacificum* in the trade. These *D. pacificum* were subjected to PCR-RAPD along with *D. shiwogiku* and *D. occidentalis japonense* var. *ashizuriense*. Some selected *D. pacificum* were evaluated for growth and flowering. RAPD analysis showed that *D. shiwogiku* with disc florets and *D. occidentalis japonense* var. *ashizuriense* with both disc and ray florets were clustered distantly from all *D. pacificum* accessions except one *D. pacificum* (accession no. 1-7) collected in the US. Variations among *D. pacificum* collected from the island of Hachijo-Jima were noticed, indicating that there is a genetic diversity of this species which are growing in one island. However, *D. pacificum* collected from Hachijo-Jima, Tokyo Pref., Simoda, Shizuoka Pref., and from Miura, Kanagawa Pref., were clustered together. Variations in growth and flowering characteristics were also observed when 14 *D. pacificum* and one *D. shiwogiku* were evaluated in the greenhouse. Accessions clustered together according to RAPD markers (accessions no. 2-7 and 3-2) flowered at the same time as accessions no. 1-7, which indicates that this could be a hybrid with other species that has ray florets or common florist's chrysanthemum. Some *D. pacificum* took longer than 204 days (accessions no. 1-2 and 3-3) for marketing, while others took less than 182 days (accessions no. 2-7, 3-2).

**1340-1440**

**S11-P-68**

**GERMINATION OF *STYRAX JAPONICUS* SEEDS AS INFLUENCED BY STORAGE AND SOWING CONDITIONS**

Mark S. Roh\*

USDA Agricultural Research Service, USNA, Floral and Nursery Plants Research Unit, B-010A, Rm 238, 10300 Baltimore Ave., Beltsville, MD 20705 USA

The objective of this study was to evaluate the effect of storage and sowing conditions on seed germination of *Styrax japonicus* Sieb. et. Zucc, an ornamental tree whose seeds reportedly exhibit double dormancy. For both experiments that were conducted, 40 seeds were sown in a 15 cm pot in a commercial seed propagation medium; there were 3 replications per treatment. After sowing, plants were kept in an 18.5/18 °C greenhouse for 0, 1, 2, 3, or 4 months, moved to a 5.5 °C cooler for 3 months, and then back to the greenhouse. In the first experiment, the germination of freshly harvested seeds was compared to that of seed that had been stored dry at 20–21 °C for a year prior to sowing. Both sets of seed were kept moist after sowing by watering throughout the experiment. Both fresh and dried seeds that received 5.5 °C immediately after sowing did not germinate. No difference in germination was observed between fresh and dried seed when the seeds were kept in the greenhouse for 1 month or longer. However, when seeds were kept in the greenhouse for 3 or 4 months, the germination percentage of fresh seeds was lower than that of the dried seeds. The second experiment studied the effect of dry and moist conditions after sowing on germination of freshly harvested seeds. Seeds were either not watered prior to being placed in the cooler (dry treatment), or watered as necessary to keep the medium moist (wet treatment). The seeds that were kept dry longer than 1 month had poor (30%–40%) germination. Seeds kept moist for 1 month or longer had greater than 60% germination. Based on the results of this study, it is recommended that *Styrax* seeds be placed under warm, moist conditions for 1 month prior to 3 months of cold stratification. It was observed that a radicle did not emerge through the seed coat after warm or at the completion of cold stratification.

**1340-1440**

**S11-P-69**

**INHERITANCE AND VARIATION OF NONBRANCHING HABIT IN CHRYSANTHEMUM**

Hak Ki Shin\*, Seong Youl Choi, Hyang Young Joung

National Horticultural Resreach Institute, 475 Imokdong, Jangan-gu, Suwon, Kyunggi-do, Republic of Korea 440-706

The inheritance of nonbranching (a habit that has no active bud in its leaf axil) in chrysanthemum was studied in 8 pollination groups using F1 progenies of 22 crosses and 1 selfing consisted of branchless and branching (normal) cultivars. Branching habit was dominant over nonbranching. The segregation for nonbranching in the progenies was 87% in a selfing of nonbranching standard (ST) cultivar, 73% in 3 crosses between nonbranching STs, 10.9% in 10 crosses of branchless STs x branching spray (SP)s, 35.6% in a cross between nonbranching ST x branching ST, 65.9% in 2 crosses of branching STs x branchless STs, and 3.6% in a cross between nonbranching STs. But in a cross of branching ST x SP and 4 crosses between branching SPs, that was zero. The percentages varied with the parents. The variation of nonbranching expression in 32 nonbranching breeding lines was investigated after the plants were overwintered under the natural cold conditions. The expression is quantitative, continuous, and varied with the lines, from 5.7% to 100% in the ratio of blind leaf axils, when counted on June 8. All leaf axils were vacant in the plant that showed the expression of 100% while only the axils of the upper part that grown at high temperature season were vacant in the plant that showed the expression of 5.7%. The result showed that the nonbranching expression in chrysanthemum varied considerably in its level and also influenced by the environmental conditions.

**1340-1440**

**S11-P-70**

**ROOT ZONE TEMPERATURE AFFECTS GROWTH OF *CYMBIDIUM GOERINGII* AND *CYMBIDIUM KANRAN***

In Sup So\*<sup>1</sup>, Ji Yong Choi<sup>1</sup>, Keun Ho Cho<sup>2</sup>, Chiwon W. Lee<sup>2</sup>

<sup>1</sup>Dept. of Horticulture, Cheju National Univ., Cheju, Cheju-Do 690-756, South Korea; <sup>2</sup>Dept. of Plant Sciences, North Dakota State Univ., Loftsgard Hall Room 266C, Fargo, ND 58105 USA

Most orchid growers in Korea use specialized containers that facilitate proper aeration and moisture condition in the plant root zone. In this study, influence of root zone temperature on plant growth was investigated using two Oriental cymbidium species (*Cymbidium goeringii* and *C. kanran*) and three different types of pots: black plastic pot (BPP), glazed clay pot (GCP), and clay pot (CP). The temperature of plant root zone inside BPP fluctuated the most by changes in ambient air temperature, mainly due to high heat conduction through the thin (1.3 mm) wall of the plastic pot. When ambient air temperature was lower than 25 °C, the root zone temperature in three types of pots remained unchanged. Root zone temperature in all pot types increased linearly as ambient temperature increased from 22 to 35 °C. Unlike in BPP and GCP, root zone temperature in CP did not exceed 25 °C when ambient air temperature rose higher than 32 °C. This might have been due to lower heat conduction through the thick wall (6.0 mm) of CP pots. *Cymbidium goeringii* plants grown in BPP for 2 years developed longer roots and weaker shoots, as compared to those grown in GCP or CP, resulting in a 60% mortality. The kind of container had little influence on the growth of *C. kanran* plants, indicating the adaptability of this subtropical orchid to a range of root zone temperature. Both *C. goeringii* and *C. kanran* grown in CP had more vigorous roots and healthier leaves with a desirable top to root (T/R) ratio, compared to those grown in BPP or GCP. Result of this study indicates that optimum root zone temperature can best be maintained by such containers as CP which buffers temperature fluctuations.

**1340-1440**

**S11-P-71**

**IDENTIFICATION OF A CYTOPLASMIC AND GENETIC MALE STERILITY IN PETUNIA**

Cheong Young Song\*<sup>1</sup>, Chang Suk Bang<sup>2</sup>

<sup>1</sup>Dept. of Floriculture, Korea National Agricultural College, 11-1 Dongwha-ri Bongdam-eup, Hwasung-si, Kyonggi-Do, Korea, 445-890; <sup>2</sup>National Horticultural Research Institute, Suwon, Kyonggi-Do, 441-440, Korea

This experiment was carried out to determine types of male sterility (MS)

petunia lines either by exposing to different temperatures or determining their fertility levels by self and cross pollinations. The 12 MS lines with different colors and growth characteristics derived from several kinds of commercial cultivar were selected and self-pollinated by selfing at low temperature during Spring from 1993 to 2001. To distinguish the type of MS, all the selected MS lines were exposed to the temperature of 15, 20, 25 and 30 °C in the growth chamber. When exposed to the temperature of 15 °C, all the lines had pollen grains in the anthers, indicating fertile nature, and almost all the lines had a few pollen grains at 20 °C under microscopic observation. All the lines, however, had no pollen at 25 and 30 °C. In March and April, all the lines produced seeds by selfing in a greenhouse with night temperature of 15 °C. However, the percentage of fertility was low (50%), and also the number of seeds in a capsule was low (30 to 60) compared to those of normal inbred lines. In summer, from July to August, all the lines of MS did not have pollen grains, thus they did not produce seeds by self-crossing. All the MS lines were crossed with several normal inbred lines to find out their fertilities. The F1 plant by crossing between MS lines of maternal plant and normal inbred of paternal plant had enough pollen and produced many seeds (200 to 300) by self pollination. MS lines used in the experiment were shown to be sensitive to the temperature, an indication of characteristic of cytoplasmic MS. The F1 lines also showed pollen grains in the anthers, indicating the genetic MS nature of MS. The results of this experiment, therefore, suggest that the type of MS in petunia lines can be classified as cytoplasmic as well as genetic male sterility.

**1340-1440**

**S11-P-72**

**FORCING OF *CAMPANULA MEDIUM* CHAMPION CULTIVARS**

J.S. Song<sup>1</sup>, T.I. Kim<sup>2</sup>, M.S. Roh<sup>3</sup>

<sup>1</sup>Rural Development Administration, National Horticultural Research Institute, 540-41 Tap-Dong, Kwonseon-Ku, Suwon, Korea, 441-440; <sup>2</sup>Chungbuk Prov. Agriculture Research and Extension Services, Umsung Protected Agriculture Experiment Station, 3 Osan-Ri, Daeso-Myun, Umsung, 369-824, Korea; <sup>3</sup>U.S. Dept. Agriculture, Agricultural Research Service, U.S. National Arboretum, Floral and Nursery Plants Research Unit, Beltsville, MD 20705 USA

Common *Campanula medium* is a biennial plant which requires at least 12 weeks of vernalization for flowering. *Campanula medium* F1 hybrids, 'Champion Blue' and 'Champion Pink', were introduced to the US floral market in 1999 as a new annual crop. We investigated the effects of temperature, light, nutrition, and growth retardant on growth and flowering of the hybrids for cut flowers and pot plant. In Expt. 1, seeds were sown on Sept. 7, 1997 and seedlings were transplanted to 5 cm pots on Oct. 22. Seedlings were grown in greenhouses maintained at 14/12, 17/15, and 20/18 °C under a natural and HID-HPS light (350 mmol·m<sup>-2</sup>·s<sup>-1</sup>) supplemented for 12 hours per day for 4 weeks from Oct. 27, and then moved to 15/12 °C greenhouse. Plants were moved to greenhouses maintained at 7/5 and 14/12 °C (day/night) on Dec. 23 and grown for 4 weeks. Plants were then grown in 17/15 °C greenhouse until completion of experiment. In Expt. 2, seeds were sown in 20/18 °C greenhouse on Nov. 27, 1998, transplanted into 10 cm pots on Feb. 15. The plants were divided into 4 groups, depending on the height and floral development. 20 mL of 5 ppm ancymidol solution was applied to each pot on Feb. 21 and 28. In Expt. 1, flowering was not affected by temperatures in both cultivars, but was accelerated by HID light only with Champion Blue. Flowering was accelerated and plant height was reduced in both cultivars when grown at 14/12 °C. The number of flowers were not affected by all treatments. The number of bottom bud-break was increased by HID light. In Expt. 2, ancymidol reduced the height of plants and delayed flowering as compared to control plants, and these effects were more pronounced when younger plants under vegetative growth were treated as compared to developed plants with several florets formed. The number of flowers on the main stem as well as the number of total bottom breaks and flowers on these breaks were not affected by the growth retardant treatment.

**1340-1440**

**S11-P-73**

**FLOWERING RESPONSE OF EIGHT PERENNIALS NATIVE TO KOREA INFLUENCED BY HEATING TIME, COLD TREATMENT AND GA<sub>3</sub>**

J.S. Song<sup>1</sup>, H.T. Chang<sup>2</sup>, J.S. Lee<sup>3</sup>, C.H. Bang<sup>1</sup>

<sup>1</sup>Rural Development Administration, National Horticultural Research Ins, 540-41 Tap-Dong, Kwonseon-Ku, Suwon, Korea, 441-440; <sup>2</sup>Daehan Nursery Co., 452-1

Kwangpyong-Ri, Masan-Myun, Kurye, 542-820, Korea; <sup>3</sup>Seoul Women's Univ., College of Natural Sciences, 126 Kongrungs2-Dong, Nowon-Ku, Seoul, 139-774, Korea

Many perennial plants that flower in the spring has a chilling requirement. *Hylomecon hylomeconoides*, *Dicentra spectabilis*, *Hepatica asiatica*, *Caltha palustris* var. *membranacea*, *Pulsatilla koreana*, *Primula sieboldii*, *Adonis amurensis*, *Aquilegia flabellata* var. *pumila*, native to Korea possess good characteristics for use as potted and also bedding plants. The objective of this research is to investigate the effects of cold and GA<sub>3</sub> treatment on growth and flowering of these perennials. Plants that were planted in outdoor were harvested and moved to a heated forcing greenhouse at 15-day intervals starting from Nov. 1 for 8 times. Also, plants were harvested and stored at 2 °C cooler up to 90 days and transferred to a heated forcing greenhouse at 15-day intervals. Flowering was accelerated and flowering percentage was increased when *Hylomecon hylomeconoides*, *Dicentra spectabilis*, *Hepatica asiatica*, *Caltha palustris* var. *membranacea*, *Pulsatilla koreana*, *Primula sieboldii*, *Adonis amurensis* were treated with cold temperature. *Hylomecon hylomeconoides* did not flower when transferred to a forcing greenhouse before Dec. 16. However, more than 63% of plants flowered when transferred after Jan. 16. This suggests that *Hylomecon hylomeconoides* required longer period cold requirement than others. *Hylomecon hylomeconoides* and *Hepatica asiatica* required longer than 60 days of 2 °C, while *Caltha palustris* var. *membranacea*, *Primula sieboldii*, and *Dicentra spectabilis* required 30 to 45 days of 2 °C treatment for flowering. The effect of cold treatment could be replaced by soaking harvested plants in 200 ppm GA<sub>3</sub> solution for 2 minutes for *Hylomecon hylomeconoides*, *Caltha palustris* var. *membranacea*, *Hepatica asiatica*, *Primula sieboldii*, *Adonis amurensis*, and *Pulsatilla koreana*, but not for *Dicentra spectabilis*.

**1340-1440**

**S11-P-74**

**SELECTION AND MORPHOLOGICAL CHARACTERS OF VARIEGATED PLANT BY COLCHICINE SEED TREATMENT ON WILD LILY (*LILIUM LEICHTLINII*) OF KOREA**

Jong-Taek Suh\*, Kwang-Soo Cho, Mi-Hee Yang

Heunggae 3RI, Doam-Myon, National Alpine Agr. Expt. Station, Pyungchang, Gangwon, South Korea, 232-955

This study was conducted to produce the mutant plant from wild lilies collected in Korea. To get the new plant, the seeds of lilies were treated with colchicine at concentrations of 10, 20 and 30 mg/L for 12, 24 and 48 hours, respectively. The results are as follows. The morphological characters, especially leaf character of the selected variegated plant, were significantly different from normal plants; the plant was variegated with white color compared with the normal plants and the color of a leaf in variegated plant consisted with 3/5 white and 2/5 green. Plant height, leaf number, and leaf width of variegated plants were 76.5, 33.3, and 0.73 cm, respectively, but those in normal plants were 96.0, 39.0, and 0.80 cm, respectively. However, the length of leaf in variegated plant was 11.8 cm, as compared to 7.6 cm in normal plant. And the size of guard cells in variegated plant was twice larger, 5,097 μm<sup>2</sup>/cell as compared to 2,665 μm<sup>2</sup>/cell in normal plants. This is the first variegated plant produced by treatment of colchicine in wild lily of Korea.

**1340-1440**

**S11-P-75**

**BLUE FILTERING LIGHT EFFECT ON PREVENTING ANTHOCYANIN ACCUMULATION IN THE LEAF ON *HANABUSAYA ASIATICA***

Dong-Lim Yoo\*, Ho-Sun Lee, Seung-Yeol Ryu, Myoung-Soon Yiem

Dept. of Horticulture, National Alpine Agricultural, Experiment Station, RDA, Doam, Pyong-chang, Korea, 232-955

One of Korean endemic plants, *Hanabusaya asiatica*, has beautiful flowers as ornamental plant. It belongs to Campanulaceae and grown in highlands (over 1000 m above sea level). Recently Korean native plants are attracting Korean's interests as commercial flowering crops. Especially *Hanabusaya* is one of the well-known native plants for ornamental in Korea. Even though there has been a sharp rise in demand, the supply is not large enough to meet the demand from the public, due mostly to the problems associated with mass propagation and production for commercial pot plant. For example, as a result of accumulation of anthocyanin in the leaves at reproductive stage, the leaf veins turn to

brownish black and whole leaves become to necrosis and dry after all. This has been a decisive problem for production of commercial pot plant of *Hanabusaya* here in Korea. This study was carried out to find out the suitable method for preventing the accumulation of anthocyanin in leaves by light quality. *Hanabusaya* was treated three filtering light quality, red, blue, far-red and control (shading) on the middle stage of vegetative growth. In this study, it was very difficult to make and maintain single color wavelength condition in the field for commercial pot plant cultivation. In spite of mixing with other wavelength, some pieces of acrylic plate with single color as red or blue by transparency were used for filtering light quality treatment as the level of commercial adaptation. Blue filtering light treatment was very effective to prohibit accumulation of anthocyanin in the leaves. Red and control (shading) treatment showed accumulation of anthocyanin in leaves. However the contents of anthocyanin in flower petals were reduced by blue filtering light treatment. On the contrary, red filtering light treatment increased the anthocyanin contents in flowers. It needs more research to produce high quality pot plant of *Hanabusaya asiatica*.

**1340-1440**

**S11-P-76**

**IDENTIFICATION OF SOMACLONAL VARIATION IN *DORITAENOPSIS* 'HAPPY VALENTINE'**

Jong Sun Yun\*<sup>1</sup>, Eui Yon Hong<sup>1</sup>, Ik Hwan Kim<sup>1</sup>, Tae Yun<sup>1</sup>, Kee Yoeop Paek<sup>2</sup>

<sup>1</sup>Experiment and Research Dept., Chungbuk Agri. R. E. Services, Ochang Gejung 383, Cheongwon, Chungbuk, South Korea, 363-880; <sup>2</sup>Research Center for the Development of Advanced Horticultural Tech., Chungbuk National Univ., Cheongju 361-763, Korea

The morphological and genetic variations in somaclones of *Doritaenopsis* 'Happy Valentine' derived from tissue culture were evaluated. The somaclones of *Doritaenopsis* 'Happy Valentine' propagated from protocorm-like bodies were subcultured for 2 years, and the mericlones were allowed to flower. Clear differences were found in the shape of leaves and flowers. In some somaclones, leaves were thickened and flowers were deformed. We investigated the use of the PCR and the associated random amplification of polymorphic DNA technique in the analysis of DNA polymorphism in regenerated plants. The randomly amplified polymorphic DNA (RAPD) data indicated that normal and variant somaclones are genetically different. For investigating the genetic variation, the sequence analysis of the 5.8S and internal transcribed spacers (ITS1 and ITS2) of the ribosomal DNA in normal and variant somaclones is underway in our laboratory.

**1440-1520**

**S11-O-77**

**ORNAMENTAL PLANT RESOURCES FROM CHINA**

Liangjun Zhao<sup>1</sup>, Donglin Zhang\*<sup>2</sup>

<sup>1</sup>Dept. of Ornamental Horticulture, China Agricultural Univ., Beijing, 100094, China; <sup>2</sup>Landscape Horticulture, Univ. of Maine, 5722 Deering Hall, Orono, Maine, 04469-5722 USA

China, "the mother of garden," is the only country in the world with unbroken connections among tropical, subtropical, temperate, and boreal forests, which nourish nearly one-eighth of the world plant species. As early as 2000 years ago, the Chinese has been cultivated plants around buildings as ornamentals. To better understand the potential ornamental plant resources in China, we investigated the origin and history of more than 50 popular ornamental plant genera, especially the survivors from glaciation in the Northern Hemisphere. We, then, compared them with existing ornamental plants around the world. With abundant plant resources and rich horticultural tradition, China has contributed more than 50% of today's ornamental plants. Plant exploitation for ornamental purpose was initiated in the 1900s in China with a representative of "Chinese" Wilson. The majority of Chinese ornamental plants were introduced to western countries during this time. Since then, wars and internal disturbance stopped the continuation of ornamental plant exploration. After 1978, the rich flora and many new ornamental plants in China were brought to worldwide attention. The economic potential has also increased the market share of Chinese ornamental plants domestically and internationally. With advanced breeding programs and biotechnology, China will continue to play the leading role in the ornamental horticulture. Further studies should focus on the germplasm preservation and market strategies of the new ornamental plants from China.

**1520-1540**

**S11-O-78**

**GENETIC RESOURCES FOR NEW CULTIVAR BREEDING OF SELECTED ASIAN ORNAMENTALS**

Kyung-Ku Shim, Yoo-Mi Ha\*

Dept. of Landscape Architecture, Sung Kyun Kwan Univ., Suwon 440-746, Korea, Suwon, Kyung-Ki Do, South KOREA, 440-746

In South Korea, genetic resources with horticultural potential for new cultivar breeding of Korean native ornamental trees such as *Pyrus calleryana* var. *fauriei*, *Sorbus alnifolia*, *Hibiscus syriacus* (Korea national flower), *Corylopsis coreana*, *Forsythia koreana*, *Stewartia koreana*, *Buxus microphylla* var. *koreana*, *Crataegus pinnatifida*, *Cornus kousa*, *Aristolochia manshuriensis*, and *Ardisia pusilla* will be introduced. F1 hybrids with red leaves were selected from the seedlings bred by crossing *P. calleryana* var. *fauriei* with *P. pyrifolia* cv. 'Ohara beni'. Out of 92 open-pollinated seedlings of F1 hybrid with red leaves, only 14 progenies had purple leaves and their morphological characteristics such as red leaves was inherited from mother plant. Therefore, these selections with red leaves originated from Korean native *P. calleryana* var. *fauriei* are also regarded as valuable genetic resources for new variety breeding. Korean native *Sorbus alnifolia* collected from its habitats showed genetic variation such as larger leaves and flowers than those of typical species, i.e., semi-weeping tree form with slender upright tree canopy. *Hibiscus syriacus*, the national flower of Korea, has been widely planted in the country for long time and thereby there are many valuable genetic resources. A native one hundred year old tree, 'Andong', is deciduous, multiple stemmed, dwarf shrub and the size is 120 cm in height, 65 cm in width at the most. More than 90% of F1 of this variety showed dwarf tree form and small flower than those of native cultivars. Therefore, 'Andong' can be utilized as genetic resource for new breeding. Clones of Korean native *Corylopsis coreana* from several habitats, showed diverse genetic variations in fragrance, leaf color, maturing time, and autumn foliage color. Korean indigenous *Forsythia koreana* is widely planted in the country for a long time and therefore has various genetic resources such as gold leaf variegata and greater flower size than that of native species.

**1540-1600**

**S11-O-79**

**THE IMPORTANCE OF ASIA-ORIGINATED PLANTS IN FOLIAGE PLANT INDUSTRY**

Jianjun Chen\*<sup>1</sup>, Dennis B. McConnell<sup>2</sup>, Richard J. Henny<sup>1</sup>

<sup>1</sup>Univ. of Florida, IFAS, MREC, 2725 Binion Road, Apopka, FL 32703 USA; <sup>2</sup>Univ. of Florida, Dept. of Environmental Horticulture, 1519 Fifield Hall, Gainesville, FL 32611

Almost all ornamental foliage plants are indigenous to the world's tropical and subtropical regions. A distinctive characteristic of foliage plants is their ability to tolerate low light levels. It is because of this quality these plants are grown and sold for indoor use. The utilization of plants in private residences and commercial establishments has increased dramatically during the last half-century, and the wholesale value of foliage plants in the USA. has risen from \$13 million in 1949 to \$574 million in 2000. The continuous growth of the foliage plant industry has been made possible by technological advances in production. However, increased interest and market demand for foliage plants is largely attributed to the activities of plant collectors and plant breeders who have introduced a multitude of diverse plant species and/or cultivars. Tissue culture laboratories can rapidly increase these new cultivars to meet market demand. Currently, more than 500 species and/or cultivars from at least 100 plant genera are produced as foliage plants with about 40 genera indigenous to Asia. The introduction of *Aspidistra*, *Codiaeum*, *Cordylone*, *Dracaena*, *Epipremnum*, *Ficus*, *Hoya*, *Begonia*, and *Sansevieria* genera in the late 1800s and early 1900s helped lay the foundation of the industry. Later introductions of *Aglaonema*, *Schefflera*, *Alocasia*, *Spathiphyllum*, *Phalaenopsis*, and other genera contributed substantially to the industry's growth and development. Details of how some plants originating in Asia became major players in the foliage plant industry will be discussed.

**1600-1620**

**S11-O-80**

**ASIAN PLANTS WITH HORTICULTURAL MERITS**

Kunso Kim\*



The Morton Arboretum, 4100 Illinois Rt 53, Lisle, IL 60532 USA

The Morton Arboretum has a long-standing commitment of plant explorations and germplasm utilization to Asian countries. Through 80 years history, the institution maintains over 41000 mostly woody plants represented by 3,300 accessions in its Taxonomic, Geographic, Special Habitat, and Horticultural collections. The institutions' Collections and Research Programs focus on collecting, breeding, evaluating, selecting, and promoting woody plants that have potential in the urban landscapes and in the rigorous climate of Midwestern U.S. The Arboretum has introduced through Chicagoland Grows Program, several selections that are of Asian origin. These include *Acer miyabei* 'Morton' (State Street Miyabe Maple), *Syringa pekinensis* 'Morton' (China Snow Peking Lilac), *Ulmus* 'Morton' (Accolade Elm), *Ulmus* 'Morton Glossy' (Triumph Elm), *Ulmus* 'Morton Plainsman' (Vanguard Elm), *Ulmus* 'Morton Red Tip' (Danada Charm), and *Ulmus* 'Morton Stalwart' (Commemoration Elm). The Elm cultivars were resulted from George Ware's life long study of Asian Elms by incorporating their resistance to Dutch Elm Disease into his research. As evidenced from the above example, the potential of Asian germplasm is enormous in developing promising plants for the North American horticulture. Diverse growing conditions such as urban situations and rigorous climate are challenging and require plants that are adaptable to variety of conditions. This talk will present some challenges in today's ornamental horticulture in North America and highlight Asian plants that demonstrated their value to overcome the challenges and will discuss some Asian woody plants that have potential.

1620-1640

S11-0-81

**PHENOLOGY OF SOME LANDSCAPE TREE SPECIES UNDER SEMIARID CONDITIONS OF HARYANA STATE, INDIA**

D.S. Dahiya\*

Dept. of Horticulture, CCS Haryana Agricultural Univ., Hisar-125004 Haryana, India

Phenological observations are given on 44 species of ornamental trees encompassing 23 botanical families growing on about 300 ha. well developed and landscaped campus of the university. Observations on growth and flowering parameters were recorded for one complete calendar year. Hisar is situated in subtropics at 29° 10' North Latitude and 75° 40' East Longitude. Phenological categories were distinct for each growth and flowering parameters. Twelve trees were small in height (<10 m), 22 medium (10-15 m) and 10 were large-sized (>15 m), whereas the spread of 18 trees was small (<6 m) and rest of 26 trees had large crown spread (>6 m). A total of eight canopy shapes were recorded; out of which 12 trees had hemispherical shape, 4 pyramidal and spreading each, 1 upright and columnar each, 7 weeping, 3 open headed and 12 trees had irregular shapes. Growth pattern of trees was evergreen, 22; deciduous, 16; and semi-deciduous, 6. Three distinct phenological categories could be recognized on flowering: species flowering once a year (86.36%), twice a year (4.54%) and species which did not produced flowers (9.10%). 13 species produced small flowers (<2 cm), 10 medium (2-4 cm) and rest 11 large flowers (>4 cm). This study will be of immense importance to landscape horticulturists or architects for their use in similar climatic conditions.

1640-1170

S11-0-81-A

TO BE ANNOUNCED

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Thursday · August 15

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1100-1140

S11-0-82

**THE GLOBALIZATION OF GINSENG**

J.T.A. Proctor<sup>1</sup>, W.G. Bailey<sup>2</sup>

<sup>1</sup>Dept. of Plant Agriculture, Division of Horticultural Science, Univ. of Guelph, Guelph, Ontario, Canada N1G 2W1; <sup>2</sup>Dept. of Geography, Simon Fraser Univ., Burnaby, British Columbia, Canada V5A 1S6

Ginseng is the world's most widely used medicinal plant. The ginseng family, Araliaceae (Order, Umbelliferales) includes the genus *Panax*, which consists of 11 recognized species, 9 of which are from Asia and 2 from eastern

North America. Members of this genus have been used in the traditional medical practices of many cultures in Asia since the beginning of recorded history. Ginseng usage in western cultures is relatively recent and can be traced to native Indians in eastern North America. As the world more seriously embraces phytomedicines, ginseng will continue to play a significant role although numerous challenges exist. The taxonomy, nomenclature, genetics and biochemistry of the species needs international standardization. For instance, global standards for chemical constituents of the ginseng plant must be created and integrated into the technologies and methodologies used in clinical trials. Expansion of global ginseng production in the last 20 years has changed its image from an obscure medicinal plant with substantial financial returns, to one with reduced returns to producers. To meet this challenge, enhancement of production efficiency is necessary. Substantive issues are: resolving the replant problem, and permitting the successful reuse of ginseng production land; improving knowledge of seed physiology and management, refining the seed stratification process, and increasing germination efficiencies: decreasing the use of pesticides through the development of comprehensive integrated pest management programs; increasing the quality of the natural forest and artificial growing environments for successful plant production; enhancing harvesting, storage, drying and processing technology for ginseng and ginseng products; and adapting, developing and refining mechanization for all phases of the ginseng production system. These many issues cannot be accomplished without research expertise, concerted and ongoing research funding support, and strong agribusiness leadership.

1140-1220

S11-0-83

**HISTORY OF GINSENG CULTIVATION IN THE ORIENT**

Hoon Park\*

Ginseng Institute, Chung-Ang Univ., Ansung & Bio-Resource Institute, BiOriGin Inc., Yongin, Kyunggi-Province, Korea

The history of *Panax ginseng* cultivation was explained according to legend, terminology, cultivation methods, ethnic tradition and literature. Legends on ginseng discovery and first cultivation were collected from all 9 provinces throughout Korea except northern 4 provinces in North Korea. Stories on collection and sowing of seeds by a person who found mountain ginseng and used it effectively were the common part of all legends. Ginseng growers still use an old word "Julgi" indicating aerial part for stem "Julgi" The letter "seng" appeared on bone of about 3500 years old in China. The 4th Tan King Osagu (2137 BC) of the Old Choseon dynasty firstly found mountain ginseng. Seven kinds of efficacy of ginseng were described in Shen nung pen tsao ching. Shen nung (3218-2698 BC) was known as Dong Yi. Primitive cultivation could be seed collection from mountain ginseng and sowing it in the similar places of mountain much earlier than Shen nung pen tsao ching was written. This type of cultivation could be practiced only in Korea since ginseng has been proper noun in Korea but general noun in China and Japan. Mountain ginseng (Sansam) includes "Man Grade" as the third grade of three grades. "Man Grade" ginseng is the one grown from seeds sown by ginseng digger (Symmani). "Ginseng Praise", an old poem of Goguryeo dynasty (3 BC-668 AD), was introduced in Ming yi pie lu in Liang dynasty (502-557 AD). This poem described physiological characteristics of ginseng plants. Seed collection and sowing of ginseng as vegetable cultivation method in the Choseon dynasty was described in Pen tsao gang mu (1552 AD). Ginseng cultivation record appeared in King Seon Jo era (1567-1608 AD). Basic method of present cultivation seems to be practiced at that time. Highly developed current cultivation technique, such as seed treatment, field selection, soil preparation etc. and quality control measure suggest a long period of cultivation experience. Chinese has long been believing that the cultivated Korean ginseng has same efficacy of Chinese wild ginseng and the grown ginseng in China has better efficacy when originated from seedlings grown in Korea. In China, first cultivation started in northeast area in around 1730. In Japan, the cultivation started with seeds and fresh roots from Korea in Tokyo in 1727-1728.

1220-1240

S11-0-84

**A CHEMICAL ANALYSIS OF ANTIOXIDANT VITAMINS IN FRESH CURRY LEAF (*MURRAYA KOENIGII*) BY REVERSED PHASE HPLC WITH UV DETECTION**

Usha R. Palaniswamy\*<sup>1</sup>, Christian Caporuscio<sup>2</sup>, James D. Stuart<sup>2</sup>

<sup>1</sup>School of Allied Health, Asian American Studies Institute, U-2101, Univ. of Con-

necicut, Storrs, CT 06269 USA; <sup>2</sup>Dept. of Chemistry, U-3060, Univ. of Connecticut, Storrs, CT 06269 USA

Curry leaf (*Murraya koenigii* Rutaceae) is an essential leafy spice used in Asia cuisines for its distinct flavor. Curry leaf has been used in folk medicine in China and other Asian countries as analgesic, astringent, antidysenteric, antioxidant, febrifuge, hypolipidemic, hypoglycemic, for improvement of vision, treating night-blindness and for regulation of fertility. The objective of the study was to determine the levels of antioxidant vitamins alpha-tocopherol, beta-carotene and lutein in fresh curry leaves available locally by reversed phase gradient HPLC. Curry leaves were purchased from four local Asian grocery stores in each of the states of in Connecticut, New Jersey and New York, and pooled for sampling. One gram of leaf tissue was homogenized for three minutes in 20 mL of 10 mM sodium phosphate water containing 0.15 N sodium chloride buffered to pH 4.7. Two milliliters of methanol containing 0.5 mg/mL butylated hydroxytoluene and 10 mL of 1 mg/mL internal standard in hexane were added and vortexed for five minutes, followed by centrifugation for 10 minutes. After two extractions of vortex-mixing and phase separation by centrifugation, the organic layer was filtered and injected into the HPLC. A rapid 20 min gradient of solvent mixture A: 85% acetonitrile, 2.5% hexane, 2.5% methylene chloride, and 10% methanol and solvent B: 50% acetonitrile, 20% hexane, 20% methylene chloride, and 10% methanol at a flow rate of 1 mL/min was used. The diode array was set at 270 nm for beta-carotene and lutein and 290 nm for alpha-tocopherol. Results indicate that the fresh curry leaves obtained from the three New England states contained 9744 ng of lutein, 212 ng of alpha-tocopherol, and 183 ng of beta-carotene per gram fresh weight.

**1340-1440**

**S11-P-85**

**MASSPROPAGATION OF *DIONAEA MUSCIPULA* BY TISSUE CULTURE**

S.J. Kwon, H.H. Kim, J.K. Hwang, C.H. Lee\*

Dept. of Horticulture, Chungbuk National Univ., Cheongju, 361-763, Korea

Leaf blades, petioles (upper, middle, lower) and rhizome of *D. muscipula* were subjected to in vitro culture and the best regeneration was obtained with upper part of petioles. The addition of 1 mM BA and 1 mM NAA singly or combination of 2 mM kinetin and 1 mM NAA to basic MS media promoted the plant regeneration. Culturing upper leaf petioles on 1 MS, 1/2 MS, 1/4 MS and Parlman media demonstrated that lower concentration MS media was better in the plant regeneration, but best regeneration was obtained with Parlman media. High concentration of activated charcoal was effective in plant growth, and treatment of 100 and 200 mg/L of ascorbic and citric acid singly or in combination was also effective in plant growth. PVP, DTT, DTE, MnSO<sub>4</sub> 4H<sub>2</sub>O and CuSO<sub>4</sub> 5H<sub>2</sub>O was either not effective, or inhibitory to plant regeneration. Agar concentration affected plant growth, the lower the better growth. To determine the effects of light on plant regeneration, plants were maintained under dark or light conditions, and under dark for 1, 2, 3 and 4 weeks and then moved to light condition. Result showed that longer dark period was better for plant regeneration and growth.

**1340-1440**

**S11-P-86**

**CHARACTERIZATION OF *EPIMEDIUM KOREANUM* LOCAL VARIETIES COLLECTED IN SOUTH KOREA**

Soon-Ryang Park<sup>1</sup>, Byoung-Ryouri Choi<sup>2</sup>, Young-Sang Lee<sup>1</sup>, Young-Ho Kim<sup>2</sup>, Yong-Ho Kim<sup>1</sup>

<sup>1</sup>Crop Science Div., Kyonggi ARES, Taeon-Eup Kisan-Ri 315, Hwasong, Kyonggi-Do, South Korea, 445-972; <sup>2</sup>Crop Div. Kyonggi ARES, Hwasong, 445-972 South Korea

As a part of breeding program, local varieties of *Epimedium koreanum* N. were collected in South Korea and their morphology, yield, and functional compound characteristics were evaluated. Total of 51 local varieties were collected from Kyonggi and Kangwon province areas and the collected plants could be classified into three groups based upon their morphological characteristics: plants with 1) 3 branches and 9 leaves (86%) 2) 3 branches and 3 leaves (6%), and 3) others (8%). After 5 years of cultivation in experimental station's research field, collected plants exhibited wide variations in plant height, ranging from 22.6 to 41.2 cm with an average of 30.8 cm. Yield-related growth param-

eters such as leaf area and shoot dry weight ranged from 678 to 2,466 with an average of 1,464 and from 9.0 g to 32.7 g with an average of 17.5 g, respectively. Collected plants also showed wide variations in functional compound properties in that the extract contents and icariin contents ranged from 25% to 41% with an average of 30.9%, and from 0.20% to 1.08% with an average of 0.52%, respectively.

**1340-1440**

**S11-P-87**

**EFFECTS OF CULTURAL CONDITIONS ON THE IN VITRO PROPAGATION OF PLANTLETS DERIVED FROM APICAL MERISTEM IN *IPOMOEA BATATAS***

Jong-Seon Eun<sup>\*1</sup>, Jong-Suk Park<sup>2</sup>, Young-Seon Kim<sup>3</sup>

<sup>1</sup>Faculty of Biological Resources Sci., College of Agriculture, Chonbuk National Univ., Chonju 561-756, South Korea; <sup>2</sup>Institute of Bioindustry, Chonbuk National Univ., Chonju 561-756, South Korea; <sup>3</sup>Dept. of Ornamental Horticulture Industry, Namdo Provincial College of Jeonnam, Changheung 529-850, South Korea

The sweet potato is a crop propagated vegetatively by vine cuttings, an ineffective method for maintaining pathogen-free stock plants. Single-node culture of virus-free plantlets derived from apical meristem in sweet potato (cv. Yulmi) was examined. Effective pH range, sugar concentration and nodal order for in vitro propagation were investigated to establish the mass propagation system with high quality and distribute virus-free stock plants to the growers. Single-nodes were cultured in Murashige and Skoog (1962) basal medium supplemented with 0.1 mg/L NAA, 0.9% (W/V) agar under a 16-h photoperiod provided by fluorescent lights at 28 °C. Growth responses were observed in various pH ranges of 4.3–6.3 with 3% sugar, sugar concentrations of 1%–10%, and node order (1st to 8th) after 30 days of culture. The pH range seemed to be relatively wide but the most effective pH of the medium was 4.8 for various plant growth responses. Shoot length of in vitro plantlet at pH 4.8 was the longest with 5.2 cm and the shortest in pH 6.3 with 3.6 cm. The explants placed on medium having pH 4.8 showed the best growth with root length of 9.9 cm and 7.9 nodes. Though the medium adjusted to pH 4.8 showed good results in the leaf area, fresh weight of shoot & root, and dry weight of shoot, there were no significant differences according to the DMRT ( $p=0.05$ ) among various pH. Sugar concentration of 60–80 g/L resulted in increased growth in shoot and root length, number of nodes, leaf area, and fresh and dry weight of shoot and root. By reducing sugar contents below 6%, reduced growth response was obtained. In the medium added with 1% sugar, plantlet became dwarf, somewhat yellowish with smaller leaves. The first node including meristem tip was the best in the shoot length, root length, number of nodes and fresh weight of shoot. The other nodes were very similar in growth responses. Uniform plantlets can be obtained massively at the same time by single-node culture except for the node including meristem tip.

**1340-1440**

**S11-P-88**

**CHANGES IN GLUCOSINOLATE CONCENTRATIONS DURING GROWING STAGES OF TAI TSAI (*BRASSICA CAMPESTRIS* L. SSP. *CHINENSIS* VAR. TAI-TSAI HORT.) AND POT HERB MUSTARD (*BRASSICA JUNCEA* COSS.)**

H. He<sup>\*1</sup>, G. Fingerling<sup>2</sup>, W.H. Schnitzler<sup>2</sup>

<sup>1</sup>Nutrition and Sensory Quality Lab, Beijing Vegetable Research Center, P.O. Box. 2443, Beijing 100089, China; <sup>2</sup>Chair of Vegetable Science, Technical Univ. of Munich, 85350 Freising, Germany

Studies were conducted on the changes in glucosinolate concentrations during growing stages of pot herb mustard (*Brassica juncea* Coss) and tai tsai (*Brassica campestris* L. ssp. *chinensis* var. tai-t sai Hort.). The total glucosinolate concentration declined from transplanting to harvest for both vegetables. In pot herb mustard, levels of progoitrin, gluconapin, 4-hydroxyglucobrassin and gluconasturtiin decreased continuously until 5 weeks after transplanting (WAT). Highest concentration of glucobrassin and neoglucobrassicin were detected at 1 WAT. Similar results were also obtained from tai tsai but there was still an increase in the glucobrassicin level until 2 WAT. For pot herb mustard and tai tsai, highest concentration of glucobrassicinapin was detected at 2 WAT. In tai tsai, progoitrin and gluconasturtiin showed an initial decrease until 2 WAT and

remained almost constant until harvested (5 WAT). After 3 WAT, there was an upward trend in gluconapin until harvest. The total glucosinolate content of tai sai decreased over the growing period with an exception at 3 WAT.

**1340-1440**

**S11-P-89**

**HEIGHT AND COLOUR OF NYLON NET AS THE ROW COVERS AND FLOATING ROW COVERS AFFECTED ON MICROCLIMATE AND YIELD OF THE PESTICIDE FREE CHINESE KALE**

Montree Issarakraisila\*

Institute of Agricultural Technolog, Walailak Univ., Tasala, Nakhon Si Thammarat, Thailand, 80160

White and blue nylon nets were used as both row and floating row cover materials for growing the pesticide free Chinese kale in the tropics. The row covers were designed as the rectangular shape tunnels with 65 or 30 cm high and 90 or 140 cm width, respectively. Small bamboo posts and wire or u-shape iron hoops were found to be suitable for the framework of the low tunnels. White nylon net decreased light intensity by 10% and blue nylon net decreased light intensity by 28%. Temperatures inside and outside the tunnels were not different when the tunnel was 65 cm high. But temperature inside the tunnel increased 1-3 °C during the midday period when the tunnel height was reduced to 30 cm. Temperatures above the beds which directly covered by white or blue nylon net (floating row covers) also increased 1-5 °C during the midday period. The temperatures were slightly lower by blue colour compared with the white one. The blue nylon net increased relative humidity 3%-5% both in the row covers with 65 cm high and floating row covers at daytime. While the white nylon net of floating row covers slightly decreased relative humidity during the mid day period. When the tunnel was lower to 30 cm the relative humidity inside was slightly lower than the outside both in blue and white nets. White and blue nylon nets reduced the rate of evaporation 13%-19% and 22%-28%, respectively. White nylon net tunnels with 65 cm high did not decrease yields and with 30 cm high slightly decreased yields compared with control whereas the blue net lowered yield 15%-20%. The floating row covers by white nylon net did not affect yields of Chinese kale grown by direct-field seeding whereas significantly reduced crop grown by transplanting.

**1340-1440**

**S11-P-90**

**A PROTOCOL FOR DETECTION OF SWEETPOTATO FEATHERY MOTTLE VIRUS IN TISSUE CULTURE REGENERATED PLANTS BY REVERSE TRANSCRIPTION POLYMERASE CHAIN REACTION**

Jong-Seon Eun\*<sup>1</sup>, Jae-Hun Jeong<sup>2</sup>, Debasis Chakrabarty<sup>2</sup>, Young-Seon Kim<sup>3</sup>, Kee-Yoeup Paek<sup>2</sup>

<sup>1</sup>Fac. of Biological Resources Sci., College of Agriculture, Chonbuk National Univ., Chonju 561-756, South Korea; <sup>2</sup>Research Center for the Development of Advanced Horticultural Technology, Chungbuk National Univ., Cheongju 361-763, South Korea; <sup>3</sup>Dept. of Ornamental Horticulture Industry, Namdo Provincial College of Jeonnam, Changheung 529-850, South Korea

A reverse transcription polymerase chain reaction (RT-PCR) protocol was developed using two specific 22-mer primers located in coat protein gene of SPFMV. A 411 bp PCR-product was detected in virus infected some of the tissue culture raised sweet potato but not in healthy plants. For optimization of RT-PCR protocol we determined the optimum crude nucleic acid concentration, annealing temperature, primer concentration and number of PCR-cycle for maximum sensitivity and specificity of PCR. The optimum condition for RT-PCR was as follows: RT-PCR reaction mixture was one-step mixture, containing 50 pmol of primer, 30 units of reverse transcriptase, 5 unit of RNasin, and the crude nucleic acid extracts (200 ng). In RT-PCR, cDNA was synthesized at 42 °C for 45 min before a quick incubation on ice after pre-denaturation at 95 °C for 5 min. The PCR reaction was carried out in 40 cycle at 96 °C for 30 seconds, 63 °C for 30 seconds, 72 °C for 1 min, and finally at 72 °C for 10 min. The viral origin of the amplified product was confirmed by sequencing, with the sequence obtained having 95%-98% homology with published sequence data for SPFMV. The benefits of this RT-PCR based detection of SPFMV would be simple, rapid and specific and can be utilized for checking the virus in tissue culture and virus free stock can be obtained easily.

**1340-1440**

**S11-P-91**

**MICROSCOPIC STUDY IN DISCOLORATION OF DRIED RED PEPPER**

J.W. Jung\*, S.K. Lee

Dept. of Horticultural Sci., College of Agriculture and Life Sci, Seoul National Univ., Suwon, Kyunggi-do, Korea, 441-744

Discoloration in dried red peppers was classified into three different types based on the appearance of discolored parts. Dried tissues in each type were analyzed for pigment distribution, membrane integrity, plastid ultrastructure, and tissue arrangement. In typex mainly caused by the infection of anthracnose, epidermis and hypodermis cells were destructed and did not show pigments. Type± and type\_ caused by inadequate storage condition retained whole cell structure but were different in pigment distribution. Pigments were not observed in parenchyma cells of type±. Scanning electron micrographs showed loose tissue arrangement and hyphae of anthracnose in typex and partly disrupted ground tissue in type\_.

**1340-1440**

**S11-P-92**

**ANALYSIS OF ENDOGENOUS PLANT HORMONES IN ROOTS OF KOREA GINSENG (*PANAX GINSENG C.A. MEYER*)**

Sung-Eun Kim\*, Ji-Heum Lee, Jung-Myung Lee

Dept. of Horticulture, Kyung Hee Univ., Kiheung-eup, Seochun-ri, Yoingin, Kyunggi Do, Republic of Korea, 449-701

Korea ginseng has been widely recognized as one of the most effective and reliable oriental medicinal plants for thousands of years. The grading of ginseng roots after harvest is strictly evaluated by government experts because it has been widely accepted that the high-grade ginseng roots contain well-balanced medicinal constituents as compared to the lower grade ones. The grading is primarily based upon morphological characteristics such as the length of the main roots, position and number of secondary roots, general root shape, presence of external defects, and so on. Since the price difference between the highest and lowest grade is usually about 4-fold, producing the high quality ginseng is often more important than obtaining only high yield under many circumstances. In order to understand the nature of root development and possibly to control the secondary root development, it is important to understand the distribution and contents of endogenous plant hormones in ginseng, both in roots and in foliage. Ginseng roots of varying ages were analyzed for the endogenous hormone contents. Cytokinins were analyzed by HPLC after immunoaffinity chromatograph and radish cotyledon bioassay. Gibberellins have been analyzed by dwarf rice bioassay up to this stage. Ginseng roots contained considerable amounts of cytokinins, mostly zeatin and zeatin riboside, and also contained a small amount of gibberellins. During the sprouting, the contents of gibberellins and cytokinins in sprouts increased very rapidly. Endogenous auxin or auxin-like substances in ginseng roots was very low and did not appear to have any significant influence in the axillary root formation even though application of root promoting substances to the root tips prior to transplanting greatly promoted rooting. Possible explanations will be given to hormonal balance in ginseng and ginseng roots.

**1340-1440**

**S11-P-93**

**THE EFFECT OF BLANCHING TREATMENT ON THE ESSENTIAL OILS AND OIL DUCTS OF MITSUBA (*CRYPTOTAENIA JAPONICA HASSK.*)**

Masanori Kimura\*<sup>1</sup>, Motoko Sato<sup>2</sup>, Yukio Yaguchi<sup>3</sup>, Toshiko Saito<sup>3</sup>, Hirokazu Negishi<sup>1</sup>, Yuuki Miyashita

<sup>1</sup>Faculty of Agriculture, Tokyo Univ. of Agriculture, 1737, Funako, Atsugi, Kanagawa, Japan, 243-0034; <sup>2</sup>Yamanashi Prefectural Government, 1-6-1, Marunouchi, Kofu, Yamanashi 400-8501 Japan; <sup>3</sup>Faculty of Regional Environment Science, Tokyo Univ. of Agriculture, 1-1-1, Sakuragaoka, Setagayaku, Tokyo 156-8502 Japan

Mitsuba (*Cryptotaenia japonica* Hassk.) is one of the traditional herbs in Japan, and is often blanched in the dark. Parent roots of Mitsuba were planted in the soil within a greenhouse at a density of 25-50 cm<sup>2</sup> per plant, and were cultivated in two ways—under natural daylight and by blanching in continued darkness, covered with silver polyethylene film. Plants were harvested at 28 days after treatment under these conditions. The essential oil concentration in the petiole and entire top part was higher when cultivated under natural daylight condition as

compared to blanching, but in the leaf blade, it was higher in the blanched plants. The percentage composition of essential oils was higher in those cultivated under natural daylight than in the blanched plants, particularly in the essential oils with a lower boiling point. In terms of the number of oil ducts and their total area in the transection of the centre of the petiole, no significant difference was recognized between the plants grown in natural daylight and those subjected to blanching treatment. In addition, regarding the number of essential oil secretory cells constituting the oil ducts, no significant difference was found between the two. In the Mitsuba cultivated under natural daylight, the cytoplasm of petiole secretory cells developed well compared with the cytoplasm of neighbouring parenchymatous cells, and was filled with electron-dense osmiophilic granules and oil drops. In the Mitsuba under blanching treatment, the cytoplasm of essential oil secretory cells had a low electronic density and no osmiophilic granules and oil drops, which could be observed in the Mitsuba cultivated under natural daylight. Considering the above, it was suggested that the essential oil obtained from the petiole under the blanching treatment might have moved through the intercellular space of the oil duct from the parent root rather than having been secreted from the secretory cells.

1340-1440

S11-P-94

#### ZERUMBONE, A MAJOR COMPONENT OF *ZINGIBER ZERUMBET* SMITH, MARKEDLY SUPPRESSES INFLAMMATORY RESPONSES AND CANCER CELL PROLIFERATION

Koichi Koshimizu<sup>\*1</sup>, Akira Murakami<sup>1</sup>, Hajime Ohigashi<sup>2</sup>

<sup>1</sup>Faculty of Biology-Oriented Science, & Technology, Kinki Univ., Iwade-Uchita, Wakayama, Wakayama, Japan, 649-6493; <sup>2</sup>Graduate School of Agriculture, Kyoto University, Kyoto 606-0852, Japan

Chemoprevention strategies using food phytochemicals currently compose one of the most visible and promising scientific fields for cancer control. We have so far screened more than 400 extracts from vegetables and fruits found in Japan, Thailand, Indonesia, and Malaysia for their inhibitory activity toward tumor promoter-induced Epstein-Barr virus activation as a means to evaluate their cancer prevention activities. It was found that edible plants from Southeast Asian countries demonstrated a markedly higher potential to prevent carcinogenesis as compared to those from Japan. More than 40 active constituents, including zerumbone (ZER), have been isolated and identified by activity-guiding fractionation of the active extracts. It effectively suppressed tumor promoter-induced superoxide anion generation from both NADPH oxidase in differentiated HL-60 human acute promyelocytic leukemia cells and xanthine oxidase in AS52 Chinese hamster ovary cells. The combined lipopolysaccharide- and interferon-gamma-stimulated protein expressions of inducible nitric oxide synthase and cyclooxygenase (COX)-2, together with the release of tumor necrosis factor- $\alpha$  in RAW 264.7 mouse macrophages were also markedly diminished, while the expression level of COX-1 was unchanged. ZER inhibited the proliferation of human colonic adenocarcinoma cell lines, accompanied with apoptosis. Intriguingly,  $\alpha$ -humulene, a structural analog lacking only the carbonyl group in ZER, was virtually inactive in all experiments conducted, indicating that the  $\alpha$ ,  $\beta$ -unsaturated carbonyl group in ZER may play some pivotal roles in interactions with unidentified target molecule(s). Taken together, our results indicate that ZER is a food phytochemical that has distinct potentials for use in anti-inflammation, chemoprevention, and chemotherapy strategies.

1340-1440

S11-P-95

#### CHANGES IN ANTIOXIDANT ENZYMES AND POLYAMINES IN RESPONSE TO LOW TEMPERATURES IN WATERMELON

Sung Whan Kwon<sup>\*1</sup>, Bok Rai Ko<sup>1</sup>, Sun Mi Huh<sup>2</sup>, Dong Gyu Bai<sup>2</sup>

<sup>1</sup>Kochang Watermelon Expt. Station, Chonbuk ARES, Chonbuk 585-863, Korea and Dept. Biol., Chonnam Natl. Univ., <sup>2</sup>Dept. Biol., Chonnam Natl. Univ., Gwangju 500-757, Korea

The changes in antioxidant enzymes and polyamines were investigated in the leaves of watermelon in response to a short exposure to chilling temperatures. Chilling temperatures not only reduced biomass and chlorophyll fluorescence but also caused an overall increase of antioxidant enzyme activities and polyamines in the leaves of watermelon. After chilling treatment at 6 °C, the photochemical efficiency (Fv/Fm) of PS II began to decrease slowly, and reached to 72.3% in 3

days as compared with 30 °C-grown plants. The antioxidant enzyme activities after chilling treatment were higher in watermelon leaves with 30 °C-grown plants. The CAT and POD activities in leaves were significantly increased, reaching a maximum at 2 days after chilling treatment, while they were decreased slightly after 3 days. The means of antioxidant enzyme activities were higher to low temperatures in leaves than shoot apices. In the native-gel assay of antioxidant enzymes, the treatment with low temperature resulted in quantitative changes in CAT and SOD isozyme profiles, while we can not find in qualitative changes in these isozymes which were induced by chilling. In contrast, low temperatures induced the new synthesis of 3 POD band isozymes in watermelon leaves. Similarly increased polyamine contents of watermelon were found to be associated with antioxidant enzyme activities under the chilling conditions. Exposure to low temperatures caused an increase in SPD and SPM, but not in PUT levels. One of the possibility mechanisms of chilling resistance was observed to be due to the increased polyamines against the marked increases in antioxidant enzyme activities. The results also indicate that SPD and SPM in watermelon leaves could have a protective role against chilling-induced active oxygen species.

1340-1440

S11-P-96

#### GROWTH AND ROOT SHAPE OF KOREA GINSENG AS AFFECTED BY VARIOUS CULTURAL PRACTICES

Ji-Heum Lee<sup>\*</sup>, Woo-Saeng Kwon, Jung-Myung Lee

Dept. of Horticulture, Kyung Hee Univ., Seochun-ri, Kiheung-eup, Yongin, Kyunggi Do, Republic of Korea, 449-701

Grading for high quality Korea ginseng has been primarily based upon root external appearance. Since the ginseng plants are usually harvested 4-5 years after transplanting, careful selection of best quality roots for transplanting and physicochemical properties of soil are considered as the two major factors influencing root shape at harvest. The roots of ginseng should have minimum length of uniform, non-branched main root (body), properly sized and shaped crown, two or more well-developed secondary roots in order to become qualified for first grade ginseng. They also should have good uniform external color, firm texture and good flavor. Roots of 1-year-old and 2-year-old ginseng were either pruned in various ways or treated with various plant bioregulators influencing rooting, mostly cytokinins and auxins. Treatment of root promoting substances to the tip of seedling root promoted root development, increased main root length and also significantly promoted overall root growth. The root shape was also effectively modified by root pruning (partial removal of secondary roots before planting), indicating the feasibility of root growth control by means of some simple cultural practices.

1340-1440

S11-P-97

#### PHYSIOLOGICAL AND BIOCHEMICAL CHANGES DURING PUPATION OF *FREESIA HYBRIDA* CORMS

Jin-Jae Lee<sup>\*1</sup>, Yeung-Geun Choi<sup>2</sup>, Jae-Cheol Kim<sup>3</sup>

<sup>1</sup>Namwon Alpine Floricultural Experiment Station, Gongnari 735, Unbong, Namwon, Chonbuk, South Korea, 590-832; <sup>2</sup>Chonbuk Provincial ARES, Iksan 570-140, Korea; <sup>3</sup>Dept. of Horticulture, Chonbuk National Univ., Chonju 560-856, Korea

Pupation in freesia is a unique phenomenon that corms, when stored at low temperatures of below 15 °C after harvest, do not sprout but form new corms on the old ones. The objectives of this study were to determine the most effective temperature to induce pupation and to determine some physiological and biochemical changes during pupation of *Freesia hybrida* 'Yvonne'. Corms were stored at 1, 5, 10, 15, 20, or 25 °C after harvest, and sampled at 15-day intervals for analyses of physiological changes. Pupation readily occurred at the range of 5 to 15 °C storage temperatures with 15 °C being the most effective. The corms held at 1 and 20 °C showed no morphological changes for 10 months of storage. Corms held at 20 °C storage broke dormancy during storage period and sprouted immediately after planting, whereas those held at 1 °C required dormancy breaking before planting. Respiration rate peaked during pupa formation, which was associated with a rapid drop in sugar concentration of old corms. Ethylene evolution peaked about 30 days before pupa formation. The concentration of abscisic acid decreased to the minimum level at 30 days before pupa formation, and increased during pupa formation. The concentrations of IAA and zeatin tended to peak at the early stage of pupation and decrease thereafter. The new corms induced by pupa-

tion were formed from the central cylinder of the apex.

**1340-1440**

**S11-P-98**

**EFFECTS OF TEMPERATURE DURING INDUCTION PERIOD OF DORMANCY ON THE DEPTH OF DORMANCY AND THE RATE OF PUPATION OF *FREESIA HYBRIDA* CORMS**

Jin-Jae Lee\*<sup>1</sup>, Jong-Sung Jeong<sup>1</sup>, Joung-Sik Choi<sup>2</sup>, Hark-Bong Bark<sup>3</sup>, Sung-Do Oh<sup>3</sup>

<sup>1</sup>Namwon Alpine Floricultural, Experiment Station, Gongnanri 735, Unbong, Namwon, Chonbuk, Korea, Namwon, Chonbuk, South Korea, 590-832; <sup>2</sup>Chonbuk Provincial ARES, Iksan 570-140, Korea; <sup>3</sup>Dept. of Horticulture, Chonbuk National Univ., Chonju 560-856, Korea

The *Freesia hybrida* 'Yvonne' corms were planted and grown in a plastic house with 25/10 °C (day/night) until before induction of dormancy, i.e., around the time of flower stalk development. Thereafter they were transplanted in the growth chamber with two temperature regimes, 18/13 °C or 28/23 °C, and grown until harvesting corms. The corms were harvested when about half of the leaves were shed and stored at 15 °C to induce pupation. The new corms induced by pupation were treated with high temperature (29 °C) for the periods of 45 to 105 days at 15-day intervals. The results showed that the corms grown at 28/23 °C advanced pupation at 15 °C more readily than 30 days than those at 18/13 °C, which was closely associated with changes in the rates of respiration and ethylene production. The corms grown at 28/23 °C sprouted in about 45 days after 29 °C treatment, 30 days earlier than those held at 18/13 °C. The longer the period of high temperature treatment at 29 °C, the shorter the time required for sprouting and flowering after planting.

**1340-1440**

**S11-P-99**

**EFFECT OF ETHYLENE ON BLOOD BLACK HEART SYMPTOMS IN WATERMELON**

Sang-Gyu Lee\*, Ki-Cheol Seong, Young-Chul Kim, Kwang-Yong Kim, Hyo-Duk Suh

Natl. Hort. Res. Inst., Rural Development Administration, Suwon, Kyonggido, Korea, 440-310

Bloody black heart (blood-flesh) symptoms in watermelon (*Citrullus lanatus* Matsum. et Nakai) have been frequently observed in Korea, resulting in unmarketable quality of fruit due to its dark water-soaked red color of flesh, low fruit flesh firmness, and unpleasant flavor. Undesirable high soil moisture conditions such as drought and waterlogging, excessive high or low temperatures of air and fruits, and infection of CGMMV and KGMMV, etc., are known to aggravate the symptom expression, but the mechanism of this symptom has not been clearly determined. Recently, the possibility of role of ethylene gas (C<sub>2</sub>H<sub>4</sub>) to degrading cell wall of watermelon fruits and research activities to enhance fruit shelf life by blocking ethylene pathways have been reported. To determine the effect of internal ethylene evolution on the bloody black heart symptoms in watermelon, the effects foliar applications of 0 (control), 100, 200, 400, 800, and 1000 mg·L<sup>-1</sup> of ethephon were compared. Ethephon was sprayed on the closest leaf from fruits at 39 days after fruit setting. Lower concentration of foliar sprayed ethephon (lower than 200 mg·L<sup>-1</sup>) did not show significant difference on the fruit firmness, but higher concentration of ethephon treatment (higher than 400 mg·L<sup>-1</sup>) showed severe symptoms in watermelon fruits with significant decrease in fruit firmness. In the occurrence of bloody black heart symptoms, 100 and 200 mg·L<sup>-1</sup> of ethephon treatments did not induce blood black heart symptoms in watermelon. However 400 mg·L<sup>-1</sup> ethephon treatment showed 25%, and 800 and 1000 mg·L<sup>-1</sup> ethephon treatments showed 100% of blood black heart symptoms in watermelon, respectively. From these results, we assumed that the frequent occurrence of blood black heart symptoms of watermelon fruits in Korea are closely associated with the internal ethylene activity caused by inappropriate cultural practices and undesirable environments in watermelon producing areas.

**1340-1440**

**S11-P-100**

**YIELD LOSSES IN VEGETABLE AMARANTH DUE TO PURPLE NUTSEDGE INTERFERENCE**

J. Pablo Morales-Payan\*, William M. Stall

1246 Fifeield Hall, Horticultural Sciences Dept., University of Florida, P.O. Box

110690, Gainesville, FL 32611 USA

Chinese spinach, Hon-toi-moi or vegetable amaranth (*Amaranthus tricolor*) is crop commonly cultivated in Southwest Asia. Few or no herbicides are registered for use in vegetable amaranth. Purple nutsedge (*Cyperus rotundus*) is a common and difficult to control weed. Little is known regarding the influence of that weed on the yield of vegetable amaranth. Greenhouse and field experiments were conducted in Gainesville, Florida, USA, to determine the yield losses caused by different purple nutsedge population densities in 'Morokot' vegetable amaranth. The treatments were purple nutsedge densities of 0, 15, 30, 45, 60 and 75 plants/m<sup>2</sup>, established in a complete block design with four replications. The weed was allowed to interfere with the crop season-long (5 weeks). The variables evaluated were amaranth number of leaves, shoot height and yield, and purple nutsedge height, number and dry weight of shoots, and dry weight and number of tubers. Analysis of variance and regression (5% level) were performed on the resulting data. The number and dry weight of purple nutsedge tubers and shoots increased as weed density increased. Similar patterns were found in the field and greenhouse studies. Purple nutsedge population density significantly influenced vegetable amaranth yield. As the weed density increased, the yield of the crop decreased exponentially. In the field, crop yield losses were 23% and 41% at 15 and 75 nutsedges per m square, respectively. These results indicate that uncontrolled purple nutsedge could cause considerable yield loss in vegetable amaranth, even at apparently low population densities. Growers would be justified to implement purple nutsedge management practices to reduce the negative impact of that weed in vegetable amaranth.

**1340-1440**

**S11-P-101**

**THE EFFECTS OF INOCULATION OF FUSARIUM ON WOUND INDUCED PERIDERM FORMATION IN TARO (*COLOCASIA ESCULENTA* SCHOTT)**

Takashi Morita\*, Masahiro Nishinoiri, Keiko Kataoka, Takashi Fudano, Koshiro Kawase

Hachonawate, Takatsuki, Laboratory of Plant Production Control, Kyoto Univ., Osaka, Japan, 569-0096

The pathological events induced by wounding applied to taro corm and the wound inoculation of *Fusarium* were observed. *Fusarium* 'F959', a pathogenic strain to taro, was multiplied on Richards media in petri dishes and used for the experiment after 7–10 days of culture. The inoculation was performed as follows. 'Celebes', an ordinary taro cultivar in Japan, was harvested at 18 September, 2001. The holes for inoculation were made on the surface of the corms of 'Celebes' using the cork borer. The position of the holes was made along the equator line of the corms at three regular intervals. The mycelia of 'F959' cut off together with culture media from petri dishes by using a cork borer. The culture media turned downward the surface where the mycelia propagated, and were filled up into each hole. In control, the holes were filled up with the sterilized Richards media. The wound holes were sealed with the mixture of paraffine and Vaseline in the ratio of 1:1 (w/w), and the corms were kept in the dark at 25 °C. The samples of the corms were extracted every day in the first week and every other day in the second week. They were fixed in FAA. Following wounding, several cell layers with lignified cell walls were formed downward about 1 mm from the wound surface in control. The cells of the tissue between the periderm and the wound surface became transparent, and starch granules were disappeared in the cells. When *Fusarium* was inoculated into the wound, the thickness of the cells which became transparent increased to 2–5 mm. Wound induced periderm formation is comparatively general phenomenon observed in many plants. It is considered that the phenomenon is the defense response to externally caused injury or invasion of microbe. It was suggested that wound induced periderm formation as defense response was emphasized by invasion of the pathogenic *Fusarium*.

**1340-1440**

**S11-P-102**

**QUANTITATIVE CHARACTERS OF FLORAL COLOR MUTANTS INDUCED BY GAMMA-RAY IRRADIATION IN *ASTER HISPIDUS* THUNB**

Byongkwon Oh\*<sup>1</sup>, U. Zangkaul<sup>2</sup>

<sup>1</sup>Bicon, 1, Ara-1-dong, Jeju, Jejudo, Rep. of Korea, 690-756; <sup>2</sup>Faculty of Horticulture Life Science, Cheju Natl. Univ., 1 Ara-1-dong, Jeju 690-756, Rep. of Korea

*Aster hispidus* Thunb is naturally found at the coast-side of Jeju Island, Korea, is known to possess good potentials for ornamentals as garden and pot flowers. The seeds of *A. hispidus* were irradiated by various doses of gamma-ray [Gamma Irradiator Model Mark I-30 (Cs-137 3000 Ci)] before sowing and the subsequent plant growth was carefully evaluated. The gamma dose for 50% survival rate was 200 Gy, but the suitable dose to induce mutant was found to be 100–120 Gy. M1 population was classified to 4 groups 58 lines based upon several quantitative characters such as plant height, leaf margin style and the degree of creeping. Some mutation sectors were also observed at the M1 generation. The floral and foliated mutants of *A. hispidus* were observed at groups 1, 2 and 4 of M2 generation. While the floral color of *A. hispidus* was light purple-white, those of mutants were a dark violet, a gray-violet and a reddish violet. The size of flower was variously changed in the range of 1.4–6.5 cm on the mutants, while that of the normal was about 3.5 cm. The leaf margin of normal was an entire style, but the selected mutants had dentate, crenate and serrate leaf margins. The dwarf-type and viridis (temperature-sensitive) mutants were also obtained from the groups, 3 and 4. The viridis mutants were 2 types; a light green leaves selected from the group 1 and 4, and a dark green leaves selected from the group 3. Three mutant lines of floral colors were obtained in this experiment and are growing in order to investigate their inherited characters at the M3 generation.

**1340-1440**

**S11-P-103**

**EVALUATION OF IMPROVED CROP MANAGEMENT PRACTICES FOR TROPICAL LEAFY VEGETABLES WITH EMPHASIS ON THE INDIGENOUS TYPES**

M.C. Palada\*<sup>1</sup>, L.C. Chang<sup>2</sup>, L.L. Black<sup>2</sup>

<sup>1</sup>Agricultural Experiment Station, Univ. of the Virgin Islands, RR2, Box 10,000, Kingshill, St. Croix, Virgin Islands 00850 USA; <sup>2</sup>Asian Vegetable Research and Development Center, AVRDC, P.O. Box 42, Shanhua, Tainan 74199, Taiwan

Tropical leafy vegetables, particularly the indigenous types, are becoming popular in developed countries where they can be seen in produce section of specialty as well as supermarkets. Increased demand and consumption in developed countries is associated with the growing ethnic population. In South and Southeast Asia the contribution of tropical leafy vegetables to total vegetable supply is increasing. There is little information on recommended and improved crop management practices for indigenous leafy vegetables. This study was conducted to evaluate the response of selected indigenous tropical leafy vegetables to improved crop management practices. Leafy vegetables included amaranth (*Amaranthus* spp.), Malabar spinach (*Basella* spp), celosia (*Celosia argentea*), jute mallow (*Corchorus olitorius*) and kangkong (*Ipomoea* spp.). The vegetables were evaluated as to their response to plant density, transplant container (cell) size, and organic fertilizer. The effect of plant density on yield was significant for amaranth, jute and kangkong. Yield responses of amaranth and jute were quadratic ( $R^2 = 0.97^{**}$  and  $R^2 = 0.98^{**}$ , respectively), whereas, for kangkong, yield response was linear ( $r = 0.94^{**}$ ). Maximum yields for these crops were attained at the highest plant density of 2000,000 plants/ha. Yields of amaranth and celosia were significantly influenced by cell size. For amaranth, yield of transplants grown in 72- and 100- cell/tray was higher than those in 50- and 128-cell/tray. For celosia, transplants grown in 50- and 100-cell/tray yielded significantly higher than those in 72- and 128-cell/tray. The yield response of Malabar spinach to levels of cow manure (0, 10, 20 and 40 t/ha) was quadratic. This study indicates that indigenous tropical leafy vegetables respond favorably to improved crop management practices.

**1340-1440**

**S11-P-104**

**EFFECT OF ADDING SEAWATER TO HYDROPONICALLY GROWN TOMATOES**

Yong Bong Park\*, Yong Duk Kim

Horticultural Life Science, Division of Hort. Agr. Research and Extension Service, Jeju National Univ., Jeju, Korea 690-756

The aim of this research is to improve tomato fruit quality by adding seawater to hydroponic systems and to determine proper amount of addition. Seawater of 1.0, 2.0 and 3.0 mS/cm electric conductivity (EC) was added to Yamazaki solution of 1.6 mS/cm (YS) to make the nutrient solutions of the following 4

EC levels; 1.6 (T1: No seawater added), 2.6, 3.6, and 4.6. Fruits on the plants were conveniently classified as mature green (MG), breaker (Br), 3 days after breaker (Br+3), 5 days after breaker (Br+5), 7 days after breaker (Br+7), and 10 days after breaker (Br+10), respectively. All the fruits were harvested on June 28th, 2001 and kept frozen at -70 C. These fruits were later extracted for quality analysis. Total soluble solids content (TSS), titratable acidity, pH, and EC were measured from the extract. To determine the effect of seawater addition on yield, all fruit per plant were harvested and mean fruit weight was determined. The concentration of Na and Cl in several plant parts were measured. TSS increased steadily with maturity up to Br+7 in all treatments and T4 treatment showed the highest TSS value of 7.8. Titratable acidity and pH were higher than control by up to 0.2%. The EC of the extract also increased up to 0.2 mS/cm compared to control. A little difference of chlorine content was observed in several parts of the plants with the treatments, but Na content was several times greater in petiole, leaves, fruit, and roots as compared to control. Total fruit number per plant was not different between treatments, but mean fruit weight decreased by treatment, resulting in 5%–18% yield decrease. These results revealed that high seawater content decreased the fruit weight and yield, but SSC, acidity, pH, and EC of extract increased by adding seawater to nutrient solution.

**1340-1440**

**S11-P-105**

**EFFECT OF CULTIVAR AND LOCATION ON YIELD, TUBERS QUALITY AND STORABILITY OF JERUSALEM ARTICHOKE (*HELIANTHUS TUBEROSUS* L.). I. GROWTH, YIELD, AND TUBERS CHARACTERISTICS**

M.E. Ragab\*, KH. A-Okasha, I.I. El-Oksh, N.M. Ibrahim

Fac. of Agr., Ain Shams Univ, Cairo, Egypt, Cairo, Egypt, 11241

This study was carried out at the Strawberry and Non Traditional Crops Improvement Center, Ain Shams Univ., Cairo, Egypt during the two successive seasons of 1998 and 1999 in two experimental farms, Shoubra El-Khema, El-Kaluobia governorate and South Tahrir, El-Behiara governorate. This study aimed to investigate the effect of cultivar and location on vegetative growth, total yield and physical and chemical components of Jerusalem artichoke tubers. Fuseau and local cultivars were cultivated in two different locations, viz., El-Kaluobia and El-Behiara locations. A completely randomized block design with four replicates was adopted. Data were recorded on vegetative growth, total tubers yield, tuber quality characters, and some chemical components of tubers. Results indicate that local cultivar could be considered as promising cultivar by exhibiting high vegetative growth characters, total yield, average tuber weight and average tuber size. Moreover, El-Kaluobia location was found to be favorable for strong vegetative growth while total tuber yield was not affected. In respect to the interactions between cultivar and location, the highest total tuber yield was obtained from local cultivar planted in El-Behiara location.

**1340-1440**

**S11-P-106**

**SELECTIVE CONTROL OF DODDER (*CUSCUTA MONOGINA* L.) PARASITIZING POMEGRANATE TREES (*PUNICA GRANATUM*)**

Saied Rassoulzadeh\*

Univ. of Tehran, Dept. of Horticulture, Faculty of Agriculture, Karaj, Iran

Glyphosate was applied at different concentrations on pomegranate trees which were heavily infested by dodder. Application of glyphosate at concentration of 3/1000 or at concentration of 3/1000 which was repeated 15 days later by concentration of 1/1000 as well as concentration of 3/1000 which was repeated 15 days later by concentration of 2/1000 could kill dodder selectively and more efficient than any other treatment without any visible injury to pomegranate trees. It is concluded that glyphosate should not be applied at concentration more than 2/1000 at once and pomegranate trees should not be received glyphosate more than 3/1000 per one growing season.

**1340-1440**

**S11-P-107**

**KOREAN PINE AS A NUT PRODUCTION SPECIES IN CHINA—PRESENT SITUATION AND FUTURE DEVELOPMENT**

Hailong Shen\*

Faculty of Forest Resources and Environment, Northeast Forestry Univ., No. 26, Hexing-Lu, Harbin 150040, Heilongjiang Province, China

Korean pine (*Pinus koraiensis*) is well known as a valuable timber tree. Almost all of the activities (scientific research, forest establishment and management, seed forests or seed orchard establishment, tree growth behavior controlling, etc) related to Korean pine, were on timber production in the past in China. Korean pine seed contains 70.3% oil, 14.8% protein, abundant vitamin A and E, and some fatty acids such as oleic acid, linoleic acid, linolenic acid that are necessary to our body. It is a very good food nut production species, but the nut or seed of this plant was just regarded as a favor of nature and usually picked from the natural forest. Along with the development of economy and improvement in the standard of living in China, the importance of increasing nut production plantations was understood gradually. Several researches were conducted on reforming current timber production plantation into timber and nut production plantation, density control of timber and nut production plantation, fruiting promotion by GA<sub>3</sub> and others. This has promoted the nut production of Korean pine in recent years. Evidently more detailed research is needed for exploiting the nut production potential of Korean pine in China. More comprehensive studies should be conducted on tree form control, nutrient control, density control, fruiting control and genetics control for both timber and seed production. In addition, special plantation like fruit garden for nut production should be established. For this purpose, two obstacles should be overcome. One is how to increase the proportion of female strobile and the other is how to control the apical dominance of trees and maintain fruitful lower and wide canopy.

1340-1440

S11-P-108

**THE POLYMORPHIC KARYOTYPE BREEDING MEDIATED DIKARYOTYPE HYBRIDS FOR ELITE BULB FLOWER IMPROVEMENT OF SPIDER LILIES (*LYCORIS* SPP.)**

M.C. Wu, Chou Tou Shii\*, M.S. Yuan

Dept. of Horticulture, National Taiwan Univ., No. 1 Sec. 4 Roosevelt Road, Taipei, ROC, Taiwan, 106

The Asiatic origin of 20 *Lycoris* species (Amaryllidaceae) is characterized with unique growth traits and polymorphic karyotypes potential and they can be developed as elite flower bulbs and useful medicinal plants. The *Lycoris* taxa are divergent into M-T and A group species varying in chromosome morphology, number, structure, and relative DNA content. The similarity coefficient of RAPD markers between native yellow spider lily (*L. aurea*, 2n = 14 = 8M + 6T) and introduced six A group species (2n = 22A) is assessed as 0.42-0.54. The contrast genome diversification does not conduct to genetic isolation or incongruity between M-T and A group species. The distant hybridization produced M-T-A dikaryotype hybrids 2n = 18 = 4M + 3T + 11A. The immature embryo culture and cold pretreatment could shorten the breeding cycle forced to bloom by 3-4 years. The growth traits of dikaryotype hybrids mainly express incomplete dominance and partial male fertility (43%). Subsequently, numerous nonparental desirable characters were selected. These dikaryotype hybrids were also capable to pair with unique hepta-heteromorphic bivalents, and competent to recombine diverse functional gametes including balanced gamete, n = 7, 8, 9, 10 and 11, FDR and SDR unreduced gametes 2n = 14%, 15%, 16%, and 21% mutant gametes. The polymorphic karyotype progenies 2n = 14, 15, 16, 17, 18, 19, 20, 21 and 22, and 3n = 24, 25, 26 were obtained. It is suggested that M-T-A hybrids carry good potential to breed neokaryotypes and to amplify genetic variability benefit for breeding.

1340-1440

S11-P-109

**APPLICATION OF REAPING METHOD FOR HARVESTING LEAFY VEGETABLES GROWN IN CAPILLARY HYDROPONIC SYSTEM**

Michiko Takagaki<sup>1</sup>, Supachai Aumuka<sup>\*1</sup>, Toru Maruo<sup>\*1</sup>, Sutevee Sukprakan<sup>\*1</sup>, Yutak Shinohara<sup>\*</sup>

<sup>1</sup>Thai Vegetable Research Center, Kasetsart Univ., Bangkok, 10900, Thailand; <sup>2</sup>Fac. Horticulture, Chiba Univ., 648, Matsudo, Chiba, Japan, 271-8510

Two leaf vegetables, Chinese kale (*Brassica oleracea* L.) and Pakchoi (*Brassica campestris* L. *chinesis* group), were cultivated using a capillary hydroponic system in greenhouse. A reaping method was introduced for harvesting

leaves to reduce labor and other costs. In this method, upper shoots were reaped off at a specific height, allowing the plants to regenerate new shoots for successive harvest. The plants were supplied with a nutrient solution through a polyester capillary mat placed on a floating board in the nutrient solution. The surface of the capillary mat was covered with one of four substrates (rice husk, rice husk charcoal, rice husk charcoal with rice husk top and coconut coir). Seedlings were transplanted to the systems with 30 L of 1/2 strength Enshi nutrient solution on 15 April 1999 and leaves were harvested at a 3-cm height from surface of the substrate every 15 to 20 days for three times. Nutrient solution was changed after each harvest. For both Chinese kale and Pakchoi, average production rates (g FW/plant/d) showed no significant differences among three harvesting times and they were significantly higher than those of plants harvested conventionally. Reaping method can be applied for leafy vegetable production, and suitable duration or height of reaping needed to be investigated. Regardless of plant species, production rates during the second to the third harvest were greater with rice husk charcoal with rice husk top or coconut coir than with the other substrates. For cultivation longer than two months, rice husk charcoal with rice husk top and coconut coir were suitable. We concluded that the harvest method examined in the present study was feasible for leaf vegetable production based on the hydroponic systems. The quality of harvested leaves and the suitable controlling method of nutrient solution were also discussed.

1340-1440

S11-P-110

**EFFECT OF THREE CHEMICAL COMPOUNDS ON FRUIT SET OF BAYBERRY**

Xingjun Li\*, JinXing Lin

Dept. of Plant Structure and Biology, Institute of Botany, Chinese Academy of Sciences, Beijing, China, 310029

Wandao bayberry (*Myrica rubra* (Lour.) Sieb. et Zucc. 'Wando'), the main cultivar in Zhoushan islands of China, often fails to set fruits. In order to stimulate fruit set, the mature trees was sprayed on full-bloom day with 0.2% sodium borate + 0.2% sucrose solution (B + Suc), 0.2% sodium borate solution (B), or 0.2% sodium borate + 15 mg/L gibberellic acid solution (B + GA<sub>3</sub>), respectively. It was found that only B + Suc stimulated fruit set and improved fruit quality, whereas both fruit set and fruit quality of B + GA<sub>3</sub> treatment were similar to that of the control.

1340-1440

S11-P-111

**SELECTION AND CHARACTERIZATION OF A NEW DWARF AND SEEDLESS MUTANT IN WATERMELON [*CITRULLUS LANATUS* (THUNB.) MATSUM. & NAKAI]**

Yun-Chan Huh<sup>\*1</sup>, Jung-Myung Lee<sup>2</sup>

<sup>1</sup>Vegetable Breeding Division, National Horticultural Research Institute, 540-41 Tap-dong, Gwonseon-gu, Suwon, Gyeonggi-do, Republic of Korea, 441-440; <sup>2</sup>Dept. of Horticulture, Kyung Hee Univ. Suwon 449-701, Rep. of Korea

Watermelons have an indeterminate growth habit which allow the vine to grow indefinitely under the normal conditions. Watermelon breeders also have been studying dwarf watermelons and four dwarf types have been identified as source germplasm for developing dwarf watermelon cultivars. We discovered a naturally occurring new dwarf and seedless mutant (NDSM) from a Mudungsan line that had been cultivated only in Mountain Mudung area nearby Gwangju City in Korea. The progeny of this line segregated in a ratio of 3 normal plants to 1 dwarf plant indicating a single recessive gene nature. Morphological characters of the NDSM were greatly differed from those of the four known dwarf types. NDSM plants grew shorter than 1 m in length with fan-shaped leaves, and fewer leaf lobes than normal plants. Therefore these plants could be distinguished based on the leaf characteristics at 2-3 true leaf stages. Male and female flowers had just one petal and each petal failed to open completely in mature plants. Flat shape of staminate buds was distinctively different from the globular shape of normal plants and there were four or five anthers inside. These anthers also showed some variation in shape as compared with those of normal plants. Even though there were some fertile pollen grains, the fruits of NDSM had no seed after fertilization. Further study is in progress to determine how dwarf gene(s) would express in progenies obtained from crosses with nor-

mal or other dwarf types, and how NDSM would maintain the sterility.

**1340-1440**

**S11-P-112**

**QUANTIFICATION OF ICARIIN CONTENTS IN *EPIMEDIUM KOREANUM* N. BY USING A NEAR INFRARED REFLECTANCE SPECTROSCOPY**

Sang-Mi Eom<sup>\*1</sup>, Soon-Ryang Park<sup>1</sup>, Byoung-Ryourl Choi<sup>1</sup>, Young-Sang Lee<sup>2</sup>, Yong-Ho Kim<sup>1</sup>

<sup>1</sup>Div. of Life Sciences, Soonchunhyang Univ., Sinchang-myon, Eupnae-ri, Asansi, Chung-Nam, South Korea, 336-745; <sup>2</sup>Crop Div. Kyounggi ARES, Hwasong, 445-972, South Korea

Near infrared reflectance spectroscopy (NIRS) has become widely accepted for rapid quantitative analysis of components in some crops. Our object was to determine icariin contents in leaves of *Epimedium koreanum* by using an NIRS system. Total 150 plant samples previously analyzed by HPLC were scanned by NIRS and 78 samples were selected for calibration and validation equation. A calibration equation calculated by multiple linear regression technique was developed and its validation gave a coefficient of determination ( $R^2$ ) of 0.96. A comparison between NIRS estimation and HPLC value was performed with the remaining samples not included in the calibration and validation sets. Most of samples also showed a positive correlation like a validation set. Our results demonstrate that this developed NIRS equation can be practically used as a mass screening method for rapid quantification of icariin contents in *Epimedium koreanum* N.

**1340-1440**

**S11-P-113**

**EFFECTS OF LIPOXYGENASE AND JASMONIC ACID ON ETHYLENE BIOSYNTHESIS DURING TOMATO FRUIT RIPENING**

Jiping Sheng<sup>\*</sup>, Jianrong Ye, Yunbo Luo

College of Food Science, China Agricultural Univ., No. 2 Westroad Yuanmingyuan Street, Beijing, P.R. China, 100094

Jasmonic acid (JA) is a metabolite of lipoxygenase (LOX) and a growth regulator, which has many physiological functions associated with ethylene. To determine the role of LOX and JA in ethylene biosynthesis during tomato fruit ripening, low-ethylene producing fruits from antisense ACC synthase (ACS) transgenic plants (ethylene production is only 0.5%–3.0% of the wild-type fruits) were compared with fruits from wild-type plants. Expression of a gene encoding LOX, TOMloxB, and relative LOX activity increased continuously in transgenic fruit after treated with 1000  $\mu\text{L}\cdot\text{L}^{-1}$  ethephon at room temperature; meanwhile, two kinds of fruit treated with exogenous JA were examined to determine the role of JA and ethylene in TOMloxB expression. In wild type fruit, exogenous JA increased relative LOX activity continuously increased TOMloxB transcripts, and promoted color change of fruits from green to yellow/orange within 24 hours of treatment. TOMloxB transcripts decreased almost to zero at 48 hours. However, exogenous JA had no effect in low ethylene transgenic fruits; no color change was detected within 24 hours; both relative LOX activity and TOMloxB transcripts remains unchanged in 24 hours. The effect of LOX on ethylene biosynthesis was less than that on ACC oxidase, suggesting an indirect role of LOX in ethylene biosynthesis. Presence of ethylene appears necessary to affect JA-induced LOX gene expression, suggesting that the JA signal pathway interacts with that of ethylene, and that LOX may play a role in ethylene biosynthesis via JA.

**1440-1520**

**S11-O-114**

**ANTIOXIDANT CAPACITY OF MEDICINAL HERBS, CULINARY HERBS, AND BERRY CROPS**

Shiow Y. Wang<sup>\*</sup>

Fruit Laboratory, Bldg. 010A, Beltsville Agricultural Research Center, U.S. Dept. of Agriculture, 10300 Baltimore Avenue, Beltsville, MD 20705-2350 USA

Herbs and berry crops have been shown to contain high levels of antioxidant compounds. These antioxidants are capable of performing a number of functions including acting as free radical scavengers, peroxide decomposers, singlet and triplet oxygen quenchers, enzyme inhibitors, and synergists. The different antioxidant components found in herbs and berry crops provide protection against

harmful free radicals and have been associated with lower incidence and mortality rates of cancer and heart disease, in addition to a number of other health benefits. Herbs have been used for many purposes including medicine, nutrition, flavorings, beverages, and industry. Since prehistoric times, herbs have been the basis for nearly all medicinal therapy until synthetic drugs were developed in the nineteenth century. Today herbs are still found in 40% of prescription drugs. Culinary herbs also have been grown and used for their ability to enhance and complement the flavors of a wide variety of foods. Even though a variety of herbs are known to be remarkable sources of phenolic compounds, data on the composition and antioxidant activities of herbs and berry crops are insufficient. We found herbs and berry crops to contain a number of phytochemicals. This study revealed that herbs and berry crops are an effective and potential source of natural antioxidants. The results from this presentation will be useful to plant breeders, other researchers, and those in the general public who are interested in the antioxidant potentials of various herbs and berry crops as dietary supplements.

**1520-1540**

**S11-O-115**

**EFFECT OF MEDIA COMPOSITION AND GROWTH REGULATORS ON PROTHALLUS PROPAGATION OF *ASPLENIUM INCISUM* AND *CAMPTOSORUS SIBIRICUS* BY TISSUE CULTURE**

J.A. Jeong, H.H. Kim, J.K. Hwang, C.H. Lee<sup>\*</sup>

Dept. of Horticulture, Chungbuk National Univ., Cheongju, 361-763, Korea

The prothalli of *Asplenium incisum* and *Camptosorus sibiricus* native to Korea were obtained through in vitro spore germination and the effects on their growth by mineral composition, sugar concentration, nitrogen source, pH and growth regulators of media were investigated. Effect of culture temperature was also examined. Best growth was obtained with 1MS media containing 0.8% agar in both species. High sugar concentration of 3%–4% promoted fresh weight of the prothalli but the quality of growth was better with 1% concentration. In *A. incisum*, the prothalli growth was promoted with 30:30 mM of  $\text{NH}_4^+:\text{NO}_3^-$  °C and in *C. sibiricus* 20:40 mM. In both species, pH 5.8 resulted in the best prothallus propagation. In both species, NAA in the media inhibited the prothalli propagation by injuring them, and 2,4-D induced callus-like tissues. The prothallus propagation tended to be suppressed as IAA concentration increased, especially in case of *A. incisum*. The prothallus propagation of *C. sibiricus* was restrained as the concentration of BA, kinetin and 2-IP increases, but the quality was not affected. In *A. incisum*, however, high concentration of above 3 growth regulators induced high number of early stage prothalli. Optimum temperature for culture proved to be 25jæ.

**1540-1600**

**S11-O-116**

**IN VITRO INVESTIGATIONS ON THE CLONAL PROPAGATION OF SOME MEDICINAL PLANTS OF INDIA**

Sharad Tiwari<sup>\*</sup>, Pankaj Shah

Plant Biotechnology Lab, Dept. of Plant Breeding and Genetics, Jawaharlal Nehru Agricultural Univ., Jabalpur, Madhya Pradesh, India, 482004

India is home to diverse flora including an array of MAPs which play a very important role in phytoremediation and in Ayurveda—the science of traditional Indian herbal medicine. Of these, most species are very difficult to propagate in nature. Being expensive, these are over exploited which puts them under threat of extinction. As such, a commercially sound and efficient in vitro propagation system is desirable. In keeping with this, a research programme has been initiated with 5 mandate species—*Chlorophytum borivilianum*, *Commiphora wightii*, *Oroxylum indicum*, *Pterocarpus marsupium* and *Rauwolfia serpentina*. There is dearth of information on the tissue culture of these species. The explants used for in vitro studies were stem discs in the case of *C. borivilianum* and nodal segments in the case of *O. indicum*, *P. marsupium* and *R. serpentina*. The explants were harvested and after proper washing and sterilization sliced into 1–2 mm and 15–20 mm transverse sections of stem discs and nodal segments, respectively. The explants were cultured on MS and B5 medium supplemented with 3% (w/v) sucrose, 0.8% (w/v) Bacto agar and different concentrations of 6-BAP alone or in combination with alpha-NAA. The cultures were maintained at 25 °C in a 16-hour photoperiod regime of 30  $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$  incident flux. Culture of the explant on a MS-based medium was found to be superior as compared to that on Gamborg's B5 medium. Inclusion of 6-BAP at a concentration of 3  $\text{mg}\cdot\text{L}^{-1}$  was generally



Thursday August 15

beneficial to the culture of all species save *P. marsupium* where a lower concentration is desirable. An auxin, preferably alpha-NAA at a concentration of 0.5 mg·L<sup>-1</sup> was particularly beneficial for *R. serpentina*. Expectedly, species vary in terms of the time taken to respond to the applied stimuli and the manipulated culture conditions. The efforts to develop efficient protocols stimulated morphogenesis in these species.

**1600–1620**

**S11–O–117**

**TEMPERATURE INFLUENCE ON GROWTH AND FLOWER DEVELOPMENT OF FOUR SPECIES FROM THE GENUS *MECONOPSIS***

Shannon Still\*<sup>1</sup>, James Harbage<sup>2</sup>, Sherry Kitto<sup>1</sup>, James Swasey<sup>1</sup>

<sup>1</sup>Dept. of Plant and Soil Sciences, Univ. of Delaware, Newark, DE 19717 USA;

<sup>2</sup>Research Division, Longwood Gardens, P.O. Box 501, Kennett Square, PA 19348

*Meconopsis betonicifolia* Franch. and *M. grandis* Prain are members of the *Papaveraceae* L. native to the Himalayan mountains. These species and the hybrids derived from them are especially prized as ornamentals for their intense blue flowers and gardenesque habit. Longwood Gardens, a horticultural display garden in eastern Pennsylvania, USA, has identified these plants as ideal for conservatory display. However, empirical observations indicate these species are intolerant of the hot summers that occur in this geographic region. The experiments were designed to identify how temperature would affect plant characteristics critical to display for blue flowered *Meconopsis* as well as the red flowering *M. punicea* Maxim. *Meconopsis betonicifolia*, *M.* 'Lingholm', *M.* George Sherriff Group variety, and *M. punicea* plants were forced in the greenhouse at minimum night/day temperatures of 7.2/10 °C, 12.8/15.6 °C, and 18.3/21.1 °C day between December and May. All plants grown in the 7.2/10 °C and 12.8/15.6 °C temperatures had larger canopy widths when first starting to flower than those plants in 18.3/21.1 °C environment. Plants grown in the two cooler temperature ranges also had taller flower stems, at 64.27 and 54.44 cm, for the coolest and medium environment, respectively, than the warmest environment at 46.27 cm. The stem diameter was greatest on plants in the 18.3/21.1 °C environment at 0.691 cm opposed to the warm temperatures at 0.526 and 0.438 cm for the medium and warmest environment, respectively. Plant dry weight was also inversely related to temperature. Plants grown at 7.2/10 °C, at 41.8 g, were 33% heavier than those grown at 12.8/15.6 °C, at 31.4 g, and 100% heavier than the plants in the 18.3 °C/21.1 °C, at 20.6 g, at harvesting. This study showed display quality plants with tall, strong flower stems and good foliage could be grown when temperatures were monitored and maintained at 7.2/10 °C and 12.8/15.6 °C and proper genotypes were selected.

**1620–1640**

**S11–O–117–A**

**TO BE ANNOUNCED**

**1640–1700**

**S11–O–117–B**

**TO BE ANNOUNCED**

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**Friday · August 16**

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**0800–0900**

**S11–P–118**

**EFFECT OF CO<sub>2</sub> AND TEMPERATURE ON THE PRODUCTION OF HIGH QUALITY SEEDLING IN TOMATO (*LYCOPERSICON ESCULENTUM* MILL. CV. MOMOTARO 8) SEEDLINGS**

C.K. Ahn, Y.W. Choi, J.S. Kang

Dept. of Horticulture, Milyang National Univ., Milyang, Kyongnam 627-702 Korea

The objective of this study was to evaluate the direct and interactive effects of temperature and CO<sub>2</sub> on plant growth, growth analysis, and C/N ratio. Tomato plants were grown in glasshouse exposed to natural light with temperature and CO<sub>2</sub> as treatments. The average temperatures were 19.6, 22.4, and 24.7 °C for 14 and 22 days at 386 and 594 ppm CO<sub>2</sub>. Elevated CO<sub>2</sub> increased

plant height, diameter, and mean fresh weight compared with 386 ppm CO<sub>2</sub>. Seedling growth was better at 19.6 than 24.7 °C at 386 ppm CO<sub>2</sub>. However, plant growth was increased at 24.7 °C at 594 ppm CO<sub>2</sub>. Leaf area was not affected by CO<sub>2</sub> concentration, but was increased at high temperature. Dry weight of leaf, stem, and root per plant were increased with elevated CO<sub>2</sub> and temperature. Elevated CO<sub>2</sub> and higher temperature increased RGR, NAR and CGR. Concentration of carbon in leaf and stem was not affected by CO<sub>2</sub> concentration, but that in root was affected. Elevated CO<sub>2</sub> and temperature decreased concentration of nitrogen in seedling, but they increased C/N ratio. Plant growth was influenced by CO<sub>2</sub> concentration and temperature. We suggest that elevated CO<sub>2</sub> compensated for the reduced plant growth when they were grown at high temperature.

**0900–0940**

**S11–O–119**

**HISTORY OF ASIAN HORTICULTURE**

Jules Janick\*

Dept. of Horticulture and Landscape Architecture, Purdue Univ., West Lafayette, IN 47905-1165 USA

The beginnings of agriculture in eastern Asia date to Neolithic times dating 7000 years ago and perhaps much longer with rice cultivation as early as 6000 years ago. Agriculture in the Indus valley date to about 5000 years ago somewhat later than the Mid-East or Eastern Asia. In North China and Manchuria a civilization was established about 4000 years ago but the legendary history of China dates the beginning of agriculture to Shen Nung the Divine Cultivator of the five grains and inventor of the plough to traditional dates of 2737–2697 BCE. Canals and extensive irrigation was practiced in the Chou dynasty 3000 years ago. In the time of Confucius (551–470 BCE) 44 food plants are mentioned including horticultural crops such as peach, plum, Japanese apricot (*Prunus mume*), jujube, chestnut, mulberry, quince, Chinese cabbage, bottle gourds, and various melons. The first century agricultural manuals describes intensive production of crops, pretreatment of seed, irrigated rice with circulated water, ridge cultivation, pot irrigation, crop scheduling, composting, and iron tools. Books on agriculture and horticulture are produced in the Chinese dynasties between 221 and 550. Ornamental horticulture became embedded in the culture of China and spread throughout Asia through the development of rural retreats and urban gardens of the emperors. Flower cultivation becomes one of the seven arts and assumed mystic importance. By the 11th century there were 20 cultivars of tree peonies and 35 cultivars of chrysanthemum in China. Exchange of crops and technology through trade and conquests between East and West have an ancient and continuing tradition. There is evidence of silk strands in Egyptian mummies in 1000 BCE. The biblical trade in spices suggest both sea routes via India and the Mid-East as well as overland routes (the Silk Road) through Persia, and it is this route that the peach, mulberry, and citrus reached the West. European incursions in the Americas in the Age of Exploration increased direct East-West contacts and New World crops such as hot pepper, maize, sweet potato, and peanut entered China. Recent horticultural exchanges in technology include plastic culture from the West, hybrid vegetables and seedless watermelon from Japan, and hybrid rice and progress in anther culture from China.

**0940–1000**

**S11–O–120**

**TOWARD A DATABASE OF EAST ASIAN CULTIVATED PLANT SPECIES**

Helmut Knüpfner\*<sup>1</sup>, Karl Hammer<sup>2</sup>, Hoang Ho-Dzun<sup>3</sup>

<sup>1</sup>Institute of Plant Genetics and Crops, Crop Plant Research (IPK), Corrensstr. 3, Gatersleben, Germany, D-06466; <sup>2</sup>Universität Gesamthochschule Kassel, FB 11, Fachgebiet Agrarbiogenetik, Steinstr. 11, D-37213 Witzenhausen, Germany; <sup>3</sup>Botanical Institute of the Academy of Sciences of the Democratic People's Republic of Korea (DPRK), Pyongyang

The database is part of the "Database for Checklist of Cultivated Plants" which provides information about species of cultivated plants in various countries. So far, data for Cuba (1,029 spp.), Korea (605), Italy (665), Albania (433), and Vietnam (461) have been recorded. The database on East Asian cultivated plant species has been developed on information from floras and other sources from China, Japan and Korea, and is in the process of being built up. It pro-

vides taxonomic data for each species covered, including synonyms, as well as vernacular names, geographical information, plant uses and plant parts used, narrative text information and literature references. For East Asia, data of 996 species have been registered so far from a hand-written source, and further data will be included. Besides Chinese, Japanese and Korean transliterated vernacular names, English ones are also recorded. Using Unicode, Chinese, Japanese and Korean characters can generally be dealt with, although the co-operation of native speakers would be required for data entry and validation. Taxonomic information is being validated against standard references and other sources, including databases. The main taxonomic backbone is *Mansfeld's Encyclopedia of Agricultural and Horticultural Crops* (P. Hanell & Institute of Plant Genetics and Crop Plant Research, eds., 2001) providing information on 6,100 species of cultivated plants world-wide (excluding ornamentals and forestry plants), and *Mansfeld's World Database of Agricultural and Horticultural Crops* (<http://mansfeld.ipk-gatersleben.de>) developed at IPK. Various checklists can be prepared using the database. Such checklists are useful for plant explorers and collectors (especially of "multi-crop" collecting expeditions), but also as a starting point for compiling floras of cultivated plants. Contributions and comments from scientists, especially from the countries covered, are welcome.

#### 1000-1020

#### S11-0-121

#### A NOVEL APPROACH OF DISEASE-FREE RHIZOME PRODUCTION OF GINGER THROUGH BIOTECHNOLOGY

C. Kirdmanee\*<sup>1</sup>, C. Theerawitaya<sup>2</sup>, M. Kriengkrai<sup>1</sup>, K. Supaibulwatana<sup>2</sup>, W. Phaephun<sup>1</sup>, M. Tanticharoen

<sup>1</sup>National Center for Genetic, Engineering and Biotechnology, 73/1 Rama VI Road, Rajdhevee, Bangkok, Thailand, 10400; <sup>2</sup>Dept. of Biotechnology, Faculty of Science, Mahidol Univ., Rama VI, Bangkok 10400, Thailand

The productivity of ginger (*Zingiber officinale* Rosc.) has been decreased rapidly due to the disease infection in many countries. The objective of this research was to discover the efficiency of production system of disease-free ginger. Ginger buds were sterilized and cultured on Murashige and Skoog (MS, 1962) medium at 31 °C air temperature for 4 weeks. The meristems of developed shoots were cut into 0.1–0.3, 0.4–0.6 and 0.7–0.9 mm in diameter and cultured on MS medium supplemented with 15% coconut water for rapid screening of bacterial infection. The bacteria-free shoots were multiplied on MS medium supplemented with 0.00, 17.76, 35.51, and 53.27 mg benzyl aminopurine (BA) at 25 °C air temperature for 5 weeks. The plantlets were transferred to ex-vitro and produced the 1st and 2nd generations of mini-rhizome. Advantages and disadvantages of mini-rhizome produced through this 2nd generation of mini-rhizome were compared with those of rhizome produced through conventional method in the commercial scale. The lowest bacterial infection of meristem was observed in the shoots cut into 0.1–0.3 mm in diameter. The shoots multiplied on the medium supplemented with 35.51 mg BA were 1.9 times faster when compared with those multiplied on the medium supplemented without BA. The vigorous growth, high yield and disease-free rhizome were observed in the ginger plants produced through 2nd generation of mini-rhizome. The cost of rhizomes produced through 2nd generation of mini-rhizome method are similar to those of rhizome produced through conventional method in the commercial scale.

#### 1020-1040

#### S11-0-121-A

#### TO BE ANNOUNCED

#### 1400-1440

#### S11-0-122

#### PRESERVATION OF HORTICULTURAL CROPS IN ASIA

S.K. Lee\*

Dept. of Horticultural Sci., College of Agriculture and Life Sci., Seoul National Univ., Suwon, Kyunggi-do, Korea, 441-744

The basic methods of preserving produce include dehydration, salting, pickling, fermentation, canning, and freezing. Pickling and fermentation are old methods of preserving various horticultural crops, and unique methods of pickling and fermentation have long been developed. There are various types of pickling and fermentation products in Asia. Kimchi is a good example for fer-

mented vegetable foods in Korea. Many types of kimchi are available depending on the raw materials, processing methods, and different regions. Chinese cabbage and radish are the most widely used vegetables in making kimchi, but many other vegetables are also used. The basic taste of kimchi is derived from salt, lactic acid fermentation, and the unique blending of ingredients including hot pepper, garlic, ginger, green onion, and pickled fish. Detailed information about other fermented products will be introduced.

#### 1440-1500

#### S11-0-123

#### PRODUCTION AND MARKET EVALUATION OF SPECIALTY COMMODITIES IN OHIO

M.D. Kleinhenz\*<sup>1</sup>, S.A. Miller<sup>2</sup>, B. Bergefurd<sup>2</sup>, P. Bierman<sup>3</sup>

<sup>1</sup>The Ohio State Univ., OARDC, 1680 Madison Avenue, Wooster, OH 44691-4096 USA; <sup>2</sup>Ohio State Univ. South Centers for Research and Extension, 1864 Shyville Road, Piketon, OH 45661-9749 USA; <sup>3</sup>Dept. of Soil, Water, and Climate, Univ. of Minnesota, St. Paul, MN 55108 USA

Demand for locally and, often, organically grown specialty commodities is increasing among Ohio's large (12 million) multi-ethnic population. Yet, few farmers are equipped to take advantage of these trends. We report here on the latest in a series of studies designed to identify and help overcome production and market related obstacles to profitable specialty commodity production in Ohio, including using organic methods. We measured production and market outcomes following growth and market evaluation of Asian-type eggplant, bitter melon, huitlacoche (corn smut), edamame-type soybean, and sweet potato. In 2000 and 2001, we employed a participatory network of scientists, extension professionals, farmers, consumers, and professional produce buyers to meet project goals: 1) identify optimal specialty commodity varieties based on production capacity and buyer/consumer acceptability, 2) develop optimal organic and/or conventional production techniques for each commodity. Replicated plots (arranged in a RCB design) of 2–16 varieties of each commodity were established at OARDC locations in Wooster and Piketon, Ohio and, for three commodities, on the farms of grower-cooperators. Asian-type eggplants and bitter melon were grown organically and conventionally, sweet potato organically, and other commodities conventionally. Measures of crop development and pest and disease pressure during the season were followed by measures of crop yield and quality at harvest. Eggplant and bitter melon fruit were evaluated by consumers and professional produce buyers throughout the state using hedonic scales. They were also asked questions about their commodity purchasing and consumption habits. Varieties differed in yield, quality, and consumer acceptance. Deviation from standard eggplant fruit shape, size, and color contributed to poor recognition of Asian-type eggplant varieties among the widest audience. But, the same varieties were preferred in specialty markets and outlets.

#### 1500-1520

#### S11-0-124

#### EVALUATION OF GLUCOSINOLATE COMPOSITION AND CONTENTS IN CHINESE BRASSICA VEGETABLES

H. He\*, L. Liu, S. Song, X. Tang, Y. Wang

Nutrition and Sensory Quality Lab, Beijing Vegetable Research Center, P.O. Box. 2443, Beijing 100089, China

Glucosinolate (GS) composition and contents were evaluated in Chinese Brassica vegetables including pak choi (*B. campestris*), mustard (*B. juncea*) and cole groups (*B. oleracea*). Among of the 9 Brassicas, collard had the highest total glucosinolate content, followed by kale, cabbage mustard and Chinese kale. The lowest concentration was found in pak choi. Glucosinolate profiles and contents varied among the different groups and also within each group. The main glucosinolates in pak choi were 3-butenyl- and 1-methoxy-3-indolylmethyl-glucosinolates, in choy sum 3-butenyl- and 2-hydroxy-3-butenyl-glucosinolates and in tai tsai 1-methoxy-3-indolylmethyl- and 4-pentenyl-glucosinolates. Two types of glucosinolate profiles were detected in mustard group. 2-Propenyl-GS was the major glucosinolate representing about 90% of the total amount in cabbage mustard. Whereas in pot herb mustard, 3-butenyl-GS was the dominant glucosinolate representing about 70% of the total. The predominant glucosinolates in kale were 3-indolylmethyl- and 3-methylsulfinylpropyl-GS. High amounts of 4-methylsulfinylbutyl-GS were only determined in Chinese kale. In addition, 3-butenyl-GS was also a dominant

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glucosinolate found in Chinese kale. In collard, 2-hydroxy-3-butenyl-GS was the predominant glucosinolate which made up 43% of the total amount; 2-propenyl-GS and 3-indolylmethyl-GS were about 20% of the total. Glucoraphanin content in Chinese kale reached 118.9 mmol/100 g FW which could be regarded as the valuable *Brassica* vegetable for antitumor.

**1520-1540**

**S11-0-125**

**THE EFFECTS OF HOT WATER TREATMENT AND POLYETHYLENE BAGS APPLICATION ON THE STORAGE LIFE AND QUALITY OF POMEGRANATE (CV: MALAS-TORSH)**

Alireza Talaie\*, Firouzeh Bahadoran, Mohammad Ali Askari

Dept. of Horticulture, College of Agriculture, Univ. of Tehran, Ap. 1108, Nilo Park Building, 8th Golestan St., Pasdaran Ave, Karaj, Iran

This research work was carried out at Dept. of Horticulture, Univ. of Tehran, Karaj to find out how the qualitative and quantitative characteristics of pomegranate fruits could be improved in cold storage room. In this experiment the effects of hot water and the use of polyethylene bags on the quality improvement of pomegranate fruits during storage were studied. For this purpose the pomegranate fruits of Malas-Torsh cv. were harvested at fully ripen stage and

treated with hot water (55 °C for 1 to 2 minutes). Thereafter, each fruit was packed in polyethylene bags of 0.01 and 0.04 mm in thickness and stored in cold storage room with 5 °C and relative humidity of 85% for 3 months. The experiments were conducted with completely randomized design with 3 replicates. The characteristics like: weights lose, fruit seed weight percentage, fruit seeds weight, total soluble solid (TSS), juice dried weight percentage, pH and titratable acidity (TA) and colour intensity were measured. Other characteristics such as fruits and seed appearance for marketability, taste and fungi contamination percentage points of views were also examined. The results indicated that polyethylene bags had significant effects on the preventing the weight lose, improving the appearance and marketability of fruits during the storage, while showing no effect on pH, TSS and dry matter of fruits. Also the fruits treated with 50 °C hot water showed significant improvement of quality where treatment with 55 °C hot water failed to show such effects. Finally the combinations between polyethylene bag packaging and 50 °C hot water treatment further increased the general quality of stored pomegranate fruits with minimum fungi infection.

**1540-1600**

**S11-0-126**

**TO BE ANNOUNCED**