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CONTENTS

segments of 10- to 15-day-old seedlings of *S. cumini* on modified MS medium supplemented with BA (0.23-8.90 μM) singly or in combination with NAA, IAA or IBA. Excised shoots were placed for root induction on MS medium containing NAA and/or IBA and then transferred to MS basal medium to form complete plantlets. The regenerated plantlets were acclimatized and successfully transferred into the soil.

VEGETABLE CROPS

1513 BAJAJ, YPS. 1990. **Cryopreservation of germplasm of vegetatively propagated crops**. *Bulletin de la Societe Botanique de France, Actualites Botaniques*, 137: 3-4, 99-114; 31 ref.

The scope of cryopreservation is discussed in relation to 3 vegetatively propagated crops, potato, cassava (*Manihot esculenta*) and sugarcane. The large-scale application of cryopreservation in gene banks for the long term storage of cell and tissue cultures and pollen is outlined.

1514 BAJAJ, YPS. 1990. **Haploids in crop improvement I**. *Biotechnology in Agriculture and Forestry Volume 12*. Berlin, Germany: Springer-Verlag, 549 p.

The first section (4 chapters) of this book considers the induction of haploids, pollen embryogenesis, ultrastructure and genetic stability. Experience with many species is summarized in tables, and theoretical and practical conclusions are drawn. The remainder of the book details in vitro production of haploids (chiefly through anther culture) with a chapter for each of the following: wheat, barley, maize, rice, rubber, poplar, apple, litchi, *Digitalis*, *Hyoscyamus*, *Arabidopsis*, asparagus, sugarbeet, cabbage and *Brussels sprouts*, *Capsicum*, carrot, strawberry, *Gerbera jamesonii*, sunflower, tomato, lucerne, *Psophocarpus tetragonolobus*, sugarcane, *Solanum carolinense*, *Solanum chacoense* and *Solanum phureja*. Each chapter includes a brief experimental protocol. This thorough treatment will be essential reading for breeders seeking to use haploids.

1515 CHOPRA, VL; KIRTI, PB; NARASIMHULU, SB; PRAKASH, S; ABDURAHIMAN, KK; DOMINIC, B. 1993. **Somatic hybridization for improvement of crop *Brassicas***. *Biotechnology in agriculture*. (Dordrecht: 1993)/edited by CB You, ZL Chen and Y Ding. Dordrecht: Kluwer Academic Publishers, p. 18-26.

1516 DHALIWAL, HS. 1992. **Unilateral incompatibility**. *Monographs on Theoretical and Applied Genetics*, No. 16: p. 32-46.

1517 ISALM, R; JOARDER, OI. 1994. **Tissue culture research on some tree and vegetable crops of Bangladesh**. *Workshop on Present Status and Future Direction of Biotechnological Research in Bangladesh*. (BARC, Dhaka: 1994: June 25).

1518 JAMBHALE, ND; NERKAR, YS. 1983. **Screening of okra cultivars, related species and interspecific hybrid derivatives for resistance to powdery mildew**. *National seminar on breeding crop plants for resistance to pests and diseases*. (Coimbatore: 1983: May 25-27). Tamil Nadu Agricultural University, Coimbatore, India. p. 44.

Of 44 accessions, including cultivars, mutants, related species, interspecific hybrids, amphidiploids and interspecific derivative lines, screened in the field for resistance to *Erysiphe cichoracearum*, five biotypes drawn from *Abelmoschus* [*Hibiscus*] *tetraphyllus*, *A. manihot*, *A. manihot subsp. manihot* and *A. moschatus* [*H. abelmoschus*] were immune from attack. Hybrids and their respective amphidiploids between the *A. esculentus* cultivar Pusa Sawani and *A. manihot*, *A. manihot subsp. manihot* and *A. tetraphyllus* were immune, highly resistant and moderately resistant, respectively. Of nine yellow vein mosaic resistant lines from the cross *A. esculentus* X *A. manihot*, one was highly resistant and two moderately so.

1519 KALLOO, G. 1992. **Utilization of wild species**. *Monographs on Theoretical and Applied Genetics (USA)* No. 16, p. 149-167.

1520 PAL, AMITA. 1983. **Isolated microspore culture of winged bean, *Psophocarpus tetragonolobus (L.) DC.* - growth, development and chromosomal status**. *Indian Journal of Experimental Biology*, 21: 11, 597-599; 9 ref.

Callus was formed by successive vegetative-cell division following culture of pollen on Nitsch & Nitsch medium supplemented with sucrose, amino acids, IAA (0.5 mg/litre) and zeatin (0.5 mg/litre). Cultures were maintained on this medium and on supplemented B5 medium. Profuse, small, leafy shoots regenerated from the callus on B5 medium supplemented with NAA, IAA and kinetin, but plantlet formation did not occur. The haploid chromosome number occurred in about 80% of cells examined from undifferentiated and differentiated callus.

1521 SALUNKHE, DK; DESAI, BB; BHAT, NR. 1987. **Vegetable and flower seed production.** New Delhi: Agricole Publishing Academy, 486 p.

This book is intended to provide highly authentic technical information related to the production of vegetable and flower seeds, and covers the crops grown in tropical, subtropical and temperate regions of the world. Botany, cultivars, breeding, method of seed production, pests and diseases, postharvest handling, and quality control of the individual vegetable and flower crops have been described. Part 1 of the volume describes the basic principles involved in vegetable and flower seed production, including the morphology of seed development, seed quality and testing, principles of breeding, and postharvest biotechnology of vegetable and flower seeds (harvesting, handling, storage, processing, packing and distribution). Part 2 and Part 3 deal with individual vegetable and flower crops, respectively. The book should prove a valuable source of reference for students, research workers, seedsmen and horticulturists.

1522 SONG, K; OSBORN, T; WILLIAMS, PH. 1988. **Phylogenetic relations of *B. rapa* and *B. oleracea* and their wild allies revealed by nuclear restriction fragment length polymorphisms (RFLPS)**. *Cruciferae Newsletter*, No. 13: 18-19; 2 ref.

Nuclear and chloroplast DNA probes were used to study RFLPs in 38 accessions consisting of 10 cultivated and wild *Brassica rapa* [*B. campestris*] accessions, 9 cultivated *B. oleracea* accessions, 13 wild populations with n = 9 and 6 other species. Of a total of 433 fragments, 6 were common to all accessions, 92 fragments were unique and 335 fragments sufficiently informative to construct phylogenetic trees. Within *B. rapa*, pakchoi, narinosa and Chinese cabbage were distinct from turnips and wild populations. Chinese cabbage was closely related to pakchoi but was separated by 45 units, suggesting that Chinese cabbage originated from pakchoi and has since diverged considerably. A wild accession from India appeared to establish a link between European and East Asian types. Within *B. oleracea*, cauliflowers were closely related to broccoli, but cabbage, Portuguese tree kale and Chinese kale had distinct RFLP patterns. The wild populations with 9 chromosomes were akin to *B. oleracea* and were distinct from *B. rapa*. Among the other wild species, *Diplotaxis erucoides* and *B. fruticulosa* were closely related; *Raphanus* was related to *Eruca* despite a distance of 66 units. *B. tournefortii* was related to both *B. rapa* and *B. oleracea*, exhibiting the shortest distance to their hypothetical common ancestor (63 units); *B. tournefortii* was almost equally closely related to *B. rapa* and *B. oleracea*. Data from 20 single copy probes appeared to indicate that changes in allele frequency were associated with divergence of species and populations.

Edible roots

1523 BANERJI, A; CHINTALWAR, GJ. 1984. **Biosynthesis of bakuchiol from cinnamic and p-coumaric acids**. *Phytochemistry*, 23: 8, 1605-1606; 6 ref.

Specific incorporation of L-[U-14C]phenylalanine, [U-14C]cinnamic acid and p-[2-14C]coumaric acid into bakuchiol was observed in *Psoralea corylifolia*. It was shown that the aromatic moiety along with 2 carbon atoms of the side chain were biosynthetically derived via the phenylpropane pathway and not by the alternate pathway proposed earlier.

1524 BHAT, SR; CHANDEL, KPS. 1991. **A novel technique to overcome browning in tissue culture.** *Plant Cell Reports*, 10: 6-7, 358-361.

1525 DATTA, SK; DATTA, K. 1984. **Chemodifferentiation of diosgenin in *Dioscorea composita***. *Phytochemistry*, 23: 11, 2684-2685; 8 ref.

Tubers, and vine internodes plus nodes with leaves from either the first 20 nodes, the intermediate 20 nodes or the upper 20 nodes of 3-year-old plants contained 3.6, 1.6, 0.039 and 0.03% diosgenin on a dry weight basis, respectively. Thirty-day-old callus, ninety-day-old callus, emergent shoots and regenerated roots from tissue cultured nodal explants contained 0.89, 1.61, 2.5 and 0.08% diosgenin on a dry weight basis, respec.

1526 BISWAS, AK; MUKHERJI, S; JHA, TB; ROY, SC. 1985. **Regulation of growth and embryogenesis in cultured carrot (*Daucus carota L.*) callus tissue by penicillin**. *Indian Journal of Experimental Biology*, 23: 3, 154-160; 20 ref.

Application of 200 p.p.m. penicillin, either alone or in combination with 0.1 p.p.m. BA, stimulated growth and embryogenesis in hypocotyl-derived callus cultured on B5 medium. Plantlets regenerated following this treatment showed a range of abnormalities with respect to shoot : root ratio and root, shoot and leaf morphology.

1527 MAITRA, RK; SEN, SP. 1989. **Production of ethylene and ethane by callus tissues of *Daucus carota L.* in presence of 2,4-disubstituted phenols**. *Plant Science Limerick*, 62: 1, 33-35; 10 ref.

Carrot explants were cultured on MS medium without coconut milk and supplemented with 2,4-D, 2,4-dichlorophenol (2,4-DCP) or 2,4-dinitrophenol (2,4-DNP) at 0.5 mg/litre; they were incubated at around 25°C under 12-h photoperiods. Callus initiation was apparent

after 10-12 days and callus was fully grown after a further 20 days. For plantlet regeneration, pieces of callus were transferred to MS medium lacking any auxin. Regeneration occurred 7-10 days after the second transfer. Tissues 5 and 20 days after initiation, as well as root tissues of young normal carrot plants and of regenerating plantlets, were incubated with MS medium in sealed vials for 120 h; samples were analysed for ethylene and ethane production by GC. When callus induction took place in the presence of 2,4-D there was an immediate rise in ethylene and ethane levels; peak values were reached at 48 h. Increases in both gases were also noted with 2,4-DCP and 2,4-DNP, although these were less than with 2,4-D. When plantlet regeneration occurred following callus transfer, there was a marked decline in the production of both gases. However, the regenerating plantlets and the normal carrot tissues did not evolve any ethane, although ethylene was still produced but in lower amounts.

Carrots

1528 ARYA, M; TIAGI, B. 1985. **Nucleic acid changes in three carrot cultivars infested with *Meloidogyne incognita***. *Ind. J. of Nematology*, 15: 1, 21-25.

Nucleic acid content in *M. incognita* galls of all the 3 carrot cultivars Early Nantes (highly susceptible), Pusa Kesar (moderately susceptible) and Black (moderately resistant) was higher as compared to their healthy roots. In galls, RNA and DNA were concentrated more in giant cells and the nematode bodies. RNA was localized in nucleoli, nucleoplasm and cytoplasm and its amount increased as the syncytium developed and decreased only when it degenerated. The intensity of feulgen stain, depicting the presence of DNA, paralleled the nuclear volume which was maximum in syncytium associated with the spike-tail stage of larvae. The giant cells within the same complex stained differently for DNA. The syncytial nuclei were larger and lobed in susceptible cultivars.

1529 KUMAR, A; BENDER, L; NEUMANN, KH. 1984. **Growth regulation, plastid differentiation and the development of a photosynthetic system in cultured carrot root explants as influenced by exogenous sucrose and various phytohormones**. *Plant Cell, Tissue and Organ Culture*, 3: 1, 11-28; 22 ref.

Radishes

1530 JAIN, VK; GURUPRASAD, KN. 1989. **Interaction of chloramphenicol and cycloheximide with GA in the regulation of anthocyanin synthesis in radish seedlings**. *Beitrage zur Biologie der Pflanzen*, 64: 2, 277-282; 15 ref.

The protein synthesis inhibitors Chloramphenicol and cycloheximide enhanced anthocyanin synthesis in radish seedlings. The increase in anthocyanin synthesis was closely paralleled by an increase in total free amino acid content, including phenylalanine, the precursor of anthocyanin. GA treatment moderated the increases in anthocyanin synthesis and free amino acid content induced by the inhibitors. GA acts by diverting anthocyanin precursors, which accumulated because of inhibition of protein synthesis, towards primary metabolism.

1531 SRIVASTAVA, SK; MUNGRE, SM. 1986. **The inhibition of nitrate reductase induction by spermine in excised radish cotyledons**. *Phytochemistry*, 25: 7, 1563-1565; 18 ref.

The induction of nitrate reductase in excised cotyledons of cv. Suttons Scarlet Globe was inhibited by the polyamines spermidine and spermine in the light and dark, but putrescine had no effect. Spermine had no effect on nitrate uptake or the stability of the enzyme, but inhibited the enzyme's synthesis.

Edible tubers

1532 ARCHANA, M; UNNIKRISHNAN, M. 1993. **Gains through biotechnology in tuber crops**. *Indian Horticulture*, 38: 3, 14-16.

1533 ARCHANA, M; UNNIKRISHNAN, M; INDIRA, P. 1993. **In vitro tuber induction in sweet potato**. *International Symposium on tropical tuber crops - problems, prospects and future strategies*. Indian Society for Root Crops, CTCRI, Trivandrum. p. 12-13.

1534 CHAUHAN, KPS; BRANDHAM, PE. 1985. **Chromosome and DNA variation in *Amorphophallus (Araceae)***. *Kew Bulletin*, 40: 4, 745-758; 16 ref.

Chromosome numbers and karyotypes are given for 17 species and DNA content is reported for 13 of them. The species studied include the tuber crops *A. paeoniifolius* (2n=28) and *A. bulbifer* (2n=39), both from southern India, and a few ornamental species such as *A. konjac* (2n = 26). A possible evolutionary scheme for the species studied is outlined.

1535 MUKHERJEE, A; UNNIKRISHNAN, M; NAIR, NG. 1991. **Growth and morphogenesis of immature embryos of sweet potato (*Ipomoea batatas*) in vitro**. *Pl. Cell, Tissue & Organ Cult.*, 26: 2, 97-99.

Sweet potato embryos excised from the fertilized ovules of 6- to 12-d-old capsules were cultured on Murashige and Skoog (MS) medium supplemented with NAA, BA and GA separately and in combinations. GA was found essential for initial morphogenesis of globular and heart stages. Seedlings were recovered from late globular stage onwards but recovery was best from advanced embryo stages. Differentiated embryos produced multiple shoots on MS medium + 1 μM NAA + 2 μM BA + 0.5 μM GA.

1536 NAIR, NG; UNNIKRISHNAN, M; ARCHANAM, M. 1989. **Tissue Culture in improvement of tropical tuber crops**. Central Tuber Crops Research Institute, Trivandrum: p. 29-35.

1537 UNNIKRISHNAN, M; ARCHANA, M; NAIR, NG. 1991. **Improvement of tuber crops through in vitro cultures**. *National Symposium on Genetics and Biotechnology for crop improvement*. (Hyderabad: School of Life Sciences, University of Hyderabad), p. 61.

1538 UNNIKRISHNAN, M; ARCHANAM, M; NAIR, NG. 1990. **In vitro conservation of tuber crops through slow growth cultures**. *J. Root Crops*, p. 296-301.

1539 UNNIKRISHNAN, M; NAIR, NG; NAYAR, GG. 1992. **Preliminary studies on the conservation of tuber crops germplasm through in vitro cultures**. *New Trends in Biotechnology. Section 1: Crop productivity*. Central Tuber Crops Research Institute, Trivandrum, p. 51-56.

Potatoes

1540 Basic seed production through tissue culture and rapid multiplication technique (RMT). *Compilation of annual reports July 1991-June 1992: potato*/ edited by ET Jr Rasco, FB, Aromin, VDR Amante, PJS Lopez. Southeast Asian Program for Potato Research and Development, P.O. Box 933, Manila (Philippines). 1992, p. 225-229.

Mother plants for the propagation of rooted stem cuttings were produced from the cultivars; Desiree, Sita, Krushi, OP-260, Atzimba and 2540. Rooted stem cuttings were used for production of pre-basic (G-0) and basic (G-1) seeds. The process of basic seed production system is being piloted in Sri Lanka to produce G-0 to G-4 seed potato tubers for commercial potato production. In this project over 25,000 generation 0(G-0) tuberlets were produced at the RARC, Bandarowela, net house. Production of basic seed (G-1) from rooted stem cuttings in the farmers fields showed that the farmers can produce seeds at a fraction of the cost of seed purchased from outside.

1541 Potato research and on-farm research activities in Kalam Valley (Swat). Pakistan Agricultural Research Council, Islamabad, Pakistan, Crop Science Division. 1988, 57 p.; 4 ref.

Results of experiments which formed part of the Pakistan-Swiss Potato Development Project to compare planting dates and seed tuber sources, to evaluate potato production from true seeds, and to study seed tuber degeneration rate during multiplication and the effects of NP fertilizers on potatoes are given. The use of the fungus, *Paecilomyces lilacinus*, and rotations with turnips or peas or resistant potato cultivars to control *Globodera rostochiensis* are also examined. Germplasm screening experiments for late blight [*Phytophthora infestans*] resistance, earliness and tuber quality are described. Results are also presented from a comparative study of cauliflowers, cabbages, turnips, peas, carrots, bush beans [*Phaseolus vulgaris*], garlic and potatoes as monocrops and of peas followed by potatoes, chinese cabbages by turnips, carrots by onions, *P. vulgaris* by onions and turnips by cabbages in double cropping systems.

1542 ANWAR, R. 1984. **Potato shoot-tip position and its regeneration potential**. *Pakistan Journal of Agricultural Research*, 5: 2, 107-109; 9 ref.

An investigation into the regeneration potential of shoot tips of potato cv. Desiree with respect to position on the shoot indicated that shoot tips from nodal cuttings from the basal part of the shoot showed greater survival and more vigorous plant development than the apical meristem when cultured on Murashige and Skoog's basal medium supplemented with NAA.

1543 AZRA-QURAISHI; JOHN, I. 1985. **Organogenetic callus formation from various potato explants**. *Pakistan Journal of Agricultural Research*, 6: 4, 271-273; 3 ref.

Nodal sections of tuber sprouts derived from potato cv. BG-15 stored at 10 or 20°C in darkness were cultured in Knop nutrient medium. Internode segments 1 cm long were placed on the medium in normal and inverse polarity. Callus formation and shoot regeneration were greatest in sections with inverse polarity of tubers stored at 10°. Normal polarity favoured root formation,

especially at the higher storage temp. Increasing BA conc. from 1 X 10-7 M to 5 X 10-7 M at 20° had no consistent effect on callus formation but decreased root formation, with complete root inhibition of sprout segments at concn >1 X 10-7 M.

1544 BAJAJ, YPS; SOPORY, SK. 1986. **Biotechnology of potato improvement.** *Biotechnology in agriculture and forestry, V. 2. Crops I*/edited by YPS Bajaj. Berlin: Springer-Verlag, p. 429-454, 485-519.

An introduction to potato breeding is provided and the following aspects of its in vitro culture are reviewed: meristem culture; anther culture; callus and suspension cultures; protoplast fusion and culture; genetic variability in callus cultures and plants, selection for disease and pest resistance; and cryopreservation and the international exchange of germplasm. Tissue culture studies in potato are summarized in tabular form.

1545 BAJAJ, YPS. 1986. **Cryopreservation of potato somaclones**. *Somaclonal variations and crop improvement: Proceedings of a seminar*. (Belgium, Gembloux: 1985: Sep 3-5). Dordrecht, Netherlands: Martinus Nijhoff, p. 244-250; 24 ref.

Somaclonal plants from protoplast-derived callus of cultivars Kufri Sindhuri, Chandramukhi and Alankar exhibited marked morphological variation, and the tubers showed a wide range of shape, colour and size. Following freezing of 1 mm cell colonies in a cryoprotectant solution at -196°C for 5 min and cryopreservation of meristems from in vitro regenerated plants for 4 years, the colonies and meristems revived and produced normal plants with tubers of uniform size and shape.

1546 BOSE, TK; JANA, BK; MOULIK, S. 1987. **A note of the micro-propagation of tuberose from scale stem section**. *Indian Journal of Horticulture*, 44: 1/2, 100-101; 4 ref.

The preparation of the culture medium (MS) and of propagation material (*Polianthes tuberosa* cv. Single) is described. Of the 3 different parts of the bulb [rhizome] used, only the scale-stem sections produced callus and regenerated into plantlets. A medium containing 2,4-D at 0.1 mg/litre was very effective in producing callus. On media containing kinetin at 0.05-0.2 mg/litre the shoot appeared earlier than the roots. Subculturing of callus on a medium containing NAA at 2 mg/litre resulted in root and shoot initiation in 15-20 days and good plantlet production; the addition of IAA and GA3 had little effect. All plantlets which were transferred to pots survived and showed normal growth.

1547 CHANDRA, R; UPADHYA, MD. 1981. **Enzymatic isolation of mesophyll single cells from potato leaves**. *Journal of the Indian Potato Association*, 8: 3, 145-147; 2 ref.

A technique of enzymatic isolation of mesophyll single cells from potato leaves is described. About 70-80% of the palisade and spongy parenchyma cells obtained were viable; they had well arranged chloroplasts and did not show plasmolysis. Plant age was not a critical factor for the isolation of single cells.

1548 CHANDRA, R; UPADHYA, MD; JHA, KK. 1985. **Regeneration of plants from rachis tissue of the potato in vitro**. *Journal of the Indian Potato Association*, 12: 1/2, 88-91; 5 ref.

Regeneration of plantlets from leaf and rachis tissue of dihaploid potato genotypes PH-258 and PH-102 and tetraploid genotypes Kufri Jyoti and Kufri Sindhuri was studied. Using Murashige and Skoog media containing 1 mg IAA and 0.25 mg BA/litre or 0.25 mg 2-ip [isopentenyladenine]/litre, all tissues formed callus, but shoots failed to differentiate from any leaf tissue or from rachis tissue of tetraploid genotypes. Best results were obtained with the medium containing BA alone; on this medium 25-35% were thin and weak and gave rise to dihaploids and 66-75% were thick and healthy and gave tetraploid plants.

1549 CHANDRA, R; UPADHYA, MD; JHA, KK. 1981. **Studies on potato callus culture**. *Journal of the Indian Potato Association*, 8: 4, 155-164; 9 ref.

A PM-2 medium containing 3 mg NAA and 0.25 mg BA/l has been standardized on which callus can be grown from different plant parts of dihaploid and tetraploid potato genotypes. However, callus could not be initiated from petals and androecium. Callus growth was significant greater in tetraploid than in dihaploid genotypes.

1550 DHINGRA, MK; KHURANA, SMP; LAKHANPAL, TN; CHANDRA, R. 1987. **Maintenance and elimination of potato virus X in leaf calli of Indian potatoes**. *Abstracts of conference papers and posters of the 10th triennial conference of the European Association for Potato Research*. (Aalborg, Denmark: 10th: 1987: July 6-31)/edited by Foldo, NE; Hansen, SE; Nielsen, NK; Rasmussen, R. p. 46-47; 6 ref.

Infected leaf discs of 6 varieties were cultured on medium containing NAA and kinetin. Kufri Jyoti and Kufri Bahar produced the most callus, and were free of the virus after 3 subcultures. Kufri Chandramukhi, however, maintained a high concentration of the virus

in tissue culture. Callus morphology differed among varieties.

1551 FRENCH, ER. 1985. **Multiple disease resistance in potato cultivars with *Solanum phureja* and *S. demissum* background**. *Phytopathology*, 75: 11, 1288.

S. phureja PI310439 and PI310491, selected for resistance to *Pseudomonas solanacearum* in Colombia (CCC1339 and CCC1386, respectively), were utilized in crosses with *Phytophthora infestans* resistant Mexican varieties (*S. demissum* background) to develop tetraploid cultivars (BR clones) by L. Sequeira and P. R. Rowe at the University of Wisconsin, USA. Field testing in Peru resulted in varieties Caxamarca (BR63.74), Molinera (BR63.65) and Amapola (unknown BR). Distribution of these sister lines and additional crosses made at CIP led to the selection of BR69.84 (Domoni) in Fiji, BR63.15 in Peru, BR63.76 in Kenya and CIP377847.5 and CIP377852.2 in Sri Lanka. These 8 cultivars were resistant to *P. solanacearum* and *P. infestans* in one or more of 7 countries, 4 were resistant to PLRV [potato leaf roll virus], 3 were heat tolerant, 2 *Alternaria* blight resistant and one was PVY [potato virus Y] resistant.

1552 HOQUE, MI; BEGUM, N; ISLAM, MA; SARKER, RH. 1995. **In vitro microtuber formation in potato**. *Annual Plant Tissue Culture Conference*. (Dhaka University, Dept. of Botany: 1995: March 19).

1553 HOSSAIN, MJ; SULATANA, N. 1993. **In vitro seed potato production**. *International Plant Tissue Culture Conference*. (Dhaka Univ., Dept. of Botany: December 19-21).

1554 HOSSAIN, MJ; SULTANA, N. 1994. **Tissue culture and micropropagation (in potato)**. *Workshop on Present Status and Future Direction of Biotechnological Research in Bangladesh*. (BARC, Dhaka: 1994: June 25).

1555 ISLAM, MA; HOQUE, MI; SARKER, RH. 1993. **In vitro plant regeneration and tuber formation in potato**. *International Plant Tissue Culture Conference*. (Dhaka Univ., Dept. of Botany: 1993: December 19-21).

1556 KALLOO. 1988. **Vegetable breeding, 3 vols.** Florida: CRC Press, 239 p.

This set of books, intended for research workers, teachers and students, consists of 3 volumes. Volume I contains 7 chapters, covering (1) reproduction, pollination control mechanisms, natural breeding systems and hybridization techniques, (2) biometrical approaches and their applications, (3) breeding methods, (4) heterosis (including hybrid seed production and cytoplasmic male sterility), (5) distant hybridization, (6) polyploidy and (7) mutations. Volume II is divided into 4 chapters concerned with resistance to diseases, insects, nematodes and stress. Aspects of resistance breeding examined include genetic resources, genetics, breeding methods and environmental factors affecting resistance. The 4 chapters in Volume III are on (1) genetic resources, (2) breeding for quality and processing attributes, (3) breeding for physiological attributes, with emphasis on photosynthesis (including a list of genes controlling important characters in 11 crops) and (4) somatic cell genetics and biotechnological applications. A wide range of sexually and asexually propagated vegetable crops, including potatoes, are covered. Each volume contains black and white photographs, references at the end of each chapter and a subject index for that volume.

1557 KEBASEN, BA; ALISTO, JU; RODULFO, GS. 1992. **Hybridization for clonal and true seed variety development.** *Compilation of annual reports July 1991-June 1992: potato*/edited by ET Jr Rasco, FB, Aromin, VDR Amante, PJS Lopez. Southeast Asian Program for Potato Research and Development, Manila, p. 278-282.

The number of successful crosses performed this year significantly increased. A total of 78 successful crosses were made in BSU [Benguet State University], Trinidad, Benguet [Philippines]. More parents with good combining ability and/or resistance to bacterial wilt were included in the crossing plan. Mass hybrid seed production of four selected combinations was started by mass producing the parentals and initial hybridization. The top five clones/varieties used as female parents in hybridization work are (377831.5 x Morens)-14, India 1035, (PPC 4-8 x IPB Sel 1)-1, (PPC 4-8 x IPB Sel 1)-12 and (CIP 379331 x PPC 4-8)-10. The top five clones/varieties used as male parents are: TS-4, (379331 x PPC 4-8)-2, AVRDC 1282-19-9, (CIP 379331 x PPC 4-8)-8 and CIP 385126-12. PPC 4-8, CIP 379331 and IPB Sel 1 are the top three parents which may be used as male and/or female in hybridization work.

1558 KHAN, IA; REHMAN, ALTAF-UR; GILL, IA; SAHI, MA. 1984. **Adaptability potential of inter and intra-specific potato hybrids under Faisalabad conditions**. *Journal of Agricultural Research, Pakistan*, 22: 4, 301-307; 9 ref.

Data on 4 growth, 3 yield and 6 quality characters were recorded for Cardinal and the USDA clone 9120-2

(controls) and the following interspecific and intraspecific hybrid clones: (1) Pimpernel X Maritta, (2) Ultimus X *Solanum* acaule, (3) Kabii X *S. acaule*, (4) *S. chacoense* X *S. demissum*, (5) *S. chacoense* X *S. acaule* and (6) *S. chacoense* selfed. Hybrids 70 (*S. chacoense* X *S. acaule*) and 10 (Ultimus X *S. acaule*) gave the highest tuber yields (404.31 and 380.46 g/plant or 20.60 and 18.99 kg/plot, respectively). Overall performance of the 6 hybrid clones was better than that of the controls for the majority of desirable characters.

1559 LEELA, D; RAO, TR. 1986. **Studies on naturally occurring cytokinins in *Dioscorea floribunda*.** *Indian J. of Horticulture*, 43: 1/2, 156-160; 10 ref.

Two cytokinin-like substances, designated DF1 and DF2, active in soybean cotyledon callus tests, were detected in freshly harvested tubers. DF1 and DF2 were tentatively identified as zeatin and zeatin riboside, respectively.

1560 MUMTAZ, NUZHAT; QURAISHI, AZRA. 1989. **In vitro performance of selected potato cultivars.** *Sarhad J. of Agriculture*, 5: 4, 363-367; 5 ref.

In tissue culture performance tests on potato cv. Cardinal, Desiree, ENEA- I, LT-8, Local Hunza, Patrones and Ultimus, cv. Cardinal produced most leaves (12.29-/plantlet) 24 d after nodal fragmentation. Cv. Cardinal, Patrones and Desiree showed the most rapid growth, producing full grown shoots with approx. 10-12 nodes within 3 weeks.

1561 QURAISHI, A. 1985. **Tissue culture studies as a means for exploring variability in potato**. *Pakistan Journal of Agricultural Research*, 6: 1, 20-22; 13 ref.

More than 30% of calluses derived from sprout explants from tubers of BF15, when cultured on a Murashige & Skoog medium with added BA and IBA, displayed the capacity for organ regeneration and retained that capacity through successive subcultures. Among regenerate shoots obtained from third and fourth subcultures, polymorphism was apparent. Besides normal shoots, 'flattened', 'articulated', 'slender', 'ramified' and 'rosette' forms were observed. Chromosome numbers ranged between 38 and 48 in the abnormal shoots.

1562 RASUL, MG; NAHAR, MS; RASHID, MH; RASHID, MM. 1990. **Variability, genetic parameters and correlation in potato**. *Bangladesh Journal of Plant Breeding and Genetics*, 3: 1-2, 31-39.

Variability and some genetic parameters of 15 potato varieties were studied to select parents for a hybridization program. The variety Obelix performed best in respect of yield, weight of tubers/hill and number of tubers/hill. Dry matter content, related to specific gravity and starch content was high in Producent and Origo. Considering the genetic parameters, high GCV was observed for plant height, number of stem/hill, foliage coverage and number of tubers/hill. High heritability values were obtained for plant height, specific gravity and foliage coverage. Plant height exhibited the highest genetic gain followed by the number of tubers/hill, tubers yield and starch content. Correlation studies showed significant positive relationship of yield with all the characters except plant height and number of tubers/hill, while it was negatively correlated with all four qualitative characters viz. dry matter content, starch content, specific gravity and insect infestation. However, starch content, dry matter and specific gravity of tubers were highly interrelated. Some of the cultivars may be selected as prospective parents in the hybridization program considering their qualitative and quantitative parameters.

1563 SADANANDAM, A. 1991. **Induced synaptic mutant from mesophyll cell protoclones of dihaploid *Solanum tuberosum*.** *Journal of Plant Physiology*, 138: 1, 107-110.

1564 SAJID, GM; AZRA-QURAISHI; MOHAMMAD-SALIM; QURAISHI, A; SALIM, M. 1986. **Thermotherapy and meristem tip culture of *Solanum tuberosum* for elimination of potato viruses X, S and Y**. *Pakistan Journal of Botany*, 18: 2, 249-253; 13 ref.

Meristem tips (0.4 mm) excised from Cardinal and Desiree potato cultivars having undergone thermotherapy at 34°C for 11-60 d regenerated into rooted plantlets. The effect of duration of thermotherapy on regeneration potential of meristems was insignificant. Thermotherapy for 60 d resulted in 8, 35 and 46% elimination of potato viruses S, X and Y respectively from Cardinal and 9, 48 and 59% respectively from Desiree.

1565 SAMARASINGHE, PWSM. 1992. **Status of seed potato production in Sri Lanka.** *Potato Seed Systems in Transition: Proceedings of the SAPPRAD Seed Systems Workshop*. Southeast Asian Program for Potato Research and Development, Manila, p. 104-108.

1566 SAMARASINGHE, PWSM. 1992. **Towards improving the seed potato production scheme in Sri Lanka.** *Potato Seed Systems in Transition: Proceedings of the SAPPRAD Seed Systems Workshop*. Southeast Asian Program for Potato Research and Development, P.O. Box 933, Manila (Philippines), p. 109-112.

1567 SANGAR, RBS; DHINGRA, MK. 1984. **Rapid multiplication of potato explant on nutrient medium**. *Indian Journal of Plant Pathology*, 2: 2, 191-193; 7 ref.

The opt. concn of naphthalene acetic acid (NAA) for supporting vigorous stem and root growth of nodal cuttings from virus-free explants was 0.15 mg/litre.

1568 SINGH, SP; SINGH, SP. 1984. **Seed production in potato (*Solanum tuberosum L.*) with the use of tubers, true potato seed (T.P.S.) and tissue culture**. *Seeds and Farms*, 10: 9/10, 21-23; 16 ref.

Systems for producing healthy seed tubers of potatoes in India, and the problems encountered in production, storage and distribution are described. The necessity of introducing a potato-growing system where true potato seed is used is discussed.

1569 TALUKDER, MM; PAUPARDIN, C. 1986. **Effect of solanine on tuberization of potato (*Solanum tuberosum L.*)-cultured-in vitro at different temperatures**. *Bangladesh Journal of Agriculture*, 11: 3, 27-30; 11 ref.

Sprout segments of potato cv. Bintje were grown on a medium containing 0, 10-7, 5 X 10-7 or 5 X 10-6 M solanine at 10, 15, 20, 25 or 30°C. At low temp. (10-20°), solanine had no effect, but at 20° solanine retarded tuberization. This retardation was directly proportional to the concn of solanine used. A temp. increase stimulated root growth but solanine partially inhibited it; shoot growth increased with increasing temp. up to 25°. It was suggested that the action of solanine in the process of tuberization may be regulated by temp.

1570 YADAV, DN; PATEL, RC; PATEL, DS. 1985. **Impact of inundative releases of *Trichogramma chilonis* Ishii against *Heliothis armigera* (Hbn.) in Gujarat (India)**. *Journal of Entomological Research*, 9: 2, 153-159; 3 ref.

The impact of inundative releases of *Trichogramma chilonis* to control the noctuid *Heliothis armigera* [*Helicoverpa armigera*] infesting tomato, gram (*Cicer arietinum*), potato and lucerne was investigated in field studies in Gujarat, India, in 1973-75. Weekly releases of *T. chilonis* at 250 000/ha were effective against *H. armigera* on tomato and potato and were reasonably effective against the pest on lucerne, but were ineffective in gram. The parasitoid could not survive above 38°C, and suggested that releases are made after the onset of monsoons when the temp. drops below 35°C.

1571 ZETHNER, O; KHAN, BM; CHAUDHRY, MI; BOLET, B; KHAN, S; KHAN, H; GUL, H; OGAARD, L; ZAMAN, M; NAWAZ, G. 1987. ***Agrotis segetum* granulosis virus as a control agent against field populations of *Agrotis ipsilon* and *A. segetum (Lep: Noctuidae)* on tobacco, okra, potato and sugar beet in northern Pakistan**. *Entomophaga*, 32: 5, 449-455; 10 ref.

The efficacy of *Agrotis segetum* granulosis virus (AsGV), propagated in Denmark, against naturally occurring cutworm populations (*A. ipsilon* and to a less extent *A. segetum*) was tested in experimental field plots of tobacco, okra, potato and sugarbeet in northern Pakistan in 1981-83. AsGV doses varied from 4 X 107 to 4 X 1011 capsules per m2 plot, and the number of applications from 1 to 3. Two treatments with AsGV reduced cutworm damage by 64-82% in tobacco, 85% in okra, 77% in potato and 78% in sugarbeet. Three treatments with AsGV were not more effective than 2 treatments. AsGV was as effective as the chemical insecticides Tamaron [methamidophos] and dieldrin and the microbial insecticide *Bacillus thuringiensis*. No difference was found between the efficiency of highly purified AsGV to which activated charcoal had been added and partially purified AsGV without charcoal.

Sweet potatoes

1572 ARCHANA, M; UNNIKRISHNAN, M; NAIR, NG. 1990. **Callus induction, embryogenesis and regeneration from sweet potato anther**. *J. Root Crops*. p. 302-304.

1573 ARCHANA, M; UNNIKRISHNAN, M; NAIR, NG. 1991. **Growth and morphogenesis of sweet potato embryo in vitro**. *Plant Cell, Tissue and Organ Culture*, 26: 2, 97-100.

1574 ISLAM, R; HOSSAIN, MM. 1992. **A preliminary study on self incompatibility and fruit setting ability in sweet potato (*Ipomoea batatas L.*)**. *Pakistan J. Botany*, 24: 223-224.

Allium

1575 LANGER, A; KOUL, AK. 1983. **Studies on nucleolus and nucleolar chromosomes in Angiosperms. VII. Nature of nucleolar chromosome polymorphism in *Allium cepa var. viviparum (Metzg.) Alef*.** *Cytologia*, 48: 2, 323-332; 25 ref.

Nucleolar number/interphase nucleus was studied in 5 clones of *A. cepa var. viviparum*, believed to be a hybrid between *A. cepa* and *A. fistulosum*, from different localities in Jammu and Kashmir, India. The value

was always one in plants from Srinagar and Bhadarwah, but varied from one to two in a clone from Kishtwar and from one to three in clones from Poonch and Mandi. Cytological studies revealed differences between clones in the morphology of the nucleolar chromosomes. The Srinagar and Bhadarwah clones possessed a single satellite, the other clones two. It is concluded that the Poonch and Mandi clones have lost one of the original *A. cepa* satellites, but retained a heterochromatin stalk carrying genes coding for rRNA synthesis and nucleolar organization, while the Kishtwar and the Srinagar and Bhadarwah clones have completely lost one and two satellites, respectively. Loss of satellites had a detrimental effect on fertility.

1576 MADHAVI, DL; PRABHA, TN; SINGH, NS; PATWARDHAN, MV. 1991. **Biochemical studies with garlic (*Allium sativum*) cell cultures showing different flavour levels**. *Journal of the Science of Food and Agriculture*, 56: 1, 15-24.

1577 WIETSMA, WA; KIK, C. 1989. **Resistance to downy mildew within reach**. *Groenten en Fruit*, 45: 10, 71.

An outline is given of current work at the Institute for Horticultural Crop Breeding (IVT), in which Welsh onions (*Allium fistulosum*) are crossed with the wild species *A. roylei* (from Afghanistan and Pakistan) in order to increase resistance to downy mildew (*Peronospora destructor*).

Allium cepa

1578 ALAM, S; KABIR, G; AMIN, MN; ISLAM, M. 1987. **Mitotic effect of leaf extracts of *Ipomoea carnea* on *Allium cepa***. *Cytologia*, 52: 721-724.

1579 AMIN, MN; ALAM, S; HAQUE, M. 1983. **Cytological effects of leaf extract from ipomoea carnea on root tip cells of onion**. *Abst. 8th Ann. Bangladesh Sci. Conf.* Dhaka, Bangladesh: p. 120.

1580 GROVER, IS; MALHI, PK. 1988. **Genotoxic effects of some organophosphorus pesticides. III. In vivo chromosomal aberration bioassay in root meristems of *Allium* and *Hordeum***. *Cytologia*, 53: 1, 181-191; 21 ref.

Ekatin (thiometon), fenitrothion, phorate and the known mutagen MNNG (N-methyl-N'-nitro-N-nitrosoguanidine) were studied using an in vivo chromosomal aberration bioassay in root meristems of *Allium* and *Hordeum*. Both physiological type aberrations (C-mitosis, despiralization, lagging chromosomes, multipolar cells) and clastogenic effects (chromosome breaks, ring chromosomes, chromatin bridges and micronuclei) were induced by the pesticides in the order phorate > fenitrothion > ekatin. The root meristem of *A. cepa* was the more sensitive.

1581 KOHLI, UK; SAINI, SS; RATTAN, RS. 1984. **Crossability between onion (*Allium cepa L.*) and Welsh onion (*Allium fistulosum L.*) cultivars**. *South Indian Horticulture*, 32: 2, 101-103; 7 ref.

The results of reciprocal crosses between 3 Indian cultivars of *A. cepa* and 3 cultivars of *A. fistulosum* from India, the USSR and the Netherlands indicated the existence of varietal differences in crossability. Crossability between the relatively primitive cultivars Madras onion (*A. cepa*) and Chong was classified as medium (5-10% germination of hybrid seed); in the other crosses it was low or poor.

1582 VIJAYAKUMAR, NK; SHARMA, DR; VASUDEVA, M. 1978. **Cellular and subcelluar changes induced by food dyes in *Allium cepa***. *All India Conference of Cytology and Genetics*. (Hisar: 3rd: 1978 Oct). Haryana Agricultural University, Hisar:

Amaranthus

1583 ARYA, ID; CHAKRAVARTY, TN; SOPORY, SK. 1993. **Development of secondary inflorescences and in vitro plantlets from inflorescence cultures of *Amaranthus* paniculatus**. *Plant Cell Reports*, 12: 5, 286-288.

1584 HAUPTLI, H; JAIN, S. 1984. **Allozyme variation and evolutionary relationships of grain amaranths (*Amaranthus spp.*)**. *Theoretical and Applied Genetics*, 69: 2, 153-165; 36 ref.

Isoenzyme variation at 9 loci was studied in 34 New World populations of cultivated *Amaranthus* species (*A. caudatus*, *A. cruentus*, which is treated as a separate species, and *A. hypochondriacus*) and 21 New World populations of weedy species (*A. quitensis*, *A. hybridus*, *A. powellii* and *A. retroflexus*) as well as 11 cultivated populations from Uttar Pradesh, India, and 6 from Nepal (species undefined). In the New World populations, heterozygosity was low, and different populations showed a range of 0 to 44% polymorphic loci. Adjacent populations were often fixed for different alleles, or had very different allele frequencies at certain loci. No geographical pattern was apparent. It is suggested that the genetic structure of the New World cultivated

species can be regarded as a collection of distinct populations, each a more or less heterogeneous group of highly homozygous individuals. The North Indian populations were less variable than those from the New World. Alleles at several loci were found to be diagnostic of the crop and weed groups and of the 3 individual crop species. Genetic distances based on pooled gene frequencies showed the crop species to be more closely related inter se than to their putative weedy progenitors (with the exception of *A. caudatus* and *A. quitensis*), implying a single domestication event with *A. hybridus* as a common ancestor. It is pointed out that some evidence of recent introgression and/or segregation of hybrids between *A. caudatus* and *A. retroflexus* is available in the form of rare individuals in crop populations with crop isoenzyme genotypes but homozygous for a single allele characteristic of the weed species.

1585 KULAKOW, PA; HAUPTLI, H; JAIN, SK. 1985. **Genetics of grain amaranths. 1. Mendelian analysis of six color characteristics**. *Journal of Heredity*, 76: 1, 27-30; 12 ref.

Analysis of data from S1 and S2 generations and from F2 and F3 generations of within-species crosses of 3 *Amaranthus* species (material collected in Latin America and India) revealed that (1) in *A. hypochondriacus*, testa colour is controlled by 2 unlinked epistatic genes, designated p (pale) and Y (yellow), pale testa being recessive to black (P) and yellow (Y) being dominant to pale (y), giving a 12 : 3 : 1 segregation ratio of black : yellow : pale; (2) in *A. caudatus*, testa colour is possibly controlled by 3 genes, designated p, Y and Br (brown), brown being dominant to pale (br) (the relationship between Br and Y has yet to be determined), giving a 12 : 3 : 1 segregation ratio of black : brown : pale; (3) in *A. hypochondriacus*, presence of a leaf spot is controlled by a single, dominant gene, designated Ls, and presence of a V-shaped leaf mark is controlled by 2 dominant, complementary, epistatic genes designated Vm1 and Vm2; (4) in *A. cruentus*, red (vs. green) seedlings, caused by the presence of betacyanin, is controlled by a single, dominant gene, designated R, while distribution of betacyanin to the stem, leaves and inflorescence is controlled by a single, dominant gene, Bd (betacyanin distributor); and (5) in *A. cruentus* and *A. caudatus*, orange (vs. red) mature plants are controlled by a single, recessive gene, designated o. Independent observations of a BC population from the cross *A. cruentus* X *A. retroflexus* suggested that at least 3 loci control testa colour. Interspecific hybrids between pale-seeded plants of (1) *A. hypochondriacus* and *A. caudatus* and (2) *A. cruentus* and *A. hypochondriacus* produced only pale-seeded F1s, indicating that homologous loci control dark vs. pale testa colour within each of the 3 cultivated grain amaranths. It is concluded that the existence of these multiple, homologous loci supports the monophyletic origin of pale-seededness in the domesticated grain amaranths.

1586 MALLIKA, VK; PETER, KV; RAMACHANDRAN, C. 1988. **Interspecific hybrid between *Amaranthus spinosus* (section *Amaranthus*) and *A. viridis* (section *Blitopsis*)**. *Current Science*, 57: 21, 1185-1188; 7 ref.

The first successful hybridization between the wild species *A. spinosus* and *A. viridis* (both n = 17) is reported. The hybrid, unlike the parents, is short and robust with perennial growth habit. Most of the male flowers produced were sterile but many of the anthers formed in some flowers dried off without dehiscence. Meiosis was regular in the parents with 17 bivalents forming at metaphase I. The hybrid formed, on average, 14.4 bivalents and 5.3 univalents, and failure of the univalents to orientate produced abnormalities in later stages. The hybrid showed 62.6% pollen sterility. These results do not support the taxonomic separation of the 2 parent species since genomic similarities exist between them.

Asparagus

1587 GHOSH, B; SEN, S. 1991. **Plant regeneration through somatic embryogenesis from spear callus culture of *Asparagus cooperi Baker***. *Plant Cell Reports*; 9: 12, 667-670; 17 ref.

Somatic embryogenesis and plantlet formation were achieved using callus derived from the subapical region of spears of *A. cooperi* [*A. africanus*]. Callus was obtained in MS medium supplemented with NAA and kinetin. Increasing the concentration of potassium nitrate in subsequent subcultures resulted in the formation of embryoids. Rapid multiplication of embryoids resulted from transfer to a medium containing a different source of nitrogen and a low concentration (0.01 mg/litre) of gibberellic acid. Media containing zeatin or gibberellic acid led to the formation of complete plantlets from embryoids. Regenerated plants were cytologically and phenotypically stable.

1588 GHOSH, B; SEN, S. 1992. **Stable regeneration in *Asparagus cooperi Baker* as controlled by different factors**. *Plant Science Limerick*, 82: 1, 119-124; 12 ref.

Spear, shoot tip, internode, node and root of mature plants of this ornamental species [*A. africanus*] were used as explants for in vitro regeneration. Induction of

callus from different explants depended on the photoperiod in addition to a specific combination of NAA and kinetin in the basal medium. The development of shoots from callus required (BA) [benzyladenine], L-arginine, adenine and a low level of NAA. The individual shoots produced roots in the presence of IBA or IBA containing potassium salt. Regenerated plants were cytologically and phenotypically stable.

1589 GHOSH, BISWAJIT; SEN, SUMITRA. 1991. **In vitro on asparagus research - a short report**. *Asparagus Research Newsletter*, 8: 2, 1-3.

1590 GHOSH, BISWAJIT; SEN, SUMITRA. 1989. **Somatic embryos in *Asparagus cooperi Baker***. *Current Science*, 58: 5, 256-257; 8 ref.

Explants of *A. cooperi* [*A. africanus*] formed calluses after culture on MS basal medium containing 1 mg NAA and 1 mg kinetin/litre. These eventually produced embryoids after the addition of 1000 mg KNO3 to the medium.

1591 KAR, DK; SEN, S. 1985. **Effect of gamma irradiation on callus of *Asparagus racemosus***. *Nucleus, India*, 28: 1/2, 52-55; 18 ref.

Chromosome breakage, clumping, bridges, stretching and migration to the cell wall were observed in calluses irradiated with 4 and 8 krad. Callus growth and the frequency of shoot bud regeneration were reduced by irradiation.

1592 KAR, DK; SEN, S. 1985. **Effect of hormone on chromosome behaviour in callus cultures of *Asparagus racemosus***. *Biologia Plantarum*, 27: 1, 6-9; 16 ref.

Variability in chromosome number and behaviour was higher in the presence of 2,4-D than of NAA. Frequency of polyploid cells increased with increase in concentration of 2,4-D or addition of coconut water. Polyploidy increased with increasing age of callus.

1593 KAR, DK; SEN, S. 1985. **Propagation of *Asparagus racemosus* through tissue culture**. *Plant Cell, Tissue and Organ Culture*, 5: 1, 89-95; 14 ref.

Shoot segments formed callus on Murashige & Skoog's (MS) medium supplemented with 2,4-D and kinetin. Regeneration of shoot buds and clonal multiplication of excised shoots through proliferation of nodal buds was achieved on medium supplemented with IAA and BA. Rooting was achieved with half strength MS medium plus IBA, and complete plants with cladode, crown and root systems were developed in hormone-free medium. The plants were successfully transferred to soil.

Cabbages

1594 PRASAD, J; KHUSHWAHA, KS. 1990. **Role of pathogenic microbes in management of the tobacco caterpillar, *Spodoptera litura (F.)* in cabbage and cauliflower crops**. *Indian Journal of Entomology*, 52: 4, 641-652.

1595 SHANKER, J; SAHA, SK; DE, SK. 1982. **Effect of certain nitrogen compounds on the biosynthesis of thiamine in cabbage plant**. *Indian Journal of Plant Physiology*, 25: 3, 306-309; 10 ref.

In pot trials with the cv. Pride of India the plants received N from 8 different sources. Maximum thiamine biosynthesis occurred at the seedling stage in plants grown on a substrate containing FYM plus PK basal dressing.

Brassica carinata

1596 NARASIMHULU, SB; KIRTI, PB; PRAKASH, S; CHOPRA, VL. 1992. **Resynthesis of *B. carinata* by protoplast fusion and recovery of a novel cytoplasmic hybrid**. *Plant Cell Reports*, 11: 8, 428-432; 28 ref.

B. carinata (2n = 34, BBCC), was synthesized by fusing dark grown etiolated hypocotyl protoplasts of *B. nigra* (2n = 16,BB) with green mesophyll protoplasts of *B. oleracea* (2n = 18,CC) using polyethylene glycol. Heterokaryons were microscopically distinguished from the parental types by their dark green chloroplasts in the colourless hypocotyl protoplast background. The mean heterokaryotic fusion frequency estimated on the basis of this morphological distinction was about 16%. A total of 626 calluses were obtained, of which 92 regenerated shoots after transfer to zeatin (2 mg/litre) supplemented MS medium. Of these, 81 calluses differentiated into plants morphologically similar to naturally occurring *B. carinata* and 11 calluses yielded plants resembling parental types. Meiosis in seven hybrid plants showed the chromosome number to be 2n = 34 the sum of *B. nigra* and *B. oleracea* chromosomes. Molecular confirmation of the amphidiploid nature of hybrids was obtained by probing with a *B. juncea* derived genomic clone. The use of chloroplast and mitochondrial specific gene probes, revealed that one plant was a cytoplasmic hybrid having ctDNA sequences of both *B. oleracea* and *B. nigra* and mtDNA sequences of *B. nigra*.

1597 UPRETY, DC; PRAKASH, S; TOMAR, VK. 1990. **Cytoplasm influences the photosynthetic efficiency in *Brassica carinata***. *Journal of Agronomy and Crop Science*, 165: 2-3, 207-210; 6 ref.

B. carinata plants of reciprocal cytoplasmic origin were obtained from the crosses *B. nigra* X *B. oleracea var. italica* (*B. carinata* 226) and *B. oleracea* X *B. nigra* (*B. carinata* 241). Natural *B. carinata* and the *B. nigra* and *B. oleracea var. italica* parents were included in the study. The rate of photosynthesis in *B. carinata* 226 with nigra cytoplasm, *B. nigra* and natural *B. carinata* was higher than that in *B. carinata* 241 with oleracea cytoplasm. This was substantiated by the diurnal values of photosynthesis among the genotypes and by seed yield data. Thus, cytoplasm affects the rate of photosynthesis in *B. carinata*.

Cauliflowers

1598 BAGGA, S; SARIN, N BHALLA; SOPORY, SK; MUKHERJEE, S GUHA. 1982. **Comparison of in vitro plant formation from somatic tissues and pollen grains in *Brassica oleracea var. botrytis***. *Phytomorphology*, 32: 2/3, 152-156; 12 ref.

Anthers excised at the uninucleate pollen stage and cultured on Nitsch's medium supplemented with IAA (2 p.p.m.), kinetin (10-6) and casein hydrolysate (1000 p.p.m.) formed profuse callus while those cultured on Gamborg's B5 medium with BA (0.5 p.p.m.) formed embryoids directly without callus but also formed callus. The embryoids, on transfer to new B5 + BA (0.5 p.p.m.) medium, formed plantlets with roots and shoots. Differentiation of the root and shoot buds was also observed from anther callus on transfer to B5 + BA (0.5 p.p.m.). Formation of plantlets with both roots and shoots was observed in callus from both leaf and stem explants. Qualitative and quantitative differences were observed in the response of the anther, stem and leaf tissues to 5 different media.

1599 BAGGA, S; RAJASEKHAR, VK; MUKHERJEE, S; SOPORY, SK. 1985. **Enhancement in the formation of shoot initials by phytochrome in stem callus cultures of *Brassica oleracea var. botrytis***. *Plant Science, Irish Republic*, 38: 1, 61-64; 16 ref.

Dark grown (20-day-old) cauliflower callus (control) obtained from stem explants formed shoot initials 12 days after transfer to continuous white light. However, if 15-day-old dark grown callus was exposed to light the production of shoot initials began in 9 days. If instead of white light, red light was given for 5 minutes each day followed by 24 h darkness for 5 days to 15-day-old dark-grown callus, shoot initiation started on the 3rd day and the response was higher than that found in control cultures. Far-red light given for 10 minutes showed no effect and if it followed red light, the effect of red light was annulled. It is suggested that phytochrome is involved in shoot initiation.

1600 BASU, A; SETHI, U; MUKHERJEE, SG. 1990. **Phytochrome in control of differentiation and phosphatidylinositol turnover in *Brassica oleracea* cultures**. *Phytochemistry*, 29: 5, 1539-1541; 27 ref.

Red-light-induced proliferation and far-red induced differentiation and red/far-red reversibility indicated the involvement of phytochrome in control of differentiation in cultures of *Brassica oleracea var. botrytis* cv. Synthetic. An increase in the level of glycerophosphatidylinositol with a concomitant decrease in glycerophosphatidylinositol phosphate and glycerophosphatidylinositol bisphosphate were obtained in the light-grown seedlings as compared to the dark-grown ones. A saturating pulse of red light stimulated glycerophosphatidylinositol. Subsequent irradiation of red-light- treated seedlings with far-red light decreased glycerophosphatidylinositol and increased glycerophosphatidylinositol phosphate and glycerophosphatidylinositol bisphosphate. The photoreversibility was lost by an insertion of a dark incubation betwen red and far-red treatments.

1601 HOREAU, N; ARORA, R; BHOJWANI, SS. 1988. **A comparative study of in vitro shoot regeneration from cotyledon and root explants of four varieties of *Brassica oleracea L.***. *Current Science*, 57: 24, 1349-1351; 6 ref.

Seeds of vars. botrytis, capitata, gemmifera and italica were germinated on MS medium. Excised cotyledons and roots from 8-day-old seedlings were cultured on 7 different media containing various combinations of growth regulators. Cotyledons showed consistently higher levels of regeneration than root segments, with shoot bud differentiation occurring at the cut end of the petiole. Cultures of var. botrytis (cauliflower) showed the highest levels of regeneration (up to 100%), with var. capitata (cabbage) exhibiting the least (up to 4%). A combination of NAA (10-6 M) and benzyladenine (5 X 10-6 M-1 X 10-5 M) induced higher percentages of regeneration than benzyladenine alone.

1602 KUMAR, M; PRASAD, M. 1992. **Cellulase production in varied crucifer seedlings having susceptible and resistent response towards *Xanthomonas campestris cv. campestris (Pammel) Dowson***. *Zentralblatt Fuer Mikrobiologie*, 147: 3-4, 167-171.

1603 PRAKASH, S; GUPTA, S; RAUT, RN; KALRA, AK. 1984. **Synthetic *Brassica carinata* - a preliminary report**. *Cruciferae Newsletter*, No. 9: 35.

When different ecotypes of *B. oleracea* (vars. *botrytis, italica, alboglabra* and *capitata*), used as female parents, were crossed with 2 strains of *B. carinata*, hybrids were produced at low frequency. Variants obtained included dwarf types (90-120 cm tall) and types with very close arrangement of a large number of siliquas (80-117) on the long fruiting branches. Some hybrids, especially those involving cauliflower, were early in maturity.

1604 SINGH, S; MATHUR, A. 1985. **In vitro plantlet formation from cotyledons, leaf lamina and midrib of cauliflower**. *Current Science*, 54: 8, 391-393; 12 ref.

Cotyledon, leaf lamina (10 X 10 mm) and leaf midrib (10 mm long) explants from aseptically grown, 15-day-old seedlings on MS [Murashige & Skoog] medium were transferred to MS supplemented with various growth regulators. Kinetin + BA at 0.5-1 mg/litre induced friable callus in 7-10 days. Kinetin or BA at 1-5 mg/litre induced 2-4 shoots/explant in 60-100% of cotyledons, 5-10 in 60% of leaf-lamina explants and 15-20 in 100% of leaf midrib explants. Maximum response occurred at 5 mg BA/litre. Differentiated shoots were cultured on filter-paper "bridges" in liquid MS medium supplemented with 3-5 mg IBA and/or NAA/litre, the best results being achieved with a mixture of IBA and NAA.

Cucurbitiaceae

1605 BHAVE, M; LAGU, M; RANJEKAR, PK. 1984. **Molecular analysis of *Cucurbitaceae* genomes: I. Comparison of DNA reassociation kinetics in six plant species**. *Pl. Sci. Letters*, 33: 2, 127-136; 20 ref.

Using a nonlinear regression analysis method, reassociation kinetics of DNAs from six cucurbitaceous species were analysed. In all the species, the repeated DNA sequences showed a wide variation and accounted for 25-65% of the total DNA. In Coccinia indica, the repetitive DNA content of 25% is the lowest reported so far in all higher plant species. Only two of the species studied (*Luffa cylindrica* and *Trichosanthes anguina*) showed a fast DNA reassociating component. The single copy DNA component of all six species reassociated with a rate constant in the range of 5.90 X 10-3 to 1.40 X 10-2 and had a kinetic complexity of 6.97 X 107 to 1.69 X 108 base pairs. It is noted that species specific variations in proportions, frequencies of reiteration and kinetic complexities of different classes of DNA in the species studied may contribute to their interspecies incompatibility.

1606 ISLAM, R; JOARDER, OI; RAHMAN, SM; HOSSAIN, M. 1992. **Micropropagation in *Cucurbita maxima* X *Cucurbita moschata* through seedling derived shoot tips**. *Indian J. Hort.* 49: 3, 249-252.

1607 KRISHNASAMY, V. 1992. **Studies on imbibition injury in bittergourd seeds**. *Proceedings of the International Seed Testing Association*, 20: 3, p. 497-502.

1608 PARKASH, V; SOKHI, SS. 1989. **Detached leaf method for maintenance of cultures of *Pseudoperonospora cubensis***. *Indian Phytopathology*, 42: 4, 575-576; 9 ref.

Leaf discs from melons, cucumber and sponge gourd (Luffa cylindrica) developed downy mildew symptoms 4-5 d after inoculation with *P. cubensis*. Sporulation was initiated 4, 5 and 5-6 d after inoculation on melons, *L. cylindrica* and cucumber, respectively, and max. sporangia/ml were produced on melons (5.75 X 106). Leaf discs supported on cotton moistened with 5% sucrose or 50 μg/ml kinetin survived longer than those on tap water. Sporangia on leaves in a Petri dish had the same morphology as those produced under natural conditions and remained viable for up to 30 d of storage. The advantages of this method for the production of a large amount of viable inoculum within the shortest period are discussed.

1609 RAHMAN, MM; DEY, SK; WAZUDDIN, M. 1991. **Study of yield, yield components and vine characters of some cucurbit genotypes [Bangladesh].** *Proceedings of the workshop on Bangladesh Agricultural University Research Progress*. Bangladesh Agricultural Univ., Mymensingh (Bangladesh) p. 75-86.

The replicated experiments of bitter gourd, bottle gourd and ribbed gourd revealed significant variations among the genotypes for weight/fruit, while yield/plant, vine length and branches/vine varied significantly in bitter gourd and ribbed gourd, and fruit length and breadth varied in ribbed gourd and bottle gourd. Significant variations for days to flowering (female) was noticed only among the bottle gourd genotypes. High coefficients of variations were observed from the non-replicated experiments for fruit length and breadth, and weight/fruit for the different new lines. Large leaves and longer vines were observed in the induced and natural polyploids of bitter gourd and teasle gourd, respectively. Pollen grain size and pollen sterility in the tetraploids did not differ appreciably from those of the diploids in both the species. Hybridization programmes among the genotypes of each of bitter gourd, bottle

gourd, sweet gourd and ribbed gourd were successfully completed and the F1 seeds have been collected for future evaluation.

1610 SINGH, AK; YADAVA, KS. 1984. **An analysis of interspecific hybrids and phylogenetic implications in *Cucumis* (*Cucurbitaceae*).** *Plant Systematics and Evolution*, 147: 3/4, 237-252; 20 ref.

Analysis of data on interspecific crossability in 8 *Cucumis* species (2n = 24) and chromosome pairing and pollen fertility of their hybrids from 15 combinations suggested that there are 3 broad groups of species: (1) spiny-fruited interfertile species whose hybrids show varying degrees of chromosome associations and low to high pollen fertility, (2) species with nonspiny fruits, which are completely incompatible with the former but weakly compatible with the cultivated species *C. melo*, producing partly developed seeds, and (3) *C. metuliferus* and *C. melo* with its different botanical varieties. The species with spiny fruits can be further divided on the basis of karyomorphological similarities and/or relative genomic affinity, indicated by chromosome pairing and hybrid pollen fertility.

Melons

1611 AHAD, A; ISLAM, R; HOSSAIN, M; KHALEKUZZAMAN, M; JOARDER, OI. 1994. **Plant regeneration from immature and mature embryo axes of watermelon.** *Plant tissue Culture*, 4: 1, 39-44.

1612 CHATTERJEE, M; MORE, TA. 1991. **Techniques to overcome barrier of interspecific hybridization in *Cucumis*.** *Report - Cucurbit Genetics Cooperative*. Div. of Vegetable, IARI, India. No. 14: 66-68.

Techniques of bud pollination, use of mentor (dried non-viable) pollen, brush pollination, growth regulator application and treatment of the stigma with an organic solvent were investigated for their potential to overcome interspecific hybridization barriers. *C. figarei* pollinated with mentor pollen of *C. figarei* mixed with viable pollen of *C. melo* produced a fruit set of 8%. Application of benzyladenine to the base of the ovaries after pollination or pollination after washing the stigma with hexane in the cross *C. figarei* X *C. melo* gave 4% and 2% fruit set, respectively. Bud and brush pollination were ineffective.

1613 HALDER, T; GADGIL, VN. 1984. **Comparison of fatty acid patterns in plant parts and respective callus cultures of *Cucumis melo*.** *Phytochemistry*, 23: 8, 1790-1791; 10 ref.

Fatty acid composition of root, hypocotyl, cotyledon, stem and leaf of *C. melo var. utilissimus* seedlings and callus tissues originating from all the parts were compared. In all parts of seedlings there was a greater proportion of unsaturated fatty acids. The predominant fatty acid in root, stem and leaf was linolenic acid whilst in the cotyledon linoleic predominated. In the hypocotyl these two acids were present in equal amounts. In callus cultures the proportion of saturated acids was greater and the predominant fatty acid was palmitic. The major unsaturated fatty acid in callus cultures was linolenic. The analysis showed that callus tissue and its respective plant part had different fatty acid patterns and that all the callus cultures had very similar patterns irrespective of their origin.

1614 HALDER, T; GADGIL, VN. 1984. **Fatty acids in callus cultures: stage of reversal in the proportion of unsaturated to saturated acids and of change in major components.** *Phytochemistry*, 23: 1, 47-49; 9 ref.

Cucumis melo var. utilissimus cotyledon lipids were mainly unsaturated fatty acids with linoleic acid as the major component, whereas those of cotyledon callus showed a marked reduction in linoleic acid, an increase in linolenic acid and a predominance of palmitic acid which increased total saturated acids. The fatty acid compositions of total lipids in the cotyledons at different stages of seedling development, in excised cotyledon tissue at different stages of callus initiation and in isolated callus showed that the observed changes in the established callus occurred in the newly formed meristematic cells as a result of the action of growth substances used for callus initiation.

1615 HALDER, T; GADGIL, VN. 1983. **Fatty acids of callus tissues of six species of *Cucurbitaceae*.** *Phytochemistry*, 22: 9, 1965-1967; 15 ref.

A comparative study was made of the fatty acid composition of the total lipids extracted from the cotyledons and the callus cultures derived from cotyledon segments of *Cucumis melo var. utilissimus*, *C. melo*, *C. sativus*, *Citrullus vulgaris*, *Momordica charantia* and *Luffa acutangula*. Conditions for callus induction and growth of cultures were identical. The difference between the two systems was in the reversal of the ratio of total unsaturated to saturated acids in all callus cultures. In callus cultures, instead of linoleic, linolenic was the major unsaturated fatty acid. In *M. charantia*, alpha-elaeostearic acid present in the cotyledon was not detected in callus and oleic acid was the major unsaturated fatty acid.

1616 JAIN, J; MORE, TA. 1992. **In vitro regeneration in *Cucumis melo cv. Pusa Madhuras*.** *Report - Cucurbit Genetics Cooperative USA*, No. 15: 62-64.

Epicotyl explants formed callus on MS medium with 0.5 mg benzyladenine (BA)/litre, and shoot buds were regenerated in the presence of IAA (1.0 mg/litre) + kinetin (5.0 mg/litre). Cotyledonary leaves also formed callus on MS medium with BA, and shoot buds were regenerated on MS basal medium with 0.5 mg GA3/-litre. Roots formed on MS medium with 0.1 mg NAA/-litre and survived 15-20 days in sterilized soil.

1617 PAL, AB; SRINIVASAN, K; VANI, A. 1983. **Development of breeding lines of muskmelon for resistance to fruitfly**. *Progressive Horticulture*, 15: 1/2, 100-104; 4 ref.

Of 50 *Cucumis melo* accessions from India and elsewhere screened for resistance to *Dacus cucurbitae* in the field over 4 years, 6 (all from India or Afghanistan) were characterized as resistant or immune (0-10% fruit damage). The resistant accessions were similar to the commercial variety Arka Jeet in many respects, but low in total soluble sugar contents. Data from a cross between Arka Jeet and the resistant wild species *C. callosus* indicated that resistance may be dominant. Incorporation of resistance from *C. callosus* into Arka Jeet by backcrossing is recommended for breeding resistant varieties with good horticultural attributes.

1618 PANDEY, B; GADGIL, VN. 1984. **Fatty acids in callus cultures: influence of growth factors on fatty acid composition of total lipids in callus cells**. *Phytochemistry*, 23: 1, 51-53; 6 ref.

Callus derived from cotyledon segments of *Cucumis melo* and *C. sativus* were treated with 4 combinations of growth factors: NAA + coconut water; NAA + kinetin; NAA + BA; and IBA + BA. These media initiated as well as promoted the growth of excised callus. The proportion of total saturated to unsaturated acid and the ratio of linoleic to linolenic acid was influenced by the change in the type of auxin and cytokinin in the combinations used. A many-fold increase of myristic acid was recorded for the IBA + BA combination.

1619 SRIVASTAVA, DK; ANDRIANOV, VM; PIRUZIAN, ES. 1988. **Organogenesis and plant regeneration in watermelon**. *Soviet Plant Physiology*, 35: 6, 1243-1247.

1620 SRIVASTAVA, DK; ANDRIANOV, VM; PIRUZIAN, ES. 1988. **Regeneration and transformation studies in Watermelon (*Citrullus vulgaris Schrad. cv. Melitopolski*)**. *International Proceedings of 4th International Youth School Conference of Genetics*. Varna, Bulgaria: p. 180-185.

1621 SRIVASTAVA, DK; ANRIAVOV, VM; PIRUZIAN, ES. 1989. **Tissue culture and Plant Regeneration in Watermelon**. *Plant Cell Reports*, 8: 5, 300-302.

Momordica

1622 HOQUE, A; ISLAM, R; JOARDER, OI; HOSSAIN, M. 1993. **In vitro propagation of *Momordica dioica Roxb*.** *Int. Plant Tissue Culture Conf.* (Dhaka Univ., Dept. of Botany: December 19-21).

1623 JOARDER, N; JOARDER, OI; ISLAM, R; HAQUE, MA. 1993. **Induction of callus and regeneration of plants through in vitro culture of *Momordica cochinchinensis*.** *Intl. Conf. Biotech. Forestry*. IARI, New Delhi. p. 33.

Cucumbers

1624 KOLGANOVA, TV; SRIVASTAVA, DK; METT, VL; PIRUZIAN, ES. 1989. **Genetic transformation and expression of foreign gene in cucumber tissue**. *IVth National Conference on Genetics of Somatics Cells in Culture*. Zvinigrad, Moscow, USSR:

1625 MORE, TA; SESHADRI, VS. 1988. **Development of tropical gynoecious lines in cucumber**. *Report, Cucurbit Genetics Cooperative, USA*, No. 11: 17-18; 5 ref.

Crosses were made between the temperate gynoecious (G) lines Gy14, SR551F, Gy3, Tablegreen 68 X Gy3 F2 and Wisconsin 2757 and the tropical monoecious lines Poona Khira, RKS296 and RKS300. Selection was applied in the segregating generations for recombinants having true-breeding G sex, good horticultural traits and vigorous germination and emergence under tropical conditions. G segregates were maintained by application of AgNO3 (250 p.p.m.) twice. Several tropical lines were thus isolated and are now in the F4 generation. Four of these are 87-304-6, 87-316, 87-319-12 and 87-338-15; they are true-breeding G lines during the summer and rainy seasons. The first line produces cylindrical, light-green fruits of medium size, with sparse black spines, while the last 3 produce cylindrical, short to medium fruits of a pale yellow colour, with sparse brownish spines. The node number of the first pistillate flower of all the lines ranges from 3 to 6. They

do not produce staminate flowers in the absence of an AgNO3 spray. When they are sprayed with AgNO3 (300 p.p.m. twice) the average node number of first staminate and pistillate flowers ranges from 1.09 to 2.89 and 4.29 to 9.29, respectively. These strongly G lines, it is concluded, could be easily maintained by AgNO3 under tropical field conditions.

1626 MUDLIAR, A; BHARTI, S. 1984. **Effect of manganese ions on benzyladenine-induced growth and chlorophyll synthesis in excised cucumber cotyledons**. *Physiologia Plantarum.*, 61: 4, 629-633.

The behaviour of endogenous Mn2+ was studied by electron spin resonance spectroscopy during BA-induced growth of excised cucumber (cv. Long green) cotyledons. The level of endogenous Mn2+ was decreased by BA treatment, most pronouncedly after 96 h. MnCl2 applied alone promoted chlorophyll synthesis at relatively low concentrations but in the presence of BA higher concentrations of MnCl2 were required for stimulation of chlorophyll synthesis. A pronounced increase in growth was observed when Mn2+ was applied with BA at 96 h, when the decline in the endogenous level of paramagnetic Mn2+ was maximal.

1627 RAAMSDONK, LWD VAN. 1989. **Minimal crossability in the Netherlands: cucumber and chrysanthemum**. *Prophyta*, 43: 6, Bijlage, 231-232.

Crossability studies at the Institute for the Breeding of Agricultural Crops (IVT) suggest that there is little chance of transgenic cucumbers and chrysanthemums hybridizing with wild relatives in North West Europe. Hybridization is to be expected between cultivated cucumbers and landraces in India and between chrysanthemums and wild Dendranthema species and varieties in East Asia and Japan.

1628 RANADE, SA; LAGU, MD; PATANKAR, SM; DEBAK, MM; DHAR, MS; GUPTA, VS; RANJEKAR, PK. 1988. **Identification of a dispersed MboI repeat family in five higher plant genomes**. *Bioscience Reports*, 8: 5, 435-441; 23 ref.

Digestion of nuclear DNAs of *Cucurbita maxima*, *Trichosanthes anguina* [*T. cucumerina*], *Cucumis sativus*, *Cajanus cajan* and *Phaseolus vulgaris* with the restriction endonuclease MboI yielded discrete size classes with molecular weights in the range of 0.5 to 5 kbp. The MboI digestion pattern of Cot 0.1 DNA in *P. vulgaris* is comparable with that of total DNA, indicating that these bands represented highly repeated DNA sequences. Cleavage patterns of the DNAs with varying amounts of MboI indicated the dispersed nature of the repeat families. Southern hybridization studies using *P. vulgaris* highly repetitive DNA as a probe indicated more homology with repeats of *Cajanus cajan* and less homology with *Cucurbita maxima*, *T. cucumerina* and *Cucumis sativus* repeats.

Solanum

1629 SHARMA, DR; CHOWDHURY, JB. 1977. **Formation of callus from the cultured anthers of *Solanum integrifolium* haploid**. *Haploid Inf. Service*, 18: 12-13.

1630 SHARMA, DR; CHOWDHURY, JB; KUMARI, R; AHUJA, U. **In vitro culture of anthers and isolated microspores of the genus *Solanum***. *Advances in cytogenetics and Crop Improvement*/edited by RB Singh, RM Singh and BD Singh. New Delhi: Kalyani Publishers, p. 355-358.

Tomatoes

1631 AJAY; SEETHARAM, A. 1984. **An attempt to cross tomato cultivar with *Lycopersicon peruvianum***. *Madras Agricultural Journal*, 71: 5, 336-338; 9 ref.

Lycopersicon esculentum cv. Bangalore was crossed as female parent to *L. peruvianum* and hybrids were obtained at a low rate. The F1 was intermediate for height, fruit size, disease resistance and some other quantitative traits. Chromosome pairing at meiosis was normal, but the F1 were less fertile than the parents.

1632 DATAR, VV; LONKAR, SG. 1985. **Inheritance of resistance in tomato to early blight**. *J. of Maharashtra Agricultural Universities*, 10: 3, 357-358; 6 ref.

F1 and F2 progenies, from a breeding programme involving resistant *Lycopersicon* species and susceptible *L. esculentum* cultivars, were inoculated with *Alternaria* solani. A disease index, calculated from disease severity and number of leaves with symptoms, showed that commercial cultivars were highly susceptible, while *L. hirsutum* strain PI134417 was highly resistant. F1 hybrid HS102 X PI134417 also had high resistance, while S12 X Heinz 1383 and S12 X EC116050 were both more resistant than their parents. This high resistance was maintained in the F2 generation. It was found that resistance was monogenically dominant over susceptibility.

1633 DIVAKAR, BJ; PAWAR, AD. 1987. **Biocontrol of tomato fruit borer, *Heliothis armigera* (Hb.) in Karnataka**. *Indian Journal of Plant Protection*, 15: 1, 57-61; 8 ref.

During field trials in Karnataka, India, in 1977-83, the egg parasites *Trichogramma chilonis*, *T. brasiliensis* and *T. pretiosum*, the egg-larval parasite *Chelonus blackburni* and the larval parasites *Bracon hebetor*, *B. kirkpatricki* and *Eucelatoria bryani* were released for the biological control of the noctuid *Heliothis armigera* on several crops. Post-release surveys showed considerable reductions in the pest populations on several occasions following release of the parasites, their effectiveness varying according to year and crop. The greatest reduction in the larval population of *H. armigera* was observed on tomato (92.4%).

1634 HADWAN, HA; KHARA, HS. 1987. **A new record of *Trichoderma* from India**. *Indian Phytopathology*, 40: 3, 437.

T. pseudokoningii was isolated from the rhizosphere of tomato seedlings in the Indian Punjab in 1983-84. It was mycoparasitic on *Rhizoctonia solani*.

1635 JALALI, SK; SINGH, SP; KUMAR, P; BALLAL, CR. 1988. **Influence of the food plants on the degree of parasitism of larvae of *Heliothis armigera* by *Cotesia kazak***. *Entomophaga*, 33: 1, 65-71; 25 ref.

The influence of the food plants of larvae of the noctuid *Heliothis armigera* [*Helicoverpa armigera*] on the degree of parasitism by the braconid parasitoid *Cotesia kazak* [*Apanteles kazak*] was studied in laboratory cages. The food plants tested were cotton, tomato, okra, *Dolichos lablab*, pigeonpea (*Cajanus cajan*), cowpea (*Vigna unguiculata*) and chickpea (*Cicer arietinum*). In single plant choice tests, parasitism of *H. armigera* was highest on cotton, tomato and okra and lowest on *D. lablab*, pigeonpea, cowpea and chickpea. In multiple choice tests, parasitism was highest on hosts reared on cotton, okra and tomato, and lowest on those reared on chickpea, pigeonpea, cowpea and *D. lablab*. Cocoon production of *A. kazak* was higher from hosts reared on okra, cotton and tomato than from those reared on pigeonpea, *D. lablab*, chickpea and cowpea. The longevity and sex ratio of the parasitoid did not differ significantly between food plants. For biological control of *H. armigera* in India, it is suggested that this parasitoid should be released first in crops such as cotton, okra and tomato.

1636 KALLOO; BANERJEE, MK. 1990. **Transfer of tomato leaf curl virus resistance from *Lycopersicon hirsutum f. glabratum* to *L. esculentum***. *Plant Breeding*, 105: 2, 156-159; 6 ref.

The lines H2, H11, H17, H23, H24 and H36, resistant to tomato leaf curl virus, were developed by controlled introgression of *L. hirsutum f. glabratum* into *L. esculentum*. Disease incidence 120 days after inoculation ranged from 8.3 to 35.0%, whereas in susceptible varieties it ranged from 95.0 to 100%. Values for the coefficient of infection (CI) in the resistant lines were very low, ranging from 0.25 to 4.55, whereas in susceptible varieties they ranged from 60.6 to 89.0. Line H2 had the highest resistance, showing the lowest disease incidence and CI values. Fruit size and days to maturity in the resistant lines were close to those of cultivated susceptible varieties.

1637 MAHESWARI, TU; MANI, A. 1988. **Combined efficacy of *Pasteuria penetrans* and *Paecilomyces lilacinus* on the biocontrol of *Meloidogyne javanica* on tomato**. *International Nematology Network Newsletter*, 5: 3, 10-11; 2 ref.

Results revealed that individual applications of *P. penetrans* (at 150 mg/kg soil) or *P. lilacinus* (at 3.0 g/kg soil) enhanced all the plant growth characteristics of tomato cv. Pusa Ruby seedlings grown individually in 15-cm-diam. pots, with *P. penetrans* being the more effective. Simultaneous inoculations of both the bacterium and the fungus were even more effective and increased dry weight of the shoot by 33.34% and lowered *M. javanica* (at 3000 J2/kg soil) populations by 66.2%

1638 RANADE, S; DAVID, SB. 1985. **Quinones as plant growth regulators**. *Plant Growth Regulation*, 3: 1, 3-13; 27 ref.

The effects of benzoquinone, naphthaquinone [naphthoquinone] and anthraquinone on the growth of tomato callus and whole plants of tomato and on rooting of mung bean cuttings were studied. Naphthoquinone effects on some oxidases and on the isozyme patterns of peroxidases in all the three systems were also observed. Quinones increased callus growth, the number of roots initiated in mung bean cuttings and the growth of tomato plants, significant increases being obtained with 10-5 M naphthoquinone. Naphthoquinone also decreased the activities of IAA oxidase, ascorbic acid oxidase and polyphenol oxidase, and led to the disappearance of one of the isozymes of peroxidase in all systems.

1639 SANGHI, N; RAJAK, RC. 1987. **Production of pectic and cellulolytic enzymes by two strains of *Myrothecium roridum* causing fruit rot of tomato.** *Perspectives in mycological research (Volume-I)*/edited by SK Hasija, RC Rajak, SM Singh. New Delhi: Today and Tomorrow's Printers and Publishers, p. 111-116; 16 ref.

Enzyme activity varied with culture medium and incubation time, both in vitro and in tomato fruits. The 2 isolates differed in activity. Pectolytic activity was greater in the presence of pectin and cellulolytic activity was greater in the presence of cellulose.

1640 SHARMA, DR; BHASKARAN, S. 1974. **In vitro culture of protoplast of *Lycopersicon pimpinellifolium***. *Proc. Symp. Biological Approach problems in medicine industry and Agriculture*. Bhaba Atomic Research Centre, Bombay. p. 45-50.

1641 SIVAPRAKASAM, N; BALASUBRAMANIAN, G; JAYARAMAN, V; NARAYANAN, A; VENKATESAN, S. 1986. **Field recovery of *Eucelatoria bryani* on *Heliothis armigera (Hubner)***. *Madras Agricultural Journal*, 73: 11, 614-617; 8 ref.

A total of 904 mated females of the tachinid *Eucelatoria bryani* and 439 parasitized larvae of the noctuid *Heliothis armigera* [*Helicoverpa armigera*] was released from April 1982 to March 1983 to control *H. armigera* in fields of tomato, lablab [*Lablab purpureus*] and red gram [*Cajanus cajan*] in Karnataka, India. No larvae of *H. armigera* collected from April to August 1982 were parasitized by *E. bryani*, but between December and April 1983 the rate of parasitism ranged from 5 to 20%, with 3 to 9 parasitoid adults emerging per host. The rate of parasitism and parasitoid emergence were highest for *H. armigera* collected from tomato fields, followed by those from red gram and lablab fields. There was a positive correlation between the number of larvae parasitized and both percentage parasitism and adult emergence. Regression equations showed that for every parasitized host larva in the field, there would be an increase of 5.63% parasitism and 3.73 adult parasitoids emerging.

1642 VARGHESE, TM; YADAV, GULSHAN. 1986. **Production of embryoids and calli from isolated microspores of tomato (*Lycopersicon esculentum Mill.*) in liquid media**. *Biologia Plantarum*, 28: 2, 126-129; 14 ref.

Isolated uninucleate microspores of cv. HS102 were cultured on DG medium [see Gresshoff P. M.; Doy, C. H.; Planta (1972) 107, 161-170] supplemented with NAA and kinetin, or on modified Murashige & Skoog medium. The microspores developed into haploid embryoids with or without an attached suspensor, or into compact or friable calluses. The results suggested the presence of 2 types of pollen, one with and one without the potential to produce embryoids or callus.

Anther culture

1643 GULSHAN, TM VARGHESE; SHARMA, DR. 1981. **Studies on anther culture of tomato, esculentum**. *Biol. Plant*, 23: 414-420.

Diseases

1644 KAPOOR, IJ; KAR, B. 1988. **Antagonistic effects of soil microbes on *Fusarium oxysporum f.sp. lycopersici*, causing tomato wilt**. *International Journal of Tropical Plant Diseases*, 6: 2, 257-262; 12 ref.

A total of 31 (18 fungal and 13 bacterial) antagonists was isolated from healthy and 3 bacterial antagonists from diseased tomato rhizospheres. The fungal antagonists belonged to the genera *Acrophialophora*, *Aspergillus*, *Chaetomium*, Stachybotrys and Thielavia, while 14 of the bacteria were *Bacillus spp.* and the remaining 21 were Gram-positive, non-spore-forming cocci. The bacterial antagonists were generally more antagonistic than the fungi against the wilt pathogen in vitro. Seed inoculation with bacterial and fungal antagonists improved germination and seedlings stand by 21-72.3%

1645 SINGH, SP; PANT, VEENA; KHAN, AM; SAXENA, SK. 1983. **Inhibitory effect of culture filtrates of some rhizosphere fungi of tomato as influenced by oilcakes on the mortality and larval hatch of *Meloidogyne incognita***. *Nematologia Mediterranea*, 11: 2, 119-123; 14 ref.

Culture filtrates of *Alternaria humicola*, *Aspergillus niger*, *Curvularia lunata*, *Sclerotium rolfsii*, *Trichoderma lignorum* and *T. viride*, obtained from the rhizosphere of tomato cv. Marglobe raised from seeds coated with oilcakes, proved to be nematoxic and inhibited the hatching of larvae of *M. incognita*. Highest mortality occurred in the culture filtrate of *T. viride*, presumably because of the presence of higher amount of phenols.

Insect pests control

1646 MAHESWARI, TU; MANI, A; RAO, PK. 1987. **Combined efficacy of the bacterial spore parasite, *Pasteuria penetrans* (Thorne, 1940) and nematicides in the control of *Meloidogyne javanica* on tomato**. *Journal of Biological Control*, 1: 1, 53-57; 10 ref.

Experiments were carried out under greenhouse conditions to test the efficacy of *P. penetrans* in combination with aldicarb, carbofuran, miral [isazofos], phorate and sebufos for the control of *M. javanica* on tomato cv. Pusa Ruby. Results revealed that the application of *P.*

penetrans in combination with the nematicides significantly improved plant growth characteristics and the increase in growth was more than additive when compared with their individual effects. Combined application resulted in greater reduction of *M. javanica* galling. When *P. penetrans* and nematicides were applied together, there was a high degree of nematode control wherein a maximum of 89.37% reduction in final nematode population was recorded with the *P. penetrans* and carbofuran combination.

1647 MATHUR, A; SINGH, S; KANT, U. 1991. **Ascorbic acid metabolism and growth in nematode induced root gall and normal tissue cultures of tomato**. *Ind. J. of Plant Physiology*, 34: 1, 9-13.

1648 RAJ, MAJ; MANI, A; JAYA-RAJ, MA. 1988. **Biocontrol of *Meloidogyne javanica* with the bacterial spore parasite *Pasteuria penetrans***. *International Nematology Network Newsletter*, 5: 1, 3-4; 4 ref.

Freshly-hatched *M. javanica* J2 (at the rate of 1500 juveniles/pot), were mixed in soil containing *P. penetrans* spore powder (at the rates of 250, 500, 750 and 1000 mg/kg soil). Four-week-old tomato seedlings were planted singly in all the treated pots. After 60 days, respective increases of 17.67, 19.95 and 14.32% in the fresh and dry weights of shoots and in the fresh weight of roots were recorded at the 1000 mg spore inoculum level. Multiplication of *M. javanica* was reduced by 48.4% and 94.42% at the 250 mg and 1000 mg inoculum levels respectively.

1649 REDDY, PP; KHAN, RM. 1988. **Evaluation of *Paecilomyces lilacinus* for the biological control of *Rotylenchulus reniformis* infecting tomato, compared with carbofuran**. *Nematologia Mediterranea*, 16: 1, 113-115; 8 ref.

Carbofuran at 2 kg a.i./ha, *P. lilacinus* at 1 and 2 g (containing approximately 120 and 240 million spores, resp.) and carbofuran + fungus at 2 g were all significantly superior over the control in reducing *R. reniformis* populations both in the soil and on the roots of tomato cv. Pusa Ruby seedlings in glasshouse studies. *P. lilacinus* at 0.5 g did not cause significant reduction in the populations. Carbofuran gave the maximum reduction in the nematode population (by 82.6%), compared with the control. *P. lilacinus* at 2.0 g gave a 66.5% reduction and the combination of both gave a 76.9% reduction. Carbofuran significantly increased the percentage of males (53% over the control) and gave the least reproduction factor (1.2). All treatments increased plant growth.

Brinjals

1650 ANISUZZAMAN, M; KAMAL, AHM; ISLAM, R; HOSSAIN, M; JOARDER, OI. 1993. **Genotypic differences in somatic embryogenesis from hypocotyl explants in *Solanum melongena L.***. *Plant Tissue Culture*, 3: 1, 35-40.

Significant differences in somatic embryogenesis from hypocotyl explants were observed among four genotypes of *S. melongena*, especially genotype "Ichifuji" which produced a large number of somatic embryos. Somatic embryogenesis was initiated on media containing 2, 4-dichlorophenoxyacetic acid. Calli retained the morphogenic potential even after repeated subculturing for over a year. Embryo maturation and germination were achieved on MS basal medium alone and the plantlets were successfully transferred to soil.

1651 BALASUBRAMANYA, RH; PATIL, RB. 1975. **Soil fumigation with chloropicrin for controlling bacterial wilt of brinjal caused by *Pseudomonas solanacearum***. *Current Research*, 4: 100-101.

1652 JAIN, RK; DHAWAN, RS; SHARMA, DR; CHOWDHURY, JB. 1986. **In vitro selection of an NaCl tolerant cell line of Brinjal (*Solanum melogena L.*)**. *Recent Advances in Plant cell and Tissue Culture of Economically Important Plants: National Symposium*. (Osmania Unv., Hyderabad: 1986: Jul 24-26). p. 67.

1653 JAIN, RK; DHAWAN, RS; SHARMA, DR; CHOWDHURY JB. 1987. **Salt tolerance and proline accumulation : A comparative study in salt tolerant and wild type cultured cells of egg plant**. *Plant Cell Reports*, 6: 382-384.

1654 JAIN, RK; CHOWDHURY, JB; SHARMA, DR; CHOWDHURY, VK. 1984. **Selection and characterization of brinjal (*Solanum melongena L.*) cell cultures resistant to tryptophan and phenylalanine analogues**. *Indian Journal of Experimental Biology*, 22: 11, 589-591; 23 ref.

Cell lines resistant to p-fluorophenylalanine, 5-methyltryptophan (5MT) and 6-fluorotryptophan were selected from cell suspensions of cv. Pusa Purple Round, either untreated or treated with ethyl methanesulphonate [dose unspecified]. Mutagen treatment increased the frequency of resistant cell lines 10-fold over that found in the control. Selected cell lines showed high rates of accumulation of the corresponding free amino acids, and of total free amino acids. Plantlets were regenerated from

a cell line resistant to 5MT, and cell cultures derived from these plantlets were also resistant to 5MT.

1655 RAO, PV LAKSHMANA. 1992. **Difference in somatic embryogenetic ability of cultured leaf explants of four genotypes of *Solanum melongena L.*** *Agronomie*, 12: 6, 469-475.

1656 RAO, PVL; SINGH, B. 1991. **Plantlet regeneration from encapsulated somatic embryos of hybrid *Solanum melongena L.*** *Plant Cell Reports*, 10: 1, 7-11; 18 ref.

Somatic embryogenesis was induced at a high frequency in leaf explant-derived callus of F1 hybrid Suphal on MS medium supplemented with 8 mg NAA and 0.1 mg kinetin/litre. Embryoids were encapsulated in various concentrations (2-6%) of sodium alginate and complexed with calcium chloride (25-100 mM); 3% sodium alginate and 75 mM calcium chloride were optimal for encapsulation. Plantlet regeneration ranged from 27 to 49.7% in vitro and from 2 to 4.5% in vivo.

1657 SRIVASTAVA, DK; DESAI, HV; BHATT, PN; MOHTA, AR. 1986. **Cell suspesnsion and protoplast culture in *Solanum* melengena L.** *International Proceedings of National Symposium 'Plant Cell and tissue culture of economically important plants'*. Hyderabad, India: p. 37-41.

1658 SWAMY, MS; CHRISTOPHER, T; SUBHASH, K. 1988. **Multiple shoot formation in embryo culture of *Solanum melongena*.** *Current Science*, 57: 4, 197-198; 11 ref.

Excised embryos of cv. Pusa Purple Long were cultured on MS media supplemented with 0.5 and 1 mg of auxin, kinetin and benzylamine [benzyladenine] per litre in various combinations. Callus, roots and more than 50% multiple shoots were induced on MS medium containing 0.5 mg 2,4-D and 1 mg kinetin per litre. The shoots were separated and transferred to a medium containing 0.1 mg NAA per litre for root formation.

1659 YADAV, NR; VERGHESE, TM; SHARMA, DR. 1989. **Morphogenetic studies in androgenic callus of *Solanum melongena L.*** *Current Science*, 58: 637-639.

Hybridization

1660 KIRTI, PB; MOORTY, KV; RAO, SV; RAO, BGS. 1984. **Cytological observations on some autotetraploids and amphidiploids in spinous solanums and their bearing on interrelationships.** *Current Science*, 53: 23, 1256-1258; 14 ref.

Several interspecific hybrids involving *Solanum melongena* and the wild species *S. indicum*, *S. integrifolium* and *S. surattense* were produced. Formation of 12 bivalents per PMC was common (2n = 24), with some higher chromosome associations. Chiasma frequency was significantly lower in autotetraploids of *S. melongena var. insanum*, *S. integrifolium* and *S. indicum* than the doubled values of the corresponding diploids. Autotetraploids showed irregular chromosome distribution at anaphase I, and had pollen sterility of up to 50%. Amphidiploids were partially sterile despite regular chromosome behaviour. From chromosome associations it is concluded that *S. melongena*, *S. indicum* and *S. surattense* are related, while *S. integrifolium* is related more closely to *S. indicum* than to *S. melongena*.

1661 KIRTI, PB; RAO, BGS. 1982. **Cytological studies on F1 hybrids of *Solanum integrifolium* with *S. melongena* and *S. melongena var. insanum*.** *Genetica, Netherlands*, 59, 127-131; 14 ref.

S. integrifolium (2n = 24) was easily be crossed as female parent with *S. melongena* (2n = 24) and *S. melongena var. insanum* (2n = 24) to give vigorous hybrids but the reciprocal crosses did not succeed. At diakinesis and metaphase I, chromosome associations higher than bivalents were observed in the hybrids, indicating structural repatterning of chromosomes. The modal chromosome association in hybrids was 12 bivalents per PMC, suggesting retention of ancestral chromosome homoeologies by the taxa concerned. Despite regular meiosis, both hybrids were highly pollen sterile (about 95%); this was attributed to the segregational behaviour of the recombined chromosomes.

1662 RAO, SV; RAO, BGS. 1984. **Studies on the crossability relationships of some spinous solanums.** *Theoretical and Appl. Genetics*, 67: 5, 419-426; 28 ref.

Interspecific crosses were attempted among six species; meiotic studies on PMCs are reported. Results showed that *S. surattense*, *S. indicum* and *S. melongena* can be crossed easily to give vigorous and sometimes fertile hybrids. These hybrids have low ranges of chiasma frequencies with means intermediate betweeen those of the parents, and fewer structural differences among genomes. *S. trilobatum* and *S. indicum var. 'multiflora'* were crossed to give vigorous but sterile progeny, showing chiasma frequencies between those of the parents and up to two interchanges among genomes. Hybrids were obtained from some crosses between

species from the above mentioned groups, but these were inviable or highly sterile. Such hybrids had low recombination values, at least three structural differences among genomes, and high frequencies of univalents. *S. torvum* proved to be isolated from all the other species studied.

1663 SHARMA, DR; SAREEN, PK; CHOWDHURY, JB. 1984. **Crossability and pollination in some non-tuberous *Solanum* species**. *Indian Journal of Agricultural Sciences*, 54: 6, 514-517; 7 ref.

S. melongena, *S. khasianum* and *S. sisymbrifolium* (all 2n = 24) were intercrossed, with reciprocals, and also self pollinated. Buds were examined 2, 4 and 24 h after pollination for pollen germination and pollen tube growth. Immature hybrid embryos were excised and cultured. Pollen fertility was 82% in *S. melongena*, 93% in *S. khasianum* and 95% in *S. sisymbrifolium*. Pollen germination after 24 h was more than 95% in all self pollinations, but ranged from 27.3 to 73.0% in the interspecific crosses. Embryos were formed in the crosses *S. melongena* X *S. khasianum* and *S. melongena* X *S. sisymbrifolium* but not in their reciprocals. Major incompatibility barriers were style length in the maternal parent and rejection of the developing embryo by the maternal tissue. Hybrid embryos at the torpedo stage were successfully cultured to give plantlets.

1664 SHARMA, DR; CHOWDHURY, JB; AHUJA, UMA; DHANKHAR, BS. 1980. **Interspecific hybridization in genus *Solanum* : a cross between *S. melongena* and *S. khasianum* through embryo culture**. *Z. Pflanzenzuchtg*, 85: 248-253.

1665 SHARMA, UC. 1983. **Compatibility studies in non-tuberiferous species of genus *Solanum***. *Thesis Abstracts*, 9: 3, 280.

Of the 20 possible crosses involving *S. melongena* cv. PPL [Pusa Purple Long] and three wild species, only *S. melongena* X *S. integrifolium* set seed.

1666 SINGH, RN; ROY, SK. 1986. **Chromosome association and pollen fertility in *Solanum melongena* X *S. surattense* hybrids**. *Cytologia*, 51: 1, 85-93.

Hybrids were produced from the cross *S. melongena* cv. Dorli X *S. surattense* only when the former was the female parent, while the cross cv. Round Black X *S. surattense* was not successful in either direction. Meiotic analysis of hybrid plants revealed a higher univalent frequency than in the parents and the presence of laggards and chromosome bridges. However, the hybrid had good pollen fertility (76.7%).

Cell culture

1667 JAIN, RK; CHOWDHURY, JB; SHARMA, DR. 1985. **Selection and characterization of methionine sulfoximine resistant cell cultures of brinjal (*Solanum melongena*)**. *Curr. Sci.* 54: 283-284.

1668 JAIN, RK; DHAWAN, RS; SHARMA, DR; CHOWDHURY, JB. 1988. **Selection and characterization of NaCl tolerant cell cultures of brinjal (*Solanum melongena L.*)**. *Indian Journal of Plant Physiology*, 31: 4, 431-433; 5 ref.

A salt tolerant cell line of cv. Pusa Purple Round was isolated as a spontaneous variant by screening cell suspension cultures on medium containing 1% NaCl. Optimum growth of this tolerant line occurred at 0.25% NaCl. Analysis of ionic cell contents revealed that salt-tolerant cells accumulated higher Na+ levels than control cultures while K+ levels decreased in both types but with a more pronounced decrease in wild type cells.

1669 JAIN, RK; CHOWDHURY, JB; SHARMA, DR; CHOWDHURY, VK. 1984. **Selection and partial characterization of brinjal cell cultures resistant to tryptohan and phynylanine analogues**. *Indian Journal Exptl. Biol*, 22: 589-591.

Hibiscus esculentus

1670 GILL, RK; MALIK, CP; SINGH, MB. 1982. **Metabolism of okra seeds during early germination. Interaction of embryonic axis and cotyledons on their metabolism**. *Acta Bot. Indica*, 10: 2, 217-222; 15 ref.

Changes in the levels of starch, sugars, proteins and enzymes (acid phosphatase, invertase and beta-amylase) were recorded for intact and excised cotyledons and the embryonic axis. The results indicated a correlation between the activity of the hydrolases and the movement of metabolites into the embryonic axis. [For earlier work see HcA 52, 7996.]

1671 HAIDER, A; ISLAM, R; KAMAL, AHM; RAHMAN, SM; JOARDER, OI. 1993. **Direct and indirect organogenesis in cultured hypocotyl explants of *Abelmoschus esculentus (L) Moench*.** *Plant Tissue Culture*, 3: 2, 85-89.

1672 HAIDER, SA; ISLAM, R; HOSSAIN, M; JOARDER, OI. 1993. **Plant regeneration from isolated meristematic tissue derived callus in *Abelmoschus esculentus L. Moench***. *International Plant Tissue*

Culture Conference. (Dhaka Univ., Dept. of Botany: December 19-21).

1673 ISLAM, R; HAIDER, SA; HAQUE, A; KHALEKUZZAMAN, M; JOARDER, OI. 1994. **Plant regeneration from leaf derived callus in *Abelmoschus esculentus (L.) Moench***. *Pakistan J. Agric. Res.*

1674 JAMBHALE, ND; NERKAR, YS. 1983. **Induction of polyploidy in the *Abelmoschus* species hybrids**. *Progressive Hort.*, 15: 1/2, 157-158; 6 ref.

Of 4 colchicine treatments tested on the hybrids *A. [Hibiscus] esculentus* X *A. tetraphyllus*, *H. esculentus* X *A. manihot* and *H. esculentus* X *A. manihot subsp. manihot*, treatment of vegetative buds of young seedlings with 0.1% colchicine was the most successful for inducing polyploidy (7, 4 and 2 polyploids from 200 buds treated in the respective crosses). Treatment of seeds with 0.1% colchicine also induced polyploidy in all 3 crosses.

1675 JAMBHALE, ND; NERKAR, YS. 1983. **Inheritance of resistance to powdery mildew in okra.** *National seminar on breeding crop plants for resistance to pests and diseases*. (Coimbatore: 1983: May 25-27). Tamil Nadu Agricultural Univ., Coimbatore. p. 13.

Inheritance of resistance to *Erysiphe cichoracearum* in *Hibiscus esculentus* was studied in the F1 and BC generations of the crosses Pusa Sawani X 155 and Pishar Local X 155. The resistant strain 155 was derived from the cross *H. esculentus cv. Pusa Sawani* X *Abelmoschus manihot*. Resistance was controlled by a single, incompletely dominant gene (Pm).

1676 JAMBHALE, ND; NERKAR, YS. 1983. **Interspecific transfer of resistance to yellow vein mosaic disease in okra**. *Journal of Maharashtra Agricultural Universities*, 8: 2, 197; 7 ref.

Some plants resistant to yellow vein mosaic virus were obtained from backcrosses of *Abelmoschus [Hibiscus] esculentus* X *A. manihot* to the *A. esculentus* variety Pusa Sawani. Seed fertility in these plants was 58-88%.

1677 NERKAR, YS. 1991. **The use of related species in transferring disease and pest resistance genes to okra.** *Report: International Workshop on Okra Genetic Resources*; International Board for Plant Genetic Resources, Rome (Italy) p. 110-113.

1678 SHARMA, BR; DHILLON, TS. 1983. **Genetics of resistance to yellow vein mosaic virus in interspecific crosses of okra (*Abelmoschus species*)**. *Genetica Agraria*, 37: 3/4, 267-275; 6 ref.

In crosses between a resistant cultivated form of *A. manihot subsp. manihot* from Ghana and two susceptible cultivars of *A. [Hibiscus] esculentus*, it is hypothesized that resistance is controlled by two complementary dominant genes with additive effects.

1679 TANDA, AS; ATWAL, AS; BAJAJ, YPS. 1988. **Antagonism of sesame to the root-knot nematode (*Meloidogyne incognita*) on okra in tissue culture.** *Nematologica*, 34: 1, 78-87; 36 ref.

Excised roots and callus cultures of okra [*Hibiscus esculentus*] and sesame [*Sesamum orientale*] were raised on synthetic media. Sesame tissues cultured alone or with okra suppressed egg hatch and penetration of roots by juveniles, delayed adult development, and encouraged development of males in *M. incognita*. Gall formation was inhibited on excised roots of okra by co-culturing with sesame. Sesame callus reduced penetration, discouraged nematode build-up in okra and caused an increase in the number of males. Use of a gnotobiotic technique for the establishment of antagonism of sesame to root-knot nematode on okra is described. Sucrose, vitamins and iron chelate increased the numbers of nematodes penetrating roots and pH 7.0 was best for penetration.

Cucurbita

1680 RAHMAN, SM; HOSSAIN, M; JOARDER, N; ISLAM, R. 1991. **Plant regeneration form cotyledon explants of an interspecific hybrid of Cucurbita**. *Plant Tissue Culture*, 1: 91-95.

1681 RAHMAN, SM; HOSSAIN, M; ISLAM, R; JOARDER, OI. 1993. **Plant regeneration form internode segments of *Cucurbita maxima Duch.* X *Cucurbita moschata. Duch.*** *Current Science*, 65: 7, 562-564.

Pisum sativum

1682 AHMED, RINA; GUPTA, SD; GHOSH, PD. 1987. **The cytological status of plants regenerated from shoot-meristem culture of *Pisum sativum L.*** *Plant Breeding*, 98: 4, 306-311; 25 ref.

Root tip cells of regenerates were predominantly diploid and cytologically normal, confirming the suitability of shoot apical meristem culture for rapid vegetative propagation and for long-term maintenance of genetic stocks.

1683 BEJIGA, G; RHEÉNEN, HA VAN; JAGADISH, CA; SINGH, O. 1991. **Relationship among the F2 and F6 generations in chickpea (*Cicer arietinum L.*)**. *Indian Journal of Genetics and Plant Breeding*, 51: 2, 240-245.

1684 CHAKRABORTY, U; CHAKRABORTY, BN. 1989. **Interaction of *Rhizobium* leguminosarum and *Fusarium solani* f.sp. pisi on pea affecting disease development and phytoalexin production**. *Canadian Journal of Botany*, 67: 6, 1698-1701; 12 ref.

Pathogenicity of *F. solani* f.sp. pisi was tested on 5 cultivars of pea under identical conditions; the fungus was more virulent on Arkel and less virulent on Sweet Stringless. Bacterization of seeds with *R. leguminosarum* biovar. vicieae was highly effective in reducing the severity of root rot of pea. In vitro tests with *F. solani* f.sp. pisi and *R. leguminosarum* biovar. vicieae showed no antagonistic effects on solid medium. However, growth of both microorganisms was retarded in dual culture. Phytoalexins (pisatin and 4-hydroxy-2,3,9-trimethoxypterocarpan) were isolated from both Fusarium- and *Rhizobium*-Fusarium-infected pea epicotyls; 4-hydroxy-2,3,9-trimethoxypterocarpan was present in a greater amount in the latter than in the former, while pisatin concn was similar in samples from both treatments.

1685 DE, KK; ROY, SC. 1985. **Morphogenetic investigation on pea under in vitro conditions**. *Bulletin of the Torrey Botanical Club*, 112: 4, 363-367; 18 ref.

Epicotyl segments from 2 to 5-day-old seedlings of cv. Early Wisconsin were used to initiate callus in MS medium supplemented with 36 combinations of auxins and cytokinins. The callus showed best growth in NAA at 2 mg/litre with either kinetin or BAP at 0.5 mg/litre. Shoots were formed at high frequency from the callus when transferred to MS medium containing IAA (0.2 mg/litre) and BAP (5 mg/litre) under 16 h light (5000 lux at 22°C). Flowers and small fruits were formed in the culture medium. The calluses were mixoploid but the tips of the regenerated shoots were always diploid, indicating that only diploid cells have the morphogenetic potentialities for shoot development. Some calluses produced only roots, and such roots were tetraploid. The abnormal shoots that developed on some calluses failed to produce flowers.

1686 GUPTA, KR; SINGH, KP; SINGH, VP. 1984. **Combining ability analysis and identification of parents for hybridization in pea (*Pisum sativum L.*)**. *Haryana Agricultural University Journal of Research*, 14: 1, 68-72; 6 ref.

Analysis of data on 7 yield-related characters in a 9 X 9 diallel set, excluding reciprocals, indicated that additive as well as nonadditive gene action was important for all characters, but the magnitude of nonadditive genetic variance was greater than that of additive genetic variance. Parents EC109196, EC109182, EC21857 and P23 were good general combiners for all or most traits. Eight hybrids recommended for use in breeding programmes on the basis of specific combining ability effects are listed.

1687 JANA, A; MITRA, B; SEN, SP. 1987. **Influence of chemical environment of the genome on the in vitro transcription process**. *National Academy Science Letters, India*, 10: 10, 337-339; 15 ref.

The incorporation of labelled nucleosides into RNA in a pea DNA transcription system was studied in the presence of sugars (10-4 or 10-5 M) or amino acids (the same concentrations). RNA synthesis was inhibited in all cases and the A : U ratio of the RNA was altered, depending on the concentration used.

1688 KHANNA, NC; LAKHANI, S; TEWARI, KK. 1992. **Identification of the template binding polypeptide in the pea chloroplast transcriptional complex**. *Nucleic Acids Research*, 20: 1, 69-74; 27 ref.

The template-binding polypeptide in the pea chloroplast transcriptional complex was identified by photoaffinity labelling. This polypeptide has an apparent molecular weight of about 150 kDa and binds to both chloroplast ribosomal (16S rRNA) and messenger (psbA) promoters. The 16S rRNA and psbA promoters were amplified from ctDNA by the polymerase chain reaction and labelled with a photoactive analogue of TTP, 5-bromodeoxy UTP, as well as with alpha-32P-dCTP. Using the filter-binding assay, the conditions for binding of the RNA polymerase complex to chloroplast promoters were optimized. The polypeptide directly interacting with the template was photo-crosslinked to it and resolved by denaturing gel electrophoresis. The photoaffinity labelling of the 150 kDa polypeptide was dependent on photoactivation by UV irradiation and the presence of chloroplast promoters. Competition experiments showed that the protein formed a strong interaction with the plastid promoters which could not be displaced by lambda-phage DNA or synthetic polynucleotides. The photo-crosslinked and nuclease-treated promoter-polypeptide complex was resistant to further digestion with DNase and RNase, but could be hydrolysed by Proteinase K. Binding of the promoters by the

150 kDa polypeptide could not be suppressed by transcription inhibitors like rifampicin and alpha-amanitin. However, heparin (0.001%) inhibited the formation of the enzyme-promoter complex, and interfered with the photoaffinity labelling of the 150 kDa polypeptide. The extent of photoaffinity labelling of 150 kDa polypeptide exhibits some degree of correlation to total transcriptional activity under various salt concentrations. The results demonstrate that the 150 kDa polypetide is a functional template-binding polypetide of the pea chloroplast transcription complex.

1689 KHANNA, NC; LAKHANI, S; TEWARI, KK. 1991. **Photoaffinity labelling of the pea chloroplast transcriptional complex by nascent RNA in vitro.** *Nucleic Acids Research*, 19: 18, 4849-4855.

1690 LAKHANI, S; KHANNA, NC; TEWARI, KK. 1993. **Nascent transcript-binding protein of the pea chloroplast transcriptionally active chromosome.** *Plant Molecular Biology*, 23: 5, 963-979.

1691 MUKHERJEE, SUMONA; SHARMA, AK. 1985. **Estimation of in situ DNA content in organs of different strains of *Pisum sativum L.* *Nucleus, India*,** 28: 3, 236-239; 30 ref.

Analysis of data from 11 varieties revealed that 4C nuclear DNA content was generally higher in root than in shoot meristems, but varietal differences were relatively slight. It is suggested that differences in total chromosome length and volume among these varieties are due to differences in chromosome condensation and spiralization and in the volume of associated protein components.

1692 SARADADEVI, K; RAGHAVENDRA, AS. 1992. **Dark respiration protects photosynthesis against photoinhibition in mesophyll protoplasts of pea (*Pisum sativum*).** *Plant Physiology*, 99: 3, 1232-1237.

The optimal light intensity required for photosynthesis by mesophyll protoplasts of pea (*Pisum sativum*) is about 1250 microeinsteins per square meter per second. On exposure to supra-optimal light intensity (2500 microeinsteins per square meter per second) for 10 min, the protoplasts lost 30 to 40% of their photosynthetic capacity. Illumination with normal light intensity (1250 microeinsteins per square meter per second) for 10 min enhanced the rate of dark respiration in protoplasts. On the other hand, when protoplasts were exposed to photoinhibitory light, their dark respiration also was markedly reduced along with photosynthesis. The extent of photoinhibition was increased when protoplasts were incubated with even low concentrations of classic respiratory inhibitors: 1 micromolar antimycin A, 1 micromolar sodium azide, and 1 microgram per milliliter oligomycin. At these concentrations, the test inhibitors had very little or no effect directly on the process of photosynthetic oxygen evolution. The promotion of photoinhibition by inhibitors of oxidative electron transport (antimycin A, sodium azide) and phosphorylation (oligomycin) was much more pronounced than that by inhibitors of glycolysis and tricarboxylic acid cycle (sodium fluoride and sodium malonate, respectively). We suggest that the oxidative electron transport and phosphorylation in mitochondria play an important role in protecting the protoplasts against photoinhibition of photosynthesis. Our results also demonstrate that protoplasts offer an additional experimental system for studies on photoinhibition.

Cicer arietinum

1693 BAJAJ, YPS. 1990. **Biotechnology in agriculture and forestry 10. Legumes and oilseed crops I.** Berlin, Germany: Springer-Verlag, 682 p.

This book, comprising 31 chapters and a subject index, deals with in vitro approaches to improvement in legume and oilseed crops. It is divided into the following 5 sections: (I) Wide hybridization, transformation, cryopreservation (3 chapters); (II) Food legumes (individual chapters on peas, chickpeas, *Psophocarpus tetragonolobus* and 3 on soyabeans); (III) Forage legumes (individual chapters on lucerne, clovers, lupins, *Stylosanthes*, *Lotus corniculatus*, *Coronilla varia* and *Galega officinalis*); (IV) Oilseed crops (3 chapters on *Brassica*, 4 on *Helianthus*, 2 on flax, 2 on coconut and one each on *Elaeis guineensis* and *Olea europaea*); and (V) Miscellaneous (*Indigofera* and *Ceratonia siliqua*).

1694 BANSAL, YK; SHRIVASTAVA, R. 1992. **Shoot differentiation from callus cultures of chickpea (*Cicer arietinum L.*).** *Indian Journal of Applied and Pure Biology*, 7: 1, 41-45; 7 ref.

Leaf and hypocotyl explants of chickpeas were cultured on MS medium with various combinations of 0.1, 1.0 or 10.0 mg 2,4-D, IBA, NAA or kinetin/litre. In general, callus production was greater from hypocotyl explants. Little or no callus was produced with 2,4-D or IBA; low to moderate NAA gave good callus production. 0.1 mg NAA + 1 mg kinetin gave good shoot initiation and elongation. Most cells had a normal chromosome complement (2n = 16).

1695 FAROOQI, H; ISLAM, R; HAIDER T; RIAZUDDIN, S. 1990. **Tissue culture of chickpea and its transformation by *Agrobacterium tumefaciens*.** ***Proc.*** *Intl. Telecommunication Symposium on Plant Biotechnology*. (Islamabad, Pakistan), p. 39.

1696 IQBAL, JAVED; BUTT, NADIRA; SAEED, FARAH; AHMAD, MS. 1989. **Changes in nucleic acid content, peroxidase content and its isozymic forms in in vitro propagated calli of chick pea.** *Pakistan Journal of Botany*, 21: 1, 13-23; 22 ref.

Culture conditions were developed to facilitate callus induction by seeds and from explants of shoot tips, root tips, nodes and leaves of chickpea cv. CM72. The DNA and RNA content and peroxidase activity of calluses raised from seeds increased up to the 3rd subculture and then gradually decreased on to the 5th. Max and min. DNA and RNA contents and peroxidase activity were not synchronized in calluses derived from different explant sources. Two peroxidase isoenzymes were detected in the parent culture which increased to 4, 5 and 6 in the 1st, 2nd and 3rd subcultures, resp., then decreased to 2 in the 4th and finally to 1 in the 5th subculture. Four isoenzymes were detected in calluses derived from shoot tips, 3 from nodes and 1 in calluses from leaf or root-tip explants. It was concluded that changes in nucleic acid content, peroxidase activity or isoenzyme number were correlated with callus growth and were manifestations of metabolic activity associated with active and stationary callus growth phases.

1697 ISLAM, R; RIAZUDDIN, S. 1994. **Changes in protein, RNA and DNA content of in vitro propagated calli of chickpea (*Cicer arietinum L.*).** *Bangladesh J. Bot.*

1698 ISLAM, R; RIAZUDDIN, S. 1993. **Effect of genotype and age of seedling on compatible reaction between chickpea and *Agrobacterium* rhizogenes.** *Bangladesh J. Microbiology*, 10: 29-32.

1699 ISLAM, R; RIAZUDDIN, S. 1994. **Effect of genotype and age of seedlings on compatible reaction between chickpea and *Agrobacterium tumefacians*.** *International Chickpea Newsletter*, 30.

1700 ISLAM, R; RIAZUDDIN, S. 1992. **In vitro induction of roots in chickpea by *Agrobacterium* rhizogenes.** *Plant Tissue Culture*, 2: 135-137.

1701 ISLAM, R; FAROOQUI, H; RIAZUDDIN, S. 1993. **In vitro organogenesis of chickpea and its transformation by *Agrobacterium tumefaciens*.** *Plant Tissue Culture*, 3: 1, 29-34.

1702 ISLAM, R; RIAZUDDIN, S. 1993. **In vitro rooting on micropropagated shoots of Chickpea.** *International Chickpea Newsletter*, 29: 21-23.

1703 ISLAM, R; RIAZUDDIN, S. 1992. **Induction of tumor formation in chickpea tissues by treatment with *Agrobacterium tumefaciens*.** *Bangladesh J. Microbiology*, 9: 31-33.

1704 ISLAM, R; RIAZUDDIN, S. 1993. **Isolation of genomic DNA from in vitro grown chickpea (*Cicer arietinum L.*) tissues.** *International Chickpea Newsletter*, 29: 23-25.

1705 ISLAM, R; RIAZUDDIN, S. 1993. **Shoot organogenesis in chickpea (*Cicer arietinum L.*).** *J. Bioscience*, 1: 1-5.

1706 ISLAM, R. 1994. **Somatic embryogenesis from immature cotyledons of chickpea (*Cicer arietinum L.*).** *Pakistan J. Bot.* 26: 1, 197-199.

1707 ISLAM, R; MALIK, T; HUSNAIN, T; RIAZUDDIN, S. 1994. **Strain and cultivar specificity in the *Agrobacterium* chickpea interaction.** *Plant Cell Reports*, 13: 10, 561-563.

1708 ISLAM, R; RIAZUDDIN, S. 1992. **Transformation of chickpea tissue by *Agrobacterium tumefaciens*.** *International Chickpea Newsletter*, 26: 11-12.

1709 ISLAM, R; RIAZUDDIN, S. 1993. **Virulence of *Agrobacterium tumefaciens* on chickpea (*Cicer arietinum L.*).** *Bangladesh J. Botany*, 22: 2, 233-236.

1710 JAISWAL, HK; SINGH, RK. 1990. **Breeding for increased nitrogen fixing ability among wild and cultivated species of chickpea.** *Annals of Applied Biology*, 117: 2, 415-419.

1711 JAISWAL, HK; SINGH, BD; SINGH, AK; SINGH, RM. 1986. **Introgression of genes for yield and yield traits from *C. reticulatum* into *C. arietinum*.** *Int. Chickpea Newsletter*, No. 14: 5-8; 4 ref.

Tabulated data are presented on the height, number of secondary branches, number of pods/plant, seed yield/plant and 100-seed weight of 4 F2 populations, "4" F3 lines and the 5 best F4 lines from crosses between the *Cicer arietinum* cultivars T3 and ICC8923

and the *C. reticulatum* line JM2106. In general, the F3 performed worse than their F2 parents, although some were better than their *C. arietinum* parent, as were generally the best F4 lines. One promising and uniform F5 line was obtained which performed well in preliminary yield trials. Some segregation for habit, flower and seed colour, and seed size and shape, was observed in the F5.

1712 JAISWAL, HK; SINGH, BD; SINGH, RM; PUNDIR, RPS. 1984. **Possible origin of desi chickpeas through introgression of *C. reticulatum* genes**. *International Chickpea Newsletter*, No. 11: 18-20; 7 ref.

Observations on morphological variation in the F3 and F4 of the reciprocal cross between the *Cicer reticulatum* genotype JM2106 and the kabuli-type *C. arietinum* genotype ICC8923 suggested that (1) some of the diversity of desi-type chickpea may have originated through introgression of genes from *C. reticulatum* into kabuli-type *C. arietinum* and, as a consequence, desi types may not be more primitive than kabuli types, and (2) *C. arietinum* kabuli and desi types and *C. reticulatum* may have originated independently from a wild progenitor. However, in a series of comments following the article, R. P. S. Pundir (of ICRISAT) refutes these suggestions.

1713 KHAN, SK; GHOSH, PD. 1983. **In vitro induction of androgenesis and organogenesis in *Cicer arietinum L.***. *Current Science*, 52: 18, 891-893; 8 ref.

Cultured anthers of the variety B108 produced callus with rootlets. Anthers with uninucleate pollen grains produced most callus. Callus-cell chromosome numbers ranged from n = 8 (haploid) to n = 16, with 28.1% being haploid, 38.2% diploid and 37.7% aneuploid [sic]

1714 KHAN, SK; GHOSH, PD. 1984. **Plantlet regeneration from cotyledonary nodes of chickpea**. *International Chickpea Newsletter*, No. 11: 22-24; 1 ref.

Of a range of concentrations of 4 growth regulators tested singly and in combination in B5 medium using the cultivar B108 as test organism, 0.5-1.0 mg BA/litre was suitable for bud differentiation and 0.5 mg NAA/litre for plantlet regeneration.

1715 KHANNA, VK; MEHARCHANDANI, N. 1985. **Effect of gamma-irradiation and seedling growth of 'kabuli' and 'desi' chickpea on the activity of alpha-amylase**. *Ind. J. of Plant Phys.*, 28: 2, 196-200; 9 ref.

Seeds of 2 *Cicer arietinum* cv. were irradiated with gamma-rays at 5-40 kR. Activity of alpha-amylase was estimated separately in cotyledons and the embryo axis. alpha-Amylase activity in cotyledons of kabuli [bold seed] cv. L 144 increased up to the 6th day and in desi [medium sized seed] cv. Hima up to the 4th day of seedling growth. In the embryo axis, max. enzyme activity was noted on the 1st and the 4th day of germination for L 144 and Hima, resp. An increase in radiation dose decreased enzyme activity in cotyledons and embryo-axis.

1716 KOUNDAL, KR; MEHTA, SL; SHARMA, RP. 1989. **Construction of chickpea genomic library**. *Indian Journal of Experimental Biology*, 27: 10, 858-860; 7 ref.

A chickpea (*Cicer arietinum*) genomic library was constructed using DNA purified by CsCl gradient centrifugation and fractionated into 15-20 kb fragments after restriction with Sau3A. The fragments were ligated to phage lambda (EMBL-3) vector and the recombinant molecules packaged in vitro into viable phage particles. Recombinant phages were obtained on a P2 lysogen of *Escherichia coli* (Spi- selection) and amplified to establish a permanent library.

1717 MANDAL, AK. 1992. **Pattern of variation of harvest index in chickpea crosses**. *Indian Journal of Genetics and Plant Breeding*, 52: 2, 164-168.

1718 MUKHOPADHYAY, SUMONA. 1986. **Intergeneric relationship between three genera of *Leguminosae***. *Journal of the Indian Botanical Society*, 65: 1, 124-129; 25 ref.

Seed protein content and several cytological traits were measured in 11 strains of *Pisum sativum*, 9 of *Cajanus cajan* and 12 of *Cicer arietinum*. Intraspecific variation was found in cytological characters and seed protein content, but 4C DNA amount was constant within species. *P. sativum* differed from the other species in having a higher DNA content and larger chromosomes, while *C. cajan* and *C. arietinum* had similar chromosome volumes, total 'F'% and DNA content. These results are considered to be consistent with the taxonomic position of the genera.

1719 NAIK, SV; KATIYAR, SK; MOSS, JK. 1994. **A new hybrid : *Cicer arietinum* X *C. pinnatifidum* obtained through embryo rescue**. *Second Asia Pacific Conference on Agricultural biotechnology*. (Madras: 1994: March 6-10). Directorate of Research Services, Indira Gandhi Krishi Vishwa Vidyalaya, Raipur.

1720 NEELAM, ANIL; REDDY, CS; REDDY, GM. 1986. **Growth and differentiation in tissue cultures of**

Cicer arietinum L. International Chickpea Newsletter, No. 14: 9-12; 1 ref.

Cotyledon, hypocotyl, root apex and shoot apex explants were taken from seedlings of 3 genotypes and cultured on 9 different media. Callus, shoot and root formation was obtained in 10 days; percentage response depended on explant, growth regulator balance and genotype. No shoot formation was observed from cotyledon or root explants.

1721 NEELAM, ANIL; REDDY, CS; REDDY, GM. 1986. **Multiple shoot and plantlet regeneration from shoot apex and hypocotyl explants of *C. arietinum L.*** *International Chickpea Newsletter*, No. 14: 13-16.

Shoot apex and hypocotyl explants of 3 genotypes were cultured on B5 medium supplemented with different combinations of growth regulators. Multiple shoot formation occurred with greatest frequency from hypocotyl explants and varied with genotype, ICCC4 producing more than H208 or Annigeri. ICCC4 also showed the best plant regeneration.

1722 NEELAM, ANIL; REDDY, CS; REDDY, GM. 1986. **Plantlet regeneration from callus cultures of *Cicer arietinum L.*** *International Chickpea Newsletter*, No. 14: 12-13; 2 ref.

Callus tissue from hypocotyl, root, cotyledon or shoot explants of 3 genotypes initiated on one medium were transferred to (1) the same medium or (2) a different one. Only hypocotyl callus of ICCC4 regenerated shoots and roots. The best plantlet regeneration medium was the original medium (B5) supplemented with 0.5 mg kinetin/litre + 1.0 mg IAA/litre. Between 30 and 40% of regenerated plants were successfully transplanted to a vermiculite/soil mixture.

1723 OHRI, D; PAL, M. 1991. **The origin of chickpea (*Cicer arietinum L.*): karyotype and nuclear DNA amount**. *Heredity*, 66: 3, 367-372.

1724 PANDEY, R; GANAPATHY, PS. 1984. **Effects of sodium chloride stress on callus cultures of *Cicer arietinum L.* cv. BG-203: Growth and ion accumulation**. *Journal of Experimental Botany*, 35: 157, 1194-1199; 21 ref.

Growth and ion accumulation were measured in callus cultures of *C. arietinum* cv. BG-203 grown on media supplemented with 0-200 mol. NaCl/m3. Fresh and dry wt. decreased at 100-200 mol., with the greatest reduction during the 3rd and 4th wk. Slight stimulation of growth was observed at 25 and 50 mol. There was a decrease in tissue water content at 100-200 mol. Tissue Na+ and Cl- conc. increased and K+ and Mg2+ decreased with increasing salinity of the medium. Ion accumulation occurred within the 1st wk while growth inhibition was apparent by the 3rd wk of culture.

1725 PANDEY, R; GANAPATHY, PS. 1984. **Isolation of sodium chloride-tolerant callus line of *Cicer arietinum L.* cv. BG-203**. *Plant Cell Reports*, 3: 2, 45-47; 14 ref.

A NaCl-tolerant callus line was isolated as a spontaneous variant on agar- solidified Murashige & Skoog medium supplemented with 100 mM NaCl. The growth of this line was comparable to that of a sensitive callus line growing in the absence of NaCl. The tolerant line performed poorly in the absence of NaCl and exhibited optimum growth at 50 mM NaCl. The tolerance persisted even after 3 passages (4 weeks each) in culture without NaCl.

1726 PANDEY, R; GANAPATHY, PS. 1985. **The proline enigma: NaCl-tolerant and NaCl-sensitive callus lines of *Cicer arietinum***. *Plant Science, Ireland*, 40: 1, 13-17; 19 ref.

Free proline content increased with concentration of added NaCl (25-200 mM) in the tolerant callus line R100 but not in the sensitive line C-O. Subculturing through 6 passages on NaCl-free medium did not affect proline accumulation in R100 when recultured in the presence of NaCl. Addition of proline (10 mM) to a medium containing 100 mM NaCl increased fresh and dry weights and free proline content of both callus lines. Growth and free proline content of R100 were markedly suppressed by substituting KCl for NaCl, while those of C-O were only marginally affected. The results are discussed in relation to the possible role of proline in stress resistance.

1727 PUNDIR, RPS; MAESEN, LJG VAN DER. 1983. **Interspecific hybridization in *Cicer***. *International Chickpea Newsletter*, No. 8: 4-5.

Among crosses involving *Cicer arietinum* and seven wild *Cicer* species attempted in the field during 1975-81, only *C. arietinum* X *C. reticulatum* proved fertile. The few viable F1 seeds produced by other crosses did not give fertile F2 plants. The F1 hybrid plants obtained in three crosses among wild species were partially sterile, while that of a fourth cross was totally sterile.

1728 RAO, BG. 1989. **Effects of constituents and their concentrations in nutrient media on callusing from chickpea hypocotyls**. *Legume Research*, 12: 4, 186-188; 6 ref.

Hypocotyl explants (3 mm) obtained from 6-d-old seedlings of *Cicer arietinum* cv. BG 256 were inoculated on media containing minerals, auxins, cytokinins, growth factors + amino acids and sucrose, each at 3 concn, in different combinations and observations on callus morphology and wt were made 28 d after inoculation. Fresh callus wt increased with increase in the concn of minerals, auxins and cytokinins, decreased with increase in the concn of growth factors + amino acids and was higher with sucrose at medium concn (60 mM/litre) than at high (120 mM) or low (6 mM) concn. Callus became light in colour with increase in auxin concn. Cytokinins imparted green colour to the callus. High concn of growth regulators produced hard and compact callus.

1729 RAO, BG. 1989. **Factors affecting chickpea protoplast isolation**. *Legume Research*, 12: 3, 128-130; 4 ref.

Optimum conditions of pH, mannitol concentration in the enzyme mixture, and method and duration of incubation were determined for isolation of mesophyll protoplasts. The optimum mannitol concentration was 0.4 M. Incubation in the light gave a significantly higher protoplast yield than incubation in the dark. Agitation during incubation also favoured high protoplast yield.

1730 RAO, BG. 1991. **Influence of explant and its stage of development on response for somatic embryogenesis in chickpea**. *Advances in Plant Sciences*, 4: 1, 43-47; 6 ref.

In a laboratory experiment with chickpeas cv. BG 256, use of cotyledon (without embryo axes), epicotyl, hypocotyl, 3 mm-long root segment, 1st leaf and its leaflet and apical dome explants were compared for induction of somatic embryogenesis. No embryogenesis occurred in cotyledons, hypocotyls or roots. Cultures from leaflets of 9-d-old seedlings gave the best response.

1731 RAO, BG; CHOPRA, VL. 1989. **Morphogenesis in callus cultures of chickpea**. *International Chickpea Newsletter*, No. 21: 7-11; 12 ref.

Six types of explant from 8 cultivars were cultured on 7 media. Calluses were transferred to 57 different shoot regeneration media. Shoots obtained were transferred to 12 root regeneration media. Callus derived from cotyledons and apical meristems of cultivar BG256 regenerated shoots. The callus of cotyledonary origin obtained on MS medium + 0.2 mg NAA + 1 mg BAP [benzyladenine]/litre gave a shoot regeneration frequency of 4.7% when transferred to shoot regeneration medium (SRM) 9 (MS medium + 3 mg BAP/litre). Calluses derived from apical meristem on Blaydes medium + 2 mg NAA + 2 mg BAP/litre, MS + 2 mg NAA + 0.1 mg BAP/litre, MS medium + 2 mg NAA/litre and MS medium + 0.1 mg 2,4-D/litre regenerated shoots at a frequency of 1.85-3.70% when transferred to SRM33, SRM37, SRM44 or SRM45. NAA was effective in inducing roots from the regenerated shoots when the strength of the MS medium was reduced in the root regenerating media (RRM7, RRM8, RRM9).

1732 RAO, BG; CHOPRA, VL. 1989. **Regeneration from apical meristem, stem nodes and cotyledons of chickpea**. *Indian Journal of Pulses Research*, 2: 1, 20-24; 9 ref.

Apical meristem, node and cotyledon explants of *Cicer arietinum*, when cultured in vitro, regenerated shoots directly. These developed roots on half strength MS medium and were successfully transferred to soil.

1733 RAO, BG. 1990. **Regeneration from induced embryoids of gram (*Cicer arietinum L.*)**. *Advances in Plant Sciences*, 3: 2, 299-302; 9 ref.

The highest regeneration rate (22.3%) was obtained after culture on MS medium supplemented with 0.5 mg benzyladenine and 0.5 mg 2,4-D/litre followed by subculturing on MS medium supplemented with 0.1 mg IAA and 3 mg benzyladenine/litre.

1734 RAO, BG; CHOPRA, VL. 1989. **Regeneration in chickpea (*Cicer arietinum L.*) through somatic embryogenesis**. *Journal of Plant Physiology*, 134: 5, 637-638; 9 ref.

Best embryogenic callus production from leaflet explants was achieved on MS medium supplemented with 0.5 mg each of 2,4-D and BAP [benzyladenine] per litre. A high frequency of embryogenesis was obtained by transferring the callus to MS medium containing IAA and BAP.

1735 RAO, S; NAIDU, MM. 1989. **A tissue culture derived pesticide tolerant line of chickpea (*Cicer arietinum L.*)**. *Proceedings of the Indian Academy of Sciences, Plant Sciences*, 99: 6, 523-527; 22 ref.

Cotyledon and hypocotyl explants of 7-8-day-old seedlings formed calluses on B5 medium supplemented with 2 mg 2,4-D, 0.5 mg NAA and 0.5 mg kinetin/litre. After about 20 days of growth light-green calluses were transferred to similar media containing various concentrations (20-500 p.p.m.) of the pesticide Rogor [dimethoate]. Cells died after about 20 days in

the 500 p.p.m. treatment; green callus surviving the 100 and 200 p.p.m. treatments showed marked reductions in weight (by 56.3 and 67.9%, respectively) and amylase activity (by 62.5 and 83.3%, respectively) and increases in peroxidase activity (by 40.2 and 50.8%, respectively). Resistance to Rogor was found to persist after culturing on a pesticide-free medium. Broken callus pieces were transferred onto a shoot-inducing medium (B5 supplemented with 2 mg NAA and 0.1 mg kinetin/litre). When roots were established and shoots were 2-3 cm long the plantlets were transferred to the soil. Seeds from plants derived from resistant cell lines showed only marginal decreases in germination (by 8 and 12%, respectively), after treatment with 1000 and 2000 p.p.m. Rogor for 24 h.

1736 RIAZUDDIN, SHEIKH; HUSNAIN, TAYYEB; MALIK, TAHIRA; FAROOQI, HUMERA; ABBAR, ST. 1988. **Establishment of callus-tissue culture and the induction of organogenesis in chickpea**. *Pakistan Journal of Agricultural Research*, 9: 3, 339-345; 17 ref.

In in vitro culture experiments using Gamborg B5 medium supplemented with NAA and BA, calli originating from apices and nodal explants of chickpea seedlings underwent organogenesis to regenerate full grown plants, whereas leaves and internodal stem segments developed only roots. Addition of L-serine and L-asparagine at 1 mg/litre initiated multiple shoot formation in calli originating from apical and nodal explants growing on Gamborg B5 medium but had no such effect on shoot formation on Murashige and Skoog medium. It was concluded that various tissue explants exhibit a differential response to differences in growth regulator concn and to variations in the internal cellular organization of different tissues.

1737 RUPELA, OP; DART, PJ. 1982. **Screening for nodulation characteristics in chickpea and subsequent generation of seeds**. *Biological nitrogen fixation technology for tropical agriculture*. CIAT, Cali, Colombia:/edited by PH Graham, SC Harris. CP No. 42, p. 57-61; 11 ref.

Field-grown plants can be assayed as intact plants for nitrogenase activity, the nodules removed and weighed, and the plant repotted with 90% survival for plants examined 48 days after planting. This permits seed production from plants of which the genetic potential for nitrogen fixation has already been established, and the use of such plants for hybridization in breeding programs. Chickpeas can also be propagated vegetatively by inducing root development from wounded branches.

1738 SANGVAN, V; CHOWDHURY, VK; SAREEN, PK; YADAV, N; CHOWDHURY, JB. 1989. **Regeneration from callus cultures of chickpea genotypes**. *International Chickpea Newsletter*, No. 21: 11-13; 2 ref.

Callus cultures were initiated from the root, shoot, cotyledon, hypocotyl, cotyledonary nodes, shoot apices and immature embryos of genotypes Gora Hisari, H75-35 (Gaurav) and C235. The explants were cultured on 6 B5 media supplemented with different concentrations of growth regulators. Gora Hisari showed callus initiation on all the media and with all the explants, whereas only root, shoot and shoot tip explants of H75-35 (Gaurav) showed any callus growth and only root and shoot explants of C235 showed callus initiation. Root explants of all genotypes were slower growing than shoot explants, although Gora Hisari callus grew faster than H75-35 (Gaurav) or C235. Callus was regenerated on 8 media and embryogenesis was observed in Gora Hisari and C235 on B5 medium supplemented with 1.5 mg benzylaminopurine [benzyladenine] (BAP) and 1.0 mg (NAA)/litre. B5 medium with 1.0 mg NAA, 4.0 mg BAP and 160 mg adenine/litre gave many shoots in C235. Subsequent root growth was achieved by dipping shoots in NAA solution and culturing on B5 medium.

1739 SHARMA, DR; KUMARI, RITA; CHOWDHURY, JB. 1979. **Plant regeneration in *Cicer* species through tissue culture**. *Indian Jouranl Experimental Biology*, 17: 607-609.

1740 SHIRKOT, P; SHIRKOT, CK; GUPTA, KG. 1990. **Effect of tetramethylthiuram disulfide (TMTD) on nodulation, plant yield and nitrogen fixation by cicer arietinam in presence of TMTD utilizing bacteria**. *Zentralblatt fur Mikrobiologie*, 1991, 146: 6, 413-418

1741 SINGH, BD; JAISWAL, HK; SINGH, RM; SINGH, AK. 1984. **Isolation of early-flowering recombinants from the interspecific cross between *Cicer arietinum* and *C. reticulatum***. *International Chickpea Newsletter*, No. 11: 14-16; 4 ref.

When *C. arietinum* genotypes T3 (desi) and ICC8923 (Kabuli) were reciprocally crossed with the *C. reticulatum* genotype JM2106, the 6 earliest flowering (data tabulated) F4 lines included the ICC8923 X JM2106 cross 250-1 which flowered 43 days (mean value) after sowing, showed 50% synchronous flowering within 6 days of the opening of the first flower and was tolerant of night temperatures of 7-9°C.

1742 SINGH, O; PARODA, RS; SINGH, O. 1986. **Association analysis of grain yield and its components in chickpea following hybridization and a combination of hybridization and mutagenesis**. *Indian Journal of Agricultural Sciences*, 56: 2, 139-141; 5 ref.

Half of the seeds from the 36 F1s from a 9 X 9 half diallel cross were treated with 30 kR gamma rays and half were used as the control. The F2 of the control and the F2M2 of the irradiated set of seeds were planted in replicated randomized blocks. Analysis of the data collected on seed yield/plant and 4 related traits revealed (1) significant and positive correlations between all traits except 100-seed weight, which showed negative correlations with the other traits; (2) reduction in the negative correlations of 100-seed weight following irradiation, particularly with seed yield/plant, from significant to nonsignificant; and 3) reductions following irradiation in the various negative direct and indirect effects of different yield components on seed yield/plant, revealed by path analysis. It is suggested that mutagenic treatment of F1 seeds may help to break undesirable linkages.

1743 SINGH, RP; SINGH, BD. 1989. **Recovery of rare interspecific hybrids of gram *Cicer arietinum* X *C. cuneatum L.* through tissue culture**. *Current Science*, 58: 15, 874-876; 5 ref.

Ovaries from *C. arietinum* X *C. cuneatum* crosses were cultured on B5 medium containing 0.5 mg benzyladenine, 0.1 mg NAA and 100 ml coconut milk/litre. Eight of the cultures had callus formation while 2 had shoot-bud formation. The shoot buds produced 10-15 shoots/culture tube after 8-10 days, with plantlet formation within 20 days. Root regeneration occurred on medium containing 1 mg NAA/litre. The hybrid plants were morphologically similar to *C. cuneatum* and failed to flower.

1744 SWAMY, AVSR; KHANNA, VK. 1990. **Application of special techniques to improve seed-set in interspecific crosses in *Cicer***. *International Chickpea Newsletter*, No. 23: 8-10; 3 ref.

Various methods were tried to overcome a stigmatic barrier which prevents seed-set. In a comparison of crosses between cultivated chickpea and 5 annual wild *Cicer sp*, maximum seed-set was obtained in *C. arietinum* X *C. reticulatum*. Application of IAA or GA increased pod and seed set in *C. arietinum* X *C. bijugum*.

1745 VERMA, MM; SANDHU, JS; BRAR, HS; BRAR, JS. 1990. **Crossability studies in different species of *Cicer (L)* - Research Note**. *Crop Improvement*, 17: 2, 179-181.

1746 WALDIA, RS; CHHABRA, AK; SOLANKI, IS; TOMAR, RPS. 1992. **Inheritance studies of speed of plumule emergence in chickpea**. *Journal of Genetics and Breeding*, 46: 3, 209-214.

Mushrooms

1747 BALASUBRAMANYA, RH. 1981. **An edible mushroom crop on cotton stalks**. *Indian Soc. Cotton Imp.* 6: 104-106.

1748 BALASUBRAMANYA, RH; BHATAWDEKAR, SP. 1988. **Bioenrichment of agricultural wastes with a free-living nitrogen fixing bacterium and a mushroom fungus**. *Indian J. Microbiol.* 28: 220-225.

1749 BALASUBRAMANYA, RH; KHANDEPARKAR, VG. 1989. **Edible mushroom crop on spent cotton stalks**. *Indian Soc. Cotton. Imp. J.* 14: 85-86.

1750 BALASUBRAMANYA, RH. 1988. **Mushroom crop on willow-dust**. *Indian J. Microbiol*, 28: 131-132.

CROP DISEASES

1751 BRAR, DS; VIDHYASEKARAN, P. 1990. **Tissue culture - a tool to develop disease resistant plants.** *Basic research for crop disease management*/edited by P Vidhyasekaran. New Delhi: Daya Publishing House, p. 19-26; 26 ref.

The principles of tissue culture are discussed under the headings: in vitro selection at cellular level; somaclonal variation; meristem or shoot-tip culture; embryo rescue and protoplast fusion; and cell culture and recombinant DNA technology.

1752 DEVI, SAI; DIVAKAR, BJ; PAWAR, AD. 1983. **A note on the rearing and storage of *Trichogramma embryophagum (Hartig)* and *Trichogramma cacoeciae pallidum Meyar***. *Plant Protection Bulletin, India*, 35: 3/4, 34.

The egg parasites *Trichogramma embryophagum* and *T. cacoeciae* pallidum, introduced for the biological control of the apple pest *Cydia pomonella* in Jammu and Kashmir, India, were mass-reared on eggs of an alternative host, *Corcyra cephalonica*. Rearing techniques for the parasites are described. Studies indicated that host eggs parasitized by both trichogrammatids could be stored at 5°C for nearly 3 months. Parasitized eggs could be stored at sub-zero temperatures for up to 10 days if the eggs were placed in the freezer not later than 72 h after parasitization.