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evaluated for resistance to the Kresek and blight phases of bacterial blight disease by using the Indian Punjab isolate of the pathogen, *Xanthomonas campestris pv. oryzae*. Varieties PAU 212, BJ 1, DV 86, DZ 78, Kalimakri 77-5, Chinsurah Boro II and AC 19-1-1 were resistant to the Kresek as well as blight phase of the disease. Nagane Tia, Nam Sakouy, Nam Sagui 19, Patong 32, Lua Ngu and PI 231129 were susceptible to the Kresek phase but showed strong resistance to the blight phase. Resistant varieties PAU 212, BJ1, DV 86 and DZ 78 were crossed with the susceptible variety Taichung Native 1. Reaction to the Punjab isolate of the F1, F2 and F3 progenies of these crosses showed that resistance to the Kresek phase in PAU 212, BJ 1, DV 86 and DZ 78 was governed by complementary gene action of two resistance genes which were independently inherited.

561 VIJAI PAL; GARDAN, L; CHARLES, M; PAL, V. 1988. **Isolation of a plasmid from strains of *Xanthomonas campestris pv. oryzae* that cause bacterial blight (BB) in rice**. *International Rice Research Newsletter*, 13: 2, 10.

A plasmid of MW 20.3 X 106 to 21 X 106 dalton was isolated from 4 strs of *X. campestris pv. oryzae*, 2 from the collection at INRA, Angers, France, and 2 from Haryana Agric. Univ. The same plasmid was reisolated from infected seedlings after 5 serial inoculations with the test strs of *X. campestris pv. oryzae*.

Insect pests control

562 JOSHI, RC; CADAPAN, EP; HEINRICHS, EA. 1987. **Natural enemies of rice leaf folder, *Cnaphalocrocis medinalis* Guenee (Pyralidae: Lepidoptera) - a critical review (1913-1983)**. *Agricultural Reviews*, 8: 1, 22-34; 69 ref.

The biological control agents of *Cnaphalocrocis medinalis*, a pest of rice, which were recorded between 1913 and 1983 are reviewed. The egg parasitoid *Trichogramma sp.* has been used successfully in China, India and Japan. The ichneumonid *Trathala flavoorbitalis*, the braconid *Apanteles sp.*, the chalcidid *Brachymeria excarinata* and the bethylid *Goniozus indicus* have also been recorded as parasitoids of *C. medinalis*. Predators which are known to attack *C. medinalis* include formicids such as *Pheidole sp.*, *Solenopsis geminata* and *Diacamma*, the carabid *Chlaenius sp.*, *Coccinella arcuata* [*Harmonia octomaculata*], and the spiders *Lycosa pseudoannulata* and *Tetragnatha japonica*. The entomogenous fungi *Beauveria bassiana*, *Syncephalastrum racemosum* and *Penicillium oxalicum* are among the pathogens of *Cnaphalocrocis medinalis*. *Bacillus thuringiensis* and *Serratia marcescens* and a granulosis virus also have potential as microbial biocontrol agents. *Neoaplectana carpocapsae* is the only parasitic nematode which has been reported in *C. medinalis*.

563 PHILIP, BM; NAIR, KPV. 1990. **Exposure of white mice, white rats and embryonated chick eggs to nuclear polyhedrosis virus of rice swarming caterpillar, *Spodoptera mauritia (Boisduval)***. *Indian Journal of Entomology*, 52: 4, 622-626.

Other aspects of Rice

564 DAWRA, S; SHARMA, DR; CHOWDHURY, JB; JAIN, RK. 1982. **Studies on growth and differentiation in cultured cells of rice (*Oryza sativa*)**. *Plant Cell Culture in Crop Improvement* /edited by SK Sen and KL Giles. New York: Plenum Press, p. 445-450.

565 HAQUE, ME; MIAH, NM; ZEENAT, Z; QUADER, B. 1989. **Genetic diversity in three groups of rice**. *Bangladesh Journal of Plant Breeding and Genetics*, 2: 1-2, 49-54.

Divergence analyses were performed in 20 rice varieties/lines each, from traditional cold tolerant indica, cold tolerant modern varieties/lines and japonica varieties. The study was made to observe the extent of genetic diversity within each group and to identify diverse genotypes to generate crosses that give transgressive segregants in later generations. Wide range of diversity was obtained in modern varieties/lines and in japonica varieties. Parents could be selected from different clusters for hybridization to obtain heterotic segregants.

566 REDDY, KRK; RAO, AH; SREE, BK; REDDY, AR. 1993. **Water stress-induced 23kDa polypeptide in cell suspension cultures of rice (*Oryza sativa L.*) is immunologically similar to that of seedlings**. *Journal of Plant Physiology*, 141: 3, 373-375.

GRAIN LEGUMES

567 GILL, RAVINDER. 1990. **Direct gene transfer in *Psophocarpus tetragonolobus* resistance to kanamycin**. *Annals of Botany*, 66: 1, 31-39; 34 ref.

Epicotyl-derived protoplasts were isolated and transformed to kanamycin resistance following uptake of plasmid (pABD1 or pHP23) DNA in combination with polyethylene glycol treatment. Protoplast-derived transformed colonies were selected on media containing kanamycin (75 mg/litre). The transformed calluses

expressed neomycin phosphotransferase II activity and also exhibited the presence of the plasmid gene integrated into the genome. None of the transformed clones showed regeneration of shoot buds.

568 MALLICK, MA; RASHID, A. 1989. **Induction of multiple-shoots from cotyledonary node of grain legumes, pea and lentil**. *Biologia Plantarum*, 31: 3, 230-232; 11 ref.

Induction of multiple shoots from cotyledonary nodes of lentil and pea seedlings proved possible on medium with cytokinin (10-5 M benzylaminopurine [benzyladenine]), but other parts of the seedlings (root, leaf, hypocotyl) failed to regenerate. On isolation, these parts underwent callusing on medium rich in cytokinin or auxin, and the tissue formed was able to regenerate only roots.

569 PANDEY, P; BANSAL, YK. 1989. **Plantlet formation from callus cultures of cowpea (*Vigna sinensis L.*)**. *Current Science*, 58: 7, 394-396; 16 ref.

Root, hypocotyl and cotyledonary leaf blade explants of *V. sinensis* [*V. unguiculata*] were cultured on MS medium containing IAA, kinetin, IBA and 2,4-D. No callus or rooting response was noted in root cultures. Hypocotyl explants were not wholly suitable for tissue culture because of their reduced callus formation response. Cotyledonary leaves formed calluses within 5-7 days at high concentrations of 2,4-D. IBA (1-10 μM) and kinetin (100 μM) proved most suitable for callus initiation. Shoot formation and rooting was obtained in medium containing 100 μM IBA and 10 μM kinetin. Regenerated plantlets had normal diploid chromosome numbers with 1% showing aneuploidy.

570 PATANKAR, S; RANJEKAR, PK. 1984. **Condensed chromatin and its underreplication during root differentiation in *Leguminosae***. *Plant Cell Reports*, 3: 6, 250-253; 27 ref.

Interphase nuclear structure was studied in 15 leguminous species. Eleven species (*Cyamopsis tetragonoloba*, chickpea, 4 *Vigna* species, *Atylosia platycarpa*, pigeon pea, *Dolichos [Macrotyloma] uniflorus*, *Medicago sativa*, groundnut and soyabean) showed chromocentric interphase nuclei while the remaining 4 (lentil, pea, *Lathyrus uniflorus* and *Trigonella foenum-graecum*) had reticulate nuclei. The number of chromocentres appeared to be dependent on the number of chromosomes. The total proportion of condensed chromatin as determined by planimetry ranged from 11 to 24% in chromocentric nuclei and from 29 to 62% in reticulate nuclei. The amount of condensed chromatin amount showed a direct correlation with the nuclear DNA content (2C). Though the interphase nuclear structure remained the same in differentiated cells, the amount of condensed chromatin was considerably less than that in meristematic cells, indicating underreplication of heterochromatin during differentiation.

571 SANDHU, TS. 1992. **Potential of genetic resources and biotechnology in pulse breeding**. *Plant Breeding Abstracts*, 62: 2, 131-139; 46 ref.

The importance of proper characterization, evaluation and enhancement to facilitate effective utilization of the rich germplasm resources available to pulse growers and researchers is emphasized. The potential use of genetic resources in pulse improvement to overcome biotic and abiotic stresses and to design new plant ideotypes with enhanced biological nitrogen fixation is discussed. The international agricultural research centres have broad and strong service capabilities to mobilize genetic resources for food grain legume improvement programmes. There is a need to further broaden the genetic base available for pulse breeding programmes by continuously introducing exotic or new germplasm. Interdisciplinary communication will promote its use. The potential applications of various biotechnological techniques to solve chronic problems constraining pulse improvement are outlined.

572 SINGH, RK; RAGHUVANSI, SS. 1989. **Plantlet regeneration from nodal segment and shoot tip derived explants of lentil**. *Lens Newslet.*, 16:1, 33-35.

A tissue culture procedure is described for plantlet regeneration directly from nodal segment and shoot tip explants as well as from callus. Nodal segments and shoot tip explants produced a single shoot and roots in 4 weeks on hormone-free MS medium; only shoots regenerated on a media containing kinetin and multiple shoots formed without intervention by callus or root formation. Best callus formation was on media containing 1.0 mg kinetin and 10.0 mg 2,4-D/litre and buds formed on transfer to media containing only kinetin. These shoot buds were transferred to MS basal media for plantlet formation and normal fertile plants developed when transferred to soil.

573 SRIVASTAVA, KALPANA; TRIPATHI, SN. 1988. ***Colchicine*-induced amphidiploid of *Atylosia albicans* X *Atylosia cajanifolia***. *Current Science*, 57: 22, 1255-1257; 4 ref.

The amphidiploid (2n = 44), when compared to the diploid F1 hybrid, showed delayed flowering and larger leaflets, pollen, stomata, flowers and seeds, as well as

reductions in pod size and set and darker green leaves. A total of 52% of the PMCs had 22 bivalents and very little meiotic irregularity was observed. Although the amphidiploid had a high percentage of fertile pollen (93.6%) seed setting was lower than in the F1 hybrid.

Lentils

574 HOQUE, MS; SATTAR, MA. 1991. **Advances in Pulse Research in Bangladesh**. *National Workshop on Pulses*. (BARI, Joydebpur: 2nd: 1989: June 6-8).

575 KHANAM, RM; HOQUE, I; SARKER, RH. 1993. **In vitro multiple shoot regeneration in Lentil (*Lens culinaris Medik.*)**. *International Plant Tissue Culture Conference*. (Dhaka Univ., Dept. of Botany: December 19-21)

576 SARKER, RH; KHANAM, R; HOQUE, MI. 1995. **Development of transgenic plants in lentil**. *Annual Plant Tissue Culture Conference*. (Dhaka University, Dept. of Botany: 1995: March 19).

Soybeans

577 AHMAD, QN; BRITTEN, EJ; BYTH, DE. 1984. **Effects of interacting genetic factors and temperature on meiosis and fertility in soybean X *Glycine soja* hybrids**. *Canadian Journal of Genetics and Cytology*, 26: 1, 50-56; 18 ref.

F1 hybrids involving three cultivars of *G. max* and three lines of *G. soja* were examined in the glasshouse during summer and winter, and also in warm (32°C day/25°C night) and cool (20/12°C) growth cabinets. Hybrids exhibited marked differences in chromosome behaviour and fertility, depending on parentage and temperature during growth. Meiosis in some hybrids was regular, while in others the frequency of PMCs with irregularities was as high as 44%. Degeneration of pollen and seed was not always proportional to meiotic irregularity. Genotype, temperature and genotype X temperature interactions all influenced chromosome behaviour and fertility.

578 BANIK, S; DATTA, M. 1988. **Effect of inoculation of a phosphate-solubilizing phytohormone producing *Bacillus firmus* on the growth and yield of soybean (*Glycine max*), grown in acid soil of Nagaland**. *Zentralblatt fur Mikrobiologie*, 143: 2, 139-147; 26 ref., 4 tab.

Inoculation of soyabeans with *Bacillus firmus* (NLIM-2636), an IAA-producing strain that also had high phosphate solubilizing ability, had little effect on grain yield but increased the available P content of the soil.

579 CHOWDHURY, VK; ZEHR, BE; WIDHOLM, JM. 1987. **Effect of herbicide DPX-F6025 (Classic), 2-([(4-chloro-6-methyl-pyrimidine-2-yl), amino carbonyl] amino sulfonyl) benzoic acid, ethyl ester, on cultured cells of corn and several genotypes of soybean**. *Current Science*, 56: 8, 362-364; 10 ref.

The ID50 values of suspension cultures of cell lines treated with the herbicide DPX-F6025 [chlorimuron] were 1, 5, 60, 75 and 800 nM for the sweet corn Black Mexican, *Glycine max cv. Old Dominion*, *G. canescens*, *G. max cv. A3127* and *G. max cv. Earliana*, respectively. When seedlings were treated with different amounts of the herbicide, the same relative tolerance levels occurred as in suspension cultures. Within Glycine, analysis revealed that sensitive Old Dominion and tolerant Earliana had the highest and lowest contents, respectively, of valine, isoleucine, leucine and protein amino acids.

580 CHOWDHURY, VK; WIDHOLM, JM 1985. **Callus production from photoautotrophic soybean cell culture protoplasts**. *Plant Cell Reports*, 4: 5, 289-292; 17 ref.

Protoplasts were prepared from a photoautotrophic (PA) soyabean cell line. A yield of 75-90% after 2-3 h digestion in a mixture of 1% Cellulase R10, 0.2% Pectolyase Y23 and 2% Driselase was obtained. Cell division and colony formation occurred from about 18% of the plated protoplasts. The cultured protoplasts were as sensitive to atrazine, a photosynthetic inhibitor, as the original PA cells under the same conditions. Protoplasts and cells of a heterotrophic (HT) soyabean culture were not as sensitive to atrazine. The isolated protoplasts retained the PA characteristics of the parental culture in the callus and cell suspension cultures obtained from the protoplasts. The chromosome numbers in the parental cell line and in cells derived from the isolated protoplasts (both PA and HT) were largely (99%) the normal diploid number of 40.

581 GOUR, VK; MEHTA, AK; MEHTA, SK. 1992. **A line with four-seeded pods derived from an interspecific hybrid in soybean**. *Plant Breeding*, 108: 3, 260-262; 4 ref.

A few plants with increased frequency of 4-seeded pods were identified in a segregating generation derived from a cross between *Glycine max* and its wild progenitor *G. soja*. One plant had about 45% of 4-seeded pods/plant whereas the *G. max* and *G. soja* parental accessions had

only 8.0 and 5.1%, respectively. An established line finally had 32.5%

582 MALIK, SS. 1991. **Genetic studies of flowering and maturity in interspecific crosses of soybean**. *Indian J. of Genet. and Plant Breeding*, 51: 3, 349-351.

583 MANANDHAR, JB; THAPLIYAL, PN; CAVANAUGH, KJ; SINCLAIR, JB. 1987. **Interaction between pathogenic and saprobic fungi isolated from soybean roots and seeds**. *Mycopathologia*, 98: 2, 69-75; 20 ref.

Various interactions were noted in culture between 11 saprobes, of which the most active were *Aspergillus terreus*, *Chaetomium cupreum*, *Epicoccum nigrum*, *Gliocladium roseum*, *Myrothecium roridum*, *Penicillium thomii* and *Trichothecium roseum*, and the soyabean pathogens *Cercospora sojina*, *Colletotrichum truncatum*, *Macrophomina phaseolina*, *Phomopsis sojae* and *Septoria glycines*. Hyphal lysis of several fungal pathogens by *Acremonium sp.*, *C. cupreum* and *P. thomii* was recorded, perhaps because of parasitism by *G. roseum* and *T. roseum*. In glasshouse studies, coating seeds with *G. roseum*, *P. thomii* and *Trichoderma harzianum* improved emergence compared with *A. terreus* treatment and the untreated control. In field studies, coated seeds with a conidial suspension of *A. terreus*, *G. roseum*, *P. thomii* and *T. harzianum* produced a better stand than the control. The area of cotyledons covered with lesions caused by *C. truncatum* was less on seeds coated with *G. roseum*, *P. thomii* and *T. harzianum* than on untreated seeds.

584 MANNUR, DM; SALIMATH, PM; PATIL, SS; PARAMESHWARAPPA, R. 1992. **Genetic studies in interspecific crosses of soybean (*Glycine max (L.) Merill.* x *Glycine formosona*). III. Selection Indices**. *Indian J. of Genet. and Plant Breeding*, 51: 4, 471-475.

585 MEHTA, SK; LAL, MS; BEOHAR, ABL. 1984. **Heterosis in soybean crosses**. *Indian Journal of Agricultural Sciences*, 54: 8, 682-684; 7 ref.

When 12 intervarietal crosses, 5 involving Kalitur, were made using 11 parents, heterosis for seed yield/plant with respect to the better parent ranged from 3.64% (Bragg X PS73-22) to 249% (Kalitur X Ankur). The 2nd highest figure 129% was given by Pb1 X Kalitur.

586 PANDEY, P; BANSAL, YK. 1992. **Plant regeneration from leaf and hypocotyl explants of *Glycine wightii (W. and A.) Verdc. var Longicauda***. *Japanese Journal of Breeding*, 42: 1, 1-5.

587 PURKAYASTHA, RP; GHOSH, S. 1983. **Elicitation and inhibition of phytoalexin biosynthesis in Myrothecium-infected soybean leaves**. *Indian Journal of Experimental Biology*, 21: 4, 216-218; 16 ref., 3 tab.

Pathogenicity of *M. roridum* was tested on 10 soyabean cultivars. Phytoalexin (glyceollin) was detected only in leaf diffusates after 48 h incubation but not in leaf exudates. Mycelial wall extract of *M. roridum* elicited glyceollin biosynthesis in soyabean leaves. X-irradiation of germinated seeds increased susceptibility of 2-wk-old plants and inhibited accumulation of glyceollin, this being related to disease resistance of the plants.

588 PURKAYASTHA, RP; CHAKRABORTY, BN. 1983. **Immunoelectrophoretic analysis of plant antigens in relation to biosynthesis of phytoalexin and disease resistance of soybean**. *Tropical Plant Science Research*, 1: 1, 89-96; 20 ref.

In tests with 10 soyabean cultivars against *Macrophomina phaseolina*, Soymax was the most susceptible and UPSM-19 the most resistant. Infected resistant cultivars produced more glyceollin than infected susceptible ones. Agar-gel diffusion tests revealed common antigenic relations between susceptible plants and *M. phaseolina*. Immunoelectrophoresis showed that 4 commmon antigenic substances occurred in susceptible cultivar-pathogen combinations but none in resistant combinations, 3 isolates of the pathogen being used. The results are discussed.

589 RAM, HH; SINGH, KAMENDRA; PUSHPENDRA; VERMA, VD. 1984. **Breeding for resistance to yellow mosaic virus through interspecific hybridization in soybean**. *Soybean Genetics Newsletter*, 11, 46-48; 4 ref.

Six breeding lines developed from the backcross (*Glycine max cv. Bragg* X *G. formosana*) X Bragg were resistant to yellow mosaic virus (YMV) and outyielded Bragg. Two of the 6, PK486 and PK515, have performed well at more than one site.

Lablab purpureus

590 KAUSHIK, P; KHANNA, D. 1989. **Four sterols from in vivo and in vitro tissue cultures of Dolichos lablab L**. *Indian Journal of Pharmaceutical Sciences*, 52: 6, 267-268; 5 ref.

Analysis of *D. lablab* [*Lablab purpureus*] seeds, stems and leaves collected locally and of seedling callus tissue

showed the presence of 4 sterols (beta-sitosterol, stigmasterol, lanosterol and cholesterol).

591 PALANISAMY, K; VIVEKANANDAN, M. 1985. **Formation of chloroplast pigments in the chloroembryo of Dolichos lablab L.** *Photosynthetica*, 19: 2, 172-176; 18 ref.

Greening of *D. lablab* [*Lablab purpureus*] embryos was initiated at the dicotyledonary stage inside the fruits. Masking fruits with black paper prevented chlorophyll formation and caused chlorophyll breakdown, resulting in etiolated embryos. Re-exposure of fruits with these embryos to natural light caused pigment resynthesis. Spraying an aqueous amitrole solution on the fruits under field conditions caused embryo chlorosis. Chloroplast pigment content in the embryo was enhanced more by red than by blue light.

Lathyrus sativus

592 KATIYAR, SK; NAIK, SV. 1992. **In vitro plant regeneration in *Lathyrus sativus L.*** *International Food Legume Research Conference. 2nd*. (Rames Hilton, Cairo, Egypt: 1992: April 12-16).

593 KATIYAR, SK; NAIK, SV; SHARMA, H. 1994. **In vitro regeneration of genetically variable palnts of *Lathyrus sativus L.*** *Second Asia-Pacific Conf. on Agricultural Biotechnology*. (Madras: 1994: March 6-10).

Phaseolus

594 AMIN, MN; MOHAMMAD, G; ALAM, S; KABIR, G. 1983. **Karyotypic analysis of eight strains of *Phaseolus aureus L.*** *Annual Bangladesh Sci. Conf.* p. 120.

595 PATANKAR, S; RANJEKAR, PK. 1984. **Interphase nuclear structure and heterochromatin in *Phaseolus* plant species**. *Plant Cell Reports*, 3: 4, 130-133; 39 ref.

In all 5 species studied (*P. mungo* [*Vigna mungo*], *P. vulgaris, P. aureus* [*V. radiata*], *P. aconitifolius* and *P. lunatus*), chromocentres were observed in both meristematic and differentiated cells. The number of chromocentres appeared to be species specific. *Heterochromatin* percentage values, as determined by using 3 different staining techniques, were higher in meristematic than in differentiated cells. There was a close correlation between heterochromatin percentage and amount of highly repetitive DNA, suggesting a possible involvement of the latter in chromatin condensation.

596 SESHADRI, M; RAJEKAR, PK. 1981. **Comparative study of repetitive DNA in *Phaseolus***. *Indian J. of Biochem. and Biophysics*, 18: 4, 254-258; 19 ref.

Fractions containing repeated DNA sequences were isolated and characterized in *Vigna mungo*, *V. radiata* and *V. aconitifola*. The thermal stability of most of the fractions was in the range 76.8-78°C and revealed a base mismatch of 3.7-5.1%. The repeated DNA sequences exhibited a low sequence divergence. Optical reassociation studies of Cot 1 DNA fraction in *V. aconitifolia* and *V. radiata* are described.

597 SREEDHAR, D; MEHTA, AR. 1984. **In vitro shoot differentiation from hypocotyledonary and epicotyledonary explants of *Phaseolus lunatus Linn.*** *Indian Journal of Experimental Biology*, 22: 6, 345-346; 13 ref.

Differentiation occurred after 2 weeks in explants from 2-week-old seedlings cultured on Gamborg's B5 medium supplemented with 2 mg BA/litre and 0.5 mg kinetin/litre.

598 TAMHANKAR, SA; GUPTA, VS; JOSHI, KS; RANJEKAR, PK. 1990. **Occurrence and characterization of a dispersed MboI repeat family in frenchbean (*Phaseolus vulgaris*) seedling DNA**. *Plant Science Limerick*, 68: 2, 203-211; 27 ref.

Southern hybridization using the Cot 0.1 fraction as a probe confirmed the repetitive nature of the MboI family. Direct evidence for its dispersed nature was obtained by using 1.15 and 0.88 kb MboI elements or a cloned 1.15 kb MboI element as hybridization probes. Double digestion with MboI-AluI and MboI-TaqI indicated the presence of at least one site for these enzymes within the MboI elements.

599 VAID, K. 1990. **Factors in artificial crossing of dry beans (*Phaseolus vulgaris L.*)**. *Legume Research*, 13: 2, 87-88; 1 ref.

Emasculation in the morning or evening and pollination between 08.00 and 11.00 h was essential to obtain a high pod set percentage (around 10-30%, depending on the cross) by crossing among 6 cultivars in June.

Vigna aconitifolia

600 BHARGAVA, S; CHANDRA, N. 1989. **Effect of sodium chloride on callus cultures of moth bean *Vigna aconitifolia (Jacq.) Marechal cv. IPCMO 926***. *Indian Journal of Experimental Biology*, 27: 1, 83-84; 14 ref.

Callus cultures were grown on MS media with the addition of 0.5%, 1.0% and 1.5% NaCl. A decrease in growth during initial subculture was followed by a gradual recovery with 0.5% and 1.0% NaCl. A shift towards salt tolerance was observed in the line cultured on 1.0% NaCl solution; after 6 subcultures callus growth was poor in the absence of NaCl. The results indicated that in vitro selection for salt tolerance would be effective.

601 BHARGAVA, S; CHANDRA, N. 1989. **Factors affecting regeneration from leaf explants of moth bean, *Vigna aconitifolia* (Jacq.) Marechal**. *Indian Journal of Experimental Biology*, 27: 1, 55-57; 15 ref.

Shoot buds were regenerated, some directly but most through callus formation, from leaf explants of *V. aconitifolia* on MS media supplemented with various combinations of IAA and kinetin or benzyladenine. Types and ratios of growth regulators and age and genotype of donor plant influenced regeneration. Of the 5 genotypes tested, IPCMO926 gave 100% regeneration on both induction media tested.

602 BHARGAWA, SC; CHANDRA, N. 1989. **In vitro regeneration of shoot apices of *Vigna aconitifolia Jacq. Merechal***. *Legume Research*, 12: 4, 170-172; 5 ref.

The shoot apices of 5 *V. aconitifolia* cultivars formed multiple shoots when incubated in the presence of cytokinin (BA or kinetin), showed whole plant regeneration in the presence of IAA, formed only callus in the presence of NAA or 2,4-D and showed both whole plant regeneration and multiple shoot formation in the presence of kinetin + IAA. Kinetin at high levels ($\geq$1.0 mg/litre) induced only multiple shoot formation and at lower levels ($<$1.0 mg/litre), singly and in combination with IAA, induced rooting and whole plant regeneration.

603 EAPEN, S; GEORGE, L. 1990. **Ontogeny of somatic embryos of *Vigna aconitifolia*, *Vigna mungo* and *Vigna radiata***. *Annals of Botany*, 66, 219-226; 22 ref.

Callus cultures were initiated from immature cotyledons of *V. aconitifolia*, *V. mungo* and *V. radiata* on MS medium supplemented with NAA, picloram or 2,4-D. On transfer to L-6 liquid medium supplemented with low concn of picloram, GA3 and cytokinins, a large number of somatic embryos differentiated from the callus. The cells destined to become somatic embryos divided to form spherical or filamentous proembryos. From the filamentous proembryo, the embryo proper developed either at single or multiple sites. Development of somatic embryos from multiple sites resulted in several embryos connected by a common suspensor at the radicle end. Continued divisions of the proembryos led to globular, heart shaped and dicotyledonary stages of somatic embryogenesis. *V. mungo* and *V. aconitifolia* somatic embryos differentiated into tiny plantlets at low frequency (1%) in liquid suspension cultures supplemented with zeatin, picloram and GA3.

604 GILL, RAVINDER; EAPEN, S. 1986. **Plant regeneration from hypocotyl protoplasts of mothbean (*Vigna aconitifolia*)**. *Current Science*, 55: 2, 100-102; 11 ref.

Protoplasts were isolated from 4-5-day-old hypocotyl callus of *V. aconitifolia cv. 88* cultured on MS (Murashige & Skoog) medium supplemented with 2 mg 2,4-D/litre. Standard procedures were used for isolation. The protoplasts were initially cultured on modified MS medium containing vitamins, 2 mg 2,4-D/litre, and 0.1 mg kinetin/litre plus various amino acids and sorbitol. Following the development of cell colonies, transfers were made to MS medium with various modifications (details given) until callus developed small green patches in 50% of cultures on MS medium supplemented with 2 mg zeatin/litre and 0.1 mg 2,4-D/litre. On transfer of these callus tissues to MS medium devoid of growth regulators plantlets developed.

605 GODBOLE, DA; KUNACHGI, MN; POTDAR, UA; KRISHNAMURTHY, KV; MASCARENHAS, AF. 1984. **Studies on drought resistant legume: the moth bean, *Vigna aconitifolia* (Jacq.) Marechal. II. Morphogenetic studies**. *Plant Cell Reports*, 3: 2, 75-78; 21 ref.

Plantlets regenerated from shoot apices, cotyledons and callus cultures were rooted and transferred to soil.

606 JAIN, J; CHOPRA, VL. 1988. **Genotypic differences in response to regeneration of in vitro cultures of moth bean *Vigna aconitifolia* (Jacq.) Marechal**. *Indian Journal of Experimental Biology*, 26: 9, 654-656; 9 ref.

Composition of the tissue culture medium strongly influenced the ability of *V. aconitifolia* callus to differentiate shoot buds. The best regeneration response was obtained in callus produced on MS medium supplemented with BA (0.5 mg/litre) and NAA (0.1 mg/litre). The frequency of shoot regeneration from such callus depended both on the explant type and the relative concn of auxin and cytokinin in the differentiation medium. Highest frequency was obtained with callus of leaf

origin at supplementation with kinetin (5 mg/litre) and IAA (1 mg/litre). For ascertaining if the shoot morphogenesis response is a genetic characteristic, 169 germplasm lines of *V. aconitifolia* were screened. Accession IPCMO 1002 gave the highest regeneration frequency of 28.33 $\pm$ 2.88 on MS medium supplemented with BA (0.5 mg/litre) and NAA (0.1 mg/litre). Under identical culture conditions, accession IPCMO 704 failed to regenerate altogether, thus establishing the existence of genotypic differences in differentiation response.

607 KRISHNAMURTHY, KV; GODBOLE, DA; MASCARENHAS, AF. 1984. **Studies on a drought resistant legume: the moth bean, *Vigna aconitifolia (Jacq.) Marechal*. I. Protoplast culture and organogenesis**. *Plant Cell Reports*, 3: 1, 30-32; 21 ref.

High numbers of viable protoplasts were obtained from callus cultures derived from shoot apices of *V. aconitifolia*. Callus and multiple shoot buds were obtained from the protoplasts on several media.

608 UPADHYAYA, A; GEHLOT, HS; DAVIS, TD; SANKHLA, N; SANKHLA, A; SANKHLA, D. 1989. **In vitro growth, metabolism and regeneration of moth bean callus as influenced by flurprimidol**. *Biochemie und Physiologie der Pflanzen*, 185: 3-4, 245-252; 26 ref.

When the gibberellin biosynthesis inhibitor flurprimidol (FLP) was added at 0.5-2.0 mg/litre to a callus medium it reduced both FW and DW of *Vigna aconitifolia* callus after 21 d. Total sugar, proline, soluble protein and phenol concn (FW basis) in callus tissue were all increased by FLP relative to the control. The activities of peroxidase, protease, RNase, alanine aminotransferase and aspartate aminotransferase were all greater in FLP-treated cultures than in controls. The presence of 1 mg FLP/litre in a regeneration medium reduced the percentage of cultures with roots as well as the mean number of roots formed per culture. FLP also reduced the formation of green meristematic nodules which are forerunners of shoots.

Vigna mungo

609 BHALLA, JK; SAROJ-BHAMBURKAR. 1988. **Mutagenicity of magnetic fields in black gram**. *Genome*, 30: supplement 1, 467.

Dry seeds of black gram (*Vigna mungo*) were treated with magnetic fields of various strengths. In the M2, chlorophyll mutations and macromutants involving alterations in seed size and coat coloration were isolated. Micromutants included those for early flowering and high protein content. It is suggested that magnetic fields have potential for producing useful mutants.

610 DASGUPTA, T; DAS, PK. 1984. **Multivariate analysis and selection of parents for hybridization in black gram**. *Philippine Agriculturist*, 67: 1, 86-92; 13 ref.

Analysis of data on 12 traits using the Mahalanobis D2 technique enabled 40 strains of *Vigna mungo* from diverse ecogeographic regions in India and Nepal to be grouped into 17 different clusters regardless of geographic origin. The maximum distance (D = 19.92) occurred between clusters 1 (containing 2 strains) and 16 (containing one). It is suggested that crosses may be performed between varieties from clusters with an intercluster D value of 8.9 or more [see also Bhatt, G. M. Australian Journal of Agricultural Research (1970) 21, 1-7]

611 GILL, R; EAPEN, S; RAO, PS. 1987. **Callus induction from protoplasts of *V. unguiculata*, *V. sublobata* and *V. mungo***. *Theoretical and Applied Genetics*, 74: 1, 100-103; 19 ref.

Protoplasts were isolated from hypocotyls of *Vigna mungo* or from hypocotyl-derived callus of *V. sublobata* and *V. unguiculata* and cultured in Murashige & Skoog liquid medium supplemented with growth regulators and 14% sucrose. After 4 weeks, protoplast colonies were transferred to the same medium with 7% sucrose. Colonies proliferated into actively growing calluses, but attempts to regenerate plants from these calluses were unsuccessful. However, protoclones of *V. unguiculata* differentiated roots on media supplemented with auxin and cytokinin.

612 GILL, R; EAPEN, S; RAO, PS. 1988. **Regeneration and differentiation of protoplasts in grain legumes**. *Progress in Plant Protoplast Research: Proceedings of the International Protoplast Symposium*. (Cambridge, UK: 7th: 1988: July 13-19)/edited by KJ Puite, JJM Dons, HJ Huizing, AJ Kool, M Koornneef, FA Krens. Cambridge, UK: Kluwer Academic Publishers, p. 500 99-100; 4 ref.

Studies with isolated protoplasts of *Vigna mungo*, *V. aconitifolia*, *V. sublobata* and *V. unguiculata* are described. In *V. aconitifolia*, protoclones showed distinct dark green patches which differentiated rapidly to form shoot buds on transfer to basal medium, and, with NAA addition, roots. Regenerated plants were transplanted into the field. Protoplast culture of the other species was less successful.

613 GILL, RAVINDER; EAPEN, S; RAO, PS. 1987. **Morphogenic studies of cultured cotyledons of urd bean (*Vigna mungo L. Hepper*)**. *Journal of Plant Physiology*, 130: 1, 1-5; 18 ref.

Excised cotyledons, with intact cotyledonary nodes, when cultured on moist filter paper or water agar or Murashige & Skoog basal medium each gave a single plantlet via callus. Multiple buds resulted from addition of cytokinins to the basal medium. Such buds originated from cells adjacent to an existing bud. Callus cultures initiated from cotyledonary nodes on a medium containing picloram, zeatin and IAA gave embryoids on transfer to agitated liquid media but no further development occurred.

614 SHANMUGAM, AS; RANGASAMY, SR. 1985. **Study of segregating generations of the interspecific hybrids of the genus *Vigna***. *Genetica Agraria*, 39: 4, 387-400; 16 ref.

In reciprocal crosses between *V. radiata* and *V. mungo*, hybrids were obtained only when the former was used as seed parent. In the F2, there were more pods/cluster, more seeds/pod and longer pods than in the F1, and lower survival and seed germination than in the parents; the proportions of sterile plants and aborted seeds were also higher than in the parents. In passing from the F2 to the F4, the percentages of aborted seeds and sterile plants decreased, and germination and survival increased; also, there was a gradual elimination of characters of *V. mungo* such that most of the F4 segregates resembled *V. radiata*.

Vigna radiata

615 BHATIA, CR; MATHEWS, H. 1988. **Inheritance of two somaclonal variants in mung bean (*Vigna radiata (L.) Wilczek*)**. *Journal of Heredity*, 79: 2, 122-124; 11 ref.

Two true-breeding somaclonal variants showing dull seed surface (Sh-tc) and green cotyledon (gc-tc) in the R4 generation were crossed to the parental cultivar ML5 having shiny seeds and yellow cotyledons. In the F1 and segregating generations, dull seed surface was inherited as monogenic dominant and the green cotyledon trait as monogenic recessive. Similar segregation was observed in the F2 of the cross between the 2 variants. Joint segregation was in the ratio 9:3:3:1. A new true-breeding phenotype having dull seed surface and green cotyledons was recovered. The somaclonal variants crossed to their respective phenotypically identical radiation-induced mutants did not show any segregation, indicating that they are allelic.

616 BHATNAGAR, PS; TEWARI, V; SINGH, BD. 1988. **Host - *Rhizobium* symbiotic interaction in mungbean (*Vigna radiata (L) Wilczek*)**. *Genetica Agraria*, 42: 2, 161-168; 13 ref.

When 3 lines highly variable for nitrogen fixation characters were inoculated with 5 cowpea *Rhizobium* strains, distinct host-symbiont interactions were observed for the nitrogen fixation characters. Strain M3 was highly efficient in increasing nitrogen content in symbiosis with line 11152 but not with the other 2 lines whereas CB756 was inefficient for all nitrogen fixation characters with all 3 lines. The combination 11152 - M3 gave the highest nitrogen content and DM/plant and although 11152 produced least nodules/plant it possessed the highest nodule dry weight. F1 progeny of 11152 X 249 in symbiosis with *Rhizobium* D10 showed heterosis for all the characters. F2 variability was higher than in the parents and, F1s with transgressive segregation were seen for all 4 nitrogen fixation characters.

617 BOSE, M; SARKER, RH; HOQUE, MI; HAQUE, MM. 1992. **Investigation into the possible causes for failure of in vitro regeneration in mungbean**. *Plant Tissue Culture*, 2: 2, 81-88.

Plant regeneration was tried from different explants of *Vigna radiata*, namely, shoot tip, epicotyl, hypocotyl, cotyledonary node and leaf segments. Leaf explants callused best when cultured on MS medium containing 1.0 mg/12, 4.D + 0.5 mg/l Kn. Only proliferation of callus took place when they were cultured on a medium specially prepared to induce regeneration. Microscopic observations revealed the presence of organogenic cell lines only at their early stages; however, at later stages these cells turned into thick-walled cells which did not differentiate. Fluorescent microscopic study of fresh suspension culture callus cells showed presence of newly synthesized starch bodies and cells of different shapes and sizes. From six weeks onward the cells lost starch grains, became partially vacuolated finally giving rise to empty cells.

618 CHOWDHURY, VK; SAREEN, PK; SHARMA, DR; CHOWDHURY, JB; GUPTA, VK. 1982. **Establishment of callus and cell suspensions and isolation of mutant cell lines in mungbean (*Vigna radiata var aureus*)**. *Plant Cell Culture in Crop Improvement*/edited by SK Sen and KL Giles. New York: Plenum Press, p. 405-410.

619 CHOWDHURY, VK; SAREEN, PK; SHARMA, DR; CHOWDHURY, JB; JAIN, RK. 1983. **Isolation and characterization of cell lines resistant to some**

amino acid analogues in mungbean (*Vigna radiata (L) Wilczek*). *International Cong. Genet.* (New Delhi: 15th: 1983: December 12-21). p. 39.

620 DEVI, TP; SAMY, PN. 1986. **Culturing of powdery mildew on blackgram and greengram callus tissue**. *Madras Agricultural Journal*, 73: 8, 474-475; 4 ref.

Callus tissue of *Vigna mungo* and *V. radiata* was obtained from excised shoot tips, hypocotyls and the first pair of leaves. When subcultured on Gamborg's medium and inoculated with a conidial suspension of *Erysiphe polygoni*, profuse fungal growth was obtained after 10 d. The type of growth and conidial characters were maintained after subculturing and pathogenicity was confirmed when reinoculated to plant leaves.

621 EAPEN, S. 1988. **Callus induction from mesophyll and hypocotyl protoplasts of mungbean (*Vigna radiata L.*)**. *Annals of Botany*, 62: 4, 441-443; 15 ref.

Protoplasts were isolated from *V. radiata cv. ML-5* using 1% Onozuka R10 cellulase and 0.2% Macerozyme. About 60% of cultured protoplasts formed colonies on modified V-47 medium; some colonies developed leaves when supplied with zeatin and roots when supplied with benzyladenine + NAA, 2iP + NAA, kinetin + NAA, kinetin + IAA, or NAA or IAA alone, but shoots were never produced even where *Agrobacterium tumefaciens* mutants were tested.

622 GOVIL, SR; AGRAWAL, DC; RAI, KP; THAKUR, SN. 1991. **Physiological responses of *Vigna radiata L.* to nitrogen and argon+ laser irradiation - Short Communication**. *Indian Journal of Plant Physiology*, 34: 1, 72-76.

623 GULATI, A; JAIWAL, PK. 1993. **Comparative salt responses of callus cultures of *Vigna radiata (L.) Wilczek* to various osmotic and ionic stresses**. *Journal of Plant Physiology*, 141: 1, 120-124.

624 GULATI, A; JAIWAL, PK. 1993. **Selection and characterization of mannitol-tolerant callus lines of *Vigna radiata (L.) Wilczek***. *Plant Cell, Tissue and Organ Culture*, 34: 1, 35-41.

625 KUMAR, V; SHARMA, DR. 1989. **Effect of exogenous proline on growth and ion content in NaCl stressed and nonstressed cells of mungbean, *Vigna radiata var. radiata***. *Indian Journal of Experimental Biology*, 27: 9, 813-815; 18 ref.

Addition of low concn (20, 25 and 33.33 mM) of proline to the medium alleviated the growth inhibition of NaCl stressed sensitive (wild type) callus cultures of *V. radiata*. At higher concn (50 and 100 mm) proline was inhibitory to the growth of NaCl stressed as well as nonstressed callus cultures. The cellular levels of K+ increased with increase in proline concn in the medium followed by a decline at supraoptimal concn of proline. The levels of Na+ and Cl- decreased up to optimum proline concn followed by an increase at supraoptimal concn. The levels of Ca2+ remained unaffected in NaCl stressed or nonstressed callus cultures with increase in proline concn in the medium.

626 KUMAR, V; SHARMA, DR. 1989. **Isolation and characterization of sodium chloride-resistant callus culture of *Vigna radiata (L.) Wilczek var. radiata***. *Journal of Experimental Botany*, 40: 210, 143-147; 28 ref.

Callus cultures were initiated from seedling root segments of cv. K851 on modified PC-L2 basal medium. Growing cells were exposed to increasing concentrations of NaCl in the medium. A concentration of 300 mol/m3 NaCl proved completely inhibitory to growth of the calluses. On incubation for 25 days, cells which could tolerate this concentration grew to form cell clones. Selected clones were characterized with regard to their growth behaviour and K+, Na+ and free proline content when grown under stress as well as on normal media and were compared with the normal sensitive callus. The selected callus was capable of growing on medium containing NaCl at the inhibitory concentration. The K+ content of the selected callus was lower in the case of the NaCl medium than for the normal medium. However, the selected clones maintained higher K+ and Na+ levels with increased salinization compared with the wild-type cells. Salt-selected cells accumulated higher levels of free proline under NaCl stress compared to wild-type cells. Under normal conditions, however, the amounts of free proline in selected and non-selected calluses were comparable.

627 KUMAR, V; SHARMA, DR. 1989. **Selection and characterization of NaCl resistant callus culture of *Vigna radiata (L) Wilkzek var. radiata***. *Jour. Expt. Bot.* 40: 143-147.

628 MATHEWS, H; BHATIA, CR. 1983. **In vitro regeneration of plants from cotyledons in grain legumes**. *Mutation Breed. Newsletter*, No. 22: 11-12.

A procedure is described for obtaining fertile plantlets from cotyledons. The procedure was tested on *Vigna radiata*.

629 MATHEWS, H. 1988. **In vitro responses of *Brassica juncea* and *Vigna radiata* to the antibiotic kanamycin**. *Annals of Botany*, 62: 6, 671-675; 12 ref.

Kanamycin sensitivity was studied in *B. juncea* and *V. radiata* as a preliminary step in developing a transformation-regeneration system for these species. Kanamycin concentration for the inhibition of growth differed between species as well as between different explants of the same species. The rooting of shoot explants in kanamycin-containing medium appeared a critical test in selecting kanamycin-sensitive plants.

630 MATHEWS, H; RAO, PS; BHATIA, CR. 1991. **Increased mutation frequencies in the M2 generation derived from irradiated in vitro cotyledonary plants of mungbean (*Vigna radiata L. Wilczek*)**. *Mutation Breeding Newsletter*, No. 38: 6-7; 3 ref.

Mung bean seeds were exposed to a 40 kR gamma ray source and the M1 plants raised either directly or from in vitro culture of cotyledons. Distinct chlorophyll and viable mutations were observed in M2 progenies and evaluated in the M3. Of the in vitro progenies, 27% segregated for mutations compared with only 12% for direct sown progenies. Also the number of mutants per 100 plants was much higher (4.4 versus 2). The spectrum of mutations was similar in both populations.

631 MATHEWS, H. 1987. **Morphogenetic responses from in vitro cultured seedling explants of mung bean (*Vigna radiata L. Wilczek*)**. *Plant Cell, Tissue and Organ Culture*, 11: 3, 233-240; 20 ref.

In a study of seedling explants of cv. ML5 cultured on various media with and without various growth regulators, direct induction of shoots or plants was possible from shoot tip, cotyledon and cotyledonary node explants. Dedifferentiation of the explants (from shoot tips, cotyledons, cotyledonary nodes, primordial leaves, and roots) occurred on basal medium supplemented with auxin and cytokinin. Shoot regeneration was limited to primary callus, while root formation occurred commonly in established calluses. The various explants showed preferential growth in different basal media (Miller, Murashige & Skoog, Nitsch, Phillips & Collins PCL2, modified Blaydes and modified Gamborg), and also differences in growth regulator requirements.

632 MATHEWS, VH; RAO, PS. 1984. **In vitro production of multiple seedlings from single seeds of mung bean (*Vigna radiata L. Wilczek*)**. *Zeitschrift fur Pflanzenphysiologie*, 113: 4, 325-329; 13 ref.

A method for obtaining more than one seedling per seed is described. It involves excision and isolation of the embryo and of both cotyledons, followed by culturing them individually on a basal medium. Cotyledons and embryos developed directly into complete plants with roots. The percentage of the cotyledonary plants that developed was inversely proportional to the imbibition period of the seed, with the highest percentage being obtained from seeds imbibed for one day. Normal pod development with seeds was observed in the regenerated plants and progenies from these plants were normal.

633 ROY, P; BHATTACHARYYA, N; BISWAS, BB. 1988. **Isolation, characterization and sequencing of a novel repetitive DNA from the mung bean *Vigna radiata***. *Gene*, 73: 1, 57-66; 33 ref.

A family of highly reiterated, small ($\approx$300 bp) sequences was identified. The members are extensively dispersed over the chromosomes, with some clustering, and also occur extrachromosomally. The repetitive DNA hybridizes with total RNA as well as with polyadenylated RNA isolated from germinated seeds. It is analogous to the human Alu1 family in its distribution and transcribability although the 2 families do not share any sequence homology. A cloned repeat from a shotgun genomic library showed an average copy number of 8 X 104 per haploid genome, thus constituting $\approx$5% of the total genome. Sequencing of the cloned repetitive DNA revealed the presence of direct and inverted repeats and some short palindromic sequences.

634 SHAHZAD, S; GHAFFAR, A. 1987. **Field application of *Paecilomyces lilacinus* and furadan for the control of root-knot disease of okra and mung**. *International Nematology Network Newsletter*, 4: 1, 33-34; 2 ref.

The following treatments were applied to microplots in a replicated field experiment : *P. lilacinus* (culture from the International Potato Centre, Peru, multiplied on rice grains) in furrow at 40g/m; furadan [carbofuran] at 1 and 2 kg a.i./ha; *P. lilacinus* at 40g/m + carbofuran at 1 and 2 kg a.i./ha (5 treatments) ; untreated plots as controls. Okra [*Hibiscus esculentus*] and mungbean [*Vigna radiata*] were sown as test plants. 60 days after planting, infestation with *Meloidogyne incognita*, assessed by root-knot index, was significantly decreased by all treatments compared with control. *P. lilacinus* alone and combined with carbofuran reduced infestation by >40% on *V. radiata* and by about 60% on *H. esculentus*. Carbofuran at 1 kg/ha (normal rate) was less effective than *P. lilacinus*. After harvest, *Cicer arietinum* was sown in the experimental area without further treatment and, 60 days later, the original *P. lilacinus* treatments, alone and with carbofuran, still gave signifi-

cant control but the effect of the nematicide alone was no longer significant.

635 SHAHZAD, S; GHAFFAR, A. 1989. **Use of *Paecilomyces lilacinus* in the control of root rot and root knot disease complex of okra and mung bean**. *Pakistan Journal of Nematology*, 7: 1, 47-53; 15 ref.

P. lilacinus, a soil borne fungus and a pathogen of *Meloidogyne* eggs was found to inhibit growth of *Macrophomina phaseolina* and *Rhizoctonia solani* in vitro. A 3-week-old culture of *P. lilacinus*, multiplied on rice grains, when applied to soil at 40 g/m resulted in significant reductions in *Meloidogyne incognita* root knot index on okra [*Hibiscus esculentus*] (from 4.8 to 1.1) and mung bean (*Vigna radiata*) (from 4.7 to 1.1). *P. lilacinus* reduced colonization of roots by *M. phaseolina* by 33% on mung bean and 45% on okra, whereas infection by *R. solani* was reduced by 67 and 73% on mung bean and okra, respectively. Furadan [carbofuran] used alone or in combination with *P. lilacinus* was less effective than *P. lilacinus* alone. The residual effect of *P. lilacinus* was greater than that of carbofuran. Inoculum of *P. lilacinus* on rice grains gave better results than its inoculum on wheat straw, rice straw or sorghum grains or application as a seed dressing.

636 SINGH, DP. 1990. **Distant hybridization in genus *Vigna* - a review**. *Indian Journal of Genetics and Plant Breeding*, 50: 3, 268-276.

637 SINGH, RS; SINGH, S. 1986. **Interaction of some isolates of Epicoccum purpurascens with *Macrophomina phaseolina***. *Plant Disease Research*, 1: 1-2, 35-40; 10 ref.

Eighteen isolates of *E. purpurascens* [*E. nigrum*] were divided into 4 groups depending on their colony characteristics, sporulation and production of antagonistic compounds. Group III isolates were most effective in inhibiting spore germination and disease development of *M. phaseolina* in mungbean [*V. radiata*]. Isolates of groups I and IV gave intermediate reactions and those of group II were the least antagonistic.

638 SRIBIR SEN; ROY, PRANAB 1986. **Construction of a genomic library from germinating seedlings of mung bean (*Vigna radiata*). Evidence for the presence of a class of repetitive sequences and selection of beta-tubulin specific recombinant phage**. *Biochemical and Biophysical Research Communications*, 137: 2, 788-794; 20 ref.

A genomic library (representing 75-80% of the total genome) was constructed in phage Charon 4A. When it was probed with a *V. radiata* DNA repetitive sequence, at least 30% of phages hybridized, indicating the presence of a class of such sequences. The library was also probed with a chicken beta- tubulin gene, which hybridized strongly to one phage.

639 TIWARI, VN; PATHAK, AN; LEHRI, LK. 1988. **Manurial value of compost enriched with rockphosphate and microbial inoculants to greengram**. *Journal of the Indian Society of Soil Science*, 36: 2, 280-283; 7 ref., 3 tab.

The effect of inoculation with Azotobacter and phosphate solubilizing microorganisms and of addition of Mussoorie rock phosphate on N and P content during composting of rice straw was studied. Inoculation of Azotobacter to one month-old decomposed rice straw increased the N content. Composting with rock phosphate increased both citrate and water-soluble P and this was further increased by inoculation with *Aspergillus* awamori. Optimum responses were recorded with the treatment receiving microbial cultures and rock phosphate. Three months-old enriched compost increased the nodulation and yield of a greengram (*Vigna radiata L.*) crop.

640 ZAKI, MJ; GHAFFAR, A. 1987. **Effect of *Rhizobium spp.* on *Macrophomina phaseolina***. *Pakistan Journal of Scientific and Industrial Research, 30: 4, 305-306.*

In dual culture plate assays, indigenous *R. isolates* from pea, lucerne and soyabean nodules in Karachi inhibited radial growth of *M. phaseolina* obtained from cotton. In greenhouse experiments the isolates led to a significant reduction in the severity of Macrophomina root rot of mungbean [*Vigna radiata*], okra [*Hibiscus esculentus*] and sunflower. It is concluded that it may be possible to control Macrophomina root rot with *Rhizobium*.

Somaclonal variation

641 BHADRA, SK. 1994. **Exploration of wild gene pool in the genetic improvement of Mungbean through in vitro genetic manipulation techniques and development of tissue culture techniques for induction of somaclonal variation in the crop**. *Workshop on Present Status and Future Direction of Biotechnological Res. in Bangladesh*. (BARC, Dhaka: 1994: June 25).

642 MATHEWS, VH; RAO, PS; BHATIA, CR. 1986. **Somaclonal variation in cotyledonary plants of mung bean**. *Zeitschrift fur Pflanzenzuchtung*, 96: 2, 169-173; 16 ref.

Plants of *Vigna radiata cv. ML5* raised from in vitro culture of deembryonated cotyledons were transplanted into soil, and seeds obtained from such R1 plants were used to raise the second generation. Ten progenies out of 70 showed chlorophyll and morphological mutations similar to those obtained in the M2 following treatment of seeds with radiations or chemical mutagens.

Hybridization

643 CHOWDHURY, RK; CHOWDHURY, JB. 1983. **Compatibility between *Vigna radiata (L.) Wilczek* and *Vigna umbellata (Thumb) Ohwi* and *Ohashi***. *Genetica Agraria*, 37: 3/4, 257-266; 11 ref.

In crosses between two varieties of *V. radiata* and one of *V. umbellata*, pod set only occurred when *V. radiata* was used as seed parent. Plants of *V. radiata cv. BSG* X *V. umbellata* died in the seedling stage; in the hybrids from *V. radiata cv. T1* X *V. umbellata*, pollen fertility was 2.6%, and no pod set was observed. In all the interspecific hybrids, meiosis was irregular, with quadrivalents, trivalents, bivalents and univalents being observed at metaphase I, and bridges, laggards and fragments at anaphase I.

644 MINOCHA, JL; RAVI; KUMAR, R; MEHTA, ARCHNA. 1992. **Morphological, cytological and peroxidase isozyme studies in diploids, hybrids and amphidiploids of *Vigna radiata* and *V. mungo***. *Indian Journal of Genetics and Plant Breeding*, 51: 4, 429-437.

645 SHANMUGAM, AS; RATHNASAMY, R; RANGASAMY, SR; RATHNASWAMY, R. 1983. **Crossability studies between greengram and blackgram**. *Current Science*, 52: 21, 1018-1020; 7 ref.

When six *Vigna radiata* genotypes (female) were crossed with three of *V. mungo*, pod set ranged from 0.7 to 11.5%. No pods were set from the reciprocal crosses. Microscopic examination revealed that the *V. radiata* pollen failed to germinate on the stigmas of *V. mungo*. Since stigmatic and stylar morphology is the same in the two species, it is concluded that failure of pollen germination was caused by the stigmatic exudate of *V. mungo*.

646 SINGH, KP; SHARMA, SK; SINGH, RK; SOOD, DR. 1986. **Performance of amphidiploid derivatives of greengram X blackgram crosses**. *Indian Journal of Agricultural Sciences*, 56: 5, 390-392; 9 ref.

Ninety C7 or C8 amphidiploids, derived from crosses between different varieties of *Vigna radiata* (green gram) and *V. mungo* (black gram), were classified into black or green-gram types on the basis of testa colour. A total of 45 were compared for yield with the green gram K851 and 45 with the black gram T9 in 1983 and 1984. In 1983, 11 of the former outyielded K851 and 10 of the latter outyielded T9; in 1984, these figures were reduced to 8 and 6, respectively. All the amphidiploids had more protein than the parental strains, 9 had more methionine and 2 more tryptophan. It is concluded that favourable genes from both species had accumulated in the amphidiploids, which showed increased variability.

647 SINGH, DP; SHARMA, BL; DWIVEDI, S. 1983. **Inheritance of hard seeds in interspecific crosses of mungbean**. *Indian Journal of Genetics and Plant Breeding*, 43: 3, 378-379.

F1 and F2 segregation ratios in crosses between the *Vigna radiata* soft-seeded cultivars G65 and T44 (female) and hard-seeded *V. sublobata* indicated that hardseededness is controlled by a single dominant gene, designated Hd1.

648 VERMA, RPS; SINGH, DP. 1986. **Problems and prospects of interspecific hybridization involving greengram and blackgram**. *Indian Journal of Agricultural Sciences*, 56: 7, 535-537; 9 ref.

In 4 crosses between *Vigna radiata* (female) and *V. mungo*, involving 2 cultivars of each, germination of F1 seeds ranged from 43.7 to 61.5% and survival on transfer to soil from 12.5 to 50%; differentiation into plantlets following embryo culture ranged from 20 to 30% and survival on transfer to soil from 33.3 to 50%. In reciprocal crosses involving the same 4 varieties, the respective figures were 0, 0, 14.2-28.1 and 14.2-22.2%.

Callus culture

649 KUMAR, V; SHARMA, DR. 1988. **Selection and characterization of thiazolidine - 4 carboxylic acid resistant callus culture of *Vigna radiata (L) Wilczek var. radiata***. *Plant Cell Reports*, 7 : 648-651.

650 SINGH, RP; SINGH, BD. 1984. **Promotory effect of glutamine on root regeneration from callus cultures of mung**. *Current Science*, 53: 3, 148-149; 9 ref.

Glutamine at concentrations ranging from 0.5 to 4.0 g l-1 when added to B6 medium containing 0.05-0.1 μg ml-1 2,4-D and 0.01-0.1 μg ml-1 kinetin induced 17-77% increases in fresh and dry callus weight and induced greater root proliferation, compared with the controls, in shoot explant callus tissues. The promotory

effect of glutamine was greatest at 0.1 g l-1. Glutamine concentrations of 1-4 g l-1 promoted root regeneration in the presence of low concentrations of 2,4-D and kinetin.

Growth regulators

651 GULATI, A; JAIWAL, PK. 1990. **Culture conditions effecting plant regeneration from cotyledons of *Vigna radiata (L.) Wilczek***. *Plant Cell, Tissue and Organ Culture*, 23: 1, 1-7; 27 ref.

Complete *V. radiata* plants were regenerated from the uncallused proximal ends of cotyledons on Murashige and Skoog (MS), Gamborg (B5) and C (MS salts + B5 vitamins) media. Regeneration frequency was greatest on C but varied with genotype, size, orientation and age of explant and with the different growth regulators in the medium. Addition of cytokinins induced callusing at the proximal ends of cotyledons followed by multiple shoot formation. Of 6-benzyl amino-purine (BA), kinetin, N (DELTA-2 isopentyl) adenine and adenine sulphate, only BA and kinetin enhanced the frequency of shoot regeneration. 1 X 10-5 M BA gave greatest (60%) shoot regeneration whereas 5 X 10-6 M BA gave the greatest number of shoots (8-9) per explant. Cotyledons excised from 2-d-old seedlings were most regenerative. The regenerative response of cotyledons decreased when sliced into 2 equal parts either longitudinally or transversely. Callusing and organogenic differentiation occurred only if the petiolar end of cotyledons was in contact with medium. None of the tested treatments were effective in inducing shoot bud differentiation from subcultured callus. Well developed shoots rooted when incubated on half strength MS, MS and MS basal medium supplemented with IAA (5 X 10-6 M). The rooted plants were transferred to pots and later established in the field with 60% success.

652 KUMAR, V; SHARMA, DR; SHEORAN, IS. 1990. **Effect of proline on growth, ionic content and osmotic potential of thioproline stressed and non-stressed wild type callus cultures of mungbean (*Vigna radiata (L.) var. radiata*)**. *Indian Journal of Experimental Biology*, 28: 7, 661-664; 23 ref.

Supplementation of growth media with low concn (0.22, 0.37, 1.12 and 2.25 mM) of proline resulted in alleviation of growth inhibition caused by 3 mM thioproline in sensitive (wild type) callus of *V. radiata*. A high concn (67.50 mM) of exogenous proline inhibited growth of the wild type callus culture, grown either in the presence or absence of thioproline. Higher levels of K+ were observed in calluses growing on low thioproline concn, while Na+ and Cl- levels were not affected by proline concn.

653 SENGUPTA, T; BAG, A; BISWAS, AK; MUKHERJI, S. 1989. **Penicillin induced stimulation of proton efflux and membrane bound ATPase in mung bean (*Vigna radiata L. Wilczek*) hypocotyl segments**. *Indian Journal of Experimental Biology*, 27: 2, 166-169; 29 ref.

Penicillin stimulated proton extrusion from excised segments of *V. radiata* hypocotyls, and the effect was further increased by the addition of IAA and divalent cations. Penicillin was also effective in promoting elongation of hypocotyl segments at rates comparable to those of proton extrusion. Penicillin-induced H+ efflux was suppressed by simultaneous application of anti-auxins such as TIBA and MH. The process of proton efflux caused by penicillin is probably coupled to ATP hydrolysis, catalysed by a membrane-located ATPase with electrogenic H+ ion transport.

654 TALWAR, KK; SINGH, IP; KALSI, PS. 1992. **A sesquiterpenoid with plant growth regulatory activity from *Saussurea lappa***. *Phytochemistry*, 31: 1, 336-338; 5 ref.

Saussureal, a new ring A-contracted aldehydrolactone, of the modified eudesmanolide type, was isolated from the biologically active fraction of the oil of costus roots from Kashmir. It showed significant activity in screening tests for the potential to generate rooting in hypocotyl cuttings of *V. radiata*.

Vigna unguiculata

655 ARYA, ID; CHANDRA, N. 1989. **Organogenesis in anther-derived callus culture of cowpea (*Vigna unguiculata (L.) Walp*)**. *Current Science*, 58: 5, 257-259; 7 ref.

Callus was produced from young anthers containing thin-walled microspores at the late unicellulate stage. Greening and leaf-like stuctures were produced from calluses subcultured on liquid MS medium supplemented with 1 mg benzyladenine and 0.5 mg IBA/litre, with rotary shaking and low light levels. Extensive rooting of calluses was obtained after subculturing on solid MS medium containing the same growth regulators under continuous light conditions.

656 CHEEMA, HK; BAWA, J. 1991. **Clonal multiplication via multiple shoots in some legumes (*Vigna unguiculata* and *Cajanus cajan*)**. *Acta Horticulturae*, No. 289: 93-96; 9 ref.

Multiple shoots were induced directly from hypocotyl and stem explants (with apex) of pigeonpea (*Cajanus cajan*) and cotyledonary node and stem explants of cowpea (*Vigna unguiculata*) on MS medium supplemented with combinations of benzyladenine, potassium and NAA at various concentrations. Complete plants were regenerated from the shoots on hormone-free medium.

657 CHEEMA, HK; BAWA, J. 1992. **Morphogenetic studies in vitro in callus cultures of cowpea (*Vigna unguiculata*)**/edited by HD Tindall; FG Dennis Jr and R von Alvensleben. International Society for Horticultural Science (ISHS), Wageningen (Netherlands) p. 165-169.

658 DE, KK; ROY, SC. 1983. **Changes in protein patterns during growth of *Vigna unguiculata (L.) Walp.* callus tissues**. *Biologia Plantarum*, 25: 5, 321-325; 8 ref.

Alterations in protein patterns were observed in callus tissues of *V. unguiculata* up to the 10th subculturing. A gradual increase in the amount of protein was found up to the 6th subculturing. Decreases in the quantity of protein after 8 months of culture were possibly correlated with the cytodifferentiation of the tissues. At the beginning of morphogenesis there was an increase in the number and intensity of protein bands at the anionic end of the polyacrylamide gel.

659 DHANJU, MS; GILL, BS; SIDHU, PS. 1985. **In vitro development of *Cajanus* X *Atylosia* hybrids**. *Current Science*, 54: 24, 1284-1286; 5 ref.

Emasculated flowers of *C. cajan*, pollinated by wild *A. scarabaeoides*, were treated with GA, NAA and kinetin for 2 weeks. Developing embryos were excised and transferred to modified Murashige & Skoog culture medium. Complete plants were obtained from 76% of embryos. Chromosomal studies showed the presence of quadrivalents, trivalents, univalents and bivalents, and also laggards at anaphase in the hybrids. Some 51% of hybrid pollen was sterile.

660 FOUGAT, RS; PATHAK, AR; BHARODIA, PS. 1992. **Regeneration of haploid callus from anthers of pigeonpea**. *Gujarat Agricultural University Research Journal*, 17: 2, 151-152.

661 GUPTA, SC; KAPOOR, RK; RAO, TP; ARIYANAYAGAM, RP. 1992. **Identification and inheritance of a new dwarfing gene in pigeonpea**. *Indian Journal of Genetics and Plant Breeding*, 52: 2, 144-148.

662 HIREMATH, RV; BALASUBRAMANYA, RH; PURANIK, SB. 1973. **Effect of culture filtrate of Fusarium *udum Butler* on the rhizosphere microflora of *Cajanus* canjan**. *Indian Journal of Microbiol*, 12: 229-230.

663 KHAN, TA; HUSAIN, SI. 1988. **Studies on the efficacy of *Paecilomyces lilacinus* as biocontrol agent against a disease complex caused by the interaction of *Rotylenchulus reniformis*, *Meloidogyne incognita* and *Rhizoctonia solani* on cowpea**. *Nematologia Mediterranea*, 16: 2, 229-231; 6 ref.

The application of *P. lilacinus* at 2 g per pot, significantly reduced damage to cowpea [*Vigna unguiculata] cv. Pusa Barsati* caused by *R. reniformis* or *M. incognita* (both at 1000 nematodes/pot) or *R. solani* at 1 g mycelia/pot when inoculated singly or in combination. The fungus also reduced nematode multiplication and root galling and was antagonistic against *R. solani*. Its efficacy was, however, more pronounced against monopathogenic than against multipathogenic infections.

664 KUMAR, AS; REDDY, TP; REDDY, GM. 1984. **Adventitious shoot formation and plantlet regeneration in pigeonpea**. *International Pigeonpea Newsletter*, No. 3: 12-15; 5 ref.

Explants of leaves, shoot apices, epicotyls, roots and cotyledons were excised from aseptically grown 7-day-old pigeonpea seedlings and inoculated on to Blaydes' medium supplemented with different concn. of auxins (2,4-D, IAA and NAA) and cytokinins (kinetin and BA), for callus initiation and shoot formation. Epicotyl explants cultured on media containing either 2 mg kinetin + 1 mg IAA/l or 2.5 mg BA/l produced 2-5 shoots from the cut ends in 38% of the cultures. Direct production of shoots was also observed from shoot apices on media with 2 mg BA + 0.5 mg NAA/l or 2.5 mg BA/l alone. Cotyledons cultured on a medium with 2.5 mg BA/l initiated 2-3 shoots within a week of culture. Leaf callus regenerated shoots on a medium containing 0.5 mg BA + 0.01 mg GA3 + 0.1 mg NAA/l. Genotypic differences were observed for shoot-forming capacity of different explants and their callus cultures.

665 KUMAR, AS; REDDY, TP; REDDY, GM. 1985. **Genetic analysis of certain in vitro and in vivo parameters in pigeonpea (*Cajanus cajan L.*)**. *Theoretical and Applied Genetics*, 70: 2, 151-156; 14 ref.

Analysis of data on callus growth from cultured leaf explants, multiple shoot production in cotyledon cultures, seedling vigour and seed yield/plant from a 7 X

7 diallel, excluding reciprocals, revealed the existence of highly significant heterosis for callus growth and seed yield. In general, hybrids showing heterosis for callus growth also exceeded the better parent for seed yield. Combining ability analysis revealed both additive and nonadditive gene effects for callus growth, while number of shoots/cotyledon was mostly governed by nonadditive effects. ICP7035 was the best general combiner for callus growth and shoot forming capacity of cotyledons. Hybrids 7186 X 6974 and 7035 X T21 showed maximum specific combining ability effects for callus growth and shoots/cotyledon. Callus dry weight was positively correlated with seed yield and seedling weight, suggesting the possibility of using callus growth as a parameter for mass screening and selection of superior hybrids.

666 KUMAR, AS; REDDY, TP; REDDY, GM. 1984. **Multiple shoots from cultured explants of pigeonpea and *Atylosia* species**. *Sabrao Journal*, 16: 2, 101-105.

Multiple shoots were developed from epicotyl segments and shoot tips of 4 pigeonpea genotypes and 6 *Atylosia spp.* on Blaydes' medium (BM) containing 2.5 mg BA/l. Shoot buds were also induced from excised cotyledons of *Cajanus* and *Atylosia spp.* on BM + 2.5 mg BA/l and from split pigeonpea cotyledons on BM supplemented with 4 mg BA, 0.1 mg GA3 and 0.5 mg NAA/l. Further growth of these shoot buds was promoted on the same medium containing 0.2 mg NAA and 0.01 mg kinetin/l. The shoots of both *Cajanus* and *Atylosia* were rooted on BM supplemented with 0.6 mg NAA, 1.0 mg IAA and 0.01 mg kinetin/l.

667 KUMAR, AS; REDDY, TP; REDDY, GM. 1983. **Plantlet regeneration from different callus cultures of pigeonpea (*Cajanus cajan L.*)**. *Plant Science Letters*, 32: 3, 271-278; 17 ref.

Blaydes' medium supplemented with 2 mg/l 2,4-D and 0.5 mg/l kinetin was generally the best of seven media tested for inducing callus in leaf, epicotyl, root and cotyledon explants from seedlings of six varieties; leaves were the most efficient in producing rapidly growing callus. Shoot formation from callus was dependent on explant, growth regulator and variety. Regenerated shoots rooted on Blaydes' medium containing 0.6 mg/l NAA + 0.01 mg/l kinetin or 1.0 mg/l IAA + 0.01 mg/l kinetin.

668 KUMAR, PS; SUBRAHMANYAM, NC; FARIS, DG. 1984. **In vitro regeneration of *Cajanus* and *Atylosia* plants**. *International Pigeonpea Newsletter*, No. 3: 15-16; 6 ref.

Tabulated data are presented on plantlet and shoot regeneration on different media from explants of mature-seed cotyledons and of leaf and epicotyl segments from one-week-old seedlings of 4 *Cajanus cajan* cultivars and one accession each of *A. cajanifolia*, *A. albicans* and *A. sericea*. Multiple shoots developed from 21% of *A. cajanifolia* cultivars while in the cultures of *A. albicans* and *A. sericea* single shoots usually developed and multiple shoots were rare. On a suitably modified medium, both shoots and roots developed from 2 to 14% of whole-cotyledon explants of *C. cajan* and from about 2% of those of *A. cajanifolia*. The *C. cajan* cultivars ICP4726, ICP7035 and Pant A2 showed various amounts of regeneration but GS4, with the smallest seeds, failed to respond to culturing almost completely.

669 KUMAR, PS; SUBRAHMANYAM, NC; FARIS, DG; KUMAR, P SATEESH. 1985. **Morphological variation and inheritance in a pigeonpea intergeneric hybrid**. *Current Science*, 54: 7, 346-348; 5 ref.

A cross between *Cajanus cajan* (female) and *Atylosia albicans* (both 2n = 22) yielded hybrids from 7% of pollinations. The hybrids formed 11 bivalents at meiosis and showed regular disjunction. The F1 hybrids were intermediate between the parents in leaflet shape (lanceolate vs. obovate) and resembled *A. albicans* in 3 other traits (twining vs. erect growth habit and presence vs. absence of seed strophiole and mottled seeds). Analysis of F2 segregation data revealed that leaflet shape was controlled by a single gene with incomplete dominance, while the other traits were controlled by 2 loci each.

670 KUMAR, PS; SUBRAHMANYAM, NC. 1984. **Nucleolar variation in a pigeonpea intergeneric hybrid: evidence for allosyndetic recombination**. *Canadian Journal of Genetics and Cytology*, 26: 5, 499-505; 20 ref.

Cytological study of a hybrid between *Cajanus cajan* and *Atylosia albicans* revealed regular bivalent formation and disjunction. Nevertheless, high pollen sterility and low seed set were evident. An examination of PMCs revealed variation in nucleolar number at telophase I (4-8) and at telophase II (0-4 in daughter nuclei), although each genome contained two nucleolar organizers. Variation was also recorded for nucleolar size and distribution at telophase II. Variation in nucleolar number and distribution is interpreted as having originated from pairing and recombination between nucleolar organizer chromosome(s) of one parental species with the nonnucleolar organizer chromosome(s)

of the other. Size variation is attributed to nucleolar dominance. The results are considered to explain the high degree of pollen sterility in the hybrid in spite of normal meiosis, and to suggest that the karyotypes of *C. cajan* and *A. albicans* have differentiated through structural heterozygosity.

671 KUMAR, PS; SUBRAHMANYAM, NC; FARIS, DG. 1985. **Plantlet regeneration from immature embryos of pigeonpea**. *International Pigeonpea Newsletter*, No. 4: 11-13; 9 ref.

When embryos aged <11, 11-14, 15-19 and >19 days from 4 varieties were cultured on Murashige & Skoog or B5 medium supplemented with 1 mg 2,4-D/litre, (1) percentage plantlet recovery was generally highest with 15-19-day-old embryos, (2) B5 was the better medium and (3) ICP7035 gave a marginally better response than the other varieties.

672 KUNDU, BS. 1988. **Effect of dual inoculation with *Azospirillum* and *Rhizobium* on nodulation and nitrogen fixation in pigeonpea**. *Indian Journal of Microbiology*, 28: 3, 233-237; 23 ref., 2 tab.

Seed treatment with diazotrophic bacteria showed an appreciable gain in nodulation, nitrogen fixation and biomass of pigeonpea (*C. cajan*) under Leonard jar conditions. The response was greater with symbiotic bacteria. Combined inoculation of pigeonpea with Rhizobium and *Azospirillum* increased nodulation and nitrogen fixation. The effect was significant when Rhizobium mutants with reduced nitrogenase activity were used. The establishment of *Azospirillum* in pigeonpea rhizoplane and nodules was confirmed by reisolation.

673 LAL, J; CHANDRA, S. 1987. **Plant breeding challenges and constraints: suggested areas of tissue culture relevance in pulses - chickpea and pigeonpea**. *Legume Research*, 10: 1, 53-59; 19 ref.

The main causes and constraints contributing to low yield in these 2 grain legumes are considered, and include such factors as lack of improved varieties, susceptibility to diseases, pests and stress, asynchronous maturity and cross incompatibility. Tissue culture techniques are seen as helping to overcome some of these constraints by allowing interspecific, intergeneric and wide hybridization, by inducing genetic variability, and by allowing preservation of pollen and the production of haploids and homozygous lines.

674 LOKESH, MS; HIREMATH, RV; HEGDE, RK. 1987. **Seed mycoflora of redgram (*Cajanus cajan (L.) Mills P.*)**. *Plant Pathology Newsletter*, 5: 1-2, 31.

Nine fungi were isolated from pigeonpea seeds, the most common were *Aspergillus flavus*, *A. niger*, *Alternaria alternata* and *Fusarium moniliforme* [*Gibberella fujikuroi*]. Germination and seedling vigour were reduced in seeds treated with these fungi and their metabolites. Seed coats were more infected than cotyledons. *G. fujikuroi* was isolated from the embryo. Exudates from all the cultivars tested inhibited germination of *Fusarium udum*. Seed treatment with *Trichoderma viride* contolled *Alternaria alternata*, *Cladosporium* and *Curvularia lunata* [*Cochliobolus lunatus*] and improved germination. Seed treatment with Brassicol [quintozene], captan and thiram improved germination and seedling vigour.

675 NAUTIYAL, CS; HEGDE, SV; BERKUM, P-VAN. 1988. **Nodulation, nitrogen fixation, and hydrogen oxidation by pigeonpea *Bradyrhizobium spp.* in symbiotic association with pigeonpea, cowpea, and soybean**. *Applied and Environmental Microbiology*, 54: 1, 94-97; 26 ref., 3 tab.

The pigeonpea strains of *Bradyrhizobium* CC-1, CC-8, UASGR(S), and F4 were evaluated for nodulation effectiveness for N2 fixation, and H2 oxidation with homologous and nonhomologous host plants. Strain CC-1 nodulated *Macroptilium atropurpureum*, *Vigna unguiculata*, *Glycine max*, and *G. soja* but did not nodulate *Pisum sativum*, *Phaseolus vulgaris*, *Trigonella foenum-graecum*, and *Trifolium repens*. Strain F4 nodulated *G. max cv. Peking* and *PI 434937 (Malayan)*, but the symbioses formed were poor. Similarly, *G. max cv. Peking, cv. Bragg, PI 434937, PR 13-28-2-8-7*, and HM-1 were nodulated by strain CC-1, and symbioses were also poor. *G. max cv. Williams* and cv. Clark were not nodulated. H2 uptake activity was expressed with pigeonpea and cowpea, but not with soyabean. *G. max cv. Bragg* grown in India in soil not previously exposed to *Bradyrhizobium japonicum* formed nodules with indigenous *Bradyrhizobium spp*. Six randomly chosen isolates, each originating from a different nodule, formed effective symbioses with pigeonpea host ICPL-407, nodulated PR 13-28-2-8-7 soyabean forming moderately effective symbioses, and did not nodulate Williams soyabean. These results indicate the six isolates to be pigeonpea strains although they originated from soyabean nodules. Host-determined nodulation of soyabean by pigeonpea *Bradyrhizobium spp*. may depend upon the ancestral backgrounds of the cultivars. The poor symbioses formed by the pigeonpea strains with soyabean indicate that this crop should be inoculated with *B. japonicum* for its cultivation in soils containing only pigeonpea *Bradyrhizobium spp*.

676 PODILE, AR; DUBE, HC. 1987. **Antagonism of *Bacillus subtilis* to *Phytophthora drechsleri f.sp. cajani***. *Indian Phytopathology*, 40: 4, 503-506; 6 ref.

Of 8 bacterial isolates tested against the causal agent of pigeonpea blight, the widest inhibition zones were caused by an Indian isolate (AF1) and a Canadian isolate of *B. subtilis*. *P. drechsleri* f.sp. cajani failed to grow in a 10-fold concentrated cell-free culture filtrate of AF1. In a 5-fold concentrated extract, the inhibitory effect on radial growth was proportional to the concn. Increasing the concn of cell-free culture filtrate of AF1 in Richard's solution decreased the dry wt of the fungus.

677 PUNDIR, RPS; SINGH, RB. 1985. **Crossability relationships among *Cajanus, Atylosia* and *Rhynchosia* species and detection of crossing barriers**. *Euphytica*, 34: 2, 303-308; 13 ref.

The *C. cajan* cultivars Pant A2 and UPAS120, 8 *Atylosia* species and one species of *Rhynchosia* were crossed in 73 combinations. Only in 12 cases were F1 plants obtained. *C. cajan* crossed successfully with 5 *Atylosia* species, while within the genus *Atylosia*, 3 interspecific crosses were obtained. *Rhynchosia* did not cross with any other species. In most of the unsuccessful combinations the pollen germinated but pollen tube growth was inhibited inside the style or stigma.

678 PUNDIR, RPS; SINGH, RB. 1985. **Cytogenetics of F1 hybrids between *Cajanus* and *Atylosia* species and its phylogenetic implications**. *Theoretical and Applied Genetics*, 71: 2, 216-220; 12 ref.

A cytogenetic study was made of 2 cultivars of *C. cajan*, 6 species of *Atylosia* and 7 intergeneric and interspecific hybrids. The following hybrids showed meiotic abnormalities, while the remainder were normal: *A. lineata* X *A. scarabaeoides*, *A. scarabaeoides* X *A. sericea* and *C. cajan* X *A. trinervia*. It is suggested that *A. cajanifolia* is the closest wild relative of *C. cajan*, followed by *A. scarabaeoides*, *A. albicans* and *A. trinervia*. *A. sericea* was closer to *A. scarabaeoides* than to *A. lineata*.

679 REDDY, LJ. 1984. **Fusion of centromeres and star formations at pachytene of *Cajanus* X *Atylosia* hybrids**. *Heredity*, 53: 2, 435-439; 7 ref.

Fusion of the centromeres of different bivalents to form star-shaped configurations (termed "stars") was observed at pachytene in hybrids of *C. cajan* with *A. lineata*, *A. sericea* and *A. scarabaeoides*. Certain bivalent combinations formed stars more frequently than others, indicating the nonrandom nature of the phenomenon. Although hexavalents, octovalents or more than one quadrivalent/-cell were not observed during diakinesis and metaphase I, as would be expected from the number of chromosome arms involved in star formation and the number of stars/cell at pachytene, the possibility that the stars result from reciprocal translocations is not ruled out. On the basis of the existence of a clear relationship between the number of cells showing star formations at pachytene and the number showing bivalent associations at diakinesis and metaphase I on the one hand, and between the number of chromosome arms forming the stars and the number of chromosomes involved in each association on the other, it is suggested that the stars are forerunners of secondary associations.

680 SAXENA, KB; ARIYANAYAGAM, RP; REDDY, LJ. 1992. **Genetics of a high-selfing trait in pigeonpea**. *Euphytica*, 59: 2-3, 125-127; 9 ref.

A true-breeding line characterized by free filaments of anthers and modified keel petal was derived from the F2 population from a cross between *Cajanus cajan* and *Atylosia lineata*. This variant displayed partial cleistogamy which favours a high level of self-fertilization. Inheritance of this trait was studied in the F1, F2, F3 and BC1F1 generations of three crosses. The results suggest that the partial cleistogamy trait is governed by a single recessive gene, designated pct.

681 SEHGAL, CB; GANDHI, V. 1985. **Studies on the endosperm of *Cajanus cajan* with special emphasis on the function**. *Phytomorphology*, 35: 3/4, 201-206; 27 ref.

The division of the primary endosperm nucleus of *C. cajan* preceded that of the zygote. The endosperm was of the nuclear type and the nuclei were aggregated at the micropylar end and around the periphery of the embryo sac; later on it became cellular in the micropylar region. The chalazal end developed into a free nuclear haustorium. The endosperm degenerated during the late stage of seed development resulting in an exalbuminous seed. Histochemical and biochemical studies indicated that the haustorium acts as secretory and absorptive organ and the endosperm provides nutrition to the developing embryo.

682 SHARMA, PK; LAXMINARAYANA, K. 1989. **Effect of high temperature on plasmid curing of *Rhizobium spp.* in relation to nodulation of pigeonpea [*Cajanus cajan (L.) Millsp.*]**. *Biology and Fertility of Soils*, 8: 1, 75-79; 27 ref.

Fifty-six isolates of *Rhizobium* and *Bradyrhizobium* (*Cajanus*) were studied for their plasmid profile and N2-

fixation efficacy. One to three plasmids were reproducibly detected in all the *Rhizobium* strains but no plasmid was detected in the *Bradyrhizobium* strains. *Rhizobium* strain P-1 was mutagenized by Tn5 and 3 nod- and 6 nod+fix- were screened for symbiotic parameters. Neomycin sensitive mutants were isolated by elevated temperature (40°C) from tranconjugants carrying Tn5 insertions. The high temperature 'cured' these mutants from the single large plasmid present in the parent strain P-1. All cured mutants were nod-, indicating that the genes for nodulation were present on this plasmid, which is readily cured at a high temperature (40°C). The high temperature in the semi-arid zones of Haryana, could be responsible for the low nodulation of pigeonpea as the plasmid carrying the nodulation genes is cured at 40°C-45°C giving rise to non-nodulating mutants.

683 SIDHU, BS; BARUAH, R; BERI, V. 1988. **Establishment and effectiveness of added pigeonpea (*Cajanus cajan*) rhizobia in different soils of narrow abiotic variability**. *Biology and Fertility of Soils*, 6: 1, 84-88; 19 ref.

Pot and laboratory experiments were conducted to study the establishment and effectiveness of a streptomycin-sulphate-resistant (1 mg/ml of medium) pigeonpea rhizobial strain (RM7) in sterile sand and non-sterile soils. Strain RM7 increased the dry-matter yield of pigeonpea (*Cajanus cajan*) by 106% over control plants under sterile conditions. However, when the rhizobial strain was introduced into 14 non-sterile soils with a narrow abiotic variability, the comparable beneficial effect was observed in only one soil inoculated with log 6.70 cells/pot. At this inoculum rate, the percentage increase in yield over control plants ranged from -1 to 140 in different soils. *Rhizobium* (RM7), applied at log 3.70 cells/pot (3 kg soil), showed less than 5% establishment in four soils. However, establishment varied from 8% to 72% at a higher level of inoculation (log 6.70 cells/pot). Displacement of native rhizobia and creation of new sites for nodulation by the introduced rhizobia were also affected by soil properties. The increase in shoot dry-matter yield over control plants was positively correlated with the percent establishment of RM7 ($r = 0.60^*$) in these soils. Some biotic stresses led to poor survival, proliferation and establishment of the added alien in the soil. Therefore, any culture that is efficient in one soil may not produce similar results under all situations.

684 SIDHU, PS; VERMA, MM; BATTA, RK; SARLACH, RS. 1992. **Implication of reciprocal cross effects in developing F1 hybrids in pigeonpea**. *Crop Improvement*, 19: 1, 60-61.

685 SINGH, I; BHARTI, S; NANDWAL, AS; GOSWAMI, CL; VARMA, SK. 1992. **Effect of temperature on in vitro pollen germination in pigeonpea**. *Biologia Plantarum*, 34: 5-6, 461-464.

686 SUDHAKAR, Y; SINGH, IS; SINGH, CP. 1986. **Anther culture of pigeonpeas: physiology of callus formation and ploidy analysis**. *Indian Journal of Plant Physiology*, 29: 1, 67-70; 10 ref.

Attempts were made to ascertain the physiological requirements for callus formation from anthers of pigeonpeas. The modified Murashige and Skoog liquid medium supplemented with 2,4-D (2 mg/1) and kinetin (0.2 mg/1) could be used to induce callus from the anthers. The callus thus formed could be maintained on the same medium solidified with agar (10 g/1). Ploidy analysis of the callus revealed its diploid nature indicating the origin of the callus from the vegetative cells of the anther but not from the pollen grains. Genotype and physiological status of the material played an important role in callus production from anthers.

687 TUTEJA, OP. 1992. **Heterosis in single and three-way crosses in pigeonpea**. *Indian Journal of Genetics and Plant Breeding*, 52: 1, 100-102.

688 TYAGI, SD; GUPTA, PK. 1991. **Interspecific nuclear DNA variation in pigeonpea (*Cajanus cajan (L.) Millsp.*) and pea (*Pisum sativum L.*)**. *Indian Journal of Genetics and Plant Breeding*, 51: 3, 357-362.

Macrotyloma uniflorum

689 SINHA, RR; DAS, K. 1986. **Anther-derived callus of Dolichos biflorus L., its protoplast culture and their morphogenic potential**. *Current Science*, 55: 9, 447-452; 19 ref.

When anthers of *D. biflorus* [*Macrotyloma uniflorum*?] *cv. BR10* were cultured on SS-A8 callus induction medium (composition detailed), maximum response (91.5%) was obtained from anthers containing PMCs. This callus produced globular somatic embryoids on medium containing BA and GA3. These developed further on medium containing any of several auxins or auxin/cytokinin combinations. Plantlets were recovered on SS-A8 medium supplemented with coconut milk. In a second experiment, protoplasts derived from anther-derived callus were themselves used to produce callus. These calluses differentiated into somatic embryoids but failed to produce roots.

690 SINHA, RR; DAS, K; SEN, SK. 1983. **Nutritional requirement of tissue cultures of some tropical legume crops**. *Indian Journal of Experimental Biology*, 21: 3, 113-119; 16 ref.

Root and leaf explants from 15 to 25-day-old seedlings of five cultivars each of *Macrotyloma uniflorum*, *Lathyrus sativus*, *Vigna mungo*, *V. radiata*, *Cicer arietinum* and *Cajanus cajan* were cultured on standard and modified media containing various growth regulators. On the basis of the results, optimal culture procedures are recommended for these species.

Vicia faba

691 ABRAHAM, S; DEVI, CKV. 1989. **Inhibition of cytokinesis and induction of mixoploidy by magnesium sulphate**. *Caryologia*, 42: 2, 121-126; 17 ref.

When roots of *Vicia faba* seedlings from seeds treated with different concentrations of magnesium sulfate were compared with those of the controls, a significant increase in cells showing abnormal divisions was evident. Normal spindle formation and cytokinesis were inhibited resulting in the formation of binucleate, polyploid and multinucleate cells. It is suggested that magnesium sulfate used in the preparation of nutrient media, when present in higher concentrations, may cause somatic instability in callus cultures.

692 CHAKRABORTY, S; ROY, SC. 1985. **Effect of adenine on regeneration of *Vicia faba* in tissue culture**. *Current Science*, 54: 15, 758-760; 7 ref.

Addition of adenine (1 mg/litre) to MS [Murashige & Skoog] medium supplemented with IAA and BA stimulated shoot formation in nodular, green, radicle-derived callus of *V. faba cv. 1502*. This was followed by root development and subsequent regeneration of plantlets on half-strength MS medium.

693 GOHIL, RN; ASHRAF, MOHMAD. 1984. **Chromosome behaviour during micro- and megasporogenesis and the development of embryosac in *Vicia faba L.***. *Cytologia*, 49: 4, 697-701; 11 ref.

Observations are presented under the headings (1) somatic chromosomes, (2) male meiosis, (3) female meiosis and (4) development of embryo sac. It was found that the megaspore mother cell becomes differentiated after the microspores are fully developed, but that anther dehiscence is delayed until after the embryo sac is fully developed, ensuring self pollination.

Sesbania

694 BANSAL, YK; PANDEY, P. 1993. **Micropropagation of *Sesbania aculeata (Pers.)* by adventitious organogenesis**. *Plant Cell, Tissue and Organ Culture*, 32: 3, 351-355.

695 MATHEWS, H; RAO, SP; BHATIA, CR. 1988. **Increased frequency of normal plant regeneration from crown gall callus of *Sesbania rostrata***. *Current Science*, 57: 23, 1304-1306; 11 ref.

During experiments on plant regeneration from tissue cultures of this annual legume, regeneration of normal, non-transformed, nopaline negative shoots from axenic *A. tumefaciens* induced tumour tissue was observed in >50% of the cultures. These results compared with <1% in stem callus cultures and it is suggested that the tumour tissue of *Sesbania* was chimeric, consisting of both transformed and nontransformed cells.

Other leguminosae

696 BHADRA, SK; HAMMATT, N; DAVEY, MR. 1989. **Prospects for the use of in vitro techniques in the improvement of *Vigna* pulses**. *Sabrao Journal*, 21: 2, 75-91; 91 ref.

The subject is reviewed under the following headings: meristem culture; embryo culture; anther culture; plant regeneration and the induction of somaclonal variation (plant regeneration from explants; plant regeneration from cells cultured in suspension; and attempts to regenerate plants from protoplast-derived tissues); somatic hybridization; and genetic transformation.

697 BHATTACHARYYA, PS; MAITI, TK; BHATTACHARYYA, BC. 1992. **Tissue culture of Abrus precatorius and in vitro Abrus lectin production a new report**. *Proceedings of the 1992 Miami Biotechnology Winter Symposium- Advances in gene technology : Feeding the World in the 21st Century*. (1992: January). Vol 1, 34, 19-24.

698 RAHMAN, SM; HOSSAIN, M; BISWAS, BK; JOARDER, OI; ISLAM, R. 1993. **Micropropagation of *Caesalpinnia pulcherima* through nodal bud culture of mature tree**. *Plant Cell, Tissue and Organ Culture*, 32: 363-365.