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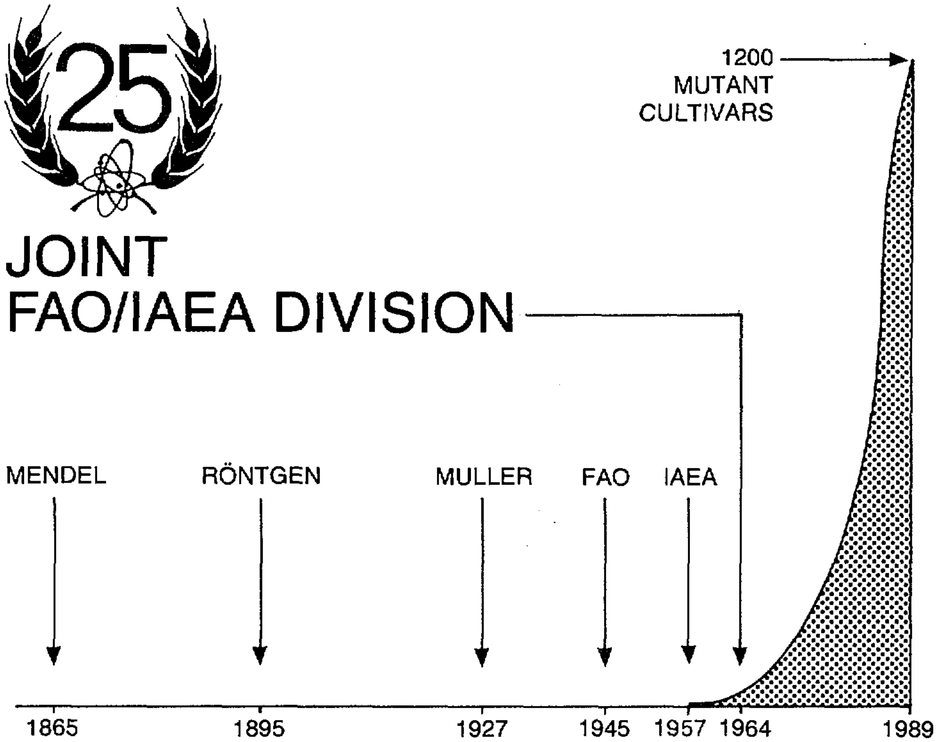

25 years Plant Breeding and Genetics Section of the Joint FAO/IAEA Division, Vienna

In 1964, FAO and IAEA in co-operation with EUCARPIA (The European Association for Plant Breeding Research), organized the "Technical Meeting on the Use of Induced Mutations in Plant Breeding" at FAO Headquarters in Rome. It was attended by 157 representatives from 32 countries, most of them well known experts in plant genetics and plant breeding. The proceedings were published by Pergamon Press in an impressive 832 page volume. Many of the papers became standard texts for mutation breeding. This symposium marks the beginning of close co-operation between FAO and IAEA in promoting the use of induced mutations for plant breeding. An earlier symposium jointly sponsored by IAEA and FAO had discussed mainly fundamental aspects of seed radiobiology and radiation genetics (Karlsruhe, FRG, 1960).

On 1 October 1964, the Joint FAO/IAEA Division of Atomic Energy in Agriculture was formed. Programmes of both organizations were pooled and the combined plant breeding and genetics programme became immediately one of strongest activities of the Joint Division. Still in the same year, a Co-ordinated Research Programme on the Use of Induced Mutations in Rice Breeding was established, comprising projects in Bangladesh, Brazil, China, India, Japan, Korea, Philippines, Sri Lanka and Thailand. In 1965, a Co-ordinated Research Programme on the Use of Induced Mutations in Plant Breeding was added and in 1966 an International Neutron Seed Irradiation Programme. The researchers co-operating in these international programmes came from Argentina, Austria, Bulgaria, Denmark, France, Fed. Republic of Germany, India, Italy, Japan, Netherlands, Norway, Philippines, Sweden, U.K., USA, USSR and Yugoslavia. They laid the scientific foundation for much of the practical work carried out during the past 25 years and made relevant contributions to the Manual on Mutation Breeding, first published by IAEA in 1970. Since 1964, the Plant Breeding and Genetics Section organized 6 symposia, 12 advisory group meetings, 4 regional seminars, 48 research co-ordination meetings and 18 training courses. In connection with IAEA Technical Assistance many developing countries received assistance for their plant breeding programmes and numerous resarchers were given the chance of training through fellowships. 35 books were published, in addition to many technical documents and scientific papers.

The following professional staff members have served the FAO and IAEA programmes on the use of nuclear techniques in plant breeding and plant genetics:

Smith, H.H. (USA)	1958-1962	Rabson, R. (USA)	1973-1976
Brunner, H. (AUS)	1961-	Bhatia, C.R. (IND)	1974-1976
Sigurbjörnsson, B. (ICE)	1963-	Hermelin, T. (SWE)	1975-1989
Mikaelsen, K. (NOR)	1963-1980	Brunori, A. (ITA)	1976-1979
Konzak, C.F. (USA)	1965-1969	Brock, R.D. (AUL)	1976-1979
Osborne, T.S. (USA)	1967-1968	Kawai, T. (JPN)	1979-1981
Luse, R. (USA)	1968-1973	Daskalov, S. (BUL)	1980-1986
Gacitua, H. (CHI)	1968-1971	Nakai, H. (JPN)	1981-1982
Bogyo, T.P. (USA)	1968-1969	Donini, B. (ITA)	1981-1985
Kamra, O. (CAN)	1969-1970	Maluszynski, M. (POL)	1983-
Micke, A. (FRG)	1969-	Novak, F. (AUS)	1983-
McKenzie, R. (CAN)	1970-1971	Ashri, A. (ISR)	1985-1986
Jansson, G. (SWE)	1970-1974	Murata, N. (JPN)	1986-1989
Hsieh, S.C. (CHINA)	1970-1974	Conger, B.V. (USA)	1986-1987

The 25th anniversary is a good occasion to give recognition to all of them for the valuable contributions they made towards the development of the mutation breeding technology and its wide adaptation. That we can now list almost 1300 cultivars derived from induced mutations against 50 in 1964 is due to the consistant efforts of people who understood the principles of evolution and adopted them in breeding programmes. The FAO/IAEA Symposium in 1990 will assess the impact of induced mutations upon plant breeding.

RESEARCH NEWS

Early ripening, productive soybean mutant variety suitable for combine harvesting

Between 1979 and 1981 seeds of the early ripening Swedish variety "Fiskeby V" were treated with N-nitroso-N-methylurea, sodium azide or gamma rays. Induced mutants were selected which are characterized by longer stalk, higher insertion point of the lowest pods and improved grain yield as well as sufficiently early maturity [1]. The frequency of the long-stalked mutants can be seen from Table 1. Starting from 60 000 treated seeds, 6 mutant lines were developed, and in 1988 one variety named "Dorado" was released. The performance of mutant lines and the variety "Dorado" is shown in Table 2 and 3. Under optimal agrotechnical conditions in fields of 2-10 ha "Dorado" achieved grain yields between 1,5 and 2,3 t/ha during the last four years.

It is intended to grow this variety in the middle and southern districts of the German Democratic Republic, primarily for human consumption. A technology for growing this variety was recommended [2].

Table 1. Amount of mutagen treated seeds, selected long stalked mutants and their frequencies (summary of 3 experiments)

	Number	Frequency related to	
		M_1 (seeds)	M_2 (plant progenies)
M_1 Generation 1979-81			
treated seeds	60 000		
M_2 Generation 1980-82			
plant progenies analyzed	8 895		
long stalked plants selected	317	$5.3x10^{-3}$	$3.6x10^{-2}$
M_3 Generation 1981-83			
confirmed mutants (A-lines)	68	$1.1x10^{-3}$	$7.6x10^{-3}$
B-lines 1982-84	34	$5.7x10^{-4}$	$3.8x10^{-3}$
C-lines 1983-85	16	$2.7x10^{-4}$	$1.7x10^{-3}$
Lines in official variety trial 1984-86	6	$0.1x10^{-4}$	$6.7x10^{-4}$
Varieties 1988	1	$1.7x10^{-5}$	$1.1x10^{-4}$

Table 2. Performance of the best long stalked mutants (official trials, mean 1986 and 1987, 4 locations)

	plant height (cm)	distance of the lowest pod from ground (cm)	vegetation period (d)	ripening date	grain kg/ha	yield rel.
"Fiskeby V"	46	7.0	133	9.9.	1205	100
M 55-82 ("Dorado")	62+	13.4+	139+	15.9.	1320	110
M 46-82	67+	12.8+	143+	20.9.	1438	119+
M 72-82	64+	11.3+	143+	20.9.	1332	110
M 112-83	71+	13.3+	144+	22.9.	1560	129+

+ Difference to the initial variety significant (P = 5%)

Table 3. Performance of the mutant variety "Dorado" (official trial, mean 1983-1987, 4 locations)

	1983	1984	1985	1986	1987	mean 1983-87	rel.
Plant height (cm)							
"Fiskeby V"	47	49	55	40	52	48.6	100
"Dorado"	56	67	62	48	75	61.6	127+
Distance of the lowest pod from the ground (cm)							
"Fiskeby V"	-	8	8	7	7	7.5	100
"Dorado"	-	10	13	13	14	12.5	167+
Grain yield (kg/ha)							
"Fiskeby V"	1703	1118	1440	890	1520	1334	100
"Dorado"	1927	1295	1605	1082	1558	1493	125+

+ Difference to the initial variety significant (P = 5%)

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(Contributed by G.W. Krausse, Institute for Breeding Research of the Academy of Agricultural Sciences Quedlinburg, Dept. Dornburg, DDR-6904 Dornburg, German Democratic Republic).

Gamma ray induced mutants in Colocasia with improved storability

Our mutation induction experiments with Colocasia esculenta (taro) were described before [1]. Poor storability of tubers and acridity of tuber flesh in tubers are problems in taro. While screening for induced mutants, variability in shelf-life of tubers was observed. Tubers of the mutant CM 17 did neither spoil nor lose their viability even after storing for 180 days. Yield and results of quality analyses are presented in the Table in comparison with the control variety C 9 (locally known as "Thamarakkannan"), the check variety Rasmi (well accepted in Kerala) and another mutant CM 1. Besides high yield and long storability, the mutant CM 17 shows a reduction in phenol and sugar, but an increase in dry matter and starch content which were found to be excellent characteristics for making taro chips as the usual browning phenomenon did not occur.

Table: Yield and quality characteristics of mutants in Colocasia esculenta

Variety	Yield/ plant (g)	Shelf-life (days)	DM %	Phenol %	Protein %	Sugar %	Starch %
C 9 (control)	476	20	30.5	1.30	2.91	0.60	69.8
CM 1	445	30	34.3	1.26	2.94	0.31	71.3
CM 17 (fresh)	640	160	31.3	0.47	2.60	0.15	80.1
CM 17 (stored)	650	160	33.2	1.49	3.51	0.26	78.6
Rasmi (check)	517	80	22.0	1.91	2.18	0.37	79.2

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[1] VASUDEVAN, K. and JOS, J.S., Gamma ray induced mutants in Colocasia. Mutation Breeding Newsletter No. 32 (1988) p.4.

(Contributed by K. Vasudevan, J.S. Jos and G. Padmaja, Central Tuber Crops Research Institute, Trivandrum, Kerala, India).

Gamma ray induced daylength tolerant mutants in Coleus

Treatment of tubers of Chinese potato (Coleus parviflorus Benth.) with gamma rays resulted in more than 50 morphologically different mutants, which are maintained as clones [1]. These mutant clones were planted bi-monthly from December 1986 to October 1987 in the field as single-row (20 plants) to test tuber production round the year. Chinese potato is normally a seasonal crop which produces tubers only from December to February. Of the 50 mutant clones tested 5 produced tubers all year round. The yield per plant of these 5 clones is given in the Table. Yields from four clones were quite similar. These daylength tolerant mutants could be used for an off-season crop and tubers could be on the market any month of the year. CPM 25 was found to be maturing in 120 days in all the six plantings, however, the other four mutants could have a higher yieid if the crop duration would be extended to 140 days.

Table: Yield of daylength-tolerant mutants of Coleus parviflorus after 120 days in six plantings

Mutants/ variety	Date of planting December	February	April	June	August	October
	Yield/plant (g)					
CPM 21	95	88	67	73	87	67
CPM 25	189	172	168	169	183	165
CPM 49	113	195	106	178	162	167
CPM 61	150	113	102	182	187	136
CPM 62	162	170	183	172	157	143
CP 11 (Control)	-	-	-	227	187	97

REFERENCE

[1] VASUDEVAN, K. and JOS, J.S., Gamma ray induced mutants in Coleus. Mutation Breeding Newsletter No. 32 (1988) p.5.

(Contributed by K. Vasudevan and J.S. Jos, Central Tuber Crops Research Institute, Trivandrum, Kerala, India).

Induced mutant of Phaseolus vulgaris L. with unusual combination of biochemical characters

Mutants with similar morophological and agronomic characteristics can often be distinguished by biochemical characteristics.

At CENA two white seed coat mutants (FT/CENEA 245 and FT/CENA 247) were obtained by EMS treatment of seeds of the recently developed black seeded cv. Rio Negro [1]. Laboratory analyses were made using seeds harvested in the state of Parana and seed produced in the greenhouse at Piracicaba (S.P.). The close relationship between the two mutants and the cv. Rio Negro was proven by the similarities of their overall protein and polypeptide composition revealed by electrophoresis using polyacrylamide gels. Agglutination tests using erythrocytes from man and cow and the electrophoretic determination of isolectin composition [2] did not distinguish between mutant line FT/CENA 245 and cv. Rio Negro, but the erythrocyte specificity and the isolectin composition of mutant line FT/CENA 247 was different. Whereas FT/CENA 245 and cv. Rio Negro were similar in these characters to a lectin purified from red kidney bean, FT/CENA 247 showed the characters found in other varieties, e.g. cv. Porrillo.

Cultivars of Phaseolus vulgaris can be separated into four groups (A,B,C and D) by their erythrocyte specificities or the isolectin compositions of their lectine [3,4]. Red kidney bean and cv. Porrillo represent groups A and C respectively. Varieties of type C are rare and the small number described in the literature includes only red and black beans [3,5,6]. Thus, the mutant FT/CENA 247 is probably the only line of beans in which white seed coat colour is combined with the production of C type lectin.

The occurrence of these two characters in the same mutant line suggests that more than one mutation was induced by the EMS treatment. To test whether several mutations occurred, crosses are being made between the mutants and cv. Rio Negro.

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(Research was supported by CNPg, KFA, IAEA, CNEN)

(Contributed by M.T.V. Carvalho, E. Derbyshire, A. Tulmann Neto, Centro de Energia Nuclear na Agricultura, C.P. 96, 13.400 Piracicaba, S.P. Brazil and J. Alberini, F.T. Pesquisa e Sementes, 84.100 Ponta-Grossa, P.R. Brazil.)

An improved type of "Kohleria" obtained through in vitro chemical mutagenesis

Kohleria hybrids (Gesneriaceae) are used as indoor ornamentals. As in other pot plants, compact plant habit and low energy requirement are major breeding objectives. A trihybrid of the following composition was used in the experiments: (K. amabilis x K. bogotensis) x K. eriantha. This hybrid has attractive flowers but long internodes, large leaves and is late flowering under low light conditions.

Adventitious buds were induced in high numbers by cultivating internode segments aseptically on agar medium supplemented with 1 mg/l kinetin and 0.5 mg/l IAA. For inducing mutations, internode explants from in-vitro grown shoots were soaked for 1 hour in a filter-sterilized aqueous solution of N-nitroso-N-methylurea (NMH; 500 mg/l) at 20^{o}C; the solution was unbuffered and immediately used after preparation. Two-node micro-cuttings of regenerated shoots were rooted ex vitro in a mixture of peat and sand (1:1 by volume) and grown into mature plants without losses.

Whereas control plants regenerated in-vitro through adventitious buds showed as little variation as plants raised from conventional tip cuttings, conspicuous phenotypic changes were observed in plants originating from NMH-treated explants. In a first experiment, 21% of the plants differed from the controls in one or more characters. While the majority of these variants were inferior to the control, one designated as "II-2-0" showed early flowering under the natural low light conditions during winter. This character was retained after cloning.

A second mutagenesis experiment was performed using aseptic stock cultures of this mutant "II-20-0", in order to obtain a more desirable plant habit. In this case, plants bearing phenotypic changes occurred about twice as frequently as in the first experiment, although the mutagenic treatment was the same. Among the selected variants there was one, designated "II-2-32", in which early flowering under low light conditions was coupled with significantly shorter internodes as well as smaller and more attractive leaves.

The mutant "II-2-32", its ancestor "II-2-0", and the control were compared in three successive generations of vegetative propagation under different light conditions. It turned out that flowering was much less controlled by daylength than by light intensity. Under conditions of high natural light intensity, there was no difference in the time required for flowering under long-day (LD) and short-day (SD) treatments among the three genotypes. In contrast, under low natural light intensity, the mutant types came into bloom up to 55 days earlier than the control; again the daylength had no effect on the control and mutant "II-2-32", whereas type "II-2-0" flowered earlier in LD than in SD conditions. The differences in internode length and leaf characters were consistent through all generations and under all light conditions.

Clones of the mutant type "II-2-32" are now being evaluated for commercial cultivation on a larger scale.

(Contributed by T. Geier, Fachgebiet Botanik, Institut für Biologie, Forschungsanstalt Geisenheim, D-6222 Geisenheim, Federal Republic of Germany).

Susceptibility of "Yuanfengzao" and other mutant rice varieties to herbicides

Herbicides are used to control barngrass and other water grasses in rice fields. However, rice may suffer in some cases too. We developed a technique to evaluate rice for herbicide tolerance at seedling stage. The seedlings were grown in 15, 20, 50 cm plastic trays with 7 cm soil. Up to 2-leaf stage, seedlings were treated with 50, 100 and 500 ppm butachlor, and 250, 500 and 1000 ppm thiobencarb respectively, in the incubator (30/25^{o}C day/night, 12 h light and 3000 lux/d) up to 11 d. The herbicide solution was filled up to the pulvinus of the second leaf, with water treatment as a check.

Light brown spots on the leaf were the most visible injury symptom and might be used as criterium of herbicide susceptibility in Indica rice at seedling stage. During treatment, the first leaf became yellow and was killed first, then the water soaked spots appeared on the second leaf and turned to light brown spots gradually. Afterwards, the light brown spots linked up with each other and the leaf became partially necrotic. On the third leaf light brown spots appeared also. Finally, the seedling was killed (Table 1).

Table 1. Standard evaluation of herbicide tolerance at the seedling stage in *Indica* rice

Group	Response
Highly tolerance (HT)	2nd and 3rd leaves normal
Tolerant (T)	2nd leaf partially with water soaked light brown spots, 3rd normal
Medium (M)	2nd leaf with many large light brown spots, 3rd leaf a little
Susceptible (S)	Spots linked with each other, leaves partially necrotic
Highly susceptible (HT)	Seedling nearly killed or killed

Herbicide tolerances could best be evaluated with 100 ppm butachlor or 500 ppm thiobencarb for 7 d treatment. Mutant varieties could be divided into five groups according to their responses (Table 2). The tolerant mutant varieties can be used in rice breeding for herbicide tolerance.

Table 2. Responses of 6 mutant varieties to 2 herbicides at seedling stage

Grade	Butachlor	Thiobencarb
HT	Radiation 8-1	
T	Radiation 85-65	
M	Zhefu 802	Radiation 8-1, Radiation 85-65
S	Yuanfengzao, Radiation 83-29	Radiation 83-29
HS	Fuyu 1	Yuanfengzao, Zhefu 802, Fuyu 1

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(Contributed by Shi Chunhai and Shen Zongtan, Agronomy Department, Zhejiang Agricultural University, Hangzhou, China).

Induced mutant for male-sterility of lentil

Lentil has very small flowers which pose problems in emasculation for cross-breeding. To induce mutations, seeds of variety LL-78 were irradiated with gamma rays 5 to 20 krad. In M_2 some male-sterile plants were observed. Male-sterile plants could easily be identified at the start of maturity. They remain green and continue flowering when other plants mature. Due to natural outcrossing a few seeds formed on these male-sterile plants. These were grown in M_2 for progeny testing. Some M_3 lines were having both normal seed set and male-sterile plants in the ratio of 3 normal:1 male-sterile, whereas in other lines all the plants were male-sterile. The former are assumed to be genic male-sterile and the latter cytoplasmic male-sterile. When the putative cytoplasmic male-sterile plants were selfed, there was no seed setting. Cytoplasmic

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male-sterility has not yet been reported in lentil. Its use could make cross-breeding easier.

(Contributed by R.P. Sinha, Tirhut College of Agriculture, Dholi Muzaffarpur 843121 Bihar, India).

Semi-dwarf mutants of bread wheat cultivar "Inia-66"

Samples of 1500 seeds were irradiated with gamma rays 10-15 krad. In M_2 generation, two semi-dwarf mutants ZB103 and ZC115 appeared of interest. When compared with their parent for two generations, a significant reduction in height was confirmed. Increases in spike length, stem diameter and number of kernels per spike were also statistically significant (Table 1). But there were no significant differences in seed quality.

Table Characteristics of mutants ZB103 and ZC115

Characteristics	M_3 generation			M_4 generation		
	parent Inia-66	ZB103	ZC115	Parent Inia-66	ZB103	ZC115
Plant height (cm)	103.6	72.3	74.1	104.5	73.0	76.2
Spike length (cm)	14.0	15.6	15.1	13.7	15.3	14.9
Stem diameter (mm)	4.2	5.2	5.0	4.3	5.2	5.5
Kernels per spike	71.0	80.9	78.5	69.6	81.3	80.2
% of protein	12.1	11.5	11.8	11.4	11.05	10.4
% of fat	1.90	1.95	1.98	1.81	1.81	1.93
% of gluten	11.8	11.5	11.0	12.0	11.7	10.7

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KUBBA, A.J., ISHU, R.M., J. Agric. Water Reso. Res., 8 No. 1 (1989).

Poster presented at the XVIth International Congress of Genetics, Toronto, Canada, 20-27 August, 1988, Abstract No. 31-54-2.

(Contributed by A.J. Kubba and I.F. Ibrahim, Agric. and Water Reso. Res. Centre, Sci. Res. Council. P.O. Box 2416, Baghdad, Iraq and Faculty of Agric. and Biology 1988. NRC, P.O. Box 765, Baghdad, Iraq).

Genic relationship of induced semi-dwarf rice mutants

Semi-dwarf mutants were induced by gamma rays or EMS in the rice varieties Ptb9, Ptb10 and Ptb28 (ref. Mutation Breeding Newsletter No. 23 (1984) p.8). By test-crossing with "Jyothi", possessing the sd_1 gene (DGWG) it was found that mutants M2, M11 and M202 carry a sd gene allelic to sd_1. The other mutants (M6, M14, M102, M107, M207, M210) also show monogenic recessive inheritance of semi-dwarfness, but apparently controlled by other genes than sd_1.

(Contributed by P.D. Vijayagopal and V.G. Nair, College of Agriculture, Vellayani, Trivandrum, India).

Selection of high hectolitre weight mutants of winter wheat

Grain quality in wheat includes hectolitre weight (HLW) besides protein content and thousand-grain weight (TGW). The British winter wheat variety "Guardian" has a very high yield potential. Although the long grain of "Guardian" results in a desirable high TGW the HLW is too low. To select mutants exhibiting increased HLW the character was first analyzed to identify traits that could more easily be screened for using M_2 seeds. In comparison of 6 wheat cultivars, correlation analyses with HLW resulted in coefficients of -0.86 (grain length, L:$P < 0.05$), +0.45 (grain height, H) and -0.29 (grain width, W). A significant negative correlation ($r = -0.85$; $P < 0.05$), was observed between HLW and TGW. "Guardian" is characterized by highly prolate (i.e. sausage-shaped) grains. It was decided to screen visually a population of approximately 500,000 M_2 seeds for shorter, less prolate grains. Mutagenesis was carried out using EMS sulphonate (1.8 or 3.6%), sodium azide (2 or 20 mM) or X-rays (7.5 or 20 kR).

69 M_2 grains with altered shape were selected. Examination of the M_3 progeny confirmed 6 grain-shape mutants, most of them resulting from EMS treatment (Table). Two of the mutants showed TGW values significantly below the parental variety, but three mutants exhibited HLW and TGW values significantly greater than those of the parental variety. Microplot yield trails on selected M_3 lines are in progress.

The influence of physical grain characteristics on HLW offers prospects for mechanical fractionation of large M_2 populations. The application of gravity separators (fractionation on the basis of grain density) and sieves (fractionation on the basis of grain length) in screening mutants possessing improved grain quality is being investigated.

This work was supported by Power Seeds Ltd., Waterford, Ireland and the National Board for Science and Technology, Ireland.

Mutant/ Variety	Mutagenesis treatment	Grain length (mm)	Grain shape (prolateness)[a]	Hectolitre weight (kg hl^{-1})	1000-grain weight (g)
Guardian	-	7.35	0.31	59.7 ± 3.1	67.9 ± 3.4
49	7.5 kR X-rays	7.20	0.31	66.5	72.9
73	1.8% EMS	6.90	0.28	66.7	76.3
75	1.8% EMS	5.60	0.20	66.8	60.5
83	3.6% EMS	6.65	0.30	67.2	62.1
87	3.6% EMS	6.55	0.29	66.5	65.5
97	3.6% EMS	6.90	0.29	66.0	72.7

[a]Prolateness = Log L- (1/2 log H + 1/2 log W)

(Contributed by C. Crowley and P. Jones, Department of Plant Science, University College, Cork, Ireland).

Useful mutations in Iraqi black barley

Barley (*Hordeum vulgare* L.) is an important fodder crop in Iraq, with a cultivated area of about 1 392 375 ha and a total production of about 838500 t. The 2-row black barley "LBB" is the most desirable one in semi-arid zone in northern part of Iraq, because of its drought tolerance and high protein content. However, this cultivar is susceptible to powdery mildew, and lodges. Gamma rays and EMS were used to induce mutations in "LBB" and its hybrid with "Arivat". Nine mutants with improved lodging were selected during the first six generations [1,2].

Five mutants INRC-BB-1, INRC-BB-3, INRC-BBR-4A, INRC-HB552 and INRC-HB-553 were resistant to powdery mildew while 2 mutants INRC-BBH-1 and INRC-HBR-3 were moderately resistant. Two mutants INRC-BB-123 and INRC-HBR-3 were also resistant to drought under 350-400 mm rainfall. Three mutants INRC-BB-1, INRC-HBR-3 and INRC-HBR-88 exceeded their original variety in seed weight per spike and TKW.

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(Contributed by I.F. Ibrahim, Dept. of Plant Protection, Faculty of Agric. and Biology, NRC, P.O. Box 765, Baghdad, Iraq).

Release to farmers of "Carioca Arbustivo Precoce 1070" (CAP-1070), a bushy bean mutant induced by gamma rays in Brazil

Seeds of the indeterminate growth type bean cultivar "Carioca" have been treated with 32 krad gamma rays. In M_2, a mutant showing bushy growth type has been selected. The mutant also shows earlier maturity (5-14 days) and therefore was called "Carioca Arbustivo Precoce 1070" (CAP-1070). The determinate (bushy) growth habit is due to one recessive gene and earliness is associated with this habit. CAP-1070 maintained the same response to diseases as the orginal cultivar [1].

In trials carried out in several states of Brazil, yield was lower, similar or greater than "Carioca" depending on conditions. The short flowering period of CAP-1070, resulting from the bushy growth habit may reduce grain yields but under favourable circumstances, CAP-1070 may yield more than other varieties. CAP-1070 raised great interest among farmers visiting experimental fields of F.T. Pesquisa e Sementes, a private plant breeding firm at Ponta Grossa, Paraná. Therefore, the firm decided to multiply the seeds and distribute them to farmers, who have now been cultivating CAP-1070 since 1986 between coffee rows.

The CAP-1070 is the first induced bean mutant cultivated by farmers in Brazil. However, like the original cultivar "Carioca", CAP-1070 became susceptible to diseases. Therefore, we crossed the mutant and have obtained promising lines with bushy habits, disease resistance and higher yield [2, 3]. CAP-1070 is also used in cross-breeding programmes of Government research institutes in Brazil.

Research was supported by IAEA under Research Contract No. 2195/SD, EMBRAPA, CNEN and CNPQ.

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(Contributed by A. Tulmann Neto, Centro de Energia Nuclear na Agricultura, C.P. 96, 13.400 Piracicaba S.P. Brazil, CNP_q fellow and J. Alberini, F.T. Sementes e Pesquisa, C.P. 409, 84.100 Ponta Grossa, PR Brazil).

New cultivars of jujube induced by mutation

Mutation breeding of jujube (*Ziziphus mauritiana* Lin.) received attention by the Food Crops Research Institute since 1978. Mutations can be directly released as new cultivars or indirectly as bud grafting source.

N-methyl-N-nitroso urea (MNH) was used at a concentration of 0.02 - 0.04% for 12 h treatment of pregerminated seeds of different jujube cultivars. Some useful mutants were selected and directly released as new cultivars to farmers. Of the selected mutants two cultivars, "Ma hong" and "Dao tien", are the most preferable and popularly grown in the country.

"Ma hong" is a mutant of "Gia Loc", a very popular cultivar. Main useful traits of "Gia Loc" such as early maturing, two crops of fruits per year are maintained (harvest in December and August). "Ma hong" has round-formed, pink rose coloured, sweeter fruits and stable fruit yield in off-season (Aug.) as compared with oval-formed, yellow-coloured and sour fruit of "Gia Loc".

"Dao tien" is a mutant of the local variety "Thien Phien" with quite different traits. The original cultivar is late maturing (harvested in Feb.) with one crop of fruit per year and has small fruits (mean wt. of fruit at harvest 20 g). "Dao tien" is one month earlier in maturing allowing two crops of fruit per year (harvested in Jan. and Nov.). Fruits are round-formed, bigger (mean wt. of fruit: 25 g) and more tasteful (peach-flavored and brittle).

(Contributed by V.T. Hoang and N.V. Tuynh, The Food Crops Research Institute, C-40, TULOC, Hai Hung, Vietnam).

Quality rice improvement by mutation breeding

"Basmati" being fragrant and fine grained represents a major export crop of India. Due to its good quality but poor yield its market price is high. Jhona-349 has also slender grains but a much higher yield than "Basmati" and is cheaper. Its grains after fine milling and heavy polishing are sold in common markets as "Basmati". But this variety is tall and lodging susceptible with bolder grains than Basmati. Following treatment with 1.5% EMS or 20 kR gamma-rays + 1% EMS, two mutants Jm_1 and Jm_4 were selected in M_2 and studied through M_3-M_5 generations (Table). Both these mutants are shorter and higher yielding than the parent. Jm_4 has a higher grain number and yield than Jm_1 and "Jhona". Crossing these mutants yielded a recombinant $JJ_{1.4}$ that is short statured and higher grain yielding than "Jhona" and "Basmati". In addition, its grain fineness is better and equals that of "Basmati". Compared to "Basmati", this recombinant is 50% shorter in culm height, 80% higher in grain number/plant and 70% higher in grain yield. Moreover, this recombinant exhibits about 10% increase in hulling and milling.

Table 1. Performance of Basmati, Jhona-349, its mutants and a recombinant*

Variety/ mutant line	Mutagen and dose used	Culm height (cm)	Growth period (days)	Fertile grains per plant (number)	Grain fineness (mm)	Grain per plant (g)
Basmati	(standard)	162	152	789	3.5	15.9
Jhona	(control)	134	127	1012	2.3	20.4
Jm_1	EMS 1.5%	123	125	1081	2.5	22.9
Jm_4	gamma-rays 20 kR+1%EMS	125	123	1130	2.5	24.1
$JJ_{1.4}$	(mutant re-combinant)	95	120	1607	3.5	29.3
C.D.		11.5	7.3	24.6	0.8	2.9

*Mean value of 120 observations (40 plants x 3 replications)
C.D. = Critical difference at 5P level

(Contributed by M.L.H. Kaul and Miss Neelangini, Cytogenetics Laboratory, Botany Department, University, Kurukshetra, Haryana 132 119, India).

Induced mutations in Iraqi bread wheat cv. Saber Beg

"Saber Beg", is a local wheat cultivar important in the semi-arid zone of Iraq where the rainfall is less than 450 mm per year. This cultivar has a good baking quality, but is of low productivity, high susceptibility to common bunt (Tilletia spp.) and to leaf rust, but (Puccinia recondita Rob. ex Desm.) only in the rainy season.

A mutation breeding programme using gamma irradiation has been started in 1978 to improve this cultivar. Seeds of all main tillers from M_1 plants were harvested and artificially inoculated with teliospores of Tilletia spp. All the seeds from healthy M_2 plants were inoculated again and sown in the same area. Out of 22920 M_3 plants, 244 resistant ones were selected [1]. During subsequent screening for 4 generations, however, only 3 mutants were confirmed [2]. These mutants were further tested in different locations in Iraq namely Baghdad, Telafar and Rabi for three successive seasons and the results are summarized in the Table.

Table Characteristics of a "Saber Beg" mutants induced by 130 Gy of gamma-rays (mean of 3 locations during 3 years)

Variety mutant	Disease reaction			agronomic characters		
	Leaf rust (1)	Common bunt % infection (2)	Lodging	Earliness days before Saber Beg	Seed weight of 100 spikes (g)	Weight of 1000 grains (g)
Saber Beg (Parent)	S	83.3	S	0	54.6	24.6
IRATOM-SB-1	MR	34.9**	R	10	130.7**	36.4**
IRATOM-SB-2	MR	38.6**	R	10	123.5**	38.6**
IRATOM-SB-3	MR	42.3**	R	10	107.2**	36.3**
L.S.D 0.05		7.3			26.0	5.9
0.01		10.5			37.4	8.5

(1) The inoculum level of uredospores for artificial inoculation at heading was 6.4×10^4 spores/ml

(2) The inoculum level of teliospores for artificial inoculation was 0.5 g spores per 100 g seed

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(Contributed by I.F. Ibrahim and H.O. Haidar, Department of Plant Protection, Faculty of Agric. and Biology, NRC and Agriculture Research Station in Telafar).

Induced mutations of winged bean in Ghana

Winged bean (*Psophocarpus tetragonolobus* (L.) D.C.) was introduced into Ghana about two decades ago and not long after a high quality baby food was compounded from it [3]. Germplasm collections are established at the Kade Agricultural Research Station of the University of Ghana and the University of Cape Coast. In 1980 a mutation breeding project was initiated at the University of Cape Coast under FAO/IAEA research contract and among various mutants a single erect stem mutant, a multiple branched bush type and a mutant with extra long pods were obtained [1]. A similar programme was started at the National Nuclear Research Centre Kwabenya in 1982. Seeds of accessions UPS 122 and Kade 6/16 were gamma irradiated (100 - 400 Gy). In M_2 a mutant was obtained that did not flower throughout a growing period of five months. This mutant had very few leaves but developed an underground tuber weighing ca. 100 g. The parent, UPS 122, although normally tuber producing did not form tubers at Kwabenya within the period studied [2].

In M_3, mutants with variations in seed size and seed coat colour have been detected. Mutant colours are cream, mottled brown and light brown compared with dark tan of UPS 122 and brown colour of Kade 6/16. Results of preliminary studies on dry seeds of these mutants are recorded in the following Table:

	Parent	Mutants			
	UPS 122	EJ 26	X25	X22	KK26
Protein (%)	29.4	31.3	30.6	30.9	30.5
Fat (%)	21.4	21.2	17.2	24.2	21.0
100 seed wt. (g)	30.8	28.3	35.3	28.4	32.5
	Kade 6/16		3/4-10-7	3/9-0-12	
Protein (%)	30.6		32.9	36.6	
Fat (%)	20.4		20.1	23.7	
100 seed wt. (g)	28.0		30.1	30.1	

These mutants are being further tested in replicated trials.

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(Contributed by G.Y.P. Klu, M. Quaynor-Addy, E. Dinku and E. Dikumwin, National Nuclear Research Institute, Ghana Atomic Energy Commission, P.O. Box 80, Legon, Ghana).

Mildew resistant and less lodging wheat mutants induced in Iran

"Tabassi" is a lodging and mildew susceptible cultivar. To induce mutations, seeds were gamma irradiated (50 to 150 Gy) in 1982 and selection for lodging resistance was carried out in M_2. During field experiments with the mutant lines in 1985/86 there has been a heavy mildew epidemic under which mutant 63-5-I (derived from 50 Gy treatment) exhibited considerable resistance and as a consequence, higher yield. The control was 100% infected, the mutant only 40%. The mutant yielded 31% more grain, 7.5% less straw and 4.5% more protein than the control. Lodging of 63-5-I was only 60% in an experiment under rainfed conditions in the same season, resulting in a relative yield increase of about 11%.

In 1986/87 there was no mildew epidemic and the mutant yielded the same as "Tabassi" (Table).

Table Performance of the mutant 63-5-I in 1986/87 in comparison with the parent cultivar Tabassi

	Plant height (cm)	Spike length (mm)	TKW	Harvested seed kg/ha	Harvested straw kg/ha
"Tabassi"	92.2	76.8	43.9	3776	5625
cv	9.1	18.5	1.2	9.1	8.4
63-5-I	86.5	86.4	41.2	3724	4505
cv	7.2	17.2	1.2	12.2	15.7

Mutant line 63-5-I has been submitted to the Ministry of Agriculture and Rural Development for release to farmers because of good lodging and mildew resistance (yield safety) and relatively early maturity (6-8 days).

"Omid" is a traditional tall wheat mostly cultivated in regions with a continental climate. To induce mutations for lodging resistance, seeds were gamma irradiated with 50 to 150 Gy in 1984. Since "Omid" is susceptible to stripe rust, the M_2 and M_3 were cultivated in a rust nursery. Mutants 64-1 and 64-4, (derived from 50 Gy treatment) showed a decrease in plant height by 10-15%, increased tillering, a smaller TGW and a yield equal to "Omid". Because of the shorter culm, the mutants could certainly benefit from higher levels of fertilizer and thus exceed "Omid" in grain yield. Both mutants are also early maturing (about 13 to 16 days earlier) and relatively resistant to stripe rust, although somewhat shattering. Also these mutants were submitted to the Ministry of Agriculture and Rural Development for release as cultivars.

(Contributed by I. Naghedi-Ahmadi, Agricultural Department of NRC/AEOI, Tehran, Iran).

Semi-dwarf mutant lines of hexaploid triticale

A spring form of hexaploid secondary triticale ADD 143/71, bred by MOGILEVA at the Plant Breeding Station at Uhretice was used for the mutagen treatment. The pedigree of this line is the following:

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Kastická osinatka      x Petkus II
(soft wheat)           |  (rye)
                       | doubling of chromosomes by colchicine

              ADD 870 x ADD 1435
   (octoploid triticale)  |  (hexaploid triticale)
                          |
             intermediate hybrid   x   Rosner
                                   |  (hexaploid triticale)
                                   |
                              ADD 143/71
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The mutation experiment started in 1979. Seeds were treated with a 0.8 mM water solution of N-methyl-N-nitrosourea (MNH) (CETL and RELICHOVA, unpublished). From 180 M_1 plants, one spike was harvested per plant. A random sample of these seeds was sown as M_2 in 1980 and several plants with shorter main culm were selected. Selfed progenies of eight mutant plants designated ADD 143-ml, ADD 143-m2, ADD 143-m3 etc. were further tested in M_3 and M_4. There were significant differences in culm length and in some other characters between the original line and the mutant lines (Table). Especially the line m8 looks like a promising source of semi-dwarfness for breeding programmes of hexaploid triticale.

During 1985-1987 genetic analysis was performed on the ADD 143/71 and the mutant lines m2, m6, m7 and m8, which suggest that their mutant genes are allelic and recessive.

Table Characteristics of mutant lines of triticale in comparison to the original line ADD 143171 (average values 1984/85).

Line	Main culm length (cm)	Main spike length (mm)	Spikelets no. per main spike	1000 grain weight (g)	Grain protein content (%)	Days from sowing to maturity	No. of productive culms
ADD 143/71	91	80	17.6	34.7	13.5	70	1.8
ADD 143-ml	71	78	16.7	35.6	14.4	70	1.6
ADD 143-m2	71	67	15.9	32.1	13.2	70	1.6
ADD 143-m3	73	70	16.4	33.2	15.2	70	1.7
ADD 143-m4	67	70	16.8	30.4	14.9	70	1.7
ADD 143-m5	64	77	18.0	29.1	14.8	76	1.9
ADD 143-m6	62	75	17.9	28.3	15.7	84	1.6
ADD 143-m7	58	70	16.9	27.7	15.3	84	1.8
ADD 143-m8	74	69	16.0	36.4	16.5	70	1.7

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(Contributed by M. Pidra, Department of Microbiology and Genetics, Faculty of Science, J.E. Purkyne University, Kotlarska 2, 611 37 Brno, Czechoslovakia).

Separate and combined application of mutagens in bean (Phaseolus vulgaris L.)

The study included gamma rays (3, 6, 9, 12 kR) and EMS (0.05, 0.1, 0.15, 0.2% solutions), independently and in combination. Seeds of the cultivar "Prelom" were treated and the effects assessed in terms of plant survival. The doses of 6 kR gamma rays; 0.2% EMS and 6 kR + 0.2% EMS were found to be optimal (LD 50%). Mutations of interest for breeding were obtained. Although the survival rate after combined mutagen treatment was the same, the number of morphological variants in M_2 was much higher (Table).

Table: Effect of different mutagen treatments on variants observed in M_2

		Mutagen treatments		
		6 kR	0.2% EMS	6 kR + 0.2% EMS
Survival in M_1, %		50.0	55.9	52.3
No. of M_2 plants		1316	1467	1638
No. of sterile plants		9	3	23
No. of M_2 mutants				
	elongated			7
	erect			4
	Alder type	2		
	dwarf	1		1
	small leaves	1	1	21
	large leaves			3
	elongated leaves			2
	short pods	3		3
	increased productivity	5	6	4
	earlier maturity	2	2	1
	later maturity	9	4	11
	changed seed colour	1	1	
Total		24	14	57

(Contributed by E. Milkov, Wheat & Sunflower Institute "Dobroudja" General Toshevo, Bulgaria).

A very early flowering and photoperiod insensitive induced mutant in chickpea (Cicer arietinum L.)

Dry seeds of cultivar C727 were irradiated with 20-25 kR of gamma rays. A very early flowering mutant was identified from 20 kR treated progeny. The mutant flowered 40 days after germination and matured 21 days earlier than the parent variety. The character was true breeding in M_3 - M_6 generations and the mutant always flowered 40 days after germination irrespective of time of sowing ranging from 15 October - 15 January. Further work is in progress. Seed of this mutant (CM 438) is available on request.

Table: Characteristics of a very early flowering chickpea mutant

Characteristics	Parent Variety C 727	Mutant CM 438
Plant height cm.	61.5	42.8
Branches per plant	20.8	21.0
Pods per plant	128.7	123.6
Grains per plant	176.5	192.2
100 grain wt g.	14.9	12.8
Days to flowering	90	40
Days to maturity	165	144

(Contributed by M.A. Haq, M. Sadiq and Mahmud ul Hassan, Nuclear Institute for Agriculture and Biology, P.O. Box 128, Faisalabad, Pakistan)

Improvement of tuber yield in yam bean by mutation induction

The genus *Pachyrrhizus*, a native of Mexico and Central America is now widely distributed throughout the tropics. *Pachyrrhizus erosus* (L.) Urb., commonly known as the yam bean is cultivated in many parts of India for its edible tubers. The young tubers have a crisp and juicy flesh and can be eaten raw or cooked. Genetic variability for agronomically important characters is rare. It was therefore felt desirable to increase it by mutation induction.

Seeds of a locally adapted variety were subjected to gamma irradiation (10, 15, 20 and 25 kR). Evaluation of the M_3 raised from the different treatments unvealed mutants possessing significantly higher yields than the control. While the control plants showed a mean tuber yield of 168 g, one of the higher yielding mutants from the progenies of 10 kR treatment recorded 415 g. Two other mutants selected from the 25 kR treatment showed yields of 401 and 411 g.

These mutants, first identified in M_2, were found to breed true in M_3 - M_5 generations. Yield trials conducted in M_5 generation showed more than two-fold increase in yield by the mutants. Apparently there are remarkable possibilities of improving the yield potential in yam bean by mutation induction.

(Contributed by S. Gopalakrishnan Nair, Central Tuber Crops Research Institute, Trivandrum, India and Susan Abraham, Department of Botany, University of Kerala, Kariavattom, Trivandrum, India).

A pentafoliate leaf mutant of black gram (*Vigna mungo* (L.) Hepper)

Genetically pure seeds of the variety T-9 of black gram, presoaked in distilled water for 9h, were treated with aqueous solutions of sodium azide (NaN_3) ranging from 0.01 to 0.04% at 27$\pm$ 2^{o}C for 6 h. In M_2, one mutant with pentafoliate instead of normal trifoliate leaves has been found in the population from 0.04% NaN_3 treatment. The mutant bred true in M_3 and M_4 and seemed to be free from yellow mosaic disease. It matured 10-15 days earlier than the parent, but the yield/plant is less.

It should be noted that the first pair of leaves of the mutant is petiolate as against the parent where it is sessile, a character which differentiates the genus *Vigna* from the genus *Phaseolus*. The mutant has been included in cross-breeding for further investigations. A similar but high yielding mutant with pentafoliate leaves has been reported before, induced in the same variety of black gram with gamma rays [1].

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(Contributed by Khan, M., Iqbal A. and Rizwi, M.A., University Department of Botany, Bhagalpur University, Bhagalpur 812 007, India)

Isozyme patterns of powdery mildew resistant wheat mutants

Wheat mutants induced by gamma irradiation and showing improved resistance to powdery mildew were analysed for isozymes. The peroxidase band 3A could be related to the disease reaction. The band 3A is absent in resistant mutants, the higher the activity of band 3A the greater the susceptibility.

From: XIA WENGAU, LI ZHENGKUI and WANG KEFENG (Institute of Applic. of Atomic Energy, Jiangsu Academy of Agricultural Sciences, Nanjing). Appl. of Atomic Energy in Agriculture No. 3, 31, 1986.

Dominant dwarf mutants in rice following split-dose gamma rays treatments

Presoaked seeds of rice variety TKM6 were exposed to 35 kR gamma rays in split treatments with 4 h intervals. In M_1, few dwarfed plants survived in 5 + 30 kR, 30 + 5 kR and 20 + 15 kR treaments. Their offspring in M_2 had only 72-89 cm plant height, compared to 155-163 cm of TKM6. The F_1 of mutants "backcrossed" with TKM 6 was 83-91 cm.

From: KUMAR, C.R.A. and SREE RANGASAMY (School of Genetics, Tamil Nadu Agric. Univ. Coimbatore, India). IRRN 12 (1987) 4-5.

Tolerance to gall midge

15 rice varieties were tested for resistance and tolerance to Orseolia oryzae Wood-Mason. Varieties Vikram, PTB10, Leuang 152 and CR94-MR1550 were found to be highly resistant. Mutant cultivar "Jagannath" (India, 1969 from x-irradiated var. T141), although rated "susceptible" in terms of pest incidence was the most "tolerant" showing the lowest yield loss among the high yielding varieties (yielding more than 4 t/ha).

From: RAO, P.S.P. (Central Rice Research Institute, Cuttack 753006, Orissa, India). IRRN 12 (1987) 4, 16.

New rice mutants in China

The later season rice variety "Xiu Shui 77" (semi-dwarf, long growing period, high yield) was gamma irradiated. Mutant lines selected include 9 mutants, 6-11 days earlier; 5 mutants with shorter culm; 8 mutants with grain protein content increased by 6%. Also mutants with higher TGW and more grains per panicle were selected. Most mutants kept the good disease resistance of "Xiu Shui 27", some have even better resistance.

From: ZHANG, M., LUO, R., XU, B. (Inst. f. Appl. of Atomic Energy), TAO, R. and WENG, J. (Plant Protection Inst., Zhejiang Acad. Agric. Sciences, Hangzhou, China). Acta Agric. Nucl. Sinica 2 (1988) 154-160.

XA0101422

XA0101423

XA0101424

Mutation breeding of barley at Krasnodar

Chemical mutagen application gave good results in breeding for earliness, short culm and winter hardiness. A very early mutant "54M17" was obtained from treating "Regia" with NEH. It was crossed with a powdery mildew resistant mutant 52M1 from "Vogelsanger Gold" treated with NDH. A cold resistant mutant tolerating -13^{o}C for 24 h is "KNIISKh 60 M_1" (from EI treated "Cyclon") and cold resistance is also high in a line "KNIISKh 249" obtained from a cross involving "Paoly", mutant 52M1 and "Novator".

From: SHEVTSOV, V.M. (N.I. Institut Sel'skogo Khozyaistva imeni Luk'yanenko, Krasnodar USSR). In: "Advances in Agricultural Science", Moscow Nauka 1987; PBA 58 No. 5755 (1988).

In-vitro culture performance of rice cultivars

Four California rice varieties (L-202, S-201, M-202 and Calmochi 101) and one Texas rice (Lemont) were tested for embryogenic calli produced from mature seeds. Of these varieties S-201, M-202 and Calmochi 101 derived from mutant crosses as follows (mutant parent underlined).

S-201	(Calrose 76 x Cs-M3) x S6
M-202	(IR8 x Cs-M3) x (10-7 x M-101)
Calmochi 101	Tatsumi mochi x (M7 x S6)

S-201 was the only cultivar that produced many shoots from virtually all portions of the embryogenic callus. M-202 produced the highest no. of shoots at the upper level of hormone (BAP). Regeneration of Calmochi 101 was rather poor. The frequency of albino shoots was also different for the varieties tested:

0.027	for L-202	0.00	for Calmochi 101
0.016	for S-201	0.045	for Lemont
0.037	for M-202		

Albino shoots were found only with 0.1 mg l^{-1} BAP in the regeneration medium, except for Lemont which produced albinos without cytokinin.

From: OARD, J.H. and RUTGER, J.N. (Dept. of Agronomy and Range Science, University of California, Davis CA 95616, USA). Crop Science 28 (1988) 565-567.

Modification of barley powdery mildew resistance controlled by the gene Ml-a12

The barley line Sultan 5 carries resistance gene Ml-a12. Seeds were treated with EMS or NaN_3. Among 10381 M_1-spike progenies inoculated with Ml-a12 a-virulent isolates of *Erysiphe graminis*, 25 segregated for less resistant infection type. Among 10 mutants analyzed, 9 had mutant allels of Ml-a12 and one had a recessive mutant gene in a different locus acting as a "suppressor" of Ml-a12.

From: TORP, J. and JÖRGENSEN, J.H. (Agric. Res. Rep. Risö National Lab., 4000 Roskilde, Denmark). Canad. J. of Genetics and Cytology 28 (1986) 725-731; Rev. of Plant Path. 67 (1988) 133.

Induced mutations for rust resistance in bread wheat

Seeds of variety "Lalbahadur" were treated with 0.04% NMH. M_2 plants were inoculated with a mixture of pathotypes of each of the 3 Puccinia species (P. graminis, P. recondita, P. striiformis). Plants with simultaneous resistance to all 3 rusts were selected. Repeated testing in subsequent generations confirmed the resistance. The mutant lines are morphologically similar to the parent cultivar and therefore could be used as components of a multiline variety. Comparison of variety pattern against the Indian pathotypes of rusts suggests that the mutant genes are different from the ones known already in bread wheat.

From: SAWHNEY, R.N. (Div. of Genetics, Indian Agric. Res. Inst. New Delhi 110012, India). Euphytica 36 (1987) 49-54.

Induced mutations in cucumber for resistance to nematodes (Meloidogyne spp.

Seeds were treated with EI and selection was carried out over 5 years. In the susceptible cv. "M15" treated with 0.05% EI for 21 h 7.6% of plants were found resistant, 72% only slightly susceptible. Mutants were used in crosses and hybrids showed 57-89% resistance over 6 generations.

From: UDALOV, V.B. and PRIKHOD'KO, V.F. (Vsesoynznyi Institut Gel'mintologii im. K.K. Skryabina, Moscow, USSR) Referatinvnyi Zhurnal (1987) 7.79.267, PBA 58 No. 6184 (1988).

"Fushi" - excellent mutant germplasm for peanut improvement

The mutant line "Fushi" was selected following seed treatment of the variety "Shi Xuan 64" in 1960 with ^{32}P. Many good peanut varieties were developed using "Fushi" in cross-breeding (ref. Mutation Breeding Newsletter No. 30 (July 1987) p.2-3). In the past 10 years, planting areas of these varieties added up to 3,3 million ha in South China, peanut production was increased by more than 500 000 t valued 500 million Yuan.

From: JIANG, X. and ZHOU, Y. (Guangdong Academy of Agric. Sciences, Guangzhou). Acta Agric. Nucleata Sinica 2 (1988) 147-153.

Smut resistance in sugar cane

From a mutation breeding programme with the popular early maturing sugar cane variety CoC 671 fourteen clones could be selected which were found to be free of smut infection after three successive years of artificial testing. Smut resistance was also found after in-vitro culture propagation of susceptible cultivars G80-454 and CoC 671.

From: Research Highlights 1987, Sugar Cane Breeding, Institute Coimbatore 641007, India.

Induction of mutations in hexaploid triticale

Several different triticale lines were seed treated with NEH or NaN_3. In M_2, chlorophyll mutants were mainly observed in line V2-30 (from 46 x Tömzsi), while short stem, compact spikes and early maturity mutants were found mainly in lines KS126 (from 57 x Stamm 300) and V2-2Z (from Bökökö x Rosner). Lines KS60 (from 46 x Tömzsi) and PS728 (from Tömzsi x 72) showed low mutability.

From: SVEC, M. (Dept. Genet. & Mol. Biol., Nat. Science Faculty, Comenius University Bratislava CSSR). Acta Fac. Rer. Nat. Univ. Comeniane, Genetica 19 (1988) 19-25; PBA 58 No. 5694 (1988).

Walnut mutation breeding

Walnut seeds were treated with 100-15000 R of gamma rays. Seedlings were subjected to measures of "de-chimaerisation". Fast-growing forms were obtained from doses below 2000 R, dwarf types at all doses but increasingly at higher doses. Among the fast growing forms, the promising ones are more precocious, flowering and fruiting at 6 years of age (one even already at 4 years).

From: KUDINA, G.A. (Botanischeskii Sad, Donetsk Ukrainian SSR) Introduktsiya i Akklimatizatsiya Rastenii 1 (1984) 42-44; PBA 58 No. 6131 (1988).

Citrus mutation breeding in the Georgian SSR

Sweet orange cultivar "Mestnyi" (local) was treated with chemical mutagens and gamma rays. Mutant 4790 resulted from chemical mutagenesis, mutant 563 from gamma irradiation. The mutants vary in content of vitamin C, sugars and acids, in fruit weight and yield. Seeds of the mandarin cultivar "Unshu" (satsuma) were treated with NEH. Among 111 variants, 31 were dwarfs, 24 had stronger vigour, 8 showed increased, 5 reduced fruit size, 10 were earlier, 28 later. The reason for the wide variation may be a complex hybrid origin of the "Unshu" mandarin.

From: KUTATELADZE, D.SH., KERKADZE, I.G., GOLIADZE, SH.K. and MEMARNE, G.R. (Vsesoynznyi N.I. Institut Chaya i Subtropicheskikh Kultur, Makharadze, Georgian SSR). Subtropicheskie Kul'tury 5 (1987) 109-124); PBA 58 No. 6076 and 6077 (1988).

Radiation induced mutations in sweet cherry (Prunus avium L.)

Shoot apices of cv. "Napoleon" and "Bing" were irradiated. The overall mutation rate in M_1V_2 was ca. 7%, including reduced growth. The use of buds 11-30 on M_1V_1 shoots is recommended for the efficient recovery of mutants.

From: SAAMIN, S. (Oregon State Univ. Corvallis OR 97331, USA). Dissertation Abstracts (1988); PBA 58 No. 6069 (1988).

Self-fertility in alfalfa after chemical mutagen treatment

Seeds of "Augune II" were treated with 0.03% EI, 0.1% EMS, 0.05% NMH and 0.03% DMS. Self-fertile plants selected in M_2 were further assessed in M_3 and M_4. Some selected lines had a seed production of 65 g/plant. One mutant had self-tripping flowers, another one was self-fertile and cleistogamous. Wide variation was also found in green and dry matter yield and in content of haemolytic saponins.

From: KYARSHULENE, Z.A. (Litovskii N.I. Institut Zemledeliya, Dotnuva, Lithuanian SSR). Sbornik Nauchnykh Trudov po Prikladnoi Botanike, Genetike i Selektin 103 (1986) 19-22; PBA 58 No.5 (1988) 868.

The Swedish mutant barley collection

The Swedish mutation research programme in barley began about 50 years ago and has mainly been carried out at Svalöv in co-operation with the Institute of Genetics at the University of Lund. The collection has been produced from different Swedish high-yielding spring barley varieties, using the following mutagens: X-rays, neutrons, several organic chemical compounds such as ethyleneimine, several sulfonate derivatives and the inorganic chemical mutagen sodium azide.

Nearly 10,000 barley mutants are stored in the Nordic Gene Bank and documented in databases developed by Udda Lundquist, Svalöv AB. The collection consists of the following nine categories with 94 different types of mutants:

1. Mutants with changes in the spike and spikelets
2. Changes in culm length and culm composition
3. Changes in growth types
4. Physiological mutants
5. Changes in awns
6. Changes in seed size and shape
7. Changes in leaf blades
8. Changes in anthocyanin and colour
9. Resistance to barley powdery mildew

Barley is one of the most thoroughly investigated crops in terms of induction of mutations and mutation genetics. So far, about half of the mutants stored at the Nordic Gene Bank, have been analysed genetically; They constitute, however, only a minority of the 94 different mutant types. The genetic analyses have given valuable insights into the mutation process but also into the genetic architecture of various characters. A number of mutants of two-row barley have been registered and commercially released. One of the earliest released, Mari, an early maturing, daylength neutral, straw stiff mutant, is still grown in Iceland.

The Swedish mutation material has been used in Sweden, but also in other countries, such as Denmark, Germany, and USA, for various studies providing a better understanding of the barley genome. The collection will be immensely valuable for future molecular genetical analyses of clone mutant genes.

From: The Nordic Barley Catalogue 1989. ISBN 91-87814-00-5. Issued by the Nordic Gene Bank for Agricultural and Horticultural Plants, P.O. Box 41, S-230 53 Alnarp, Sweden.

LIST OF CULTIVARS

The Plant Breeding and Genetics Section of the Joint FAO/IAEA Division undertakes the collection and dissemination of information on commercially used agricultural and horticultural cultivars developed through the utilization of induced mutations. This list does not claim to be comprehensive. Its content is strictly based on information transmitted by the breeders themselves and/or other institutions involved. Listing of a cultivar does not imply its recommendation by FAO/IAEA.

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
***Alopecurus pratensis* L.** (meadow foxtail)			
Alko	FRG, 1983 U. Simon, Ph. Berner Saatsucht von Schmieder Steinach/Straubing	Gamma rays seeds, 1959	Improved seed retention
Limosa	FRG, 1984 U. Simon Institute for Agronomy and Plant Breeding University Giessen	Gamma rays seeds, 1959	Improved seed retention
***Arachis hypogaea* L.** (groundnut)			
Luhua 6	China, 1986 Qiu Qingshu Institute of Peanut Shandong Acad. Agric. Sci.	Gamma rays 24 kR seed, 1971 [Baisha 1016]	10 d earlier than parent variety yield 13.6% higher

Brassica juncea (L.) Czern and Coss. (oriental mustard)

Shambal (BAU-M/248)	Bangladesh, 1984 L. Rahman Md. Shah-E-Alam M.A. Quddus Bangladesh Agric. Univ. Mymensingh	EMS 0.64% seeds, 1975 [BAU-M/14]	Short plant type, bold seed size; 1988 grown on 7000 ha = 10% of *B. juncea* area

Chrysanthemum morifolium (chrysanthemum)

Golden Cremon	Thailand, 1987 Ch. Buranakanit O. Sahavacharin Dept. Horticulture Faculty of Agriculture Kasetsart University Bangkok	Gamma rays 1 krad tissue culture, 1986 [Cremon]	Golden yellow ray florets
KU 1	Thailand, 1988 S. Eiamfang O. Sahavacharin Dept. Horticulture Faculty of Agriculture Kasetsart University Bangkok	Gamma rays 1.5 krad tissue culture, 1986 [Hangzhou]	Larger flower, more disease tolerance

Citrus reticulata Blanco (mandarin)

Hongju 420	China, 1986 Zhou Yubin Zhou Jiangxing Zhou Kailong a.o. Citrus Research Institute Chinese Acad. Agric. Sci. Beibei, Chongqing	^{60}Co gamma rays seeds, 1983 [Dahongpao]	Only few seeds (3-4 instead of 13-14), cold tolerant

Corchorus capsularis L. (white jute)

Hyb 'C' (Padma)	India, 1983 D.P. Singh Jute Agric. Research Institute Barrackpore W.P.	JRC-6165 x JRC-412 (JRC-6165 = mutant of JRC-919 induced by 90 kR X-rays, dry seeds)	Tolerance to water logging, less affected by diseases and pests

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Dianthus caryophyllus L. (carnation)			
Chaichoompon	Thailand, 1983 Ch. Suriyasak O. Sahavacharin Dept. Horticulture Faculty of Agriculture Kasetsart University Bangkok	Gamma rays 1 krad tissue culture, 1981 [White Sim]	White with pink streaks on petal
Festuca pratensis Huds. (meadow fescue)			
Fesko	FRG, 1982 Ph. Berner Saatzucht v. Schmieder Steinach/Straubing	Gamma rays seeds, 1961	Improved seed retention
Lifesta	FRG, 1981 E. Lütke Entrup G. Michelmann Deutsche Saatveredelung Lippstadt	Gamma rays seeds, 1961	Improved seed retention
Liforte	FRG, 1984 G. Michelmann E. Lütke Entrup Deutsche Saatveredelung Lippstadt	Gamma rays seeds, 1961	Improved seed retention
Gladiolus sp. (gladiolus)			
Red Reflection	The Netherlands, 1988 A.G. Bakker Ens	X-rays 40-70 Gy corms, 1979 [Peter Pears]	Deeper orange flower colour with yellowish throat

Shobha	India, 1988 S.P.S. Raghava et al. Div. of Ornamental Crops Indian Inst. of Hortic. Res. Bangalore 560080	Gamma rays 1 krad [Wild Rose]	Change of flower colour from "Roseine Purple" to "Shell Pink"
Glycine max (soybean)			
Dorado	GDR, 1988 G.W. Krausse Inst. f. Züchtungsforschung Akad. d. LWW Quedlinburg	NMH 1mM seeds, 1979 [Fiskeby V]	Higher grain yield, longer stem higher insertion of lowest pod early ripening
Fengdou 1	China, 1988 Xifeng Research Inst. and Inst. Appl. Atomic Energy Liaoning Acad. Agric. Sci. Shenyang	^{60}Co gamma rays 20 kR F_2 seeds of [(Qunxuan 1 x Qun Ying Dou) x 5621]	110-120 d till maturity
Liaonong 1	China, 1988 Inst. Appl. Atomic Energy Liaoning Acad. Agric. Sci. Shenyang	^{60}Co gamma rays 18 kR F_2 seeds of [Heinong 11 x Tiefeng 9]	7-10 d earlier, 10% higher yield than check cv "Heihe 3"
Gossypium hirsutum L. (cotton)			
Chuanpei 1	China, 1982 Zhang Fengxin et al. Dept. of Agronomy South West Agric. Univ. Chongqing	Gamma rays seeds, 1972 [Dongtin 1]	8 d earlier maturity, elongated upper internode, increased boll weight and lint yield
Hordeum vulgare (barley)			
Anna Abed	Denmark, 1979 K. Vive Abed Planteavlsstation 4920 Sollested	Cross with Midas	Stiffer straw

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Hordeum vulgare (barley) continuation			
Ayr	UK, 1986 Cereal and Legume Genetics Department Scottish Crop Res. Inst. Invergowrie Dundee DD2 5DA	(Goldmarker x Athos) x (Goldmarker x Magnum)	Short culm, high yield, good disease resistance
Beauly	UK, 1983 Cereal and Legume Genetics Department Scottish Crop Res. Inst. Invergowrie Dundee DD2 5DA	Trumpf x Georgie	Short culm, high yield, early maturity; good disease resistance
Cromarty	UK, 1983 Cereal and Legume Genetics Department Scottish Crop Res. Inst. Invergowrie Dundee DD2 5DA	Aramir x Trumpf	Short culm, high yield; good disease resistance
Donan	UK, 1983 Cereal and Legume Genetics Department Scottish Crop Res. Inst. Invergowrie Dundee DD2 5DA	Ark Royal x Trumpf	Short culm, high yield; good malting quality and disease resistance
Esk	UK, 1985 Cereal and Legume Genetics Department Scottish Crop Res. Inst. Invergowrie Dundee DD2 5DA	(Goldmarker x Athos) x (Goldmarker x Magnum)	Short culm, early maturity high yield, medium malting quality, good disease resistance

Nairn	UK, 1983 Cereal and Legume Genetics Department Scottish Crop Res. Inst. Invergowrie Dundee DD2 5DA	Trumpf x HB 855/467/8	short culm, early maturity, good malting quality and disease resistance
Novum	CSSR, 1988 J. Kosak SLOVOSKIVO Breed. Station Sladkovicovo	SK 1429 x Krystal	High yield, stable yield, resistant to lodging and to leaf diseases
Profit	CSSR, 1988 F. Slaby OSEVA Breed. Station Cejc	Koral x (H357 x (Jubilane x Jantar))	High yield, resistant to lodging
Tyne	UK, 1987 Cereal and Legume Genetics Department Scottish Crop Res. Inst. Invergowrie Dundee DD2 5DA	(Goldmarker x Athos) x (Goldmarker x Magnum)	Short culm, early maturity medium malting quality; good disease resistance
Vega Abed	Denmark, 1977 Abed Planteavlsstation 4920 Sollested	Lofa Abed x Kristina	Stiffer straw general good disease resistance

Hyacinthus sp. (hyacinth)

Orion	The Netherlands, 1987 J.M. van Tuyl Inst. of Hortic. Plant Breeding Wageningen	X-rays 2.5 Gy bulbs before scooping [Jan Bos]	Flower colour orange instead of "Spiraea red"

Oryza sativa L. (rice)

Hari (TR-RNR-21)	India, 1987 P. Narahari Nuclear Agric. Division BARC Trombay Bombay 400 085	IR8 x TR5 (TR5 dwarf mutant of salt tolerant variety SR-26-B induced by fast neutron irradiation	Short culm, higher yield

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
IRAT 104	Côte d'Ivoire, 1983 M. Jacquot J. Dallard IRAT/IDESSA	IRAT 13 x Moroberekan	Taller than IRAT 13; high yield
IRAT 112	Côte d'Ivoire, 1983 Togo, 1986 Haiti, 1987 M. Jacquot J. Dallard IRAT/IDESSA	IRAT 13 x Dourado Precoce	Higher tillering, earlier maturing than IRAT 13 recommended by WARDA for upland conditions in Côte d'Ivoire and Burkina Faso
IRAT 144	Burkina Faso, 1978 Côte d'Ivoire, 1984 M. Jacquot C. Poisson IRAT/IDESSA	IRAT 10 x IRAT 13	Medium tall, high yield 103 d till maturity, lodging resistant
IRAT 170	Côte d'Ivoire, 1984 M. Jacquot, M. Arraudeau G. Clement, C. Poisson IRAT/IDESSA	IRAT 13 x Palawan	Medium tall, high tillering 124 d till maturity; good cooking quality; recommended also in Nigeria
IRAT 177	Brazil, 1988 D. Dechanet IRAT Guayana	Spontaneous mutant selected from IRAT 79	Taller, high tillering
IRAT 216 (IDSA 6)	Côte D'Ivoire, 1985 M. Jacquot G. Clement C. Poisson IRAT/IDESSA	Columbia 1 x M 312A (M 312A induced by gamma rays)	Good adaptation to wetland rice culture resistance to *Pyricularia* tolerance to flooding

Phaseolus vulgaris L. (bean)

Mitchell	Canada, 1986 S.J. Park J.W. Aylesworth Agric. Canada Research Station Harrow, Ontario	Seafarer x Tuscola	
Carioca Arbustivo Precoce 1070 (CAP-1070)	Brazil, 1986 A. Tulmann Neto CENA Piracicaba S.P. J. Alberini F.T. Sementes e Pesquisa Pont a Grossa, Parana	Gamma rays 32 krad [Carioca]	Bush type, 5-14 d earlier maturity

Rhododendron obtusum (Japanese azalea)

Odilia	The Netherlands A.S. Bouma Research Station for Nursery Stock Boskoop	X-rays 20-60 Gy plants, 1969 [Silvester]	Rosy-pink flower colour instead of pink; one week earlier forcable than "Silvester"
Stefan	The Netherlands A.S. Bouma Research Station for Nursery Stock Boskoop	X-rays 20-60 Gy plants, 1969 [Silvester]	Salmon-pink flower colour instead of pink; one week earlier forcable than "Silvester"

Vigna unguiculata (L.) Walp. (cowpea)

Uneca-Gama	Costa Rica, 1986 W. Navarro Alvarez Secc. Genetica Vegetal Universidad Nacional Heredia	Gamma rays 10 krad [Centa]	high yield

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Ziziphus mauritiana Lam (Indian jujube, ber)			
Dao tien	Vietnam, 1986 V.T. Hoang N.V. Tuynh Food Crops Research Institute Tu Loc, Hai Hung	MNH 0.02-0.04%, 12 h pregermin. seeds [Thien Phien]	Harvestable 1 m earlier (Jan instead of Feb), 2 crops/year (second harvest November); fruit size increased (from 20 to 25 g) better taste (peach flavour)
Ma hong	Vietnam, 1986 V.T. Hoang N.V. Tuynh Food Crops Research Institute Tu Loc, Hai Hung	MNH 0.02%, 12 h pregermin. seeds [Gia Loc]	Maintained useful traits of "Gia Loc" such as early maturity, 2 crops/y (harvest December and August). Altered characters: fruits round instead of oval, pink rose instead of yellow, sweeter, more stable fruit yield

Corrections

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Abelmoschus esculentus (L.) Moenck (lady's finger, okra)			
MDU 1 (instead of MDU 2) (ref. MBNL No. 33)	India, 1978 K.S. Jahangir V. Thandapani G. Sountharapandian P. Chandrasekaran Agricult. College and Research Institute, Madurai	DES, 0.04% [Pusa Sawani]	light green fruits, less crude fibre (12.3%), higher yield (30%), field tolerant to yellow mosaic, cultivated on ca. 5000 ha.
Chrysanthemum sp.			
Kumkum (ref. MBNL No. 31)	India, 1982 S.K. Datta B.K. Banerji H.M. Jungran National Bot. Res. Inst. Lucknow 226001	(rest unchanged)	

NEW PUBLICATIONS

Radiation Mutagenesis in Wheat
P.G. Savov
ISBN 81 85005605
Agricole Publishing Academy New Delhi 110024. 1989, 312 p., US $36

Plant Biotechnology: In vitro selection upon cells and tissue cultures
1987 Plant Science Lectures Series at Iowa State University.
The topics covered in this publication are:

1. Selection for amino acid overproducer mutants in maize: Valine selection.
2. *Agrobacterium* - mediated gene transfer to plants; engineering tolerance to glyphosate.
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4. The use of cell selection to obtain novel plant genotypes resistant to mineral stresses.
5. Science in the art of plant regeneration from cultured cells: An essay and a proposal for a conceptual framework.
6. Sorghum cell culture: Somaclonal variation/screening.
7. *In vitro* selection with plant cell and tissue cultures. An overview.

Copies can be purchased for $8.00 by prepaid orders from Darlene Fleig, Agronomy Department, Iowa State University, Ames, IA 50011. Make checks payable to "Iowa State University". Orders from outside the USA should be prepaid by international money order.

Proceedings 5th International Lupin Conference
5-8 July 1988, Poznan (Poland)
Edit. T. Twardowski
c/o Institute of Bioorganic Chemistry, Polish Academy of Sciences, 31704 Poznan, Noskowskiego 12 Poland, 735 pp.

New Frontiers in Breeding Researches
Proceedings of 5th SABRAO Congress, Bangkok 1985.
Edit. B. Napompeth, S. Subhadrabandhu
Publ.: Faculty of Agriculture, Kasetsart University, Bangkok, Thailand, 1986, 931 pp.

Plant Breeding and Genetic Engineering
Proc. of SABRAO Symposium, Kuala Lumpur, Malaysia, 30.11 - 3.12.1987
Edit. A.H. Zakri
Publ.: SABRAO, c/o Department of Genetics, University Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Darul Elisan, Malaysia. 1988, 384 pp.

Plant Domestication by Induced Mutations
Proc. of FAO/IAEA Advisory Group Meeting on the Possible Use of Mutation Breeding for Rapid Domestication of New Crop Plants. Vienna, 17-21 Nov. 1986
IAEA, 1989, 189 pp., 500 AS. ISBN 92-0-111089-8

Plant Cell and Tissue Culture of Economically Important Plants
Proc. of a national symposium, July 1986
Edit. G.M. Reddy
Dept. of Genetics, Osmania University, Hyderabad, 500007 AD. India 1987, 462 pp. 300 Rs

FUTURE EVENTS

1989

12-15 October — Genetics and Molecular Biology of Arabidopsis (Indiana Molecular Biol. Symposium IV), Indiana State University, Bloomington
Contact: P. Percival
Inst. for Molecular and Cellular Biology,
Jordan Hall 322A
Indiana University
Bloomington, IN 47405

1990

2-5 June — 4th International Conference of Arabidopsis Research "Contributions to Molecular Genetic, Biochemistry, and the Cellular and Developmental Biology of Plants", Vienna (Austria)
Contact: K. Peuker
Institute of Botany, University of Vienna
Rennweg 14
A-1030 Vienna, Austria

LAST BUT NOT LEAST

Please submit your contribution 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. References to publications containing a more detailed description of methods or evaluation of findings are welcome but should generally be limited to one or two.

Alexander MICKE

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