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Mutation Breeding Newsletter

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RESEARCH NEWS

Induced mutations in okra (Abelmoschus esculentus (Linn.) Moench.)

Abelmoschus esculentus, commonly known as okra, lady's finger, or gumbo, is an important vegetable crop of the Afro-Asian countries. The reports on spontaneous and induced mutations in this crop are few. Mutants with supernumerary inflorescence [2], resistance to Phytophthora [4], increased number of nodes and branches [5], bushy plant type [6], and palmatisect leaves [3] have been reported previously.

In the present study, seeds with 12% moisture content of a widely grown Indian cultivar, "Pusa Sawani", were exposed to 10-100 krad gamma rays or 2 krad fast neutrons. Seeds presoaked in distilled water for 24 hours were treated with 1.0% EMS for 3 h at 25°C.

The LD_{50} for gamma rays based on survival at maturity was 80.5 krad. The M_2 generation was raised as fruit progenies [1]. A total of 36,983 seedlings and 8,757 plants were screened for mutations in the M_2 generation. Highest mutation rates in M_2 were obtained in the dose range of 60-80 krad gamma rays. Among the 25 viable mutations obtained, 14 had altered leaf characters. The diagnostic features of 10 mutants, which were studied in more detail, are presented in the table. All showed monogenic recessive inheritance of the mutant trait.

The inheritance of 8 mutants mentioned above was studied in the F_2 generation after back-crossing to the parent "Pusa Sawani" while the segregation pattern of the drooping and dwarf mutants was derived from heterozygous sister plants.

Four promising mutants were selected on the basis of fruit number per plant and fruit weight. These were evaluated in replicated yield trials for

two seasons. The thick fruit mutant showed numerical superiority over the parent in the winter crop of 1981. In summer 1982, the thick fruit mutant yielded 17,2 t/ha of marketable fruits from 12 harvests compared to 14,0 t/ha for the parent "Pusa Sawani" (LSD at 1% = 2,79 t/ha) showing an increased yield of ca. 22%. This mutant is now being further tested for yield at two different locations in India.

Table: The gene symbols and diagnostic characters of some okra mutants

Mutant/Mutagen	Gene symbol	Diagnostic characters
1. Chlorina-1 Gamma rays	ch-1	Slender, very tall, faster growing during seedling stage, leaves pale green with conspicuous veins.
2. Dark green Gamma rays	dg	Stem leaves and fruits are dark green; leaves with shorter petioles, plants with slender habit.
3. Drooping Gamma rays	dp	Plants with drooping leaves; does not set any fruits; it is maintained through heterozygous sib plants.
4. Dwarf EMS	dw	Very short and late, leaves dark green, very small flowers, fruits almost globular.
5. Pale leaf Gamma rays	pl	Plants have pale green colour, and stiff habit.
6. Short bushy Gamma rays	sb	Full grown plants are short bushy with hairy stem and leaves.
7. Subdariffa Gamma rays	sdl	First true leaf, long and narrow, old leaves long trifoliate, leaflets very long and narrow, with deep serrations resembling Hibiscus subdariffa during vegetative growth.
8. Trilobed leaf Gamma rays	trl	Plants with trilobed leaves, lobing very shallow.
9. Virescent Gamma rays	vr	Young leaves light green turning to normal green at maturity
10. Wavy leaf Gamma rays	wyl	Plants with wavy leaflets giving a twisted appearance for the leaf.

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(Contributed by V. Abraham and C.R. Bhatia, Biology and Agriculture Division, Bhabha Atomic Research Centre, Bombay, India.)

Gamma-ray induced early mutant in Trigonella foenum-graecum L.

Trigonella foenum-graecum L. (fenugreek) is cultivated for vegetable and condiment purposes. Few attempts have been made to improve yield and yield components through induced mutations (Raghuvanshi and Singh, 1977; 1980; Muthuswamy and Ponnuswamy, 1981). We obtained, an early mutant from a bulked M_2 population of 7,000 pods following 20 krad acute gamma irradiation of 10,000 seeds of variety FOS 8. Control plants flowered 85 days after planting while the mutant flowered 50 days after planting. The character earliness was found to be true-breeding in subsequent generations (M_3, M_4 and M_5). The mutant matured 25 days earlier than the control. The mutant also possesses high seedling vigour, tolerance to water-stress, less bitterness of leaves and pungent smell as compared to the control. Data from replicated trials in three generations indicate that the mutant possesses yield traits equal or superior to the control. The average values for plant height, number of branches, number of pods on the main branch, and seed yield per plant were 79.2 cm, 4.9, 13.4 and 14.5 g in mutants, as against 66.5 cm, 4.5, 9.2 and 11.3 g in the control. Hence, the short duration mutant could be profitable and may fit into a new cropping pattern.

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(Contributed by K. Vasudevan, K. Shanker and R.P. Dua, National Dairy Research Institute, Karnal-132001, India.)

Gamma-ray induced erect and semi-erect mutants in Vigna unguiculata (L) Walp.

Cowpea (Vigna unguiculata (L) Walp), is mainly cultivated as a pulse crop, but is also grown as a fodder crop either in monoculture or in combination with fodder maize (Zea mays). Few attempts have been made to improve its pod size and seed yield through induced mutations (Lawhale, 1982, Avita and Murthy, 1983; Sharma and Kharkwal 1983). However, well adapted high yielding fodder cowpeas are mostly twining and trailing types, which poses problems at the time of harvest. We found 2 non-twining erect and 2 semi-erect mutants in a M_2 population (8,000 single seed bulk) following 20 krad acute gamma irradiation of seeds of variety C28. These mutants were studied for their yield performance in M_3 and M_4 generations and the results obtained are presented in the table.

There were significant differences between the mutants and the original variety. Though the erect mutants (1 and 2) showed reduction in plant height, the green yield per plant was higher due to more branching. The mutants grown in a nematode infested field showed a fairly tolerant or resistant reaction to nematode attack. Therefore, these mutants, particularly erect mutant 1 could be profitably cultivated together with maize. The combination of maize and cowpea could provide a balanced diet to cattle.

Table . Mean plant height, number of main branches and weight/plant of mutants and control in M_3 and M_4 generations

Mutants and Control	M_3 generation			M_4 generation		
	Plant height (cm)	No. of branches	yield/ plant (g)	Plant height (cm)	No. of branches	yield/ plant (g)
Erect 1	163.2	3.8	770.0	157.2	3.7	730.0
Erect 2	174.0	3.5	706.6	169.2	3.2	701.0
Semi-Erect 1	190.3	2.8	776.6	185.0	2.4	709.0
Semi-Erect 2	202.2	2.5	651.7	203.2	2.1	690.3
C28 (Control)	196.0	1.9	612.7	198.7	2.0	621.6
LSD	15.0	0.1	NS	8.6	0.02	79.5

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(Contributed by K. Vasudevan, K. Shanker and R.P. Dua, National Dairy Research Institute, Karnal-132001, India.)

Rice mutants with short culm and improved grain quality

The rice cultivars, Tellakattera, HR-47, Yerragaluvadlu, Pottibasangi, Early Basangi, Tellahamsa, Kumkumbantulu, Nizulu, Bangaruteegalu, Gottelu, W-1263, Mashuri, HR-5, and Godavari isuka, IR-8 and IR-20, were treated with different concentrations/doses of EMS, DES, HZ and gamma rays. Various mutants affecting plant, panicle and grain characters were identified.

Of the many short-culm mutants induced in local rice cultivars, 66 mutants are subject of further investigations. Five of the Tellakattera dwarfs, d_6-d_{10}, were found to possess dwarfing genes nonallelic to DGWG; these dwarfing genes were also found to be nonallelic to each other.

Of the 124 grain type mutants recovered from different local cultivars, mutants of HR-5 showed considerable variability for their protein content ranging from 11.5-13.7%. Most of these high protein mutants also had fine grains and are being utilized in cross breeding programmes.

Protein in rice is mostly concentrated in the outer layers of the endosperm. The low protein content, which is a serious problem in rice, is aggravated by its partial loss on milling. Thus an improvement in the distribution of protein in the endosperm is desirable. Among induced grain type mutants, IR-8 - FG-26 and IR-8 - FG-33, have a deeper distribution of protein when compared to the parent. These mutants are being used in cross breeding programmes aimed at increasing the nutritive value of high yielding cultivars.

A semi-dwarf mutant of the basmati variety HR-47 grows to a mean height of 89.8 cm. The mutant has also an increased panicle number, higher protein content to the control, matures ten days earlier and gives 15-20% more yield when compared to the parent.

The coarse grain of IR8 restricts its commercial cultivation. The fine grain mutant FG-19 has translucent grain with a length/breadth ratio of 2.91 against 2.52 of the parent. This mutant was evaluated for its yield at 29 research stations throughout the country and also at IRRI and shows promise for release as a commercial cultivar.

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(Contributed by G.M. Reddy and T.P. Reddy, Dept. of Genetics, Osmania University, Hyderabad - 500 007 (A.P.) India.)

Double dwarf mutant in rice

Following EMS treatment of the high yielding semi-dwarf variety TH (control) several short culm mutants were selected in M_2. One of these, $THsd_{7-3}$, with 53 $\pm$ 3.42 cm. matures in 110 days. The F_2 ratios of 3:1 in crosses of the induced mutant with its control and 9:6:1 in crosses with a

tall variety Kalanamak reveal that the mutant is homozygous for two short culm genes, one common to the semi-dwarf original variety and another one mutated. Variety TH is derived from a cross HR22xT$(N)_1$, so the source of semi-dwarfness is DGWG. The F_2 of the above crosses presented additional variability in plant type, maturity time and yield components, and a number of plants were selected.

(Contributed by Aruna Reddy, T. and G.M. Reddy, Dept. of Genetics, Osmania University, Hyderabad - 500 007 (A.P.), India.)

In-vitro culture of rice

Regeneration of rice plants from long-term callus cultures

The ability to regenerate rice plants from callus cultures is often lost after 2-3 subcultures. We were able to regenerate rice plants from calli older than 700 days with a frequency of 50% by osmo-regulation. Calli from one week old seedling roots and mature embryos of rice variety Bala were initiated on Linsmaier and Skoog's medium supplemented with 2 mg/l 2,4-D, 2% sucrose and/or sorbitol and/or mannitol. Tissues grown on only sucrose medium were brown to tan and loosely arranged, while on sucrose plus sorbitol and sucrose plus mannitol media they were light yellow in colour and looked healthy. Without sorbitol or mannitol root callus lost its ability to organize shoots after 74 and embryo callus after 100 days in culture. However root and embryo calli of the same variety proliferating on 2% sucrose with addition of 3% sorbitol and/or 3% mannitol produced shoots over a period of 700 and 600 days respectively. From different sucrose concentrations (0,1,2,3,6 and 10%) tested 2% sucrose was optimal for shoot formation. 6% sucrose drastically reduced plantlet production and 10% sucrose totally inhibited shoot but not root regeneration. Plants regenerated from callus cultures showed variation in total number of tillers per plant, number of productive tillers per plant, length of panicle, number of fertile and sterile seed per panicle. Work is in progress now to evaluate the heritability of these regenerated plants.

In vitro selection of PEG and NaCl resistance in rice

Embryo derived callus of Tellahamsa was grown in Linsmaier and Skoog's liquid medium containing 2% sucrose for about 10 days. Cells growing in small clumps (few celled clumps) were then taken and plated out on LS agar medium supplemented with 2.5 and 5% polyethyleneglycol (Mol.wt.6000). Cells resistant to 2.5% and 5% PEG were selected. Cells resistant to 5% PEG were grown on this medium for 95 days and plantlets were regenerated with 14-15% frequency. Cells resistant to 2.5% PEG (250 days old) were also regenerated and grown to maturity. Regenerated plants will be tested again for PEG tolerance and for drought resistance. Similarly, embryo derived callis of Jaya and Tellahamsa were grown on LS medium containing 1% or 3% sodium chloride. Cells resistant to 3% sodium chloride were grown for 88 days and plantlets were regenerated with 2-3% frequency. The selected mutant plants are now under investigation for elucidating the mechanisms underlying toxic ion tolerance and to facilitate our understanding of salt tolerance.

(Contributed by P.B.K. Kishor, and G.M. Reddy, Dept. of Genetics, Osmania University, Hyderabad - 500 007 (A.P.) India.)

Variation in photosynthetic rates and RuP2 carboxylase activities among induced dwarfs of rice

Dwarf mutants of rice obtained after EMS treatment were planted along with controls under fluorescent illumination at 27°C for 30 days. Steady state CO_2 incorporation by the leaves was determined using radioactive carbon ($NaHCO_3$-^{14}C). RuP_2Case activities were assayed by ^{14}C incorporated into acid stable products.

The data summarized in the table show variations among the mutants. The leaves of HR-5-japonica and THsd-6-20 exhibited high rates of photosynthesis and greater activities of RuP_2Case. The chlorophyll content did not vary much among the tested plants. There appears a positive correlation of photosynthetic rates with RuP_2Case activities.

Table 1: Photosynthetic characteristics in induced dwarfs of rice*

Genotype	$^{14}CO_2$ fixation* ($mg/dm^{-2}hr^{-1}$)	RuP Case activity* ($umoles/mgchl^{-1}hr^{-1}$)	Chlorophyll* ($mg/g^{-1}fr.wt.$)
TH-control	29.68	203.82	1.47
TH-d-3	27.36	187.64	1.39
TH-d-5	29.56	190.03	1.32
TH-d-10	24.75	181.33	1.40
TH-sd-6-20	35.63	308.50	1.44
YV-control	29.07	199.35	1.30
YV-d-4	26.15	175.58	1.41
YV-sd-6	27.23	180.17	1.35
HR-5	30.13	280.11	1.47
HR-5-japonica	37.97	310.27	1.38

*average of three independent determinations

(Contributed by Ramachandra Reddy and G.M. Reddy, Department of Genetics, Osmania University, Hyderabad - 500 007 (A.P.) India.)

Induction of useful mutants in triticale

Hexaploid triticale strains DTS 330 and DTS 34-3, were treated with EMS, DES, HZ and gamma rays. Several mutants with altered plant, spike and grain characters were recovered from the mutagenised populations.

Investigations on inheritance of the mutants (large spike, dwarf, $dwarf_2$, long grain and small seeded), revealed monogenic recessiveness of the traits. An early heading mutant character was found to be controlled by two recessive genes.

Endogenous GA levels were more in the induced two dwarfs ($42.1x10^{-4}$ and $45.3x10^{-4}\mu g/g$) compared to control ($33.2x10^{-4}\mu g/g$). The reaction of F_1 plants was similar to the control. Seedlings of both dwarfs were non-responding to external GA_3, suggesting that the mutant character may be the result of a partial block in the GA utilizing mechanism rather than in GA synthesis.

Alpha and beta amylase activities, amount of reducing sugars and endogenous gibberellins were higher in more shrivelled long grain mutants and lower in less shrivelled small grain mutants. This suggests an association of these enzymes with grain shrivelling.

Techniques for callus initiation and plantlet regeneration were developed using embryos, seedling roots, seedling shoot bases seedling leaves and glumes. Among the three seedling explants tested, the shoot base was better for callus initiation and plantlet regeneration. An induced monogenic dwarf regenerated with greater frequency than the control. Induced variability for callus growth and morphogenesis is tested by using embryo cultures in M_3 generation.

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(Contributed by V.D. Reddy and G.M. Reddy, Department of Genetics, Osmania University, Hyderabad - 500 007 (A.P.) India.)

Induction of mutations in pigeon peas (Cajanus cajan L.)

Three varieties of pigeon peas, T-21, ICP-7409 and CIP-2836, were treated with various doses/concentrations of gamma rays, DES, EMS, HZ to recover desirable mutants. In this study, gamma rays proved to be the most potent mutagen and HZ the least. Based on mutant frequency and spectrum, T-21 was the most mutagen sensitive variety followed by ICP-2836 and ICP-7409.

A wide range of viable mutants, with alterations in plant height, stem, branch, leaf, flower, pod, and seed characters besides maturity, were recovered. Reduced height mutants such as medium talls, semi-dwarfs, dwarfs, determinates and semi-determinates, and plants with erect and compact habit were the most frequent variants observed. These mutants seem promising as parents for cross breeding programmes. Early maturing mutants may facilitate multiple cropping. Several mutants with profuse branching, prolific podded clusters and bold-seeded pods appear promising for increased yield potential.

(Contributed by D. Manohar Rao and Tummala P. Reddy, Department of Genetics, Osmania University, Hyderabad - 500 007 (A.P.) India.)

Induction of mutations in castor bean

Seeds of three varieties of castor, (279, HC6 and HC8), were treated with various doses/concentrations of EMS, DES, HZ, gamma rays to recover desirable macromutants. Different types of viable mutants with alterations in plant height, stem, branch, leaf, raceme, fertility and capsules were observed, the reduced height mutants being the most frequent ones. The spectra of viable mutants differed between varieties but also within a variety in different treatments.

The semi-dwarfs with normal fertility, induced in HC6 and HC8, were compact with a decrease in the number and length of internodes. More plants may be grown per unit area thus achieving increase in yield but these types

are also more convenient for harvest. Non-spiny capsules are indehiscent, thus this mutant may be promising for reducing losses in seed yield.

The induced semi-dwarf and dwarf mutants of HC6 exhibit varied responses to gibberelic acid. The parent, HC6, and the mutants sd3 and d5 show moderate response, while d7 and d8 exhibit high response.

Castor plants (var. 279) were exposed to acute doses of gamma rays (2000, 3000 and 4000 R) at seedling, meiotic, gametic and post-gametic stages. The highest chlorophyll and morphological mutant frequencies, with widest spectra, and a substantial increase in phenotypic variability for days to flower, seed yield/plant and harvest-index were obtained from gametic stage irradiation. The spectrum of chlorophyll mutants from this treatment differed significantly from that of the other three stages. Particularly interesting mutants with early maturity, dwarf stature and tetralocular capsules were also recovered more frequently after treatment in the gametic stage. The gametic stage may be the most suitable one for irradiation to recover useful mutants.

(Contributed by Prasenna Athma and Tummala P. Reddy, Department of Genetics, Osmania University, Hyderabad - 500 007 (A.P.) India.)

Ljulin - a hybrid cultivar of pepper based on induced male sterility

The cultivar "Ljulin" was developed by combining mutagenesis, heterosis and interspecific hybridization. It was released officially in 1981. The female male sterile parent was developed in 1971 by gamma irradiation of dry seeds of the cultivar "Zlaten medal" with 135 Gy and selection in M_2. Male sterility is caused by a recessive mutant gene.

The male parent was developed by hybridization of the cultivated species Capsicum annuum with Capsicum pendulum. The plants are approximately 60 cm tall, vigorous, with strong stems with two or three main branches. The fruits are dark green, pending, "Kapia-type", smooth, glossy, 60-80 g, 14-16 cm long, with 2-3 lobes and 3.0-4.3 mm thick pericarp. At botanical maturity the fruits become dark red.

The cultivar "Ljulin" is suitable for early field production or for cultivation under plastic houses. It exceeds the standard cultivar "Zlaten medal" by 42-92% early yield and 10-13% total yield. The cultivar possesses good transportability and endures long storage.

(Contributed by Lilia Milkova and Stefan Daskalov, Institute of Genetics, Sofia 1113, Bulgaria.)

In-vitro mutation breeding of potato

Buds of cv. Desiree were cultured on a solid medium containing MS macroelements, Heller microelements, Casein HCl (1 g/l), malic acid, Thiamine HCl, Piridoxine (each 1 mg/l) and sucrose 4%. The plantlets obtained were irradiated at a dose of 30 Gy of gamma rays and single node pieces were cut and transferred to a fresh medium. After a growth period of about 40 days MV_1 plantlets were again cut in single node pieces, and transferred once again to fresh medium (MV_2). The plantlets derived from the second cycle of micropropagation were taken out of the test tubes, transferred to pots in a greenhouse and after about one month finally transplanted to the field. Among

the 1094 plants available at adult stage 158 mutations were detected: namely 36 for leaf size and shape, 39 for leaf colour (dark green, pale green), 24 for flower colour (white or dark purple), 1 for flower shape (exserted style), 7 anthocyanin-less on the stems, 5 dwarf-type, and 46 for tuber skin colour (yellow, dark purple or spotted). The 200 control plants on the contrary did not show any variation in respect of the phenotype of the mother clone. Out of the 102 detected mutants, 78 were apparently homogeneous and the rest appeared to be chimeric. The recoverable mutant frequency increased from the top to the basal bud position in the MV_1 shoot.

(Contributed by Andrea Sonnino, Giorgio Ancora and C. Locardi, ENEA, Dipartimento Fonti Alternative Rinnovabili e Risparmio Energetico, Divisione Agricoltura, C.R.E., Casaccia, Roma, Italy.)

Photoperiodinsensitivity in jute mutant

D-154, the main commercial Corchorus capsularis variety is strongly photoperiod- and thermoperiod-sensitive [2,3] and drastic reduction in fibre yield is experienced due to off-season sowing in Bangladesh. The necessity of a high yielding, temperature and daylength tolerant variety was long felt. Mia et al. (1974) obtained a dwarf mutant (C-5) of D-154 by exposing seeds to gamma irradiation and reported it to have a flowering behaviour different from the mother variety.

Experiments were conducted in a controlled environment cabinet as well as in the field. In the controlled environment cabinet, seeds were sown in pots with 1 kg of soil mixed with cowdung and proper doses of NPK. The canopy light intensities were 3000 fc and 1000 fc respectively. Seedlings were subjected to 8, 12 and 16 hours day conditions fixed day/night temperatures of $30^{o}C/25^{o}C(\pm 2)$. In the field, seeds were sown at 15 day intervals from 1st February to 1st May in randomised blocks with four replicates. The experiments were repeated twice in the field.

C-5 seedlings when grown under fixed day and night temperatures in the controlled environment cabinet showed strict photoperiod insensitivity (Table 1). But when the mutant was on trial under field conditions, it showed a considerable variation in time for bud initiation and flower opening dependent upon sowing date (Table). This variation in flowering time may be inferred to interaction with variation in temperature. In the colder temperature of February ($27.6^{o}C$ Max/$8.7^{o}C$ Min), there was delay in flower bud initiation. But when sown later up to the second week of March (32.6^{o} Max/12.1^{o}Min), there was acceleration of flower bud initiation.

From the study, it may be concluded that C-5 is a dwarf photoperiod neutral but thermoperiod-sensitive mutant.

Table 1: Effect of photoperiods on the anthesis of jute mutant C-5 under a temperature of $30^{o}C$ day and $25^{o}C$ night ($\pm 2^{o}C$)

Variety	Photoperiod		
	12D/12N	16D/8N	8D/16N
	Days to anthesis		
C - 5	34($\pm$0.5)	35($\pm$0.6)	33($\pm$0.4)

Average of three experiments in the controlled condition

Table 2: Effect of date of sowing on bud initiation and begin of flowering of jute mutant C-5

Date of sowing	Days to bud initiation	Days to flowering
1.2.79	49 ± 2.0	57 ± 3.0
16.2.79	40 ± 1.0	54 ± 2.0
2.3.79	29 ± 0.7	35 ± 0.9
17.3.79	22 ± 0.5	29 ± 0.8
2.4.79	26 ± 0.8	32 ± 1.0
17.4.79	24 ± 0.7	34 ± 2.0
1.5.79	25 ± 0.6	35 ± 3.0

Pooled data of two experiments

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(Contributed by R.K. Dutta, L. Rahman and M.M. Mia, Plant Physiology Division, Bangladesh Institute of Nuclear Agriculture, P.O. Box No. 4, Mymensingh.)

Induction of mutations in jute through gamma irradiation

Jute (Corchorus capsularis L. and C. olitorius L.), being the highest foreign exchange earner of Bangladesh, has not yet undergone much genetic manipulation and contains still little genetic variability (1,2). Mutation breeding was therefore carried out to create genetic variability with the ultimate objective of increasing fibre yield. In 1976, seeds of the recommended jute variety, D-154 (C. capsularis) were irradiated with the doses of 70, 80, 90 and 100 kR from a Co^{60} source, taking 1500 seeds/dose. Out of the surviving plants, seeds from 253 vigorous ones were collected. In the M_2 generation, growing in progeny lines, a lot of variation was observed. Among the visually observable variants were characters like albino, xantha, green petiole, narrow leaves with earliness, stipules changed into leaflets with green petiole, small fruit, stem bifurcation and vigorous growth (Table 1). The most frequent type of variants was albino followed by xantha and late flowering. Seeds of 74 M_2 plants having noticeable plant vigour and other interesting characters were collected. In the M_3, segregation was observed for stipule modification and stem bifurcation characters, the rest of the mutants bred true. Out of these, 14 lines were selected considering characters like narrow leaves with earliness, green petiole, stipule modification, tallness, higher base diameter, disease (Macrophomina phaseolina) tolerance, late flowering, stem-bifurcation and high fibre yield/plant.

In the M_4 generation, these 14 lines were grown for further testing of inheritance and evaluation. The green petiole character of the mutant C-47 segregated into grey and green petioles in a ratio of 3:1, respectively. The others did not segregate. In the M-5 (1981), 12 lines were sown for preliminary yield assessments and four mutants viz. C-30, C-37, C-41, C-47 produced higher yield of fibre than D-154, the parental cultivar.

In the M_6, the mutant C-37 produced higher fibre yield than the other mutants and the parental cultivar. It was, therefore, put in a micro-plot yield trial in M_7 along with all the existing varieties.

Table 1: Frequency of variants in the M_2 generation of jute following various doses of gamma-radiation treatment

	Control	70 kR	80 kR	90 kR	100 kR	
Total no. of M_2 plants	730	2672	4820	2440	998	
Albino	–	12	18	33	11	74
Xanth	–	23	14	6	3	46
Green petiole	–	–	1	1	–	2
Narrow leaves with earliness	–	2	3	–	–	5
Stipules changed into leaflets with green petioles	–	–	4	1	–	5
Small fruit	–	–	1	1	–	2
Vigorous growth	–	3	9	2	2	16
Stem bifurcation	–	1	3	–	–	4
Total no. of variants	–	41	53	44	16	
% variants	–	1.53	1.09	1.80	1.60	

Table 2: Yield of jute mutant C-37 compared to other existing cultivars

Variety/Strains	Yield/plot (g) (4m long one line)	Yield/plant (g)
C-37 (mutant)	458.3	10.74
CVL-1 (released variety)	454.0	9.20
D-154 (recommended parental variety)	442.6	8.73
Dhab Dhabe (Newly developed strain, D.J.R.I.)	369.0	8.58
CVE-3 (released variety)	370.0	7.76
CC-45 (released variety)	348.0	7.62
C-8 (early mutant from previous programme)	350.0	7.24

The mutant C-37 outyielded all the varieties used in the trial (Table 2). The strain is in intensive trials during the M_8 generation in 1984.

REFERENCES

[1] MIA, M.M., M.A.Q. SHAIKH, C.S. SAHA and A.D. BHUIYA (1974): Gamma radiation induced mutants in jute (Corchorus capsularis L.). SABRAO J. 6: 175-179

[2] MIA, M.M., M.A.Q. SHAIKH and C.S. SAHA (1976): Genetical, anatomical and yield studies of some early maturing jute mutants. Indian J. Exptl. Biol. 14: 71-72

(Contributed by M.A.Q. Shaikh, A.D. Bhuiya, M.R.I. Khan and C.S. Saha, Plant Genetics Division, Bangladesh Institute of Nuclear Agriculture, P.O. Box 4, Mymensingh, Bangladesh.)

Resistance to soybean mosaic virus in mutant variety "Raiden"

Soybean line PI 96983 carries a dominant gene for resistance to SMV and accordingly has been widely used in cross breeding. However, two isolates of SMV strain G7 and sixteen isolates of SMV strain G6 cause severe necrosis or mosaic symptoms in PI 96983 derivatives. In an epiphytotic of SMV in 1976 at the Horrow Research Station (Canada), the cultivar "Raiden" (PI 360844) and some of its progeny in crosses were free of leaf symptoms and seed-coat mottling.

Testing a Raiden derivative line OX615 against a PI 96983 derivation line L78-379 it was found that both are resistant against SMV strains G1-G6. When inoculated with strains G7 and G7A, OX615 remained free of symptoms, but in L78-379 the strain G7 caused "large local lesions on inoculated leaflets, and dull mosaics on systemically infected leaves". When L78-379 was inoculated with SMV strain G7A, it showed "small brown lesions on inoculated leaflets, severe mosaic on systemically infected leaves and somewhat stunted plants.

Crossing experiments between the two soybean lines lead to the conclusion that the two soybean lines carry different (independently segregating) dominant genes for resistance. The Rsv_2 gene derived from Raiden sofar has given resistance against all SMV strains tested. The "Nemashirazu" cultivar from which the mutant "Raiden" was obtained, was reported in Japan to be susceptible to two out of five strains of SMV.

REFERENCE

BUZZELL, R.I. and J.C. TU (1984): Inheritance of soybean resistance to soybean mosaic virus. J. of Heredity 72: 82

Treating in-vitro cultures of floriculture crops with mutagens

The importance of bud mutations for improvement of vegetatively propagated floriculture crops is generally recognized. Callus and suspension cultures of five different seedling clones of florist's Chrysanthemum in glass vessels were subjected to gamma-rays (800 to 1,800 R, acute, ca. 100 R sec^{-1}), and one clone also to EMS (0.5 to 1.5% 2 hrs) by

submerging a sieve containing small callus and cell clusters in the solution. Complete plants were regenerated from controls and treatments and grown to flower [1]. In a similar way leaf pieces, callus and suspension cultures of Kalanchoe blossfeldiana hybrids were treated with X-rays (1,500 and 3,000 R, 250-270 $Rmin^{-1}$, plastic vessels). Regenerated plants were grown to flowering [2].

Plants with changes in flower colour, flower shape, growth type, leaf shape and temperature sensitivity were selected and propagated to MV_2. More

Table 1. Percentage of flower colour changes in mutagenically treated in-vitro cultures

Clone	treated material	dose kR	flowering shoots	% colour changes	% chimeras*
Chrysanthemum					
1032	C	0	924	9	100
		1.2	892	32	57
		1.8	8512	38	55
	S	0	918	18	0
		1.2	897	37	0
		1.8	858	43	0
7520	C	0	900	2	0
		1.2	889	25	0
		1.8	858	31	0
	S	0	877	4	0
		1.2	869	31	0
		1.8	849	38	0
Kalanchoe					
G	LE	0	449	11	12.2
		1.5	3027	29	2.1
		3.0	2437	27	1.5
	C	0	137	22	6.7
		1.5	171	23	5.1
		3.0	193	33	4.7
M	LE	0	554	10	0.2
		1.5	1763	33	0.1
		3.0	413	39	0.0
	C	0	1334	31	2.4
		1.5	1753	27	1.1
		3.0	1197	32	1.8
	S	0	979	34	6.9
		1.5	223	43	1.1
		3.0	443	38	4.2

C = Callus culture
S = Suspension culture
LE = Leaf explant

* % of colour changes

than 8,500 flowering shoots from the gamma-ray treatment and nearly 1,700 from the EMS-treatment of Chrysanthemum, were evaluated. In Kalanchoe nearly 9,000 plants of two clones were regenerated from treated leaf explants and 6,000 from callus or suspensions.

Some of the most important results are presented in table 1. A great number of changes occurred in the shoots coming from the treated material, and could be propagated to MV_2. Though the spontaneous variation in untreated controls of callus and suspension treatments was high, a significant enhancement of mutations by mutagenic treatments of in-vitro cultures could be demonstrated in most cases. Regeneration rate and the rate of variation was clearly dependent on dose and genotype. In Chrysanthemum the rate of chimeras was lowest in plants coming from suspensions, in Kalanchoe in those from leaf explants. It is concluded that plants regenerated generally from single cells.

Table 2. Number of weeks till flowering for physiologically differing variants of Chrysanthemum derived from mutagenic treatment (MV_3)

Clone No.	night/day temperatures	
	12°/20°C	16°/20°C
1230	11,1 b	10,0 a
19	11,7 b	11,8 b
24	10,4 ab	10,4 ab
83	12,6 c	12,6 c
54	10,3 ab	12,6 c

Replicated trials in climatically controlled rooms were carried out on Chrysanthemum MV_3-clones. Results from two different temperature regimes are presented in table 2. It is shown that mutagenic treatment of clone 1230 induced changes regarding response to low night temperature during short photoperiod given for flower induction: There are temperature tolerant clones which induce and develop their flowers at low night temperature as fast as at 16°C or even faster. It should be mentioned, however, that these experiments could not be carried on, so that we could not prove whether the observed variation is due to true mutations or epigenetic changes.

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[1] JUNG-HEILINGER, H. and W. HORN 1980: Variation following mutagenic treatment of cuttings and in vitro cultures of Chrysanthemum (in German). Z. Pflanzenzüchtg. 85: 189-199

[2] HORN, W. and R. SCHNEIDER-MOLDRICKX 1983: Mutagenic treatment of in vitro cultures of Kalanchoe. Unpubl. Paper Ann. Mtg. German Soc. Hort. Sci.

(Contributed by W. Horn, Floriculture Division, Techn. Univ. of Munich, Weihenstephan, D-8050 Freising 123, FRG.).

New sources of short culm in barley

By a modified method of mutagenic NMH treatment [1,2] consisting of 8h presoaking of seeds – 3^h x 0.7mM NMH treatment – 6^h interincubation germination – 3^h x 0,7mM NMH a very high frequency of semi-dwarf mutations was obtained in varieties Julia, Delisa, Plena, Aramir, Diva, Trumph and in stocks Mg 4170, Q 448 of spring barley. Semi-dwarf mutants were also obtained after sodium azide (3^h x 1,5 mM) and fast neutron (500 rad, 700 rad) treatment of stocks Mg 4170, Q 448, HDM and varieties Georgia and Salka. We possess now in our collection ca. 600 dwarf or semi-dwarf mutant lines (M_6–M_8), many of which carry as well other mutated traits concerning productivity, tillering, length and width of leaves, habit and distribution of leaves on culm and morphology of ear.

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MALUSZYNSKA, J. (1978): Frequency of mutations caused by chemical mutagens increases when interincubation period is introduced. International Congress of Genetics, Moscow, Abstracts Part 2, 253

MALUSZYNSKA, J., MALUSZYNSKI, M. (1983): MNUA and MH mutagenic effect after double treatment of barley seeds in different germination periods. Acta Biologica 11: 238–248

(Contributed by M. Maluszynski, Plant Breeding and Genetics Section FAO/IAEA, Vienna, Austria; I.Szarejko, Department of Genetics Silesian University, Katowice and R.Madajewski, Plant Breeding Station Polanowice–Lagiewniki, Poland.)

Two new loci for semi-dwarfism in barley

From genetic analysis of 11 dwarf and semi-dwarf nonallelic mutants of spring barley, it was found that the semi-dwarf character of mutants 270MK, 538DK, 592DK and 638DK is polygenically inherited. Semi-dwarfness is controlled by single recesive genes in mutants 392JK, 409JK, 421JK, 555DK, 648AK, 862PK and 267MK. Three genes responsible for semi-dwarfism could already be localized by using ten translocation lines from Svalöf. Two genes are located on chromosome 3: gene dw–1 (from mutant 862PK) in distance 20.5 % c/o from gene uz; gene sdw–b (from mutant 267MK) showing linkage with dw–1 (34,5% c/o).

The gene responsible for dwarfism in mutant 648AK is located in locus br on chromosome 1. Determination of loci for other semi-dwarf mutant genes is under way by the use of another translocation set.

REFERENCES

SZAREJKO, I. and MALUSZYNSKI, M. (1984): New brachytic mutant of spring barley variety Aramir. BGN 14, in press

SZAREJKO, I. and MALUSZYNSKI, M. (1984): Two new dwarfism genes on barley chromosome 3. BGN 14, in press

(Contributed by M. Maluszynski, Plant Breeding and Genetics Section FAO/IAEA, Vienna, Austria; I. Szarejko, Department of Genetics, Silesian University, Katowice, Poland.)

Mutation breeding of jute

C. capsularis:

JRC 7447 (Shyamalia). This variety, evolved between 1958 and 1964 from X-ray treatment of dry seeds of JRC 212 and subsequent pureline selection, was officially released in 1967.

It belongs to pigmentation grade 0 and is similar to JRC 212 in its morphological character. Height of the crop reaches 380 to 400 cm. Flowering behaviour is similar to JRC 212. The thousand seed weight is 3.21 gm and the colour is chocolate brown.

Special features of the variety are that it tends to branch much less than D 154 and responds to application of N beyond 60 but not exceeding 80 kg N/ha. With N at levels between 40 and 60 kg per hectare, yields are similar to JRC 212.

Quality of fibre is good and yield potential slightly exceeds 4 t/ha. Average yield in demonstration plots was 2.44 t/ha.

C. olitorius

Rupali. (T 149) JRO 632 seeds were irradiated with 50 kR (X-ray). In the M_2 generation mutants having greenish yellow leaves were detected; the mutant, named "Yellow Leaf", has a recessive character. The chlorophyll content was half that of JRO 632 while the length of ultimate fibre cells was more than that in JRO 632.

The yield of Rupali is comparable to JRO 632 as is the flowering behaviour. It has become popular in some areas in the Nadia district because adulteration of seed can easily be detected from the crop which must have a yellow-green leaf.

The variety has been released by BCKV for regional use in West Bengal.

JRO 3690. This variety was evolved by crossing two mutants, either of which were good for cultivation. One parent 'Tobacco leaf' has large tobacco-like leaves and is marked by large numbers of internodes, but is a dwarf (185 cm). The other parent 'Long Internode', also a dwarf (145 cm), has internodes longer than JRO 632. Both were derived from the M_2 generation of JRO 632 dry seed irradiation by 50 kR X-rays.

The hybrid JRO 3690 attains the maximum height of 450 cm but on average grows to 300-350 cm. Its yield generally exceeds JRO 632 by about 0.2 t/ha. The variety has shown the least damage by Apion and is rarely affected by yellow mite. It is recommended for mid-April sowing.

JRO 514. An X-ray derivative of JRO 632, it resembles the latter in external morphology. It is recommended for mid-April sowing.

IR 1 (JRO 68 = Anobika). JRO 632 plants were exposed to chronic gamma radiation (10,000 R) from germination to seed set. Seeds from selected irradiated plants were then sown under normal condition. The more vigorous plants were selected and tested from 1961 to 1964 and 'JRO 68' was spotted. Through further purification IR 1 was developed which yields about 12 percent more than the standard JRO 632 when sown in mid-April.

REFERENCE

GOSH, T. (1983): Handbook on jute. FAO Plant Production and Protection Paper No. 51.

Performance of mutant barley on Mn deficient soil

Various barley varieties were cultivated by R.D. Graham on Mn-deficient calcareous sand in Southern Australia. The performance was as follows:

Variety	relative yield[1)]	degree of chlorosis[2)]	Mn concentration[3)] ug/g-1
Golden Promise (mutant of Maythorpe)	93	5	6.4
WI 2598	86	5	4.4
Maythorpe	62	4	4.0
Proctor	7	3	-

1) yields relative to Weeah barley
2) 1 = chlorotic 5 = green at tillering stage
3) Mn concentration in youngest expanded leaf blades at stem extension

Obviously there is a substantial difference between var. "Maythorpe" and its gamma-ray induced short straw mutant "Golden Promise", which would be worth further investigations.

REFERENCE

GRAHAM, R.D., W.J. DAVIES, D.H.B. SPARROW and J.S. ASCHER (1982): Tolerance of barley and other cereals to manganese-deficient calcareous soils of South Australia. In: Genetic Specificity of Mineral Nutrition in Plants. Proceedings of a Symposium, Belgrade 30 August - 4 September 1982. Serbian Academy of Sciences and Arts, Scientific Assemblies Vol. XIII: 277-283

FUTURE MEETINGS

1985

The Importance of Biotechnology for Economic Development, Szeged (Hungary), 3 - 7 June.
Participation through nomination by governments of ECE countries.

Biotechnology in Agriculture, Biotechnology Institute, Cornell University 23 - 27 June.
Contact: Milton Zaitlin, Plant Pathology, Cornell, Ithaca, NY 14853, USA.

Nuclear Techniques and in-vitro Culture for Plant Improvement. FAO/IAEA Symposium, Vienna, 19 - 23 August.
Contact: A. Micke, Joint FAO/IAEA Division, P.O. Box 100, A-1400 Vienna.

Genetic Manipulation in Plant Breeding. International Symposium jointly organized by the Ornamentals and Genetic Manipulation Sections of EUCARPIA, 9 - 13 September, Berlin (West).
Contact: W. Odenbach, Inst. f. Angewandte Genetik, Freie Univ. Berlin, Albrecht-Thaer-weg 6, D-1000 Berlin 33.

First International Congress of Plant Molecular Biology, Savannah, Georgia (USA), 27 October - 2 November.
Contact: Congress Secretary 1st ICPMB, The Georgia Centre, Athens GA 30602, USA.

5th Congress of Society for Advancement of Breeding Research in Asia and Oceania (SABRAO), Bangkok (Thailand), 25 - 29 November.
Contact: SABRAO-Congress Secretary, c/o Department of Agriculture, Bangkhen, Bangkok, Thailand.

NEW PUBLICATIONS

The 1983 Plant Science Lecture Series at Iowa State University was "Polyploid Breeding". The following general topics were covered: the nature, evolution, and breeding of polyploids; mechanisms and genetic implications of 2n-gamete formation; potential of meiotic polyploidization in breeding allogamous crops; haploids as a tool in breeding polyploids; and fundamental considerations on interspecific hybridization. Specific topics: breeding octoploid strawberries; wide-hybridization and induced-polyploid breeding strategies for perennial grasses; production and utilization of triploid hybrid aspens. The eight lectures have been published in the May, 1984 issue of the Iowa State Journal of Research. To purchase copies of "Polyploid Breeding", send a $ 7,00 prepaid order to: Mary Jo Vivian, Agronomy Department, Iowa State University, Ames, Iowa 50011. Make checks payable to: Iowa State Journal of Research. Foreign orders should be prepaid with international money orders.

Induced Mutations for Crop Improvement in Latin America
Proceedings of a FAO/IAEA Regional Seminar, Lima (Peru), 17 - 23 October 1982, IAEA-TECDOC-305, 1984.

Semi-dwarf Cereal Mutants and their Use in Cross Breeding II
Proceedings of a FAO/IAEA Research Co-ordination Meeting, Davis, California, (USA), 30 August - 3 September 1982, IAEA-TECDOC-307, 1984

Cereal Grain Protein Improvement
Proceedings of a FAO/IAEA/GSF/SIDA Research Co-ordination Meeting, Vienna, (Austria), 6 - 10 December 1982. STI/PUB/664 IAEA Vienna 1984, 404 pages, Austrian Schilling 760.—

Selection in Mutation Breeding
Proceedings of a FAO/IAEA Consultants Meeting, Vienna, (Austria), 21 - 25 June 1982. STI/PUB/665 IAEA Vienna 1984, 192 pages, Austrian Schilling 360.—

MANUAL ON MUTATION BREEDING

The FAO/IAEA Manual on Mutation Breeding first published in 1970 and revised in 1977 (IAEA, STI/DOC/10/119) is soon expected to be sold out. Therefore, we are planning a revised and updated 3rd Edition. For this it would be extremely valuable, if our readers would point out to us printing errors and outdated statements and let us have their views as to which chapters need a revision (shortening, updating, expansion), which topics (also tables, figures) could be eliminated and what would be desirable to have included in a revised third edition.

Please write - the sooner the better.

A. Micke

LAST BUT NOT LEAST

Please submit your contributions to the Newsletter by 1 June and 1 December of each year.

Authors are kindly requested to take into account that the readers want to learn about new findings and new methods but would also like to see the most relevant data on which statements and conclusions are based. Conclusions should be precise and distinguish facts from speculation. The length of contributions should not exceed 2–3 typewritten pages including tables. We regret that photographs cannot be accepted for technical reasons. Reference to publications containing a more detailed description of methods or evaluations of findings are welcome but should generally be limited to one or two.

Alexander Micke

Please return the questionnaire enclosed to Mutation Breeding Newsletter No. 23, if you have not done so and want to receive future issues.

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