Final Report on the
THIRD INTERNATIONAL SYMPOSIUM ON ROSE RESEARCH AND CULTIVATION
Herzliya, Israel; May 21-26, 2000

by Soo Kim, Loren Oki, and Heiner Lieth.

The following is a compilation of notes taken by Soo Kim, Loren Oki, and Heiner Lieth at the Rose Symposium. The symposium drew researchers from all over the globe. In addition to scientists interested in cut-flower rose production, there were also scientists focusing plant breeding and molecular techniques for plant improvement. There were also scientists interested in garden roses.

It should be noted that we cannot be accountable for the information presented here since it is (in almost all cases) the work of others. Where information is of particular interest it should be verified.

Also, note that eventually there will be a proceedings book published for the symposium. This is being edited by Prof Naftaly Zieslin (the symposium organizer) and will be available for purchase through the International Society for Horticultural Sciences (ISHS). It will be published in the series Acta Horticulturae. A catalog and ordering information can be found at the web site: www.ishs.org

Our attendance at the symposium and this report were made possible, in part, by a grant from Roses Inc.

The information here is presented in the order in which they were presented in the program. In all cases the title and name information was taken from the printed program; the text was supplied by one of us. Where we have not provided any text this is due to one or more of the following: (1) the talk was not presented (many speakers had not been informed that they were making presentations), (2) none of us were in attendance, or (3) the particular talk was so boring that all three of us could find nothing interesting to jot down in our notes.

GENETICS, MOLECULAR BIOLOGY, BREEDING

1 ROSE BREEDING TECHNOLOGIES

S. Gudin Universite Aix-Marseille, France

Rose may be the first nonedible crop in history with over 20,000 varieties grown worldwide. Eleven species of roses have given rise to all of the current cultivars. There are more than 120 wild species. In conventional breeding methods, seeds are removed 4 months after fertilization and the first flower develops 3-4 months after germination. Germination rate that is typically low, has been increased as a result in improvements in pollen care, pollination, seed maturation, and germination. Genetic analysis of hybridization problems has also improved success.

Biotechnology techniques using chemical and radiation mutagens is little used but has resulted in 24 cvs. Tissue culture methods relying on somaclonal variation in callus cultures will need to be coupled with selection pressure for success. Protoplast fusion has not led to new varieties. The embryo rescue method has led to an interspecific hybrid between *R. rigosa* and *R. fitida*. Efforts to increase ploidy with colchicine has not been successful. Methods in molecular biology is used to identify molecular markers for cv. identification and the construction of genetic maps.

2 TRANFORMATION OF ROSES WITH GENES FOR ANTIFUNGAL PROTEINS

A. Dohm and T. Debener Institute for Ornamental Plant Breeding, Ahrensburg, Germany

A system utilizing an *in vitro* culture of *Diplocarpon*, an *Agrobacterium* vector, and a tissue culture of rose were used to induce resistance to blackspot. The rose tissue culture involved callus culture, the generation and germination of somatic embryos, and shoot multiplication.

3 **USE OF ISOLATED PROTOPLASTS IN ROSE BREEDING**

A. Schum and K. Hofman Institute for Ornamental Plant Breeding, Ahrensburg, Germany

Somatic hybridization allows the exploitation of a larger gene pool. Utilizing somatic genetic material involves the combination of nuclear and cytoplasmic genomes. The methodology discussed utilizes an auxin preculture treatment of nonembryonic suspension cultures. The highest yield of protoplasts was obtained when the suspension was in the early linear growth phase. Fusion of protoplasts was accomplished with callus regeneration. Mutagenesis treatments with radiation or chemicals inhibited callus regeneration but treatment with PEG can reverse the inhibition.

4 **GENETIC AND MOLECULAR ANALYSIS OF IMPORTANT CHARACTERS IN ROSES**

T. Debener, B. Malek and H. Kaufman Institute for Ornamental Plant Breeding, Ahrensburg, Germany.

This work focused on the analysis of genes linked to disease resistance and stress tolerance. Since genetics in tetraploid background is complicated, reduction to diploid is necessary. The fact that black-spot resistance is the result of a single dominant gene means that it may be possible to move this trait into rose fairly readily. Markers closely associated with the genes of interest in wild types are identified. Using markers helps breeders direct their breeding work, thus speeding up the process of putting particular genes into various cultivars.

5 **IDENTIFICATION OF APOMICTIC PLANTS IN *ROSA HYBRIDA* L. BY USING THE AFPL TECHNIQUE.**

L. Crespel[1], D. Zhang[2], J. Meynet[3] and S. Gudin[4]
[1]Meilland Star Rose, Le Cannet des Maures, France
[2]Bio GEVES, Surgeres, France
[3]INRA, Station d'Amelioration des Plantes Florales, Saint Aygulf, France
[4]Laboraotire de Morphogenese vegetale, Universite d'Aix-Marseille, Marseille, France.

Serge Gudin spoke (ad hoc) describing his poster information. He spoke of various crosses/hybrids and various breeding issues.

6 **OPTIMIZING CONDITIONS FOR CHROMOSOME DOUBLING IN ROSES.**

M. J. Kermani, K. Yokoya and A.V. Roberts.
Department of life Sciences, University of East London, London, UK.

Chromosome doubling is induced or the rate is increased by inhibitors of spindle formation. Oryzalin, typically used in agriculture as an herbicide, is a spindle inhibitor with much greater affinity and less toxicity than colchicine used for chromosome doubling. It is easy to handle and economical. Excised shoot tips are exposed to oryzalin for 0 to 42 days and then transferred to a shoot elongation medium. An exposure at 5uM for 14 days delays stem elongation but the residual effect is short and results in doubling rates as high as 40%. Chromosome doubling can be induced in vitro, in a diverse range of roses.

Rose cultivars whose chromosomes are doubled using oryzalin are the following: (1) diploid to tetraploid - 'Martin Frobisher', 'Mermaid', 'Pink Surprise', 'Therese Bugnet', (2) triploid to hexaploid - 'Alister Stella Gray' x 'Abraham Darby', 'New Dawn'. The distinct characters of tetraploids in comparison with diploids are decreased nodes, increased length of internodes.

PLANT RESISTANCE, PLANT PROTECTION

7 EVALUATION OF ROSE SPECIES AND CULTIVARS FOR RESISTANCE TO *DIPLOCARPON ROSAE* (MARSONINA ROSAE).

B.U. Carlson-Nilsson, Balsgard Department of Horticultural Plant Breeding, Swedish University of Agricultural Sciences, Kristianstad, Sweden.

Not presented

8 VARIABLE RESISTANCE OF ROSES TO DIFFERENT RACES OF *DIPLOCARPON ROSAE*.

K. Yokoya, M. J. Kermani, A. V. Roberts Department of Life Sciences, University of East London, London, UK.

Four pathogenic races of rose black spot fungus (*D.rosae*) were isolated on the basis of host range. Two roses, *R.davidii* var. *elongata* and a hybrid of *R.multiflora*, 88/124-46, were completely resistant to all four races of *D.rosae*. One pathogenic race was found specifically to infect roses of the section *Cinnamomeae*. Leaf disks (12mm. dia.) are placed on moist filter paper and inoculated with spores. Wounded leaf discs generally showed more infection than unwounded leaf discs. A correlation between the infection rate and the diameter of the legions were found indicating that the ability of the fungus to enter the cuticle and subsequently invade the leaf tissue is related. Note that single-spore isolation is important so that you don't get varying effects due to individual differences between spores.

There are two kinds of resistance of roses to *Diplocarpon rosae*. These are horizontal and vertical resistance. Horizontal resistance is unusable and vertical resistence is potentially unreliable.

9 EVALUATION OF REDUCED RISK AND OTHER BIORATIONAL FUNGICIDES ON THE CONTROL POWDERY MILDEW ON GREENHOUSE ROSES.

S.A. Tjosvold, S.T. Koike University of California Cooperative Extension, Watsonville, CA, USA.

40% of all chemical control material used in rose production is directed towards the control of powdery mildew. The objectives of these studies is to evaluate the effectiveness of reduced risk and biorational materials, determine if they cause any phytotoxic and adverse effects, and introduce the materials into commercial practice.

10 RESISTIBILITY AGAINST CROWN GALL DISEASE IN PROGENIES BETWEEN RESISTANT 'PEKCOUGEL' AND SUSCEPTIBLE 'DUKAT' OF ROSE.

L. Zhou[1], B. S. Tan[1], H. Fukui[1], S. Matsumoto[2] and K. Kageyama[1]
[1]Faculty of Agriculture, Gifu University, Gifu, Japan
[2]Faculty of Education, Gifu University, Gifu, JAPAN

Resistance to the crown gall disease using the seeds from self and reciprocal crossings between the resistant and susceptible varieties. Resistance of crown gall disease in rose could be divided into two processes: (1) Resistance tumor formation- reduction in disease incidence and (2) Resistance to tumor development- reduction in tumor size. Using an *in vitro* method, they found that the resistance of crown gall is multigenic and 'PEKcougel', the resistant parent variety, is related to tumor formation resistance to crown gall disease, but not to tumor development

11 **SPREAD OF CROWN GALL DISEASE IN ROSE CULTURES.**

C. Poncet, G. Bonnet, S. Pionnat, D. Hericher and A. Bettachini Institut National de la Recherche Agronomique (INRA), Phytopathologie et Botanique, Unite Sante Vegetale et Environnement, Antibes, France.

Crown gall disease caused by *Agrobacterium* is one of the most damaging rose diseases, reducing both the vigor of the plants and the yields of marketable flowers. The study found that the exponential spread of crown gall disease in Mediterranean rose culture is related to: (1) the vegetative propagation of rootstocks, (2) the frequent exchange of plant material between professional breeders, multipliers, and grafters, and (3) the increasing turnover rates of flower production. Currently, the propagation of the disease can only be reduced by selecting healthy rootstocks. A method for detection and characterization of the bacteria using PCR (polymerase chain reaction) and molecular markers is discussed.

12 **CANADA'S WILD ROSES AS SOURCES OF INSECT PESTS ATTACKING CULTIVATED ROSES.**

J. D. Shorthouse Department of Biology, Laurentian University, Sudbury, Ontario Canada.

Dr Hosrthouse spoke about various wild rose species found across Canada and the various insects that thrive on them. There are 12 species of *Rosa* common in Canada. Four species of *Diplolepsis* have infested rose cultivars. A species that is naturally found on *R. banksii* has moved onto *R. rugosa* on which it is more successful, creating more and larger galls. Three species of *Diplolepsis* have been introduced into Canada. Biological invasions can lead to serious problems. Plant introductions can also introduce the associated pests. Cultivated roses that include the genetic material from wild roses will always be susceptible to new insect and diseases. Extreme caution is necessary when transporting plant material between regions and continents to avoid carrying unwanted diseases and pests.

13 **EVALUATION OF REDUCED RISK AND OTHER BIORATIONAL MITICIDES ON THE CONTROL OF SPIDER MITES (*TETRANYCHUS URTICAE*).**

S.A. Tjosvold and W.E. Chaney University of California Cooperative Extension, Watsonville, California, USA.

A study similar to that performed with disease control agents was done using materials to control spider mites on roses.

14 **IPM FOR FIELD-GROWN ROSE PLANTS IN CALIFORNIA**

J.F. Karlik[1], J. O. Becker[2] and U. K. Schuch[3].
[1]University of California Cooperative Extension, Bakersfiels, CA, USA
[2]Department of Nematology, University of California at Riverside, Riverside,CA,USA
[3]Department of Plant Sciences, University of Arizona, Tucson, AZ, USA

ECONOMICS MODELING

15 **DEVELOPMENT OF A CROP SIMULATION MODEL FOR OPTIMIZATION OF ROSE PRODUCTION.**
J. H. Lieth Environmental Horticulture, University of California Davis, CA, USA.

(It's hard to take notes when your talking; but this was obviously an outstanding presentation focusing on the model that is being developed with the financial support of Roses Inc and the Foundation)

16 **MICROCALORIMETRY: A NOVEL APPROACH TO DECISION MAKING IN CUT ROSE PRODUCTION.**
M. Raviv[1] and D. W. Burger[2]
[1]Agricultural Research Organization, Newe Ya'ar ResearchCenter, Ramat Yishay, Israel.
[2]Dept. of Environmental Horticulture, University of California, Davis, CA, USA

This is work reported to Roses Inc in other reports.

17 **MODELING DIURNAL VARIATION OF WHOLE-PLANT PHOTOSYNTHESIS OF GREENHOUSE ROSES.**
S. H. Kim and J. H. Lieth. Environmental Horticulture, University of California, Davis, CA, USA.

Whole-plant photosynthetic rate of rose (cv. Kardinal) was measured with an open system consisting of a computer-controlled data acquisition system and an infrared gas analyzer (IRGA). The system was used to monitor diurnal patterns of whole-plant gas exchange in response to environmental variables and a model to simulate this was constructed. A model for leaf photosynthesis was calibrated and scaled up to the whole-plant level. The simulated whole-plant photosynthesis compared well with the observed data. The model can be used for identifying the impacts of varying environmental factors on whole-plant or canopy photosynthesis of roses in the greenhouse.

PROPAGATION

18 **DISINFECTION OF RECYCLING WATER IN ROSE CULTURES**
C. Poncet, M. Offroy, G. Bonnet, C. Antonini, A. Bettachini, J.M. Drapier, D. Hericher and P. Julien
Institut National de la Recherche Agronomique (INRA), Phytopathologie et Botanique, Unite Sante Vegetale et Environnement, Antibes Cedex, France

A system using chlorine gas for the disinfection of the recycled water was set up. An amount of 4 ppm of active chlorine during 30 min could eliminate the bacteria and fungal spores. Recycling and disinfecting did not decrease the production. At the concentration of 4 ppm during 30 min, no phytotoxicity / no accumulation of chlorides higher than 2 meq/l was found. The system was reliable for 3 years. No plant health problem was detected after 4 years of operation. The system is a low-cost, yet excellent preventive method requiring $ 4,000 for installation and $ 0.006 per m^2 for application.

In comparison, an ultraviolet radiation system using a low pressure U.V. source at 70mJ/cm^2 with flow rates of 6 and 2 l/min. and 2 l/min recycled for 24 hrs. did not result in satisfactory control. Thermal exposure to 95°C for 30 s gave total removal, although the system is expensive.

19 **MORPHOLOGICAL CHARACTER AND GERMINATION IN ACHENES OF *ROSA PERSICA* MICHAX.**
Y. Ueda[1], H. He[1], T. Kurosawa[1], E. Nishino[1], B. Wang[2] and K. Liao[2].
[1]Faculty of Horticulture, Chiba University, Chiba Prefecture, Japan
[2]Xinjiang Agricultural University, Urumqi, Xinjiang, China.

Distribution of the species '*R.persica*' that exhibits relatively easy germination encompasses almost all northern hemisphere (20-70 N) . The dormancy of *Rosa* species was thought to be related to ABA content. The objective of the study was to clarify the germination mechanisms of the seeds of the species '*R.persica*'. Among the species examined, ABA content of *R. platycacantha* was very high, which did not germinate at all irrespective of stratification. On the other hand, low ABA content in *R. persica* gave easy germination. Anatomically, a thick exocarp of the achene in *R.persica* was thought to promote rapid swelling by water imbibition and decrease the physical inhibition of germination due to the pericarp . The thick endocarp might protect the embryo from drying until germination and the pericarp structure might be an adaptation to the desert region.

20 **PHOTOSYNTHATES: MAINLY "STORED" AND YET LIMITING IN PROPAGATION OF ROSE CUTTING.**

J. M. Costa[1], H. Challa[2], U. Van Meeteren and P. Van de Pol[3].
[1]Horticultural Production ChainGroup – Plant Sciences, Wageningen University, Wageningen, The Netherlands.
[2]Agrotechion and Physics Section, Wageningen, The Netherlands
[3]PRO Plant Research Overberg, Overberg, The Netherlands

In rose cuttings, photosynthates are mainly stored and yet limiting in propagation affecting the rooting characteristics of the material. Propagation is difficult due to losses or poorly rooted material, heterogeneous material, quickly changing cultivars, complaints of the growers. Leaves have a determinant effect of rooting and growth of rose cuttings. Carbohydrates have a key role of propagation because of the influence on survival and rooting. The results of the study demonstrated that (1) leaves are necessary for propagation, (2) there is a linear relation between LAD (leaf area duration) and the number of roots and total DW, and (3) one of the most important factors of light on cuttings was photosynthesis, other than hormone and phytochrome activity. The study concludes that current photosynthesis of the cutting is an important determinant for survival and rooting. Application of IBA did not show a significant effect.

21 **SHOOT PRODUCTION OF ROSE CUTTINGS ROOTED BI-LATERALLY AND PLANTED HORIZONTALLY.**

S. Gudin[1], N. Massot[2] and C. Lorenzini[2].
[1]Laboratoire de Morphogenes Vegetale, Universite d'Aix-Marseille, Marseille France.
[2]Meilland Star Rose, Domaine Saint Andre, Le Cannet des Maures, France

Dr Gudin showed an interesting propagation idea for roses by taking a long cane and applying root cubes and IBA at various places along the stem. 20 cm long cuttings were made with 3 or 4 nodes. Each end was treated with IBA at 1000 mg/l at the proximal end and 0-4000 mg/l at the distal end. Each end was placed into rockwool cubes and rooted. The treatment resulting in the best bilateral rooting rate (80%) was with 4000 mg/l. Flower production was increased (stems/plant) but productivity on an area basis (stems/m^2) was lower compared to conventionally rooted cuttings. So this may be a great thing in theory, but of poor efficiency in practice. Some discussion after the talk provided some interesting enhancement ideas.

22 **MICROPROPAGATION, PROTOPLAST CULTURE AND ITS IMPLICATIONS IN THE IMPROVEMENT OF SCENTED ROSE.**

P. Kumar Pati, M. Sharma and P.S. Ahugu

Div. of Biotechnology, Institute of Himalayan Bioresource Technology, Himachal Pradesh, India.

Selection and characterization of *R.damacsena* (fragrant roses) in the Himalayan region of India is the focus of this project. Objectives are: (1) to enhance the flowering duration of the species using biotech tools and (2) to develop an efficient micropropagation technique. In micropropagation, when using solid medium for shoot proliferation, there is a tendency for necrosis, while healthy growth results with a liquid medium. Rooting responses were significantly better when liquid medium was used. The liquid culture is also very cost effective because of the elimination of agar.

Protoplast subculture using a cell suspension technique is currently being developed and examined. High planting efficiency results using either TAL or liquid medium. The modified MS media performed better than the original formula. So far, they have successfully fused protoplasts of *damascena* and *bourboniana* and in some cases regeneration was observed.

AXILLARY BUDS AND FLOWERS

23 **GIBBERELLINS AND INHIBITION OF FLOWERING IN ROSES.**

A.V. Roberts[1] and P. S. Blake[2]
[1]Department of Life Sciences, University of East London, London, UK
[2]Department of Crop Science, Horticulture Research International, East Malling, UK

The effect of gibberellins on flowering control was examined using ‘Felicite et Perpetue’(garden roses), which flowers seasonally, and its sport ‘Little White Pet’, which flowers recurrently. Examinations of GA content found that GA concentrations must be low for flowering to occur. In the seasonal flowering cultivar, the GA concentration is low only at the start and end of the growing season while in the recurrent flowering culivar, GA concentration is low throughout the growing season.

24 **TOPOPHYSIC INFLUENCES ON ROSE BUD AND SHOOT GROWTH AND FLOWER DEVELOPMENT ARE DETERMINED BY ENDOGENOUS AXILLARY BUD FACTORS.**

N. Bredmose[1], J. Hansen[1] and J. Nilsen[2].
[1]Danish Institute of Agricultural Science, Department of Ornamentals, Aarslev, Denmark
[2]Department of Agricultural Systems, Tjele, Denmark

Dr Bredmose talked about doing single-stem rose production of cut-flowers from cuttings. He claimed that the system to produce single stem plants using self-rooted, single node cuttings can result in higher production rates (stems/m^2). Greater growth control and automation is possible with this system. This study examined the influence of the position of the axillary bud along the shoot axis on its subsequent growth and differentiation. Single node cuttings with five leaflet leaves were made from stems of ‘Tanorelav’ (Red Velvet). The node with a five leaflet leaf closest to the stem apex is designated as position 1. The best plants were obtained from positions 4 through 7. Plants from these positions had the greatest stem diameter, stem growth rate, and biomass accumulation. Cuttings taken from the very top were the best. There were no differences in flower diameter and cut flower vase life.

25 **EFFECTS OF TEMPERATURE ON LEAF AREA AND FLOWER BUD DEVELOPMENT IN ROSE.**

H.K. Shin[2], J.H. Lieth[1] and S.H. Kim[1].

[1]Environmental Horticulture, University of California, Davis, CA, USA.
[2]National Horticultural Research Institute, Republic of Korea.

The response of ‘Kardinal’ rose plants to temperature was measured to develop a model for predicting rose flower size for a range of greenhouse conditions. The number of days from bud break (BB) to flowering increased from 21.6 to 63.0 days as temperature decreased from 30 to 15°C. The number of days to flower was primarily influenced by the temperature after the visible bud (VB). This suggests that the temperature before VB may not significantly affect the rate of flower development. Leaf area, stem length, and stem diameter generally increased with decreasing temperature, but the best quality of stems was observed at 18°C. Flower dry weight, however, increased from 0.7 to 3.0 g as temperature decreased from 30 to 15°C. When plants were moved to a lower temperature at VB, flower dry weight increased. Temperature is most influential on flower development during the period between VB and flowering. This may mean that during commercial greenhouse rose production, any reduction in temperature during that period can result in larger rose flower buds.

26 DEVELOPMENTAL CHANGES IN CARBOHYDRATE CONTENT IN YOUNG ROSE SHOOTS (*ROSA HYBRIDA* ‘FRISCO’).

M. C. Van Labeke[1], P. Dambre[1] and M. Bodson[2]
[1]Research Center for Ornamental Crops, Destelbergen, Belgium
[2]Gembloux Agricultural University, Horticulture Unit, Gembloux, Belgium.

Developmental stages and light intensity have a strong effect on the carbohydrate level in the shoot. Temperature does not have an effect.

IRRIGATION, NUTRITION

27 A TRIAL OF THE PHYTOMONITORING TECHNIQUE FOR ROSES

M. Kopyt, Y. Ton, Z. Ben-Ner and A. Bachrach. Solo Shtil, Shahar, Israel.

The application of the Phytomonitoring system in cut-flower rose production was demonstrated. Use of this system allows growers to identify more optimal production conditions.

28 IRRIGATION BASED ON SOIL MOISTURE TENSION INCREASES ROSE PRODUCTIVITY AND FLOWER QUALITY.

L.R. Oki[1], J. H.. Lieth[1] and S. Tjosvold[2].
[1]Environmental Horticulture, University of California, Davis, CA, USA.
[2]University of California Cooperative extension, Watsonville, CA, USA

An irrigation system utilizing a tensiometer modified with a pressure transducer in place of the vacuum gauge was installed in a greenhouse of ‘Kardinal’ plants. The system was configured to initiate an irrigation when the substrate moisture tension reached 5 kPa. While water is applied, the system monitored tension and closed the water valve when either tensions decreased to 1 kPa or five minutes had elapsed. The system applied 26% less water compared to the grower controlled irrigation and productivity (number of stems harvested /m^2) increased 66%. Stem lengths also increased.

29 IRRIGATION OF FIELD-GROWN ROSE PLANTS IN CALIFORNIA WITH BURIED DRIP TUBING.

J. F. Karlik[1], U. K. Schuch[2] and J. O. Becker[3].

[1]University of California, Cooperative Extension, Bakersfield, CA, USA
[2]Department of Plant Sciences, University of Arizona, Tucson, AZ, USA
[3]Department of Nematology, University of California at Riverside, Riverside, CA, USA.

Performance of the drip irrigation system vs. furrow irrigation for field grown roses in CA was compared. The drip irrigation system can manage water more precisely so that growers can use water more efficiently. The objectives of the study were: (1) to evaluate effects of drip irrigation tape depth on rose growth and (2) to evaluate the growth of roses planted on flat ground (30 inches between rows, spacing within rows of 6,8,10 inches). The results of the study showed that: (1) tape depth of 20-30 cm resulted in larger dimensioned roses, (2) significant effects of cultivar and the tape depth treatments were observed, (3) in the spacing experiment, 20 cm within row spacing resulted in largest plant diameter, shoot and root dry weight. The implications for the California field rose industry are: (1) establishment of rose cuttings is difficult with drip irrigation alone, (2) for the 10cm depth, the frequency domain (FD) soil moisture sensor used caused premature valve closure, (3) the FD sensors should be calibrated with tensiometers, (4) by observation, roses grown on beds were earlier and grew larger than rose in the furrow and drip 2 experiments, (5) despite uniform valve settings for the drip 2 experiment, delivery of water was not the same among the 7 valves suggesting that the delivery system should be calibrated also. Differences in hydraulic conductivity due to soil compaction probably could account for the differences.

30 INORGANIC NITROGEN LOADING AND DISTRIBUTION IN SOIL PROFILES BENEATH ROSE GREENHOUSES.

R.I. Cabrera[1] and R.Y. Evans[2]
[1]Texas A&M University Research & Extension Center Dallas, Texas,
[2]Department of Environmental Horticulture, University of California, Davis, CA, USA.

Dr Cabrera showed work that he did when he was a PhD student at UCDavis. In this work they identified nitrogen concentrations in the soil solution in rose greenhouses and found huge amounts that were inaccessible to the plants. This work showed that there is a tremendous amount of wasted fertilizer in typical in-ground production and that growers will need to improve their fertigation practices to reduce improve this situation

31 WATER RELATIONS OF ROSE ORGANS AND THEIR RELATION TO FLOWER DEVELOPMENT AND QUALITY.

Z. Plaut[1], E. Dayan[2], A. Grava[2], E. Matan[1], I. Dori[1], Y. Presnov[1] and L. Ben-Yunes[1]
[1]Besor Exp. Station, Southern R&D Network, Negev, Israel.
[2]Inst. Of Soils, Water and Environmental Sci., Bet-Dagan, Israel.

The objective of the study was to examine the effect of water relations on quality and production. The following combinations of cooling methods were used as treatments.
1. Roof vent + night cooling; 2. Roof vent + shading; 3. Roof vent (control); 4. Roof vent + shade
5. Intensive irrigation; 6. Roof vent + driven air; 7. Pad+fan

Among the treatments, night cooling resulted in the highest modulus elasticity. The modulus elasticity is defined as the change in pressure for a given fractional change in the weight of simplastic water. If modulus elasticity increases, then tissue elasticity decreases. Tissues would thus become more rigid and growth would be less susceptible to changes in plant water potential and dehydration. Lower night temperature may have a direct effect on the flowering bud (larger buds) and allow better growth.

32 **EFFECT OF IRRIGATION AND SHADING AT THE STAGE OF FLOWER BUD APPEARANCE.**
D. Chimonidu-Pavlidou. Agricultural Research Institute, Nicosia, Cyprus.

Water stress at the time of stamen induction results in a reduction in productivity, stem length, and fresh weight. Stamens are formed when the first 5 leaflet leaf unfolds. Increased shading increases stem length. The study gives the conclusion that the primary factor for quality is substrate aeration.

MINERAL NUTRITION

33 **EFFECT OF NaCl-SALINITY AND NITROGEN FORMULATION ON YIELD AND NUTRIENT STATUS OF ROSES.**
R. I. Cabrera Texas A&M University, Research & Extension Center, Dallas, USA.

The author suggests that a NO_3^-: NH_4^+ ratio of 70:30 can increase productivity and can be beneficial in salt tolerance. Using 'Bridal Pink' fed with a base solution of half-strength Hoagland's solution, tests of various ratios of NO_3^-: NH_4^+ (112mg/l) at 100:0, 75:25, 50:50 and supplements with NaCl at 0, 5, and 10 mM and later at 1, 15, and 30 mM resulted in no differences in flower yield or quality.

34 **CA UPTAKE AND CONCENTRATION IN THE FLOWERING STEM OF ROSE FLOWERS IN RELATION TO *BOTRYTIS* FLOWER BLIGHT.**
A. Bar-Tal, R. Ganmore-Neumann, R. Baas, A. Kerssies, N. Marrisen, A. Zilber, M. Keinan, S. Davidov and Y. Elad Agricultural Research Organization, Bet-Dagan, Israel

Ca deficiency occurs due to competing cations affecting Ca uptake (i.e., ammonium) . Ca is taken up by the root through the apoplast and is transported by the xylem. The uptake rate during the day is a function of transpiration, while root pressure controls its uptake and transport during the night. Ca concentration [Ca^{++}] in transpiring organs is higher than in non-transpiring organs such as flowers, fruits and young leaves. Flower susceptibility to *Botrytis* is related to Ca concentration. [Ca^{++}] in petals, stem and leaves was reduced by competing cations. Leaf [Ca^{++}] is about 10x petal [Ca^{++}]. In petals, K and Mg competes with Ca, whereas in the leaves, only K competes with Ca. As competing cations, Ca was reduced more with K than Mg. Ca deficiency symptoms was that the bottom leaves were curling. [Ca^{++}] in the bottom leaves are lower than top leaves. This is due to the fact that the upper leaves are transpiring more than the bottom leaves. In petals, Ca was the highest. Ca transported through the phloem (Contradiction to the known theory). Increasing [Ca^{++}] in solution enhanced [Ca^{++}] in leaves and petals. Cations reduce Ca uptake in the following order, K, Mg and Na.

35 **LEAF ANATOMY FUNCTION AND MORPHOLOGY OF CUT ROSES GROWN AT HIGH AND LOW AIR HUMIDITY**
S. Torre. Agr. University of Norway, Department of Horticulture and Crop Sciences, Ås, Norway.

Leaf anatomy and morphology under two relative humidities (RH): high (70%) and low (40 %) were examined. Plants grown in high RH wilt easily due to the inability of stomata to close under water stress and they do not close completely at night. High RH resulted in more stomata that were larger in aperture and longer in length in comparison with low RH. Variation in stomatal size in high RH plants was higher. Reduced density of leaf veins when grown at high RH was also observed. Less vascular tissue and fewer mesophyll cells were observed in high RH. RH appeared to affect the differentiation of the stomata, vascular tissue, mesophyll and pallisade cells. The excessive water loss of high RH grown plants was due to the increased number stomata and wider stomatal apertures.

36 ON SOURCES OF VARIATION IN VASE LIFE LENGTH OF CUT ROSES <– CANCELLED

L. E. Sarkka[1], H. J. Rita[2] and S. O. Ripatti[3].
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Not presented

55 EFFECT OF GROWTH CIRCUMSTANCES ON THE VASE LIFE OF THE ROSE 'FIRST RED': A NURSERY COMPARISON

N. Marissen, and J. Benninga
Research Station for Floriculture and Glasshouse Vegetables, Aalsmeer, The Netherlands

After surveying flowers of 'First Red' grown at 35 different nurseries and using statistical analysis methods, it has been determined that the factors during cultivation influencing vase life are: mean temperature, mean PAR, RH, bud stage. The factors that do not influence vase life are: [CO_2], mineral nutrition, chemical pest control.

37 EFFECTS OF GIBBERELLIN ON SENESCENCE OF ROSE FLOWER PETAL

H. Agbaria, E. Zamski and N. Zieslin. The Hebrew University of Jerusalem, Israel.

The objective was to characterize gibberellin (GA) effects in physiological, biological and anatomical aspects. Two cultivars were used : 'Mercedes' and 'Madelon'. Petals from each cultivar were immersed in 20ppm GA_3 for 22 hrs. 'Mercedes' was affected (vase life increased) by external GA treatment while no effect was found on 'Madelon'.

38 A MOLECULAR MARKER MAP FOR ROSES

T. Debener Institute for Ornamental Plant Breeding, Ahrensburg, Germany.

Current status of the construction of the molecular marker map (MMM) in roses was reviewed. MMM is being developed for diploid for now since tetraploid would be too complicated. So far 360 RAPD and AFLP makers have been mapped in roses. The microsatellite technique can be very effective since the cross between any species will be made possible by the method. Any segregating population can be mapped using the microsatelite technique. It can also serve as a tool to study the systematic relationship between different species.

39 PETAL GENOMICS: AN INTEGRATED APPROACH TO ROSE PETAL FUNCTIONALITY

D. Weiss[1], Z. Adam[1], E. Lewinsohn[2], D. Zamir[1], A. Vainstein[1]
[1]The Hebrew University of Jerusalem, Faculty of Agriculture, Rehovot, Israel
[2]ARO, Newe Yaar Research Center, Ramat Yishay, Israel

A big petal genomics project in Israel was introduced.

40 **GAMETIC BEHAVIOUR OF PARTHENOGENETIC PLANTS OF *ROSA CANINA* L. AND *R. HYBRIDA***

H. El Mokadem[1], L. Crespel[2], J. Meynet[1], S. Gudin[3].
[1]INRA, Station d'Amelioration des Plantes Florales, Saint-Aygulf, France
[2]Meilland Star Rose, Domaine ST-Andre, Le Cannet des Maures, France
[3]Laboratoire de Morphogenese Vegetale, Universite d'Aix Marseille, Marseille, France

41 **EFFECT OF BENDING ON PRODUCTION AND QUALITY OF COMMERCIAL GREENHOUSE ROSES IN FIELD SOIL**

S. A. Tjosvold University of California cooperative Extension, Watsonville, CA, USA.

California growers have converted to either bending or hydroponics, but sometimes not to both simultaneously probably due to the costs involved. In this study, eight year old plants of 5 cultivars grown in ground beds were hedged back to 1 meter in height. Plants in beds were either then grown conventionally in hedges or bent-down. Bending occurred at the second or third 5 leaflet leaf and stems were decapitated. All plants were trained for three months before daily productivity data were collected. Every two weeks, 25 stems were measured and weighed. The study resulted in the conclusion that cultivars respond differently to the bending method. The grower needs to balance increases in productivity with increases in quality. Growers can convert ground beds to the bending method successfully.

42 **EFFECTS OF SHOOT-BENDING IN RELATION TO ROOT MEDIA ON CUT-FLOWER PRODUCTION IN ROSES**

J. H. Lieth and S. H. Kim. Environmental Horticulture, University of California, Davis, CA, USA.

Cut-flower production of *Rosa hybrida* 'Kardinal' and 'Fire and Ice' were compared between two canopy management regimes: shoot-bending and hedgerow without shoot-bending, and between hydroponic and non-hydroponic (UC Mix) culture with a tensiometer-based irrigation system. We observed the number and length of all harvestable flowering shoots from September 1997 to August 1999 in order to assess productivity and quality. Shoot-bending resulted in increased stem length of individual flowering shoots in both cultivars. However, this treatment also resulted in significantly fewer harvestable flowering shoots. In 'Fire and Ice', plants grown in hydroponics produced a greater number of harvestable flowering shoots in comparison with the plants grown in UC Mix. On the other hand, 'Kardinal' plants did not exhibit any difference in the number of harvestable flowering shoots between these two treatments. Both cultivars did not show differences in the stem length of flowering shoots between hydroponics and UC Mix. We calculated the value of each shoot based on a formula developed to simulate the market value of each stem. With 'Fire and Ice', the improvement in stem lengths did not offset the economic loss due to the reduction in flower number under shoot-bending. For 'Kardinal' there was no significant difference in economic value between shoot-bending and non-bending.

43 **EFFECTS OF PLANT DENSITY, HARVEST METHODS AND BENDING OF BRANCHES ON THE PRODUCTION AND QUALITY OF ROSES**

J. de Hoog, M. Warmenhoven, B. Eveleens-Clark, N. van Mourik and N. Marissen. Research Station for Floriculture and Glasshouse Vegetables, Alsmeer, The Netherlands.

Exp1: Effect of bending on production and quality

The aim of the study was to find the optimal method of bending in the Netherlands. The number of stems decreased from the least bending to heaviest bending for both ‘Frisco’ and ‘First Red’ while the stem weight changed in the opposite direction. Total harvested weight was decreasing with heavier bending. More and regular bending resulted in lower production but greater average branch weight. Different responses of different cultivars were found as well. LAI can vary per plant and per season. No significant difference was found in LAI between bending and non bending. Increase in LAI to 4-5 (‘Frisco’) or about 6 (‘First Red’) was observed by bending. When light decreased, LAI also decreased. Bending simultaneously influences both production and quality, so the method must be practiced to balance productivity and stem weight. The method is cultivar dependent, but different climate conditions can influence results.

Exp2: Plant density and harvest method on production and quality

Two harvesting methods: first scale vs. knuckle cut were examined. Three planting densities: 5,7.5 and 10 plants /m^2 were tested with 4 cultivars: ‘Frisco’, ‘Bianca’, ‘Mercedes’, and ‘First Red’. The number of stems per unit area increased with planting density. However, lower plant density resulted in more branches per plant. The average branch weight increased with lower plant density. The number and quality of the first bottom breaks was not influenced by planting density. A higher plant density resulted in decreased branch weight and diameter of the harvested flowers. In harvesting methods, first scale resulted in higher production. An interaction between plant density and harvest method was found. Varietal differences were also observed. Knuckle cut gave higher weight per branch. In conclusion, plant density and harvest method can influence the production level and quality of roses. Commonly used planting density in the Netherlands is 7.

44 OPTIMIZING LAI IN BENT ROSE SHOOTS

H. Pien[1], E. Bobelyn[1]. M. C. Van Labeke[2] and R. Lemeur[1],
[1]Laboratory of Plant Ecology, Ghent University, Gent, Belgium
[2]Research Centre for Ornamental Plants (PCS), Destelbergen, Belgium

It is well known that shading decreases photosynthesis. The question is whether having many lower leaf layers is beneficial. The objective of the study was to estimate the contribution of the undermost leaf layer of the bent canopy to total canopy photosynthesis. The cultivar studied was ‘Frisco’ and supplemental lighting (30 μmol) was used during the winter. Based on their measurements and simulation, the optimal leaf area index for a bent canopy falls between 1.5 to 4 in the environmental conditions that were experienced. Excessive leaf area would be rather detrimental due to the consumption of the photosynthetic products by the respiration of the older, undermost leaves where the light level may become lower than the compensation point.

45 APPLICATION OF MODIFIED ATMOSPHERE PACKAGING FOR FLOWER AND FRESH PRODUCE EXPORT

S. Zeltzer FreshSpan Ltd., Kibbutz Ein Hamifratz, Israel

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1 **EFFECT OF CO_2 AND ARTIFICIAL LIGHT ON THE PRODUCTION AND QUALITY OF ROSES**
J. de Hoog, T. Rijsdijk, E. van Rijssel, N. van Mourik and N. Marissen
Research Station for Floriculture and Glasshouse Vegetables, Aalsmeer, The Netherlands

2 **SELECTION OF ROSE CULTIVARS FOR LOW LIGHT GREENHOUSE PRODUCTION BY PHOTOSYNTETIC FEATURES**
N. Sevelius[1], T. Hyttinen[1], and S. Somersalo[2]
[1]Department of Plant Production, University of Helsinki, Helsinki, Finland
[2]Helsinki University Licensing Ltd, Helsinki, Finland

3 **ANATOMY OF CUT *ROSA* XYLEM OBSERVED BY SCANNING ELECTRON MICROSCOPE**
H.M.C. Put[1], A.C.M. Clerkx1 and D.J. Durkin[2]
[1]Plant Research International, PRI-UR, Wageningen NL, USA
[2]State University of New Jersey, Department of Plant Science, New Brunswick, New Jersey, USA

Described the xylem components of cut stems. The cut stems act as a microfilter of any matter that is in the water supplied to the stems and results in the loss of vessel function leading to water stress.

4 **TOWARDS THE MAINTENANCE OF SINGLE SPORE ISOLATES OF ROSE RUST**
M.J. Kermani and A.V. Roberts
Department of Life Sciences, University of East London, London, UK

5 **EFFECT OF MELA AND TWEEN-20 ON SHOOT MULTIPLICATION AND ROOTING IN MICROPROPAGATED ROSES**
J. Bringloe, V. Sarasan, V.K. Sieber and A.V. Roberts
Department of Life Sciences, University of East London, London, UK

6 **EVALUATION OF ROSE SPECIES AND CULTIVARS FOR RESISTANCE TO *DIPLOCARPON ROSAE* (*MARSSONINA ROSAE*)**
B.U. Carlson-Nilsson, Balsgard Department of Horticultural Plant Breeding
Swedish University of Agricultural Sciences, Kristianstad, Sweden

7 **SOMATIC EMBRYOGENESIS IN ROSES**
A. Dohm, C. Ludwig and T. Debener
Institute for Ornamental Plant Breeding, Federal Centre for Breeding Research on Cultivated Plants, Ahrensbur, Germany

8 **MARKER ASSISTED SELECTION FOR BLACKSPOT RESISTANCE IN ROSES**
T. Debener and B. Malek Institute for Ornamental Plant Breeding, Ahrensburg, Germany

9 **EFFECT OF GROWTH CIRCUMSTANCES ON THE VASE LIFE OF THE ROSE 'FIRST RED': A NURSERY COMPARISON**
N. Marissen and J. Benninga Research Station for Floriculture and Glasshouse Vegetables, Aalsmeer, The Netherlands

10 **DEVELOPMENTAL CHANGES IN CARBOHYDRATE CONTENT IN YOUNG ROSE SHOOTS (*ROSA HYBRIDA* 'FRISCO')**
M.C. Van Labeke[1] and P. Dambre[2]
[1]Research Centre for Ornamental Crops, Destelbergen, Belgium
[2]Gembloux Agricultural University, Horticulture Unit, Gembloux, Belgium

11 **PRODUCTION AND FLOWER STEM QUALITY OF *ROSA HYBRIDA* 'GOLDEN GATE' GROWN ON VARIOUS COIR SUBSTRATES.**
L. Blindeman and M.C. Van Labeke Research Centre for Ornamental Crops, Destelbergen, Belgium

12 **THE INFLUENCE OF BUDDING TECHNIQUE ON THE QUALITY OF BUDDED ROSE PLANTS**
K. Pudelska Department of Ornamental Plants, Agricultural University, Lublin, Poland

13 **PHYLOGENETIC ANALYSIS OF GENUS *ROSA*: POLYPHYLY OF SECTION *PIMPINELLIFOLIAE* AND ORIGIN OF *ROSA* X *FORTUNIANA* LINDL**
S. Matsumoto[1], H. Nishio[1], H. Fukui[2], and Y. Ueda[3]
[1]Faculty of Education, Gifu University, Gifu, Japan
[2]Faculty of Horticulture, Chiba Universiy, Matsudo, Japan
[3]Faculty of Agriculture, Gifu University, Gifu, Japan

14 **MOLECULAR EVIDENCE FOR THE PRESENCE OF ASTER YELLOWS RELATED PHYTOPLASMA IN ROSE PLANTS**
D. Dziekanowska, M. Kaminska and H. Wisniewska-Grzeszkiewicz Research Institute of Pomology and Floriculture, Skierniewice, Poland

15 **PROPAGATION OF GROUND COVER ROSES BY STEM CUTTINGS AND TISSUE CULTURE**
H. Wisniewska-Grzeszkiewicz and M. Podwyszynska Research Institute of Pomology and Floriculture, Poland

16 **EVALUATION OF THE RESISTANCE TO POWDERY MILDEW, *SPHAEROTHECA PANNOSA* VAR. *ROSAE*, OF ROSE-TREE SPECIES AND HYBRIDS. FIRST EXPLOITATION OF THE RESISTANCE BIODIVERSITY IN A CROSSING PROGRAM ON RESISTANCE.**
F. Ferrero[1], P. Cadour-Marvaldi[1], E. Guilloteau, Y. Jacob[1], A. Coudret[2] and H. Sallanon[2]
[1]INRA – Station d'Amelioration des Plantes Florales – Domaine de La Gaudine, Aygulf, France
[2]Laboratoire de Biotechnologies Environnement – Sante, Universite d'Auvergne , Aurillac, France

17 **EVALUATION OF THE RESISTANCE TO POWDERY MILDEW, *SPHAEROTHECA PANNOSA* VAR ROSAE, OF ROSE-TREE SPECIES AND HYBRIDS BIOLOGICAL TEST ON EXCISED LEAFLETS, MICROSCOPIC OBSERVATIONS O THE FUNGUS, PHYSICAL EVALUATION OF THE LEAF CUTICLE PROTECTION**
F. Ferrero[1], P. Cadour-Marvaldi[1], E. Guilloteau, Y. Jacob[1], A. Coudret[2], H. Sallanon[2] and L. Urban[3]
[1]INRA – Station d'Amelioration des Plantes Florales – Domaine de La Gaudine, Aygulf, France
[2]Laboratoire de Biotechnologies Environnement – Sante, Universite d'Auvergne , Aurillac, France
[3]INRA – URIH Sophia Antipolis, Biot, France

18 **FLUORESCENT STAINING OF ROSES POLLEN TUBES AND NUCLEI BY MICROSCOPY AND FLOW CYTOMETRY ANALYSIS**

Y. Jacob[1], V. Priol[1], F. Ferrero A. Coudret[2] and H. Sallanon[2]
[1]INRA – Station d'Amelioration des Plantes Florales – Domaine de La Gaudine, Yygulf, France
[2]Laboratoire de Biotechnologies Environnement-Snate, Universite d'Aubergne, Aurillac, France

19 **PRODUCTION AND PHOTOSYSTEM II ACTIVITIES OF *ROSA HYBRIDA* (CV. FIRST RED) CULTIVATED ON WASTEWATER**

F. Monnet[1], A. Coudret[1], F. Ferrero[2], Y. Jacob[2] and H. Sallanon[1]
[1]Labortoire de Biotechnologies Environnement-Sante Universite d'Auvergne, Aurillac, France
[2]Unite d'Amelioration de Plantes Florales, I.N.R.A Centre de Recherche d'Antibes, Saint-Aygulf, France.

20 **PHYLOGENETIC ANALYSIS OF SECTION SYNTYLAE ON THE GENUS *ROSA* BASED ON RAPD. MARKERS**

S. Wu, Y. Ueda Faculty of Horticulture, Chiba University, Chiba, Japan

21 **COLOR FADING OF ROSE PETALS DUE TO A TRANSIENT HIGH TEMPERATURE STRESS**

M. Oren-Shamir and G. Dela, Ornamental Hort. Dept. Volcani Center, Bet Dagan, Israel

22 **EFFECTS OF FLOWER BUD SHADING ON GROWTH AND DEVELOPMENT OF ROSE FLOWERS**

R. Ganelevin and N. Zieslin, The Hebrew University of Jerusalem, Faculty of Agriculture Food and Environmental Quality Sciences, Rehovot, Israel

23 **QUALITY OR QUANTITY**

H. Eijkelboom Greenhouse Consultancy, Best, Netherlands