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CONTENTS

biotechnology in weed control with particular emphasis on herbicide resistance in crops.

1810 NAGAR, PK; SAHA, S. 1985. **Distribution of cytokinin-like activity in different plant parts of the water hyacinth, *Eichhornia crassipes*.** *Physiologia Plantarum*, 64: 3, 328-332; 22 ref.

Cytokinin-like activity in extracts of leaf laminae, petioles, shoots, roots and flowers of young plants of *Eichhornia crassipes* was analysed using the soyabean callus bioassay. In all plant parts analysed, 2 prominent peaks of cytokinin activity having elution vol. similar to zeatin and zeatin riboside were detected. Putative cytokinin glucoside-like activity was detected only in leaves and flowers. The cytokinin complements of the leaves and the roots were qualitatively different. It would appear that cytokinins supplied by the roots were metabolized in the leaves or that certain cytokinins were synthesized in the leaves themselves. The possible significance and distribution of cytokinins in different plant parts in relation to roots is discussed.

1811 RAM, RL; SINGH, MPN. 1991. **In vitro haustoria regeneration from embryo and in vitro formed leaf callus cultures in *Dendrophthoe falcata (L.F.) Hings*.** *Advances in Plant Sciences*, 4: 1, 48-53; 14 ref.

Embryo and leaf calli of *D. falcata* grown in modified White's medium showed concn-dependent differentiation of haustoria on exposure to IAA and IBA. Concn >4 ppm stimulated additional haustoria differentiation from callus cultures. White's medium containing IBA 5 ppm and casein hydrolysate 2000 ppm was ideal. Increasing the concn of IBA from 5 to 10 ppm suppressed haustoria differentiation but caused profuse callusing. To a certain extent the formation of haustoria from callus cultures could be chemically controlled.

AROMATIC PLANTS

1812 KOTHARI, SL; CHANDRA, N. 1986. **Adventitious shoot production from stem internode and callus cultures of *Artemisia scoparia* Waldst. et Kit.** *Journal of Plant Physiology*, 124: 5, 409-412; 12 ref.

A. scoparia is used for the isolation of scoparone, a compound with hypotensive and tranquillizing properties. Stem internode sections and callus derived from them (on a medium containing 0.5 mg/litre kinetin and 1 mg/litre IBA) were cultured on Murashige and Skoog media supplemented with various cytokinins and/or auxins. Shoot differentiation in explant and callus cultures occurred only with IAA and BA combinations and the best results were obtained with high IAA/BA ratios. No shoot differentiation occurred when auxins or cytokinins were used singly. Explants formed roots with IAA, NAA or 2,4-D alone, but not with IBA; no root differentiation occurred in the presence of cytokinins. Callus cultures formed roots with IAA, IBA, NAA or 2,4-D (1 mg/litre), but IBA at 3 mg/litre gave the best results; kinetin or BA at low concentrations (0.1-0.5 mg/litre) also induced rooting.

1813 PHILIP, VJ; NAINAR, SAZ. 1986. **Clonal propagation of *Vanilla planifolia* (Salisb.) Ames using tissue culture.** *Journal of Plant Physiology*, 122: 3, 211-215; 15 ref.

Plantlets were produced in vitro from aerial root tips taken from elite vines and cultured on Murashige & Skoog medium. This rapid multiplication method is recommended for the production of material free from *Fusarium batatatis var. vanillae*.

1814 PHILIP, VJ; PADIKKALA, J. 1989. **The role of indoleacetic acid in the conversion of root meristems to shoot meristems in *Vanilla planifolia*.** *Journal of Plant Physiology*, 135: 2, 233-236; 13 ref.

Aerial root tip explants cultured in MS media containing more than 5 mg/litre IAA continued to grow as roots, but the root meristem of young tips grown in media containing 1-5 mg/litre IAA developed into shoots and plantlets. Scanning the root tip extracts for IAA using UV, TLC, GLC and GC-MS showed higher levels of auxin in root tips from old aerial roots and also in young cultured tips in which the root meristem had transformed to shoots.

ORNAMENTAL PLANTS

1815 BHATTACHARYA, PS; BHATTACHARYYA, BC; BHATTACHARYA, PS; DAS, N; DEY S. 1990. **Table-top *Chrysanthemum garden*.** *Chrysanthemum (NCS, USA)*, 46: 3, 150-151.

1816 BHATTACHARYYA, PS; MAITI, TK; BHATTACHARYYA, BC. 1990. **New cost effective method of rooting of in vitro grown ornamental plants.** *International Symposium on Industrial Biotechnology*. (Hyderabad, India: 1990: November 18-20). Osmania University. p. 44.

1817 PRADESH, JITENDRA. 1988. **Plant health. A useful service for large scale propagation of ornamental plants through micropropagation.** *Acta Horticulturae*, No. 226: 115-120; 2 ref.

The services offered by the AV. Thomas Group of Companies are briefly described. Sensitive techniques are used to detect pathogens on ornamentals. ELISA is used to detect viruses, PAGE to detect viroids, fungi and bacteria are detected using selective growth media and mycoplasma-like organisms are detected by fluorescent light microscopy, EM and tetracycline tests. Once detected the pathogens can be eliminated by meristem tip culture combined with thermo- and chemotherapy.

1818 SALUNKHE, DK; BHAT, NR; DESAI, BB. 1990. **Postharvest biotechnology of flowers and ornamental plants**. Berlin: Springer-Verlag, 192 p.

An introductory chapter which analyses production, consumption and trade figures for different countries of Europe and North America, and describes quality criteria, postharvest losses, and loss reduction techniques for cut flowers and ornamental pot plants is followed by a chapter on the basic principles of flower and plant senescence. The following 6 chapters are each dedicated to an individual cut flower crop or group, viz. carnation, rose, *chrysanthemum*, tulip, orchid and gladiolus. Each of these chapters (except for the brief chapter on tulips) provides information on commercial cultivars, the nature and causes of postharvest losses, techniques for reducing losses, including appropriate cultural practices, harvesting, grading, packing and storage methods, and the use of floral preservative solutions. The final 3 chapters deal with postharvest loss reduction in other cut flowers (cut foliage included), in flowering pot plants, and in foliage plants.

Amaryllidaceae

1819 BEGUM, S; HADIUZZAMAN, S. 1993. **In vitro multiple shoot regeneration from bulb scale and leaf segments of *Pancratium biflorum Roxb***. *Plant Tissue Culture*, 3: 1, 41-45.

Regeneration of multiple shoots via bulblet induction from aseptically cultured bulb scale and leaf segments of *Pancratium biflorum Roxb.* was accomplished by the addition of different combinations of NAA and BAP to the MS, modified MS (MMS) and B5 media. A large number of bulblets was induced when bulb scale segments were cultured in MMS medium containing 1.0 mg/l NAA + 4.0 mg/l BAP. The induced bulblets produced shoots when transferred to MS medium supplemented with 0.5 mg/l NAA + 3.0 mg/l BAP. On the other hand, leaf segments produced a large number of adventitious bulblets on B5 medium supplemented with 1.0 mg/l NAA + 0.2 mg/l BAP. On transfer to MS medium containing 1.0 mg/l NAA + 4.0 mg/l BAP, the bulblets produced shoots. Healthy roots in both the cases were produced when individual shoots were cultured on MS medium containing 0.5 mg/l IBA.

1820 BEGUM, S; HADIUZZAMAN, S. 1995. **Plant regeneration from immature stamens and ovaries of three members of *Amaryllidaceae***. *Annual Plant Tissue Culture Conference*. (Dhaka University, Dept. of Botany: 1995: March 19).

1821 MUJIB, A; BANDYOPADHYAY, S; JANA, BK; GHOSH, PD. 1993. **Direct embryogenesis from bulb-scale explant of Eucharis grandiflora**. *Plant Tissue Culture*, 3: 1, 5-9.

Bulb-scales excised from bulb produced somatic embryos directly without callus formation when cultured on MS basal medium supplemented with either NAA/BAP or BAP aline. The somatic embryos resembling water droplets, were transparent at the initial stage became opaque and developed into plantlets after passing a ling dormant phase. The significance of development of non-zygotic embryos vis-a-vis in vitro cloning is discussed.

Bougainvillea

1822 GUPTA, VN; KHER, MA. 1991. **A note on the influence of auxins in regeneration of roots in the tip cuttings of *Bougainvillea sp. var. Garnet Glory* under intermittent mist**. *Haryana Journal of Horticultural Sciences*, 20: 1-2, 85-87; 11 ref.

Shoot tip cuttings, 15 cm long and with 4-6 leaves, were taken from cv. Garnet Glory, a cultivar that does not root readily when propagated by cuttings. The cuttings were dipped in IAA, IBA or NAA (2000, 4000 or 6000 p.p.m. in 50% alcohol) for 10 s before planting and were then maintained under a daylight hour mist cycle of 15 s on and 3 min off for 37 d. IBA at 4000 p.p.m. gave the best rooting (highest root numbers and greatest root length). All of the treatments induced better rooting than that of control cuttings dipped only in alcohol.

1823 OHRI, D; KHOSHOO, TN. 1982. **Cytogenetics of cultivated bougainvilleas. X. Nuclear DNA content**. *Zeitschrift fur Pflanzenzuchtung*, 88: 2, 168-173; 20 ref.

The DNA content of 3 basal *Bougainvillea spp.* (*B. peruviana cv.* Princess Margaret Rose, *B. spectabilis cvs* Splendens and Pradhan's Profusion, and *B. glabra* cvs Formosa and Jennifer) ranged from 7.00 to 8.91 pg. The content of *B. peruviana* differed significantly from that of the other 2 spp. DNA values of cvs in 3 hybrid groups (*B. specto-glabra*, *B. specto-peruviana* and *B.*

glabra-peruviana) and synthetic hybrids were intermediate between the parents. Similarly, in triploid and tetraploid hybrid cvs there was a positive correlation between ploidy level and DNA content. Two induced tetraploids (Thimma and Mrs. McCleans) were shown to be cytochimaeras.

1824 SHARMA, AK; CHATURVEDI, HC. 1988. **Micropropagation of *Bougainvillea* X *Buttiana* 'Scarlet Queen Variegated' by shoot tip culture**. *Indian J. of Experimental Biology*, 26: 4, 285-288; 13 ref.

One-cm-long shoot apices of this difficult-to-root cultivar, taken from a field-grown plant, were induced to multiply in vitro. Shoots were initially grown in a basal medium for a minimum of 120 days before further culture in a medium containing 1 mg/litre BA plus 0.1 mg/litre IAA, in which about 7 offshoots were produced in 60 days. A rooting rate of 100% was achieved in shoots cultured with 5 mg/litre NAA for 15 days and then transferred to a medium (of pH 4.5) containing 0.5 mg/litre NAA for a further 15 days. A minimum of 42 plantlets were produced from each original shoot apex in one year. The in vitro raised plants grew normally in soil and flowered true-to-type under field conditions.

1825 SHARMA, R; DHIR, KK. 1985. **In vitro culture of axillary buds of *Bougainvillea* cultivar 'Marypalmer'**. *Indian Journal of Plant Physiology*, 28: 2, 169-176; 11 ref.

In vitro development of axillary buds of stem explants was studied under 12 and 24 h photoperiods during 2 seasons. In March, under 12 h photoperiods the thorn-inflorescence axis developed into sterile flowers but under 24 h photoperiods and in November under 12 h photoperiods the thorn-inflorescence axis remained suppressed. In March vegetative axillary buds sprouted and exhibited good subsequent growth in a medium supplemented with IBA and kinetin (each at 1.0 mg/litre). In Nov, however, under 24h photoperiods sprouting was very poor and the explants eventually died.

Chrysanthemum

1826 BAJAJ, YPS. 1993. **A suggested method for in vitro long-term storage at 4 degree C of chrysanthemum and petunia germplasm [short communication - India]**. *Plant Tissue Culture*, 3: 1, 57-58.

1827 BAJAJ, YPS; SIDHU, MMS; GILL, APS. 1992. **Some factors enhancing micropropagation of *Chrysanthemum morifolium Ram***. *Plant Tissue Culture*, 2: 1, 41-47.

Plants and multiple shoots have been regenerated from in vitro grown shoot tips, segments of stem, capitulum, peduncle, and callus culture of a slow-multiplying summer flowering cv. Fredyule of *Chrysanthemum morifolium*. Of different explants, the best response was obtained from excised segments of inflorescences grown on Murashige and Skoog's medium supplemented with indole-3- acetic acid and kinetin. The in vitro-derived plants acclimated better when they were transferred to pots containing soil mixture of sand, leaf mould and farmyard manure, covered with polythene bags and left to grow for a week. The terminal cuttings from these plants were utilized for further multiplication in pots. The plants thus obtained produced normal flowers. A combination of tissue culture and the conventional cuttings method has been successfully practised for the propagation of *Chrysanthemum*.

1828 BHATTACHARYA,PARTHASARATHI;DEY, SATYAHARI; DAS, NILANJANA; BHATTACHARYYA, BC. 1990. **Rapid mass propagation of *Chrysanthemum morifolium* by callus derived from stem and leaf explants**. *Plant Cell Reports*, 9: 8, 439-442; 11 ref.

MS medium supplemented with 2 mg 2,4-D/litre yielded green calluses from both leaf and stem segments of [*Dendranthema morifolium*] cv. Birbal Sahni within 2 weeks. Callus 1 cm2 regenerated 2-3 shoots after 3 weeks on MS solid medium supplemented with 0.1 mg IAA and 0.2 mg benzyladenine/litre. Each of the regenerated shoots when transferred to the same medium without agar yielded about 150 new shoots, which in turn regenerated roots after 1 week in half-strength MS or modified White's media. It was estimated that about 1014 plantlets could be produced in a year from one explant.

1829 BHATTACHARYA, PS; DAS, N; DEY S; BHATTACHARYYA, BC. **Mass propagation of *Chrysanthemum* plants using leaf explant**. *Proceedings of the National Seminar on Biotechnological approaches for upgradation of Agricultural and horticultural Crops*. Bhaba Atomic Research Centre, Bombay. p. 52.

1830 HOQUE, MI; FATEMA, M; HASHEM, R; SARKER, RH. 1995. **In vitro plant regeneration in Chrysenthemum *morifolium Ramat***. *Annual Plant Tissue Culture Conference*. (Dhaka University, Dept. of Botany: 1995: March 19).

1831 PAUL, A; DHAR, K. 1988. **Organogenesis from selected culture lines of pyrethrum, *Chrysanthe-***

mum cinerariaefolium Vis. clone HSL 801. *Pyrethrum Post*, 17: 1, 17-20; 16 ref.

Shoot morphogenetic capacity of the 2 *C. cinerariaefolium* [*Tanacetum cinerariifolium*] leaf-explant culture lines C5 and C9, with higher pyrethrin content, exceeded that of culture line C10. Pyrethrin content of C10 only equalled that of the leaf explants. Culture line C5 had a higher regeneration capacity than the other 2 lines. Loss of totipotency in long term culture was accompanied by concomitant decrease in pyrethrin synthesis.

1832 RAJASEKARAN, T; RAVISHANKAR, GA; RAJENDRAN, L; VENKATARAMAN, LV. 1991. **Bioefficacy of pyrethrins extracted from callus tissues of *Chrysanthemum cinerariaefolium***. *Pyrethrum Post*, 18: 2, 52-54; 11 ref.

Pyrethrins extracted from cultured leaf calluses of *Chrysanthemum cinerariaefolium* [*Tanacetum cinerariifolium*] were applied topically to adults of *Drosophila melanogaster*. The LC50 for the pyrethrins was 28.21 ng/fly, whilst the LC50 of pyrethrin standards was 22.41 ng/fly.

1833 RAVISHANKAR, GA; RAJASEKARAN, T; SARMA, KS; VENKATARAMAN, LV. 1989. **Production of pyrethrins in cultured tissues of pyrethrum (*Chrysanthemum cinerariaefolium Vis.*)**. *Pyrethrum Post*, 17: 2, 66-69; 6 ref.

Calluses were initiated from elite high-yielding (2.5% pyrethrins) lines of *C. cinerariaefolium* [*Tanacetum cinerariifolium*] on MS medium supplemented with 2,4-D at 2 mg and kinetin at 0.5 mg/l. Callus growth was slow until the third week of culture; during this period the pyrethrins content rose rapidly to reach peak value (0.224%) in the third week. Exponential growth occurred, concurrently with a decline in pyrethrins, from week 3 to week 6. The callus extracts showed effective insecticidal activity in bioassays against mosquito larvae, when compared with authentic samples of pyrethrins.

1834 VIJ, SP; PATHAK, PROMILA. 1989. **Micropropagation of *Dendrobium chrysanthum Wall.*. through pseudobulb segments**. *Journal of the Orchid Society of India*, 3: 1-2, 25-28; 9 ref.

Pseudobulb segments (0.5-1.0 cm in length), from axenic seedlings, were cultured on MS medium supplemented with various growth regulators and nutrients. Shoots were regenerated only on media supplemented with yeast extract or urea. Kinetin promoted shoot bud multiplication through callusing, and NAA favoured rooting. Activated charcoal proved beneficial in maintaining luxuriant growth. Complete plantlets were formed after 18 weeks in media supplemented with yeast extract and NAA.

Papaveraceae

1835 SULAIMAN, IM; RANGASWAMY, NS; BABU, CR. 1991. **Formation of plantlets through somatic embryogeny in the Himalayan blue poppy, *Meconopsis simplicifolia* (*Papaveraceae*)**. *Plant Cell Reports*, 9: 10, 582-585; 19 ref.

This work was undertaken with a view to countering the effect of intensive grazing which threatens to make this poppy an endangered species. Exuberant and subculturable calluses could be induced only from hypocotyl and leaf segments of approximately 4-month-old seedlings cultured on MS medium supplemented with 10-6 M kinetin + 10-5 M NAA. Suspension cultures were initiated from the calluses in a similar medium but with 10-5 M 2,4-D. In about 80% of the suspension cultures somatic embryos differentiated freely (80-85%) as well as on the surface of small clumps of tissue (15-20%). Somatic embryos that developed beyond the heart-shaped stage were transferred to agar-solidified MS medium free from growth substances. When maintained in 10 h light and 14 h dark the somatic embryos developed into plantlets bearing cauline leaves. From seed sowing to production of normal plantlets via callus required 28 weeks; on average 80 plantlets were obtained from one explant in 3 passages.

1836 SULAIMAN, IM; BABU, CR. 1993. **In vitro regeneration through organogenesis of *Meconopsis simplicifolia* - an endangered ornamental species**. *Plant Cell, Tissue and Organ Culture*, 34: 3, 295-298.

Phlox drummondii

1837 RAJA, VG; KOUL, KK; RAINA, SN; PARIDA, A. 1993. **Ploidy-dependent genomic stability in the tissue cultures of ornamental *Phlox drummondii Hook***. *Plant Cell Reports*, 12: 1, 12-17.

1838 WAKHLU, AK; BAJWA, PS. 1985. **Cytological studies in plants regenerated from callus cultures of *Phlox drummondii Hook***. *Chromosome Information Service*, No. 38: 26-28; 4 ref.

Plants regenerated from cultured shoot tips resembled plants propagated from seeds in meiotic chromosome behaviour, pollen fertility (91% and 81%, respectively) and seed set (3 seeds/flower).

Rastrococcus invadens

1839 MOORE, D; FISCHER, HU; AGOUNKE, D. 1988. **Biological control of *Rastrococcus invadens* Williams in Togo**. *FAO Plant Protection Bulletin*, 36: 4, 169-174; 8 ref.

The pseudococcid *Rastrococcus invadens* became a serious pest of a number of fruit, ornamental and shade trees in Togo after its accidental introduction into the region in the early 1980s. The progress of a biological control programme for the pest which was started in June 1986 is outlined. Surveys for species of *Rastrococcus* and their natural enemies were initiated in 3 states of India and attempts were made to rear the natural enemies found. After detailed biological studies under quarantine in the UK, the encyrtid parasitoid *Gyranusoidea tebygi* was selected as a candidate for introduction to Togo in October 1987. The parasitoid was first released in November 1987 and by May 1988 parasitism was recorded from the field at up to 15 km from the release sites and the pseudococcid was effectively controlled in the immediate area of the release. The parasitoid was also released and established in 4 other experimental sites. Further searches for natural enemies are still in progress.

1840 NARASIMHAM, AU; CHACKO, MJ. 1988. ***Rastrococcus spp.* (*Hemiptera*: *Pseudococcidae*) and their natural enemies in India as potential biocontrol agents for *R. invadens Williams***. *Bulletin of Entomological Research*, 78: 4, 703-708; 17 ref.

Rastrococcus invadens, a pest of fruit and ornamental trees in West Africa, was introduced from the Oriental Region. In 1986, a search was initiated in India for natural enemies of *Rastrococcus spp.* with a view to selecting potential biocontrol agents for introduction into West Africa. The results of the survey, laboratory breeding of the hosts and their natural enemies and host-specificity of the natural enemies are reported. On the basis of host-acceptance tests, 2 encyrtids, *Gyranusoidea tebygi* and *Anagyrus sp.*, have been sent to the UK for further screening.

Roses

1841 BARVE, DM; IYER, RS; KENDURKAR, S; MASCARENHAS, AF. 1984. **An effective method for rapid propagation of some budded rose varieties**. *Indian Journal of Horticulture*, 41: 1/2, 1-7; 13 ref.

Axillary vegetative buds of the cultivars Crimson Glory and Glenfiditch, with a 10 mm stem portion, were cultured on modified White or Murashige and Skoog (MS) medium. Multiple shoot formation was induced on MS medium containing kinetin at 0.2 mg/litre + BA at 0.5 mg/litre. Good rooting (60%) was also obtained on the proliferated shoots by lowering the MS conc. to half strength and by adding IAA+IBA+indole propionic acid, each at 0.5 mg/litre. The plantlets were then transferred to pots in a greenhouse and later to the field. In the field the plants showed a high degree of uniformity in growth, petal number and flower size and colour.

1842 DOHARE, SR; BHAT, MS; KAICKER, US. 1991. **A method for rapid propogation of the *Rosa hybrida cv. Super Star***. *Acta Horticulture (Plant Biotechnology)*, p. 289.

1843 DOHARE, SR. 1992. **Commercial exploitation of Micropropagation of carnation (*Dianthus Caryophyllus*)**. *Nat. Sem. on Commercial Floric. in India; Present and potential*. (IAHS, Bangalore:1992: Jul 12-13).

1844 DOHARE, SR; YADU RAM. 1992. **Commercial exploitation of stenting method of propagation in roses**. *National Seminar on Commercial Floriculture in India; Present and Potential*. (IAHS, Bangalore: 1992: Jul 12-13).

1845 RAHMAN, SM; HOSSAIN, M; ISLAM, AKM RAFIUL; JOARDER, OI. 1992. **Effects of media composition and culture conditions on in vitro rooting of rose**. *Scientia Horticulturae*, 52: 1-2, 163-169.

1846 RAO, S; CHENNAVEERAIAH, MS; NATARAJA, K. 1983. **Effect of indole-3-acetic acid on phenolic accumulation and peroxidase activity in cell cultures of *Mussaenda rosea L.***. *Indian Journal of Experimental Biology*, 21: 12, 653-655; 15 ref.

Callus cultures from stems and leaves were maintained on a modified Murashige and Skoog medium to which was added 0.2, 2.0 or 5.0 mg/litre IAA. Controls received no IAA. Growth was optimal with 2 mg/litre. The 2 lower rates stimulated the accumulation of phenolic compounds and enhanced peroxidase activity, but 5.0 mg suppressed growth and delayed phenolic accumulation and peroxidase activity. A positive correlation was found between phenolic production and the enzyme activity and both were restricted to early stages of growth.

1847 ROUT, GR; DEBATA, BK; DAS, P. 1989. **Induction of somatic embryogenesis in *Rosa hybrida cv. Landora*.** *Orissa J. of Hort.*, 17: 1-2, 46-49; 11 ref.

Leaf and stem internode sections were cultured on half-strength MS medium supplemented with 0.2-0.5 mg BA, .25-6.0mg NAA and 0.1-2.0mg 2,4-D/l for callus induction and with .5mg BA +0.01mg NAA + .1mg GA3 + 200-800mg L-proline/l for induction of somatic embryogenesis. 92% of leaf segments formed callus on medium containing 0.5 mg BA + 1.0 mg NAA + 0.5 mg 2,4-D/l and 76% of stem segments formed callus on medium containing 0.5 mg BA + 1.0 mg NAA + 2.0 mg 2,4-D/litre. Stem-derived callus required higher levels of L-proline for induction of somatic embryogenesis compared with leaf-derived callus.

1848 ROUT, GR; DEBATA, BK; DAS, P. 1989. **Micropropagation of *Rosa hybrida L. cv. Queen Elizabeth* through in vitro culture of axillary buds.** *Orissa Journal of Horticulture*, 17: 1-2, 1-9; 11 ref.

Axillary buds were cultured on MS medium at 25 ±2°C with a 14-h light and 10-h dark photoperiodic cycle. Shoot multiplication experiments were carried out on MS medium supplemented with BA and GA3. The highest number of shoots/explant (3.5 ±0.74) was obtained with 0.1 mg BA/litre. BA + GA3 produced more robust shoots compared with BA alone. Explant survival was 80-90% for all treatments. In vitro-regenerated shoots were separated and cultured on solid or liquid media, or directly potted in an autoclaved sand, soil and compost mixture for assessment of rooting. In some cases, microshoots were transferred to pots after an initial 4-6 days' culture in MS medium supplemented with NAA and 2,4-D. Rooting occurred only on auxin-supplemented media and was best on half-strength liquid MS medium with 0.1mg NAA/l (4.85±0.91 roots formed within 8 days of inoculation, in 87.5% of microshoots). Transfer to pots after 4-6 days' culture in liquid medium produced the best results as the micropropagated plants adapted to soil conditions while rooting occurred. On transfer to field conditions (acclimatization in the growth chamber) >70% of plants survived.

1849 SRIVASTAVA, DK; BHATT, PN; MOHTA, AR. 1987. **Cell division in the mechanically isolated mosophyll cells in rose.** *Jrl. M.S. Univ. Baroda*, v.??.

Tagetes

1850 KOTHARI, SL; CHANDRA, N. 1984. **In vitro propagation of African marigold.** *HortScience*, 19: 5, 703-705; 14 ref.

Leaf segments of *Tagetes erecta* were cultured on Murashige and Skoog (MS) basal medium supplemented with BA, kinetin, IAA, IBA and/or NAA. Regeneration of a large number of adventitious shoot buds was observed on a medium with BA (3-5 mg/litre) + IAA (1 mg/litre). When shoot buds plus some callus were subcultured on the same medium, additional buds differentiated for up to 2 years. The shoot buds elongated when subcultured on a medium with BA (2 mg/litre) + GA3 (0.5 mg/litre). Shoots with sufficiently developed internodes were rooted on filter paper bridges in culture tubes on MS liquid medium with IBA (0.5 mg/litre) + GA3 (0.5 mg/litre) to obtain complete plantlets with well-developed root and shoot systems. Abnormal negatively geotropic green roots formed on a medium with kinetin (1 to 4 mg/litre) + IBA (1 to 4 mg/litre).

1851 KOTHARI, SL; CHANDRA, N. 1986. **Plant regeneration in callus and suspension cultures of *Tagetes erecta L.* (African marigold).** *Journal of Plant Physiology*, 122: 3, 235-241; 25 ref.

Leaf callus isolated on Murashige and Skoog (MS) medium with 10 mg/litre BA + 2.0 mg/litre NAA + 0.5 mg/litre GA3 and maintained through subcultures showed regeneration of adventitious shoots and roots when transferred to MS medium with 7.0 mg/litre BA + 5.0 mg/litre IAA, while at lower BA concentrations (0.5-5.0 mg/litre) only rhizogenesis occurred. Freshly isolated callus from cultured leaf explants showed shoot regeneration on a range of BA and IAA concentrations. Stock suspension culture maintained in batch cultures by regular subcultures on MS medium with 1.0 mg/litre BA + 2.0 mg/litre NAA + 0.5 mg/litre GA3 did not show shoot regeneration when transferred to a medium with 3.0 mg/litre BA + 5.0 mg/litre IAA, whereas freshly isolated callus from cultured leaf explants transferred to a liquid medium of similar composition showed shoot, root and plantlet regeneration. The results indicate a loss of morphogenetic potential due to aging of the culture.

1852 KOTHARI, SL; CHANDRA, N. 1984. **Plant regeneration from cultured disc florets of *Tagetes erecta L.*** *Journal of Plant Physiology*, 117: 2, 105-108; 20 ref.

The immature unpollinated disc florets showed differentiation of a large number of shoot primordia on Murashige and Skoog basal medium supplemented with BA (5 mg/litre) + IAA (3 mg/litre). These shoot buds were further grown on a medium with BA (3 mg/litre) + IAA (5 mg/litre) + GA3 (0.5 mg/litre) where they grew

to a well developed shoot system. Complete plantlets were obtained by subculturing the shoots on a medium with IBA (0.5 mg/litre) + GA3 (0.5 mg/litre). Plant regeneration from callus tissue could be maintained for two years by subculturing the callus together with developing shoot buds.

1853 MUKUNDAN, U; HJORTSO, MA. 1991. **Growth and thiophene accumulation by hairy root cultures of *Tagetes patula* in media of varying initial pH**. *Plant Cell Reports*, 9: 11, 627-630.

Orchids

1854 AGRAWAL, DC; MORWAL, GC; MASCARENHAS, AF. 1992. **In vitro propagation and slow growth storage of shoot cultures of *Vanilla walkeriae Wight* - an endangered orchid**. *Lindleyana*, 7: 2, 95-99; 29 ref.

A method of clonal propagation was devised for *V. walkeriae* which is restricted to the tropical forests of Tamil Nadu, India. MS basal medium supplemented with 0.5 mg kinetin, 1.0 mg BA and 1000 mg casein hydrolysate/litre supported rapid proliferation of multiple shoots from stem node segments. Rooting of shoots could be induced readily on a half strength semi-solid MS medium without hormones. Plantlets were transferred to soil successfully. In slow growth, shoot cultures were stored for 13 months on low nutrient medium with a thin overlay of liquid paraffin. Cytological examination of root tips of in vitro raised plantlets before and after storage and control plants revealed an identical chromosome number (2n = 24).

1855 BEATH, M; BARTHAKUR, B; SARMAH, J; DEKA, PC. 1991. **Embyo Culture of *Pynetostylis retusa* and *Vanda coerulea***. *Journal Orchid Soc. India*, 5: 97-101.

1856 BHAUMICK, D; DATTA, KB. 1988. **Induction of callus and regeneration in an elite *Cymbidium* hybrid**. *Indian Agriculturist*, 32: 2, 129-131; 7 ref.

1857 DAS, A; GHOSHAL, KK. 1989. **In vitro germination behaviour of some orchids' seeds developed in plains of West Bengal**. *Indian Agriculturist*, 33: 2, 103-109; 8 ref.

In vitro germination of seeds produced by selfing and crossing of different species was studied on modified Knudson C and Burgeff Eg-1 media. Of the 2 media, the Burgeff Eg-1 original medium was of wider application and seeds from the green pods of *Dendrobium chrysotoxum*, *D. pierardii* X *D. crepidatum*, *Aerides multiflorum* and *Cymbidium aloifolium* germinated successfully on it. Both media supplemented with NAA (1 mg/litre) were suitable as media to which seedlings could be transferred after the initiation of the 2nd leaf.

1858 DEVI, J; DEKA, PC. 1992. **Pollen viability, thingma receptivity and corss - incompatibility of some Indian orchids**. *J. Orchid Soc. India*, 6: 79-84.

1859 HOQUE, MI; HOSSAIN, MA; SARKER, RH. 1995. **Seed germination and protocorm development in seven local and exotic orchids**. *Annual Plant Tissue Culture Conference*. (Dhaka University, Dept. of Botany: 1995: March 19).

1860 MITRA, GC. 1987. **Some aspects of asymbiotic nutrition of orchid embryos**. *Journal of the Orchid Society of India*, 1: 1-2, 91-103; 77 ref.

A review and discussion of in vitro culture.

1861 PRODIP CHANDRA, J; DEVI, J; DEKA, PC. 1989. **Self Incompatibility in *Dendsobium amocnum***. *Orchid News*, 5: 3.

1862 ROY, AR; HOQUE, MI; SARKER, RH; HAQUE, MM; ISLAM, AS. 1993. **Large scale in vitro multiplication of nine orchid species in solid and liquid cultures**. *International Plant Tissue Culture Conference*. (Dhaka Univ., Dept. of Botany: December 19-21).

1863 SINGH, F; PRAKASH, D. 1984. **In vitro propagation of *Thunia alba (Wall.) Reichb. f.* through flower stalk cuttings**. *Scientia Horticulturae*, 24: 3/4, 385-390; 10 ref.

This rare orchid species from the North Eastern Himalayas was propagated by in vitro culture using flower stalk sections which were cut after the plant had flowered. Each section had one dormant bud. The buds were brought to sprouting and then rooted using modified Vacin and Went media. Basal parts of the in vitro sprouted bud were also successfully used for multiple plantlet formation. The methods used did not damage the mother plant.

1864 SINGH, F; PRAKASH, D. 1985. **Suspension culture technique for the culture of orchid embryos**. *Gartenbauwissenschaft*, 50: 5, 236-238; 8 ref.

Immature embryos from unripe capsules of Epidendrum radicans [ibaguense] were cultured in liquid or agar solidified Vacin and Went medium. In suspension

cultures the greening and first-leaf stages were reached in 9 and 31 days after inoculation, respectively, while on solid medium 21 and 58 days were required. When transferred to fresh solid medium at the first-leaf stage, plants originating from liquid culture reached the second-leaf stage in 48 days while plants from solid medium needed 77 days.

1865 SINGH, FOJA. 1991. **Encapsulation of *Spathoglottis plicata* protocorms**. *Lindleyana*, 6: 2, 61-63; 6 ref.

Twenty-day-old green protocorms cultured from seeds of *S. plicata* were encapsulated in alginate to produce individual beads which could be stored for up to 180 days at 4°C with little loss of viability. After 180 days the % germination fell to 70%. Non-encapsulated protocorms stored at 4° showed no viability after 30 days of storage. Of many encapsulating agents tested, sodium alginate was considered most suitable due to its solubility and formation of a completely permeable gel with calcium chloride at room temperature (25°). Encapsulated protocorms regenerated complete plantlets on a Vacin and Went modified medium. All the plantlets were robust and had good root and shoot growth. The encapsulation technique offers a method of preserving desirable genotypes and an easy and novel delivery system for orchid propagules.

1866 SOOD, SK. 1985. **Gametophytes, integuments initiation and embryogeny in *Microstylis cylindrostachya* (*Orchidaceae, Epidendreae*)**. *Proc. of the Indian Academy of Sc., Plant Sciences*, 95:6, 379-387; 22 ref.

The development of gametophytes, initiation of integuments and embryogeny are described and illustrated in *Microstylis [Malaxis] cylindrostachya*. The anther wall consists of an epidermis, fibrous endothecium, one middle layer and secretory tapetum with uninucleate cells. Its development corresponds to the monocotyledonous type. Cytokinesis is simultaneous. The microspore tetrads are decussate, isobilateral and tetrahedral. At shedding, the pollinia are 2- celled. The ovules are anatropous, bitegmic and tenuinucellate. Both the integuments are dermal in origin. Development of the female gametophyte is of the monosporic type. Double fertilization occurs, the primary endosperm nucleus degenerates and development of the embryo corresponds to the asterad type. The mature embryo is undifferentiated. Seed is non-endospermic and the seed coat is formed entirely by the outer layer of the outer integument.

1867 VIJ, SP; SOOD, ANIL; PATHAK, PROMILA. 1989. **On the utility of rhizome segments in micropropagating *Eulophia hormusjii Duth***. *Journal of the Orchid Society of India*, 3: 1-2, 41-45; 19 ref.

Rhizome segments (3-4 mm), from 24-week-old seedlings, were cultured on basal medium with or without various supplements (peptone, yeast extract, IAA, NAA, GA3, kinetin, BA and activated charcoal) under a 12-h photoperiod (3500 lux) at 25 ± 2°C. Data are tabulated on the responses to the various media combinations. The development of shoot buds into plantlets was dependent on the presence of peptone or yeast extract. The combination yeast extract + NAA + kinetin as best for shoot bud formation. Plantlets (3-4 cm in length) were produced within 6 weeks with peptone + NAA + kinetin.

1868 VIJ, SP; SOOD, A; PLAHA, KK. 1984. **Propagation of *Rhynchostylis retusa* Bl. (*Orchidaceae*) by direct organogenesis from leaf segment cultures.** *Botanical Gazette*, 145: 2, 210-214; 19 ref.

Young leaf segments from plants growing in vivo and in vitro were cultured on Mitra et al. medium (BM) supplemented variously with auxins (IAA, NAA, 2,4-D), kinetin, GA3, and organic supplements (peptone, urea, casein hydrolysate, and yeast extract). Explants from mature leaves did not grow and became necrotic, while those obtained from juvenile leaves of 6-month-old plantlets growing in vitro developed protocorm-like bodies (plbs) at their cut surfaces within 4-7 weeks, depending on the growth medium. Histological studies revealed their epidermal origin. Formation of plbs subsequently spread all along the explant and suggests a meristematic/generative potential of the epidermal cells in immature leaves. Upon subculture in basal medium, the plbs differentiated into plantlets within 4-5 weeks. Although regeneration of plbs was achieved in BM + auxins or GA3, BM + kinetin + IAA (or NAA) + peptone accelerated their formation.

1869 YAM, TW; ARDITTI, J; WEATHERHEAD, MA. 1989. **The use of darkening agents in seed germination and tissue culture media for orchids: a review**. *Journal of the Orchid Society of India*, 3: 1-2, 35-39; 30 ref.

The practice of incorporating charcoal or activated carbon into culture media for orchid seed germination or in vitro propagation is discussed.

1870 DEVI, J; MATH, M; DEVI, M; DEKA, PC. 1990. **Effect of different media on germination and growth of some North-East India**. *Journal Orchid Soc. India*, 4: 45-49.

Cassia fistula

1871 AHUJA, ASHOK; SAMBYAL, MANJU; KAUSHIK, JP. 1991. **Regulation of anthraquinone production by nutritional and hormonal factors in *Cassia fistula* callus cultures**. *Fitoterapia*, 62: 3, 205-214; 19 ref.

Growth and production of anthraquinones by callus cultures derived from *C. fistula* seedlings were studied. The effects of phytohormones (IAA, 2,4-D, BA and kinetin), mineral constituents of basal medium, C:N:-P2O5 ratio, maleic hydrazide and light on callus growth and anthraquinone production were examined in detail.

1872 BAJAJ, YPS; DHANJU, MS. 1983. **Pollen embryogenesis in three ornamental trees - *Cassia fistula*, *Jacaranda acutifolia* and *Poinciana [Delonix] regia***. *Journal of Tree Sciences*, 2: 1/2, 16-19; 8 ref.

Anthers excised at 3 stages (uninucleate, early binucleate and binucleate) were cultured on modified MS medium supplemented with various combinations of kinetin, IAA, NAA, BAP [BA], 2,4-D, casein hydrolysate, coconut water and yeast extract. Pollen embryogenesis and callus formation were induced in all 3 species, with the best response occurring in *D. regia* and the poorest in *C. fistula*. Callus formation was frequent (>30%) in *D. regia* and was best from uninucleate anthers. It was less frequent (<10%) in J. acutifolia and sparse in *C. fistula*. Callus developed from anther and pollen tissue. The frequency of formation of multinucleate pollen and pollen embryos was much less than that of callus formation in all species.

1873 GHARYAL, PK; MAHESHWARI, SC. 1990. **Differentiation in explants from mature leguminous trees**. *Plant Cell Reports*, 8: 9, 550-553; 9 ref.

Stem and petiole explants obtained from mature trees of *Albizzia lebbek* and the ornamental street trees, *Cassia fistula* and *C. siamea*, formed callus and differentiated shoot-buds, and later shoots, on B5 medium supplemented with either 0.5 mg/l IAA+1 mg/l BA or 2 mg/l NAA + 0.5 mg/l BA. The stem explants were more responsive than the petiole explants. In *A. lebbek*, the IAA-substituted medium favoured differentiation from both types of explants. However, in *C. fistula*, the type of explant rather than the medium composition influenced shoot differentiation; petiole explants showed little differentiation in either medium. It was possible to obtain plantlets from *A. lebbek* and *C. fistula* under conditions conducive to rooting (basal medium alone, or supplemented with 0.1 mg/litre IAA). Plantlets of *A. lebbek* were successfully transferred to the field.

1874 IYER, RI; NAGAR, PK; SIRCAR, PK. 1984. **Cytokinin changes in embryo and endosperm of *Cassia fistula* during fruit growth**. *Journal of Plant Physiology*, 117: 1, 87-92; 18 ref.

Cytokinin activity was determined in embryo and endosperm tissues from 30- (stage 1), 55- (stage 2), and 80- (stage 3) day-old fruits of *C. fistula*. High cytokinin activity was associated with stage 1 and the least activity with stage 3. This indicated that the cytokinins disappeared during the course of seed development. Sephadex LH-20 column chromatography with 35% ethanol indicated the presence of cytokinins coeluting with zeatin glucoside, zeatin riboside, and zeatin. Qualitatively the cytokinins in the embryo and endosperm were identical at all the stages. The putative zeatin glucoside predominated at stage 1 but was absent in the later stages, while only zeatin riboside was present at stage 3. The high cytokinin activity in the endosperm at early stages indicates that it may act as a supplier of cytokinins to the embryo during these periods. The possible significance of these findings is discussed.

Ficus

1875 AMATYA, NIRMALA; RAJBHANDARY, SB. 1989. **Micropropagation of *Ficus auriculata Lour.***. *Applications of biotechnology in forestry and horticulture*/edited by Vibha Dhawan. New York: Plenum Press, p. 157-163; 14 ref.

Cotyledonary nodes of *Ficus auriculata* (a popular fodder tree in Nepal) were cultured on Murashige and Skoog medium supplemented with benzylaminopurine (1 mg/litre) and NAA (0.01 mg/litre) to induce shoot formation. Shoots were subcultured every 8-10 wk. Microshoots were dipped in IAA solution (100 p.p.m.) and rooted in a mixture of sand and powdered dry leaves. One micropropagated plant has survived in the field at Godawari, Nepal, for 6 months.

1876 LAL, M; NARAYAN, P; JAISWAL, VS. 1988. **Induction of somatic embryogenesis and associated changes in peroxidase activity in leaf callus cultures of *Ficus religiosa L.***. *Proceedings of the Indian National Science Academy. Part B, Biological Sciences*, 54: 4, 271-275; 18 ref.

Callus cultures were raised from leaf explants from an approximately 20-yr-old tree (from Varanasi, Uttar Pradesh) on Murashige and Skoog's (MS) medium containing 0.5 mg/litre 2,4-D. The calli were transferred to a medium supplemented with various combina-

tions and concentrations (0.5-1.0 mg/litre) of benzyladenine (BA) and NAA. In the presence of 0.1 mg/litre BA and 0.05 mg/litre NAA, globular, heart and torpedo shaped somatic embryoids were formed on the surface of the calli 4-5 wk after transfer. These embryoids germinated on MS medium to give plantlets. During somatic embryo induction, peroxidase activity was higher than in non-embryogenic callus, and new isoenzyme bands were observed.

1877 NARAYAN, P; JAISWAL, VS; NARAYAN, P. 1986. **Differentiation of plantlets from leaf callus of *Ficus religiosa L.*** *Indian Journal of Experimental Biology*, 24: 3, 193-194; 5 ref.

Callus cultures were induced from leaf discs of mature trees on Murashige & Skoog medium supplemented with 2,4-D. Shoots were regenerated on transfer to a medium containing BA and these produced roots and developed into plantlets on liquid medium supplemented with NAA. Possible uses mentioned for the technique include acceleration of breeding programmes, selection of desirable genotypes and vegetative propagation.

Other Ornamental plants

1878 AGRAWAL, DC; PAWAR, SS; MORWAL, GC; MASCARENHAS, AF. 1991. **In vitro micropropagation of *Delphinium malabaricum (Huth) Munz.* - a rare species**. *Annals of Botany*, 68: 3, 243-245.

1879 ARA, M; JAHAN, A; HADIUZZAMAN, S. 1993. **In vitro plant regeneration from leaf explant of *Solanum sisymbrifolium Lamk* in Bangladesh**. *International Plant Tissue Culture Conference*. (Dhaka Univ., Dept. of Botany: December 19-21).

1880 BABELEY, GS; KANDYA, AK. 1986. **Excised-embryo test of seed germinability - an evaluation through the seeds of six dry-deciduous tropical forest tree species**. *Journal of the Japanese Forestry Society*, 68: 5, 197-199; 3 ref.

Embryos were excised from soaked seeds of *Acacia catechu*, *Albizia lebbek*, *Bauhinia variegata*, *Cassia fistula*, *Leucaena leucocephala*, and *Wrightia tinctoria* and incubated. At the same time, whole seeds were germinated in the laboratory. The excised-embryo test produced comparable values for seed viability and took the same or less time to complete than the standard germination test in all species except *L. leucocephala*, which produced lower viability values in the embryo test.

1881 BEGUM, S; HADIUZZAMAN, S. 1993. **In vitro multiple shoot regeneration from rhizome of Day Lily (*Hemerocallis fulva L.*)**. *International Plant Tissue Culture Conference*. (Dhaka Univ., Dept. of Botany: December 19-21).

1882 BEGUM, S; HADIUZZAMAN, S. 1993. **In vitro multiplication of May Flower (*Haemanthes coccineus L.*)**. *International Plant Tissue Culture Conference*. (Dhaka Univ., Dept. of Botany: December 19-21).

1883 DATTA, K; DATTA, SK. 1984. **Rapid clonal multiplication of *Angelonia salicariefolia* through tissue culture**. *Plant Cell, Tissue and Organ Culture*, 3: 3, 215-220; 12 ref.

Nodal explants were cultured on Murashige and Skoog basal medium and induced to form shoots when supplemented with either kinetin (1.0 mg/litre) or BA (1.0 mg/litre). Rooted shoots were formed in response to kinetin + NAA (1.0 mg/litre + 0.5 mg/litre). Subcultures of the shoots of these cultures grown on the same medium supplemented with 0.5 mg/litre of NAA, IAA or IBA, together with lowered concentrations of inorganic salts, induced root formation in 20- 30 days. Up to 18 X 103 plants were produced from one plant in less than a month. Regenerants were successfully transferred into soil.

1884 DESAI, HV; MEHTA, AR. 1985. **Changes in polyamine levels during shoot formation, root formation, and callus induction in cultured *Passiflora* leaf discs**. *J. of Plant Physiology*, 119: 1, 45-53; 15 ref.

Endogeneous levels of putrescine, spermidine, and spermine, and the activity of agmatine iminohydrolase, an enzyme involved in putrescine biosynthesis, were measured during shoot formation, root formation, and callus induction in cultured leaf discs of *P. alatocaerulea*. Shoot formation from the leaf discs was achieved on MS (Murashige and Skoog) medium containing BA and kinetin; root formation was achieved on MS medium containing NAA and kinetin; and callus was induced on MS medium containing IAA, NAA and kinetin. Putrescine content increased before any visible appearance of shoots or roots. Putrescine also increased during callus induction. Spermidine content increased slowly during shoot formation, root formation, and callus induction, and there was no significant change in spermine content. The observed increase in the activity of the enzyme agmatine iminohydrolase substantiated the findings. Results are discussed in relation to the role of polyamines during organized and unorganized growth.

1885 DORLE, UP; KULKARNI, AR. 1984. **Anther culture for production of pollen haploids in *Tropaeolum majus, Linn*.** *Curr. Sci.*, 53: 16, 867-868; 3 ref.

1886 NGUYEN, R. 1986. ***Encarsia lahorensis (Howard)* a parasite of *Dialeurodes citri (Ashmead)* (*Hymenoptera: Aphelinidea*).** *Entomology Circular*, Division of Plant Industry, Florida Dept. of Agriculture and Consumer Services, No. 290: 2 p.; 7 ref.

Information is given on the history of the introduction of *Encarsia lahorensis*, a specific parasitoid of *Dialeurodes citri*, from California to Florida, and on the morphology, biology and distribution of the aphelinid in India, Pakistan and the countries to which it was introduced (including Italy, Israel and several southern states of the USA). After an abortive introduction of the parasitoid in 1911, releases in 1977 resulted in its establishment in 2 counties of Florida, where it eliminated aleyrodid populations on *Viburnum* and *Gardenia* and was distributed on gardenia plants in pots to 66 counties, in 9 of which it became established. Heavy mortality of overwintering immature stages occurred in northern Florida.

1887 OHRI, D; KHOSHOO, TN. 1983. **Cytogenetics of garden *Gladiolus*. III. Hybridization**. *Zeitschrift fur Pflanzenzuchtung*, 91: 1, 46-60; 35 ref.

Intra- and interploidal crosses (using tetraploid, triploid and diploid hybrid and garden cvs) and one intergeneric cross (cv. La Paloma X *Acidanthera bicolor*) were made. Only 2 of the progeny of self and cross combinations involving tetraploid cvs were not tetraploid. The progeny essentially showed the same meiotic behaviour as the parents, with predominant bivalent formation. The 4x X 2x cross was successful only when a tetraploid was used as the female parent; 28 of 29 plants were triploid. *A. bicolor var.* murielae (2n = 30) could be crossed only with the *Gladiolus* cvs La Paloma and Pacifica (2n = 60) when these were used as female parents. *Gladiolus psittacinus* hybrids (5x) and garden cvs (4x) could be crossed reciprocally; bivalent formation was most usual in progeny but other configurations were observed.

1888 PANDA, N; DEBATA, BK; DAS, P. 1989. **In vitro regeneration of *Mussaenda erythrophylla cvs.* 'Queen Sirikit' and 'Rosea' from callus cultures**. *Orissa Journal of Horticulture*, 17: 1-2, 18-22; 7 ref.

Leaves takes from field-grown ornamental shrubs were washed in 2% Teepol for 5 m. The lamina was removed and the midrib and petiole surface were sterilized in 0.1% HgCl2 for 15 min. Segments (0.3-0.5 mm) of midrib and petiole were inoculated onto agar-gelled MS medium containing 30 g sucrose/litre and supplemented with IAA, NAA, BA, adenine sulphate and ascorbic acid, alone or in combination. The cultures were incubated under cool white fluorescent light at 25 ± 2°C. The best callusing response was observed with 0.5 mg BA + 10 mg ascorbic acid/litre. Shoot regeneration was best following subculture on MS medium supplemented with 3 mg BA + 2 mg IAA + 10 mg ascorbic acid/litre. Excised shoots were multiplied by culturing nodal cuttings on MS with 40 mg adenine sulphate/litre. Rooting was best on MS with 0.5 mg NAA/litre. On transfer to field conditions, after hardening, >80% of plants survived.

1889 RAHMAN, SH; HOSSAIN, M; ISLAM, R; JOARDER, OI. 1992. **Micropropagation of *Delonix regia* through immature embryo derived shoot tips.** *Pakistan J. Botany*, 24: 60-63.

1890 SHARMA, DR; YADAV, NR; CHOWDHURY, JB. 1988. **Somatic embryogenesis and plantlet regeneration from shoot tip calli of *Phoenix sylvestris Rox*.** *Ind. Jour. Exp. Biol.* 26: 854-857.

1891 SOMANI, VJ; JOHN, CK; THENGANE, RJ. 1989. **In vitro propagation and corm formation in *Gloriosa superba L.*** *Indian Journal of Experimental Biology*, 27: 6, 578-579; 15 ref.

1892 VIJAYARAGHAVAN, MR; BHAT, U. 1983. **Synergids before and after fertilization**. *Phytomorphology*, 33: 1/4, 74-84; 42 ref.

In this review, synergids are regarded as active and highly polarized cells. Their micropylar half is occupied by a nucleus and many organelles. In most genera the wall is thickest towards the micropylar end of the cell but towards the chalazal end only a plasma membrane is present. The wall stains for carbohydrates and proteins and contains significant amounts of pectin. The filiform apparatus is a highly convoluted extension of the micropylar portion of the wall. Cytoplasm surrounding it is rich in various organelles. The synergids play a role in pollen tube growth and its direction into the embryo sac, in pollen tube discharge, and also function as transfer cells.

FORESTRY

1893 AGRAWAL, V; GUPTA, SC. 1991. **In vitro plantlet development from explants of 25-year-old**