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RESEARCH NEWS

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Agronomically valuable mutant lines of castor

Dry seeds of four castor varieties (VNIIMK 165-improved, VNIIMK 18, Chervonnaya and Antika) were treated with six chemical mutagens, N-nitroso-N-methyl urea (NMU), N-nitroso-N-ethyl urea (NEU), dimethyl sulphate (DMS), diethyl sulphate (DES), ethylenimine (EI) and 1,4-bis-diazoacetyl-butane (DAB) in various doses during 18 hours.

About 40,000 plants were studied in M_2 and 80 types of mutations were found, including a number of valuable mutants: short-stemmed, semi-dwarf, dwarf, early maturing, with female and interspersed types of racemes, highly productive etc.. Based on trials in M_3-M_4, on small plots with two or three replications, the superior mutant lines were identified. The best mutants are presented in the table.

Early maturation is very important for growing castor in the USSR, as it is the predecessor of winter wheat in crop rotation. The mutants M2-323 and M1-83 are of great value as they show early maturation and high yield. Their productivity is mainly conditioned by a high percentage of interspersed plants.

The reduction of plant height is of great importance for the successful combine harvesting of castor. Mutant lines M2-119 and M1-284 characterised by low plant height and high yield are very interesting in this respect. The obtained initial material will be used in further breeding work.

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Table: Characteristics of the superior castor mutants (average for M_3-M_4, 1988-1989)

Mutants	Mutagen dose (%)	Vegetation period days	Plant height (cm)	Female plants (%)	Seed yield (t/ha)
M1-83	DAB 0.20	127*	190	28[1]	2.54*
M1-168	DES 0.20	125*	167	15	2.22
M2-323	EI 0.05	126*	169	73[1]	2.29*
M2-219	NMU 0.07	123*	163*	13	1.91
M2-29	NMU 0.07	142	188	23	2.34*
M2-27	NMU 0.05	131	156*	10	2.44*
M2-46	DMS 0.10	140	198	12	2.35*
M2-119	NEU 0.10	132	182	98[1]	2.35*
M2-248	EI 0.05	136	196	18	2.23*
M2-116	NEU 0.05	139	154*	71	1.88
M2-123	EI 0.03	131	163*	78[1]	2.12
M1-284	NEU 0.10	150	157*	28	2.29*
VNIIMK 165-improved (check)		133	192	0	1.76
LSD_{05}		4	27	-	04.7

[1]-interspersed female type of flowering;
*- significant difference at 95% level of probability.

(Contributed by I.K. Bokhan, Laboratory of Castor Breeding, The All-Union Research Institute of Oil Crops, Krasnodar, 350038, USSR).

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Yield improvement in barley by using gamma-irradiation

Breeding work for barley improvement in Libya is very rare. All varieties grown here are foreign varieties. Yield per hectare is low compared with other countries having similar climatic conditions. Productivity, lodging, disease resistance, drought and salt tolerance are the main characteristics that need to be improved.

A mutation breeding programme for barley improvement was initiated at the Tajoura Nuclear Research Centre in 1983-1984. The objectives of this programme are the development of new lines that could be used directly or indirectly in the development of new varieties. The locally adapted barley (Hordeum vulgare L.) variety "California Mariout" was used as a parent material. Grains with 14% moisture were exposed to 200 Gy gamma-ray from ^{60}Co source at the Centre.

Three experiments were conducted during 1986-1989. From the first experiment (1986-1987), 62 mutant lines were evaluated. From the second and third experiments (1987-1989), only seven mutant lines were evaluated.

In the 1988-1989 experiment, the crop was irrigated and fertilised with 0, 100 and 200 kgN/ha. Lodging score was low in 0 kgN/ha and increased significantly by the increase in N level. None of the mutant lines more lodging resistant than the parent or the control. However, yield differences were significant and the application of 100 kgN/ha increased the grain yield (Table).

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Table: Means for grain yield (g per m^2) for mutant lines, their parent and the contol in 1987-1988 and 1988-1989 experiments

Mutants and varieties	1987-1988 Experiment 100 kgN/ha	1988-1989 Experiment 0 kgN/ha	100 kgN/ha	200 kgN/ha
(2-6-26)	415	426	610	594
(2-3-19)	413	276	513	497
(2-9-26)	408	318	519	450
(2-2-27)	408	328	587	573
(2-2-26)	282	352	591	537
(1-1-2)	333	447	452	571
(2-6-8)	341	208	383	389
Cal. Mariout (Parent)	379	170	432	414
Beecher (Control)	263	284	474	546
L.S.D. at 0.05	121		164	

Mutant line 2-6-26 outyielded the mother variety due to increase in number of heads per plants, but there are no changes in other yield components. This result was confirmed in 2-year experiments in which the mutant outyielded the mother variety and the control.

We conclude that mutant 2-6-26 is very promising. This mutant will be named Tajoura 1, and will be released for further evaluation in yield trails over different areas in the country.

(Contributed by Ibrahim Mohammed Benamer, Radioisotopes and Radiation Application Department, Nuclear Research Centre, Tajoura, Libya).

Induced mutations for resistance to powdery mildew in wheat

The most serious diseases of wheat in the Yangtze River Valley in China are powdery mildew and scab. Breeding for disease resistance either using conventional methods or through mutation breeding is the best way of controlling these diseases. Mutation breeding may be valuable in obtaining genotypes with resistance or tolerance, or for breaking undesirable linkages involving existing genes for disease resistance.

Table: Selection of wheat mutants resistant to mildew following treatment with 20 krad gamma rays

	M_2			M_3		M_4	
Variety	Inoc. seedl.	Resist. lines	Suscept. lines	Resist. lines	Suscept. lines	Resist. lines	Mutant lines
Ningmai 6	8,000	3	2	1	5	0	
Ningmai 3	12,000	7	3	4	35	1	34080
Yangmai 3	20,000	62	4	23	37	2	34157 + 34158

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The following commercial varieties were used: Yangmai 3, Ningmai 3 and Ningmai 6. They are high-yielding varieties, but susceptible to powdery mildew. Seeds of these cultivars were treated with gamma-rays. The material was screened in the seedling stage in M_2 in the greenhouse and under field conditions in M_3-M_4 and later generations. The seedlings were inoculated with a spore suspension of the powdery mildew fungus.

The most resistant mutant selected from variety Ningmai 3 was the line 34080 with resistance to races 4, 16 and 20. According to the number of progenies in M_2, the mutation frequency was 1.2×10^{-4}. The other two mutants (34157, 34158) were screened from variety Yangmai 3. Mutant 34157 showed a stable resistance to races 4, 16 and 20; mutant 34158 was resistant to races 4 and 20 but susceptible to race 16. Tracing them back to M_2 progeny, the mutation frequency was 1.0×10^{-4}.

From electrophoretic analysis of mildew resistant mutant lines of wheat we found that the zymogram of peroxidase in resistant lines 34080 and 34157 was different from their parents and that these lines do not have band 3A.

(Contributed by Xueyu LIU, Institute for Application of Atomic Energy in Agriculture, Jiangsu Academy of Agricultural Sciences, Nanjing, China).

Induced lodging resistance in upland rice

Seeds of two short duration but tall upland rice varieties "PMK 1" and "Poongar", susceptible to lodging, were subjected to mutation breeding in 1988-1989. Dry seeds of these two varieties were treated with 20, 25 and 30 krad of gamma rays and soaked seeds were treated with 40, 50 and 60 mM concentration of EMS.

In M_2 generation lodging was measured and a correlation study was made between the angle of lodging and various characters like plant height, length of lower internode, productive tiller number, culm diameter and panicle weight. The angle to which the main tiller can be bent before lodging on the 25th day after flowering was measured by using a protractor. Those plants which lodged at an angle beyond 30° from the vertical plane were classified as lodging. From 60,000 M_2 plants, 78 lodging resistant semi-dwarf mutants and 5 dwarf mutants were selected.

As expected, there was generally a negative correlation between internode length and lodging resistance and a positive correlation of culm diameter with lodging resistance. For plant height and tiller numbers, correlations were not so clear.

(Contributed by M. Arumugam Pillai and M. Subramanian, Department of Agricultural Botany, Agricultural College and Research Institute, Madurai 625 104, Tamil Nadu, India).

Mutants with increased resistance to herbicide in Guinea corn *Sorghum bicolor* (L.) Moench

Sorghum is an important staple food in many tropical countries. In Nigeria, it is extensively cultivated for food and, in recent times, as raw material for the brewing, baking and starch-making industries. We have investigated the possibilities of breeding crop cultivars of *Sorghum*

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with improved seed protein, -amylase activities and resistance to herbicide by means of induced mutation.

Seeds were treated by soaking them in an aqueous solution of ethyl methane sulphonate (EMS) 8 or 64 mM at room temperature 3, 6, 9, 12, 15 or 24 hours. After the treatment, the seeds were briefly rinsed in water and transferred to petri dishes containing moist filter paper for germination. The seedlings were later transplanted to loamy sand soil in plastic trays. M_1 seedlings were grown to maturity in the greenhouse. The M_1 contained plants with variegated leaves and other morphological abnormalities. Only the progenies of normal plants were grown for further generations. Resistance to Igran 500 E.C. (2-tert-butylamino-4-ethylamino-6-methylthio-striazine; from Ciba Geigy) was tested in M_2 seedlings by mixing 1 part per 100 (by volume) of the herbicide with the soil a day before sowing the seeds.

Preliminary screening of 2,500 M_2 plants revealed a number of morphological and leaf colour mutations. 50 seedlings were more resistant to the herbicide but no seedling resistance was observed in the parent cultivar. There was a 23.43% reduction in seedling weight of the M_2 lines grown in soil treated with Igran 500, whereas the reduction in seedling weight of the original cultivar was 42.46% (Table). The resistant M_2 seedlings had longer and better roots.

Table: Effect of Igran 500, added to soil prior to sowing, on the fresh weight of Sorghum seedlings

Lines/variety	Weight per seedling (mg) untreated	treated	Weight reduction (%)
original var.	928	534	42.46
M_2	875	670	23.43
Standard Error	25.7	25.7	

(Contributed by P.G.C. Odeigah, A.F. Adewoyin, O.O. Obatayo, Genetics Laboratory, Department of Biological Sciences, University of Lagos, Akoka, Lagos, Nigeria.)

EMS induced dwarf and high yielding mutant in yam bean (*Pachyrrhizus erosus* Linn.)

The species *Pachyrrhizus erosus* Linn., commonly known as yam bean, is cultivated in many countries for its edible underground tubers. The young tubers can be eaten raw, cooked, or can be sliced and made into chips. As genetic variability is limited in this species, a mutation breeding programme, using physical and chemical mutagens, was initiated to induce variability in a locally adapted cultivar. Genetically pure seeds were treated with concentrations of EMS ranging from 0.25 to 2%. Evaluation of M_2 raised from 1.25% treatment revealed a dwarf mutant showing a higher yield than the control. This mutant attained a height of 20 cm only in M_3 as against 82 cm in the controls (Table). Though the starch content of the tuber and rotenone content in the seeds were the same as that in the control, protein content was slightly higher and the sugar content slightly less.

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Table: Characters of the control and a high yielding dwarf mutant of yam bean

	Length of main vine (cm)	Weight of tuber (g)	Starch %	Sugar %	Protein (dry weight basis) %	Rotenone* content of pods (%)
Control	85.15	157.50	8.74	3.74	4.13	0.25
Mutant	20.55	367.60	8.74	3.30	5.31	0.25

* a natural insecticide.

The mutant bred true and the potentialities were evaluated in M_3 - M_5. In M_5 generation the mutant showed an average yield of 351 g per tuber.

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

Alkaline azide mutagenicity in cowpea

Sodium azide is known as a potent mutagen in cereals and legumes [1]. It is very effective in acidic medium in barley [2, 3]. Here an attempt is made to measure the effectiveness of sodium azide in alkaline medium (pH 7.4) on cowpea (Vigna unguiculata (L.) Walp., variety FS-68).

Seeds pre-soaked in distilled water for 5 hours were treated with different concentrations (10^{-6}, 10^{-5}, 10^{-4} and 10^{-3}M) of sodium azide (NaN_3) for 4 hours at 28 $\pm$ 2°C. Bottles were intermittently shaken, then the seeds were thoroughly washed in running tap water and subsequently planted in pots.

The treatment caused significant biological damage (Table 1) such as reduction in seed germination, length of root and shoot, number of nodules and pods per plant and morphological leaf variations. Morphological, as well as chlorophyll mutants, were detected in M_2. The important features of the mutants are as follows:

Table 1: M_1 effects of alkaline sodium azide treatment

Concentration (molar)	Germination %	Root length	Shoot length	Nodules/ plant	Pods/ plant	Branches/ plant
		% reduction				
Control	95	0.00	0.00	0.00	0.00	0.00
Buffer only	90	2.46	1.75	11.11	0.00	0.00
10^{-6}	85	3.37	3.45	14.81	5.88	11.76
10^{-5}	75	7.82	6.55	22.22	23.53	17.65
10^{-4}	50	8.51	10.04	33.33	29.41	17.65
10^{-3}	45	8.81	18.34	33.33	41.18	23.53

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(a) Reduced internodal length: Plants showed a 27% to 39% reduction in the internodal length as compared to control.
(b) Fasciated stem: Fasciation in the lower part of the stem led to a change in the orientation of cotyledonary leaves.
(c) Delayed flowering: Formation of flowers delayed for 12 to 15 days compared with control. Other characters liked normal plants.
(d) High yield: Increased number of flowers (38.8%), pods (25%), and seeds (50%) over the original variety. The mutant also showed more vegetative growth.
(e) High nodulating: Increased number of nodules and lateral roots. Dry biomass 2.7 g compared with 2.0 g of normal plants.

All the mutants described bred true in M_3. Sodium azide in alkaline medium (pH 7.4) was found to be quite effective in inducing mutations in cowpea.

Table 2: Frequency of mutations in M_2 population of Vigna unguiculata L.

Concentration (molar)	Reduced internodal length	Fasciated stem	Delayed flowering	High yield	High nodu-lating	Chlorophyll change
Control	-	-	-	-	-	-
10^{-6}	2.88	-	-	-	-	5.76
10^{-5}	2.59	1.29	-	1.29	1.29	2.59
10^{-4}	1.05	-	1.05	-	-	2.10
10^{-3}	-	2.17	-	-	-	4.34

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(Contributed by S.K. Mahna, Anubha Bhargava and Lalit Mohan, Cytogenetics and Mycology Laboratory, Department of Botany, Government College, Ajmer, India).

Gamma-ray-induced bold seeded early maturing groundnut selections

"Chico" is an early maturing (85-90 days) erect groundnut (*Arachis hypogaea* L.) genotype utilised in groundnut improvement to incorporate earliness in high yielding varieties. Though it has high shelling out-turn, its yield potential is low since it has small seeds [1-3]. Mutation breeding was started with the objective of improving the seed size.

In a preliminary experiment, dry seeds were treated with 20, 30, 40 or 50 kR of gamma rays. The M_1 generation was grown during the post

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rainy season of 1988-1989. The M_2 generation was planted as individual plant progeny rows during the rainy season of 1989. 105 progeny rows were studied, the total number of M_2 plants being 1,730. All the M_2 plants were harvested 90 days after sowing.

Seven mutants with bold seed size were obtained. The mutants had 100 kernel weight ranging from 22.2 to 40.4 g compared to 21.1 g of control. The study is in progress.

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(Contributed by V. Manoharan and S. Thangavelu, Regional Research Station, Vriddhachalam 606 001, Tamil Nadu State, India).

Application of mutagenesis for the improvement of an indigenous black seeded soybean variety of India

The large scale cultivation of soybean in India (nearly 2 million ha at present) with yellow seeded varieties) is a comparatively recent development. In early times, black seeded soybean was grown on a limited area, under local names like "Bhat", "Bhatmash", "Kalitur" or "Kala Hulga". These indigenous varieties are characterised by small black seeds, the ability to thrive well under suboptimal conditions, good seed germinability and organoleptic suitability for certain indigenous food preparations. However, they show low yield, long duration, high pod-shattering, vulnerability to insect-pests and diseases.

Dry seeds of the variety "Bhat" were treated with gamma rays (15, 20 and 25 k) with and without additional exposure to UV (2 hours at 260 nm). In M_2, the frequency of viable mutations ranged from 0.42 to 5.64%. Both macro- and micro-mutations were identified in the M_2 and M_3 generations. Agronomically useful mutants were evaluated in replicated trials for three consecutive years. A mutant "$T_1$54", resulting from 20kR + UV, surpassed the parent and local checks in yield. Besides, the mutant has other improved desirable attributes viz., yellow seed coat, early maturity (110 days) and tolerance to yellow mosaic and bacterial pustules. The mutant has retained the good seed viability and tolerance to stress conditions as observed in the parent. It is semi-determinate in nature and possesses white flowers in contrast to purple flowers found in the parent variety "Bhat".

This mutant, later named "NRC-1", was entered in the multi-locational varietal trials under the All-India Co-ordinated Research Project on Soybean in 1988. It has faired well in three zones to enmerit its promotion for large scale evaluation in the northern plain zone, the central zone and the southern zone. It has yielded up to 3.64 t/ha at Parbhani in the Central Zone.

(Contributed by P.S. Bhatnagar, S.P. Tiwari and Prabhakar, National Research Centre for Soybeabn (ICAR), Indore, 452 001, M.P., India).

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Early maturing and good yield mutants in soybean (Glycine max (L.) Merr.) in Brazil

Sugar cane is planted in large areas in Brazil. A rotation crop for sugarcane should be early maturing. With the objective of obtaining early mutants in soybean for rotation with sugar cane, seeds of two cultivars of soybean were treated with gamma rays or EMS.

The tests in one location indicate that some precocious mutants which maintained the level of productivity of the original cultivar "Paraná" were obtained with 22 krad [1]. Tests in three localities of the State of Sao Paulo were conducted and the results from all four tests are summarised in the table.

Table: Performance of mutants from "Paraná" cultivar

	Yield	Date relative to control (days)		Height (cm)	
Mutants	(% control)	Flowering	Maturity	Plant	First Pod
Control	100	0	0	52	12
M1	112	-4	- 7	47	10
M2	103	-7	- 6	46	9
M3	110	-5	- 6	47	10
M4	109	-4	- 6	46	10
M5	110	-5	- 4	48	11
M6	100	-6	-10	47	11
M7	107	-4	- 5	48	11
M8	111	-1	- 3	50	11

These data, as well as the results of other tests, permit the conclusion that some promising mutants have been obtained. The mutants M_1 - M_4 and M_6 especially show a significantly earlier maturation while maintaining the capacity of grain production of the original cultivar.

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(Contributed by A. Tulmann Neto and T.C. Peixoto, Centre for Nuclear Energy in Agriculture and COPERSUCAR, Piracicaba, Sao Paulo, Brazil.)

Nodulation studies with induced mutants of black gram (Vigna mungo L.)

Mutation breeding has been widely used to generate genetic variability in plants, but reports of mutations affecting the root system are less common [1, 2 and 3]. In the present work, black gram (Vigna mungo L. var T9), has been used for studies on the effect of induced mutations on nodulation patterns. Soaked seeds were treated with hydroxylamine or sodium azide. The M_3 obtained from seeds of M_2

Table: Root and shoot characteristics of three mutants of black gram (average of 10 plants in 2 replications)

Mutants	Root Length (cm)	Shoot Length (cm)	Dry weight of root g	Dry weight of shoot g	Number of nodules	Number of lateral roots
Control	18.4 ±0.12	19.0 ±0.14	0.30	1.15	12.0 ±0.5	16.0 ±0.2
High Nodulating	25.5 ±0.64	23.1 ±0.26	0.59	3.84	39.7 ±0.6	19.4 ±0.2
Excessively Branched	43.2 ±0.54	30.1 ±0.42	0.54	5.10	25.4 ±0.7	16.8 ±0.5
Dwarf	9.8 ±0.24	10.3 ±0.41	0.12	0.25	5.0 ±0.2	14.0 ±0.6

segregants was used for confirming the mutants and for nodulation studies. These plants were uprooted at the time of flowering (50 days old plants).

Three mutants "high nodulating" (morphologically more or less like control), "excessively branched" and "dwarf" (reduced axillary branches, small sized leaves, reduced number of flowers, pods, and seed weight) were subjected to studies using the parameters root/shoot length, dry weight of root/shoot, number of nodules, number of lateral roots, total nitrogen (root and shoot) and seed protein content (Table).

"High nodulating" and "excessively branched" mutants were characterised by an increased number of nodules and a considerable gain in root as well as shoot length and dry weight. An increase in the number of lateral roots was also observed. A higher level of total nitrogen (7.0% and 6.0% as compared to 4.8% in control) and seed protein content (35% and 32% as compared to 29% in control) were recorded in these mutants. The "dwarf" mutant showed a significant reduction in the number of nodules, root and shoot length and dry weight as well as a lower amount of total nitrogen (4.2%) and seed protein content (25%).

The increase or decrease in the number of nodules was apparently associated with alterations in root or shoot length, number of lateral roots and biomass.

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(Contributed by S.K. Mahna, Rekha Garg and M. Parvateesam, Cytogenetics and Mycology Lab., Dep. of Botany, Government College, Ajmer, India).

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Seedless induced mutant in highly seeded lemon (Citrus limon)

We have reported earlier on the induction of a seedless mutant in "Eureka" lemon [1]. Further irradiation work with gamma rays was performed with another lemon cultivar, "Israeli Villafranca". This highly prolific cultivar has usually up to 25 seeds per fruit.

Budwood of "Villafranca" was exposed to 50 Gy gamma rays from a Co source at the Nuclear Soreq Centre (by courtesy of Mr. R. Padova). Buds from M_1V_1 plants (usually buds 3 to 15) were individually budded in the nursery on sour orange, as well as buds from non-irradiated material. Out of 120 M_1V_2 plants grown in the field at 3 x 2 m spacing one tree bore completely seedless fruit. Fruit on adjacent trees had 22 seeds on the average. The selected tree has been observed for two seasons and found to bear normal seedless fruit. M_1V_3 trees from budwood of the selected original tree have been raised. Some of these have started bearing. Nearly all fruits are completely seedless, with a maximum number of 1 seed per fruit.

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(Contributed by P. Spiegel-Roy, Aliza Vardi and A. Elhanati, Department of Fruit Breeding and Genetics, Volcani Centre, Bet Dagan, Israel).

Radiosensitivity of protoplasts of orange (Citrus sinensis)

The Radiation Genetics Section of the Centre for Nuclear Energy in Agriculture (CENA), University of Sao Paulo, is utilising both "in vivo" and "in vitro" methods for mutation induction in Citrus, cv. "Pera", aiming at resistance to citrus canker. The experiments carried out so far, determined the methodology to isolate protoplasts and their sensitivity to gamma-rays [1].

Regarding the culture of protoplasts from embryogenic callus, the best experimental conditions were: enzymatic digestion for 5 h on a medium containing cellulase (307.6 mg/10 ml), macerozyme (30.3 mg/10 ml), mannitol (328.0 mM) and sucrose (336.2 mM) as osmotic stabilisers. The isolation efficiency of 1.2 x 10^6 viable protoplasts/g will make it possible to use protoplasts in mutation breeding.

To determine radiosensitivity of protoplasts, gamma-irradiation from ^{60}Co source was conducted 42 h after their isolation. This time interval is recommended because during this period protoplasts will reach the stage prior to or at the first mitotic division. Survivals were determined by metylen-blue dyeing, and the LD_{50} was found to be around 37.5 Gy. Any difference compared with other authors might be due to different genotypes used or different methods of calculation of survival.

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(Contributed by M.H.S. Goldman and A. Ando, Centre for Nuclear Energy in Agriculture (CENA), and Department of Genetics, College of Agriculture (ESALQ), University of Sao Paulo, Piracicaba, SP., Brazil).

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<u>"In vivo" methodology for mutation induction in banana, cultivar "Maça"</u>

The "Maça" cultivar is a banana of high acceptability in the south west of Brazil. However, it is very susceptible to several diseases. Due to the difficulties in the application of the traditional plant breeding methods, the Radiation Genetics Section of CENA is utilising the "<u>in vivo</u>" and the "<u>in vitro</u>" mutation breeding approach. The "<u>in vivo</u>" methodology is based on the work of HAMILTON [1]. This method is being utilised in Brazil for rapid banana propagation.

Rhizomes (20 cm diameter) were obtained from young field grown plants before flower differentiation. In these rhizomes, only 5-6 leaf sheaths were retained, the others being removed. The rhizomes were maintained in a greenhouse in boxes with vermiculite, covered with plastic. After one week, all leaf sheaths were removed, until the exposure of the meristematic apex with about 2 mm size. This apex was cut off with a scalpel and a cross shaped cut (2,5 cm) was made. This stimulates the development of lateral buds. After four months, the meristematic apices of these new buds were cut off in the same way and immediately the rhizomes were irradiated with gamma rays. Around the eliminated lateral buds callus developed and new lateral buds were formed. The LD_{50} in relation to the number of these new buds produced was around 30 Gy. According to the author of the original method, from the callus one can obtain axillary or adventitious buds. In the early stages it is possible, based on the shape, to distinguish both types. The advantage of utilising adventitious buds originating from only one cell to avoid chimerism, is well known in mutation breeding. However, it is not certain whether this is the case in the present method.

After detachment from rhizomes and rooting in soil, plants with 15-20 cm height were inoculated with <u>Fusarium</u> <u>oxysporum</u> f.sp. <u>cubense</u>. After 3 weeks the plants showed symptoms of the Panamá disease and screening could be done at this stage. The total time between the removal of rhizomes from the field and the development of the new young plants was about 8.5 months. However, this time can be reduced if a temperature controlled greenhouse is used. This method seems suitable for mutation breeding of banana.

REFERENCE

[1] HAMILTON, K.S., Reproduction of banana from adventitious buds. Tropical Agriculture (1968), 69-73.

(Contributed by A. Tulmann Neto, E.T. Domingues, A.L.F. Alvarez, B.M.J. Mendez and A. Ando, Centre for Nuclear Energy in Agriculture (CENA), University of Sao Paulo, Piracicaba, SP., Brazil).

<u>"In vitro" mutation breeding methodology for Fusarium wilt resistance in banana</u>

Besides "<u>in vivo</u>" methods, the Radiation Genetics Section of CENA/USP is also using "<u>in vitro</u>" methods for mutation breeding to obtain resistance to Panamá disease caused by <u>Fusarium</u> <u>oxysporum</u> <u>f.sp.</u> <u>cubense</u> in the banana cultivar "Maça".

A protocol has been established for the "<u>in vitro</u>" development of shoot tips, obtained from plants in the field or already cultivated under "<u>in vitro</u>" conditions. For both cases, only one culture medium was used

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during all steps of "in vitro" cultivation. New buds were formed and these buds grew and developed to form roots. The medium was composed of macro and micro nutrients, with added Morel vitamines, BAP (5 mg/l), saccharose (30 g/l) and agar (6.5 g/l), at pH 5.7. Cultures were allowed to grow in a controlled environment at 27°C and 16 h illumination. Shoot tips which originated from "in vitro" plantlets, were cut longitudinally down the middle. This was done to avoid a tendency of regeneration of the original tissue instead of the formation of new lateral buds. To resolve the chimerism resulting when mutagenic treatment is applied to shoot tips, there is a need of vegetative propagation of new lateral buds. Selection can then be done at M_1V_4 generation [1].

Once the protocol was established, the gamma ray sensitivity was determined. The dose that produced a 50% decrease in the number of new lateral buds was around 40 Gy and this dose will be utilised. The methodology was completed by soil inoculation with Fusarium of young plants 15 cm in height, obtained from "in vitro" cultures. After 3 weeks all inoculated plants showed symptons of wilt, demonstrating the possibility of screening. The method is now being utilised on a large scale in an attempt to induce a resistant mutant.

REFERENCE

[1] "In vitro" technology for mutation breeding, IAEA, TECDOC-392 (1986).

(Contributed by A. Tulmann Neto, E.T. Domingues, B.M.J. Mendes and A. Ando, Centre for Nuclear Energy in Agriculture (CENA), Piracicaba SP., Brazil).

Ionophoren - a new method of mutation induction in plants

For many years the work on mutagenisis focussed on using ionizing radiation or chemical compounds. The treatments and doses inducing optimal effect were studied extensively. Many studies concerned mutation spectra observed after the action of different mutagens. Here we describe a new method for obtaining mutants and the first experiences of its application.

The new method consists of exposing plants (germinated seeds) to the action of electromagnetic field, which is formed between the anode and cathode of direct current with a voltage of 12 and 24 V. The cathode is a graphite electrode permanently immersed in distilled water. The other electrode (made from silver) is inserted between the germinating seeds. The seeds are in contact with water, though they are not immersed. Therefore, the current flows between the electrodes through the seedlings. In order not to destroy the meristems of young roots the roots were placed above the water. The distance between the electrodes did not exceed 15 cm. After placing the electrodes and seeds the current is switched on.

The current did not exceed several Amperes in all the variants of the experiment. The exposure was 2, 5 and 10 minutes. During the exposition the current decreased; differences were distinct - from some tenths to some Amperes. Germinating seeds of maize (pure lines from Exp. Station Smolice), barley, wheat and soybean were exposed in this way to the action of an electromagnetic field. A comparatively low voltage and current caused necrosis of most plants. Few plants produced seeds. In the M_2 generation they were singly sown in pots. Distinct mutants, were detected

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in the M_3 though the scale of their variation was not large. Barley and wheat had a different response than soybean. Certain sectors of spikes were sterile. Plants grown out of these sectors developed seeds again showing sterile sectors.

In soybean morpohological and physiological differences observed exceeded the variation encountered in hybrid populations and in populations of plants obtained under the effect of other mutagens. A final description will be made on M_4 lines. Continuation of the studies is necessary. Results will be published in "Genetica Polonica".

(Contributed by Stanislaw Starzycki, Plant Breeding and Acclimatisation Institute, Radzików, 05 - 870 Blonie, Poland).

Performance of induced mutant derived rice varieties in California

In 1988, 63% (or 265,800 acres) of the rice grown in California stem from rice varieties which have induced mutants as ancestors. In 1989, the figure increased to 77% (or 316,443 acres). The table gives details:

	Total rice acreage	Short grain varieties			Medium grain varieties	
		S-101 (1988)	S-201 (1980)	Calmochi-101 (1985)	M-202 (1985)	M-401 (1981)
1988	420,000	20,000	35,000	4,200	180,000	26,600
1989	410,000	13,575	38,473	4,327	235,534	24,534

In addition, the induced mutant derived varieties M-102, M-103, M-203, Calpearl and Valencia are grown on several thousand acres.

Source: Rice Journal 93, No. 3, March 1990, p. 36.

Performance of disease resistant peppermint mutants in the USA

The mutant varieties of Mitcham peppermint "Todd's Mitcham" and "Murray Mitcham", developed by field selection for *Verticillium* resistance following irradiation of stolons with thermal neutrons [1, 2, 3, 4] being cultivated since 1971 (TM) and 1976 (MM) are still going strong. This can best be shown by the peppermint acreage in 1989:

Producing district	Total acres	Peppermint varieties		
		Regular Mitcham	Todd's Mitcham	Murray Mitcham
Midwest	28,740	11,740	5,500	11,500
Willamette	24,660	2,660	22,000	0
Madras	19,938	1,938	18,000	0
Idaho etc.	20,122	20,122	0	0
Yakima Valley	17,561	17,561	0	0
Total	111,021	54,021	45,500	11,500

"Todd's Mitcham" has been an extremely useful variety in the Oregon districts of Willamette and Madras. In the Midwest district both varieties are useful, but some growers find that, in the absence of the disease, "Regular Mitcham" has a better vigour. Idaho does not have a wilt problem. The Yakima Valley would require a wilt resistant variety, but neither "Todd's Mitcham" nor "Murray Mitcham" have worked well in this district, perhaps because of a high alkali content of the soils.

The total value of the 1989 peppermint crop is estimated to be about 90 Million US$ of which 40 Million could be ascribed to "Todd's Mitcham" and 7 Million to "Murray Mitcham".

The Mint Industry Research Council continues to sponsor research using the late Dr. Murray's techniques in the search for improved varieties of peppermint and spearmint [5].

REFERENCES

[1] MURRAY, M.J., Successful use of irradiation breeding to obtain *Verticillium*-resistant strains of peppermint, *Mentha piperita* L. In: Induced Mutations in Plants, IAEA, Vienna (1969), 345-371.

[2] MURRAY, M.J., Additional observations on mutation breeding to obtain *Verticillium*-resistant strains of peppermint. In: Mutation Breeding for Disease Resistance, IAEA, Vienna (1971), 171-195.

[3] Mutation Breeding Newsletter, No. 10, July 1977, p. 16

[4] Mutation Breeding Newsletter, No. 11, February 1978, p. 18.

[5] HORNER, C.E. and H.A. MELOUK, Screening, selection and evaluation of irradiation-induced mutants of spearmint for resistance to *Verticillium wilt*. In: Induced Mutations against Plant Diseases, IAEA, Vienna (1977), 253-262.

(Contributed by A.J. Todd, A.M. Todd Company, Box 711, Kalamazoo, Michigan, 49005, USA).

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
***Hordeum vulgare* L. (barley)**			
Alexis	FRG, 1986; Denmark 1988 J. Breun D-8522 Herzogenaurach	1622 (F1 (Helena x Ribari x 1455) x Trumpf	ml-o mildew resistance
Alis	Denmark, 1985 Abed Plant Breeding Station DK-4920 Söllested	Trumpf x Rosie Abed	Resistant to nematodes, stiff straw, good malting quality
Amazone	FRG, 1986 J. Breun D-8522 Herzogenaurach	F_1 (1453 e 16 x Aufis-Him T253) x Trumpf	
Arena	FRG, 1983 H. Schweiger, Feldkirchen D-8052 Moosburg	H464 (= Amethyst) x Aufhammer 38/68	Short culm, lodging resistant, very good malting quality
Beate	FRG, 1984 J. Körber, Saatbau-Linz Plant Breeding Station Reichersberg, Austria	(Quantum x Union) x Trumpf	Good brewing quality, short culm, lodging resistant

BH-75	India, 1983 D. Singh et al. AICBI Project Dept. of Plant Breeding Haryana Agric. Univ. Hisar, Haryana	RD-150 (= RDB-1 x EB-795) Ahor-131'/68	Dwarf, profuse tillering, early maturing, resistant to yellow rust and CCN
Blenheim	UK, 1987 P.B.I. Cambridge	Triumph x Egmont	High yield, rel. small grain low protein content, good malting quality
Camir	Denmark, 1985 Carlsberg Kornforädling DK-2500 Valby	Trumpf x Emir	Good malting quality
Cheri	FRG, 1987 Bayr. Pflanzenzucht D-8000 München 40 and Saatzucht Schweiger & Co. D-8052 Moosburg	Trumpf x (Medusa x Diamant)	Early maturing, lodging resist-tant, good brewing quality
Comtesse	FRG, 1987; Austria 1988 G. Frimmel, Nordsaat GmbH D-2322 Waterneverstorf	(CIV 195 x Trumpf) x (5238.8/74 x Aramir)	
Diana	Bulgaria, 1983 T.G. Stephanov, S.G. Zapryanov, Y.G. Burgazova, M.B. Gramatikova Institute of Barley Karnobat	Seed. 10kR Gamma rays [Miraj]	Ca. 5% higher yield, better cold and winter resistance larger grain
Dorett	FRG, 1985 H. Schweiger & Co. Feldkirchen D-8052 Moosburg	H464 (= Amethyst) x Aufhammer 36-68	High yield, rel. small kernels acceptable malting quality, lodging resistant
Goldfield	UK, 1969 Miln Masters Group King's Lynn	Golden Promise x Emir	

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 L. (barley) contd.			
Hesk	USA, 1979 M.F. Kolding Oregon State University Pendelton, Oregon	Jone x Luther	Winter barley, feed barley short culm, rel. lodging resistant, wide adaptation
Inga	Denmark, 1982 Abed Plant Breeding Station DK-4920 Söllested	Vatonga x (Goldfield x Mala)	
Ingot	UK, 1980 Miln Masters Group King's Lynn	Midas x Lofa Abed	
Jamina	UK, 1979 P.B.I. Cambridge	Midas x Betina x Maris Jak	
K-2578	India, 1980 L. Ram C.S. Azad Univ. of Agric. & Technology Kanpur, 208002	RDB-1 x Vijaya (K-572/11)	Medium tall, high yield potential, long ears
Karan-3	India, 1982 M. Ram IARI Regional Station Karnal, Haryana	(RDB-1 x EB-7576) x Riso mutant 1508	dwarf, erect leaves, non-lodging, hull-less amber-coloured grain

Karan-4	India, 1983 M. Ram IARI Regional Station Karnal, Haryana	RDB-1 x EB-7576	Semidwarf, lodging resistant, erect and narrow leaves, hull-less amber-coloured grain
Karan-15	India, 1982 M. Ram IARI Regional Station Karnal, Haryana	RDB-1 x EB-20	Dwarf, profuse tillering high yield potential
Karan-201	India, 1984 M. Ram IARI Regional Station Karnal, Haryana	(Azam dl x 1B-65) x (RDB-1 x Riso mutant 1508)	Semidwarf, hull-less grain, high protein (16%)
Karan-265	India, 1989 M. Ram IARI, Regional Station Karnal, Haryana	(RDB-1 x EB-7725) x Riso mutant 1508	Dwarf, non-lodging, high tillering, thick short narrow leaves, hull-less grain
Kingspin	UK, 1985 Miln Master Group King's Lynn and Abed DK-4920 Söllested Denmark	Trumpf x Rosie Abed	
Korinna	GDR, 1988 D. Lau Institut für Getreideforschung Bernburg-Hadmersleben	Complex cross incl. Diamant	High yield, lodging resistance disease resistance, good brewing quality, used only for variety mixtures of spring barley
Krassi 2	Bulgaria, 1983 C.I. Gorastev, P.L. Vulchanov, N.L. Lazarov, S. Navoushtanov Institute of Barley, Karnobat	Markeli 5 x Trumpf	Short culm, resistant to lodging, very good productivity, very good brewing characteristics

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 L. (barley) contd.			
Larissa	GDR, 1989 D. Lau Institut für Getreideforschung Bernburg-Hadmersleben	Complex cross incl. Diamant	High yield, lodging resistance, good brewing quality, used only for variety mixtures of spring barley
Mal	USA, 1979 M.F. Kolding Oregon State University Pendleton Oregon	Jone x Luther	Winter barley, feed barley, lodging resistant, narrow adaptation
Natasha	France, 1986 Unisigma Froissy	Trumpf x Aramir	Medium to high yield, high malting quality
Nomad	FRG, 1990 Nickerson Seeds Ltd. Rothwell Lincoln, LN7 6DT, UK	Kym x Trumpf	
Octave	Austria, 1986; France, 1986 Nickerson RPB Ltd. Lincoln LN7 6DT, UK and Saatbau Linz A-4021 Linz	Trumpf x Medina	
Prisma	Netherlands, 1985 B.V. Landbouwbureau Wiersum NL-8250 AB Dronten	(Trumpf x Cambrinus) x Piccolo	High yield, stiff straw, low protein content, very good malting quality

RD-137	India, 1981 V.K. Bhatnagar, S.C. Gupta, R.C. Sharma, K.S. Nathawat Agric. Research Station Durgapura, Jaipur-302018	RDB-1 x EB 795	Medium tall, high yielding, less water requirement
RD-2035	India, 1988 S.M. Bhatnagar, D.K. Handa, Srikant, S.D. Saxena, V.K. Bhatnagar, B.D. Yadava Agric. Research Station Durgapura, Jaipur-302018	RD-137 (= RDB-1 x EB-795) x PL-101	Medium tall, profuse tillering, wide adaptation, resistant to CCN, early maturity
Romi	Denmark, 1983 Abed Plant Breeding Station DK-4920 Söllested	Abed 079 x Rupal	
Rosie	Denmark, 1980 Abed Plant Breeding Station DK-4920 Söllested	Midas x Abed 0625	
Rumba	FRG, 1988 G. Frimmel, Nordsaat GmbH D-2322 Waterneverstorf	(Trumpf x CIV P176) x Trumpf	
Seru	Sweden, 1973 Swedish Seed Assoc. S-26800 Svalöf	Hellas x Pallas x Rupee	
Sila	Denmark, 1986 Abed Plant Breeding Station DK-2920 Söllested	Triumph x Rosie Abed	Stiff straw, good malting quality, nematode resistance
Stella	FRG, 1989 Mike Collins New Farm Crops Market Stainton Lincoln, UK	(Triumph x Dram) x Kym	Good brewing quality, high yield, good grain size

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 L. (barley) contd.			
Taarn	Sweden, 1982 Swedish Seed Assoc. S-26800 Svalöf	Kristina x Hellas 3 (Pallas 5 x Rupee)	
Toga	FRG, 1986; Austria, 1989 H. Hänsel, Probstd. Saatzucht A-2301 Gross-Enzersdorf	Welam x Trumpf	Short culm, good malting quality
Ursel	FRG, 1985 Firlbeck KG D-8441 Rinkam	Aramir x Trumpf	
Vavilon	USSR, 1990 V.M. Shevtsov, U.A. Gruntsev, N.V. Serkin, P.P. Vasjukov, P.K. Polukhina Research Institute of Agric. SU-350012 Krasnodar	Meteor x 84/11-1 (= Ager x 31M13) 31M13 = Mutant of Krasnodar 1, induced by NEU,0.06%, 6h.	Winter barley, good ecological stability, higher yield
Yubilei 100	Bulgaria, 1982 C.I. Gorastev, N.L. Lazarov, S.I. Navushtanov Institute of Barley Karnobat	Markeli 5 x Malta	Good productivity, very good cold and winter resistance, large grain, very good brewing characteristics

FAO/IAEA EXPERTS AND CONSULTANTS IN 1988/1989

Ahloowalia, B.S. (Ireland)	Quito (Ecuador)
Ahnström, G. (Sweden)	FAO/IAEA Vienna (Austria)
Amano, E. (Japan)	Bangkok (Thailand)
Ammirato, P.V. (USA)	FAO/IAEA Vienna (Austria)
Andreev, V.S. (USSR)	Beijing (China)
Ashri, A. (Israel)	Suweon (Rep. of Korea), Maracay, Maracaibo (Venezuela)
Awan, M.A. (Pakistan)	Bogota (Colombia)
Backman, P.A. (USA)	Bangkok (Thailand)
Baenziger, P.S. (USA)	Bogota (Colombia)
Barriga, G.P. (Chile)	Bogota (Colombia)
Brown, P. (FRG)	FAO/IAEA Vienna (Austria)
Brunner, H. (IAEA)	Bogota (Colombia), Rangoon (Burma), Panama City (Panama)
Constantine, D. (UK)	FAO/IAEA Vienna (Austria)
Dabin, P. (Belgium)	Kinshasa (Zaire)
Daskalov, S. (Bulgaria)	FAO/IAEA Vienna (Austria)
Dolezel, J. (CSSR)	Accra (Ghana), Lima (Peru)
Donini, B. (Italy)	Suweon (Rep. of Korea), FAO/IAEA Vienna (Austria)
Douglas, G.C. (Ireland)	Suweon (Rep. of Korea)
Franckowiak, J.D. (USA)	Quito (Ecuador)
Ford-Lloyd, B.V. (UK)	Irapuato (Mexico)
Gale, M.D. (UK)	La Paz (Bolivia), FAO/IAEA Vienna (Austria)
Green, A. (Australia)	Bombay (India)
Gustafsson, J.P. (USA)	Lima (Peru)
Goldsmith, M.R. (USA)	Suweon (Rep. of Korea)
Haunold, E. (Austria)	FAO/IAEA Vienna (Austria)
Heberle-Bors, E. (Austria)	FAO/IAEA Vienna (Austria)
Hergert, G.W. (USA)	Lima (Peru)
Hine, R.B. (USA)	Bangkok (Thailand)
Hoffmann, F.J. (FRG)	Suweon (Rep. of Korea)
Hughes, S.G. (Italy)	FAO/IAEA Vienna (Austria)
Jefferson, R.A. (UK)	FAO/IAEA Vienna (Austria)
Kirkpatrick, B.C. (USA)	Bangkok (Thailand)
Kleinhofs, A. (USA)	Katowice (Poland), FAO/IAEA Vienna (Austria)
Knauft, D.A. (USA)	Bangi (Malaysia)
Legg, J.T. (UK)	Tafo (Ghana)
Lehmann-Danzinger, H. (FRG)	FAO/IAEA Vienna (Austria)
Li, L. (China)	Suweon (Rep. of Korea)
Liu Mingchin (China)	Maracay (Venezuela)
MacDonald, M.V. (UK)	Beijing (China), Tafo (Ghana)
Maluszynski, M. (FAO/IAEA)	Bogota (Colombia), Guatemala City (Guatemala) Tanger (Morocco), Heredia (Costa Rica), Nairobi (Kenya)
Melli, M. (Italy)	Bogota (Colombia), Sotuba (Mali)
Menten, J.O. (Brazil)	FAO/IAEA, Vienna (Austria)
Metz, S.G. (USA)	Bogota (Colombia)
Micke, A. (FAO/IAEA)	Beijing (China)
Moldenhauer, K.A.K. (USA)	Bangi (Malaysia)
Murata, N. (FAO/IAEA)	Rangoon (Burma), Bangkok (Thailand)
Novak, F.J. (IAEA)	Bogota (Colombia), Quito (Ecuador), Kitwe (Zambia)
Omar, M.S. (Iraq)	Accra (Ghana)

Perea Dallos, E.M. (Colombia)	Heredia (Costa Rica),Bogota (Colombia), Habana (Cuba)
Pinson, S.R. (USA)	Guatemala City (Guatemala)
Powell, W. (UK)	Mymensingh (Bangladesh)
Read, P.E. (USA)	Kitwe (Zambia)
Reddy, T.P. (India)	Peradeniya (Sri Lanka)
Satour, M.M. (Egypt)	Maracay (Venezuela)
Schmidt, J. (Austria)	FAO/IAEA Vienna (Austria)
Schwarzbach, E. (Austria)	FAO/IAEA Vienna (Austria)
Schiessendoppler, E. (Austria)	FAO/IAEA Vienna (Austria)
Shaikh, M.A.Q. (Bangladesh)	Peradeniya (Sri Lanka), FAO/IAEA Vienna (Austria)
Simonson, R.L. (USA)	Quito (Ecuador)
Snape, J.W. (UK)	Irapuato (Mexico), FAO/IAEA Vienna (Austria)
Strobel, G.A. (USA)	Bangkok (Thailand), FAO/IAEA Vienna (Austria)
Swiecicki, W. (Poland)	Kinshasa (Zaire)
Tanasch, L. (Austria)	FAO/IAEA Vienna (Austria)
Tanksley, S.D. (USA)	FAO/IAEA Vienna (Austria)
Tulmann Neto, A. (Brazil)	Guatemala City (Guatemala), Habana (Cuba)
Ullrich, S.E. (USA)	Suweon (Rep. of Korea), La Paz (Bolivia),
Algiers	(Algeria)
Watkins, J.E. (USA)	Bogota (Colombia)
Wu, H.K. (Taiwan)	Suweon (Rep. of Korea)
Yankulov, M.T. (Bulgaria)	Darhan (Mongolia)
Zakri, A.H. (Malaysia)	FAO/IAEA Vienna (Austria)
Zhou, H. (China)	Lima (Peru)
Zwatz, B. (Austria)	FAO/IAEA Vienna (Austria)

FAO/IAEA TRAINEES AND FELLOWSHIP HOLDERS IN 1988 and 1989

AFGHANISTAN	
Fazli, H.H.	IAEA 2w
ALBANIA	
Kola, V.	IAEA 10m
Kraja, A.	IAEA 1.5m
ALGERIA	
Maatougi, M.E.H.	USA 6m
Bellah, F.	Belgium 6m
BOLIVIA	
Pierola Mercado, L.A.	UK 2w
Espindola Candeo, G.	Sc. visit UK, USA, Brazil
BRAZIL	
Mendes, B.M.J.	IAEA 6m
BULGARIA	
Nikolaeva, V.	USA 12m
Gechev, K.	Sc. visit Denmark, GDR, Netherlands, UK
Boyajiev, P.	Sc. visit France, FRG, UK
Nedkovska, M.P.	UK 12m

BULGARIA	
Perfanov, K.	Philippines 7m
Bojanova, V.	FRG 6m
Kosturkova, G.P.	UK 6m
Gramatikova, M.	Sc. visit Denmark, Sweden, UK
Amaniev, E.D.	France 12m
Nikolov, N.N.	Sc. visit IAEA, Netherlands, UK
CHINA, PEOPLE'S REP. OF	
Qu, Liang	IAEA 12m
Qiu, Ch.	Sc. visit Malaysia, Singapore, Thailand
Gao, Shan	Sc. visit Malaysia, Singapore, Thailand
Liu, Guangzhen I	
Chen, Zougdao I	
Xu, Dengyi I	Sc. visit France, FRG,
Wan, Zhaoliang I	Italy, Netherlands, IAEA
Nie, Guangming I	
He, Shoulin I	
COSTA RICA	
Sandoval, J.A.	IAEA 6w
Blanco Rojas, F.A.	IAEA 6m
ECUADOR	
Rivadeneira, M.E.	USA 1m
GHANA	
Amponsah, J.D.	Sc. visit IAEA, France, Italy, UK
Osae-Awuku, F.F.	Austria 3m
Osei, S.Y.	IAEA 6m
Lamptey, T.	IAEA 9m
Asumeng, A.K.	IAEA 9m
IRAQ	
Omar, M.S.	IAEA 6m
KOREA, REP. OF	
Park, Rae-Kyeong	Sc. visit France, FRG, IAEA
Lee, Soo-seong	Sc. visit France, FRG, IAEA
Lee, Min-Huo	USA 14m
Kim, Hyeong-Do	IAEA 6m
Kim, Junggon	USA 6m
Mah, Young-Il	Japan 3m
Park, Kwang-Jun	Japan 3m
Cho, Heu Je	USA 3m
MALAYSIA	
Othman, R.	IAEA 5d
Kadzimin S.B.	IAEA 6m
MALI	
Bretaudeau, A.	Switzerland 2m
MONGOLIA	
Damba, T.	Sc. visit Hungary, IAEA, Poland
NIGERIA	
Mbanaso, E.N.A.	IAEA 6m
Nwachukwu, C.E.	IAEA 7m

PAKISTAN	
Khattak, A.B.	USA 12m
Javed, M.A.	USA 12m
POLAND	
Gaj, M.D.	UK 6m, Netherlands 6m
Arseniuk, E.	Switzerland 6m
Kilian, A.	UK 6m
Sawicka, E.J.	Italy 3m
SRI LANKA	
Andrahennadi, C.P.	IAEA 8m
Peiris, R.	Japan 12m
THAILAND	
Naritoom, K.	Sc. visit China, India, Japan
Nuntapunt, M.	USA 3m
Lamseejan, S.	USA 3m
Janorn, J.	Sc. visit USA
Kumphai, S.	USA 3m
Sarakarn, S.	IAEA 2m
Pakkong, P.	IAEA 3m
To-Anun, Ch.	USA 3m
UGANDA	
Mwanga, R.O.M.	Poland 6m
VIETNAM	
Pham, Le Ha	Bulgaria 12m
ZAMBIA	
Hangandu, A.K.	Italy 6m
Chishimba, W.K.	USA 6m
ZAIRE	
Kalumvueziko, L.	France 6m

<u>FAO/IAEA Interregional training course on the induction and use of mutations in plant breeding, Seibersdorf, Austria, 5 April - 19 May 1988</u>

Abdalla, A.B.	Sudan
Abdulai, M.S.	Ghana
Al-Janabi Abbas, K.K.	Iraq
Bammoun, A.	Algeria
Cabezas Avila, F.	Chile
Cagirgan, I.	Turkey
Espino, A.A.	Mexico
Fundora Mayor, Z.M.	Cuba
Hafsah, J.	Malaysia
Herrera Quiros, J.G.	Costa Rica
Hyon Gun O	Korea, DPR
Liu Jin-Yuan	China
Maganti, R.	India
Meesilpa, P.	Thailand
Mir Ali, Nizar	Syria
Ndour, B.	Senegal
Sanabria Diaz, C.A.	Guatemala
Trejo de Diaz, M.M.	Venezuela

ARCAL VII RLA/5/021 Workshop on Improvement of rice and other cereals in Latin America through mutation breeding, Villavicencio, Colombia, 6-10 June 1988

Abadie, T.	Uruguay
Alarcon, E.	Paraguay
Barriga Bezanilla, P.	Chile
Berretta, A.	Uruguay
Castellano, G.	Venezuela
Davalos, A.	Colombia
Favret, E.A.	Argentina
Franco, E.O.	Guatemala
Gutierrez, A.	Cuba
Montepeque Roldan, R.	Guatemala
Muñoz Betancourt	Colombia
Navarro Alvarez, W.	Costa Rica
Quevedo, L.A.	Colombia
Rivadeneira, M.	Ecuador
Romero Loli, M.	Peru
Tola Cevallos, J.	Ecuador
Tulmann Neto, A.	Brazil
Zapata Siles, A.	Bolivia

FAO/IAEA Regional Seminar on Improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 June 1988

Abdelrahman, M.E.	Sudan
Abifarin, A.O.	Liberia
Amet, T.M.	Liberia
Bhatia, C.R.	India
Bretaudeau, A.	Mali
Bunyolo, A.M.	Zambia
Chileshe, R.	Zambia
Chimbelu, E.G.	Zambia
Chimbwe, B.	Zambia
Ching'ang'a,.M.	Tanzania
Chishimba, W.K.	Zambia
Deedat, Y.D.	Zambia
Diallo, A.	Guinea
Donini, B.	Italy
El-Sebaaie, F.A.	Egypt
El-din Hassan El-Shimy, G.	Egypt
Elton Mpata, B.F.	Zambia
Gumbo, M.	Zambia
Gumisiriza, G.	Uganda
Kaitisha, G.C.	Zambia
Kaliangile, M.	Zambia
Lubozhya, B.M.	Zambia
Lungu, D.M.	Zambia
Mansaray, M.S.	Sierra Leone
Mbewe, D.N.M.	Zambia
Micke, A.	FAO/IAEA
Munyinda, K.L.	Zambia
Muunga, X.T.	Zambia
Mwala, M.S.	Zambia
Mwamba, C.K.	Zambia
Mwambula, C.	Zambia

Murata, N.	FAO/IAEA
Novak, F.	IAEA
Nyabyenda, P.	Rwanda
Omanga, P.	Kenya
Pedro, J.	Benin
Rubaihayo, P.R.	Uganda
Safo-Kantanka, O.	Ghana
Sakufiwa, E.M.	Zambia
Uzo, J.O.	Nigeria

FAO/IAEA Interregional training course on the induction and use of mutations in plant breeding, Seibersdorf, Austria, 29 March - 12 May 1989

Al-Dulaimi, I.A.	Iraq
Anderson de Marco, C.	Argentina
Da, S.	Burkina Faso
Deus Renteria, E.	Cuba
Dwimahyani, I.	Indonesia
Fadlalla, A.S.	Sudan
Ferreyros Cabieses, P.	Peru
Grafia, A.	Philippines
Kim, S.J.	Korea, Rep. of
Kihupi, A.N.	Tanzania
Kraja, A.	Albania
Mussana, S.	Uganda
Nasseri, M.	Iran
Orozco Rodriguez, R.	Costa Rica
Ramirez Garcia, J.	Guatemala
Sawa, A.B.	Syria
Senghaphan, R.	Thailand
Tokpa, G.	Côte d'Ivoire
Yaman, M.	Turkey
Zhen, X.B.	China

Advanced Training Course RLA VII RLA/5/021-003 on the Use of mutants for different cross-breeding programmes, Heredia (San José), Costa Rica, 7-25 August 1989

Brenes, A.	Costa Rica
Barragan Cadena, J.R.	Ecuador
Orozco Rodriguez, R.	Costa Rica
Pelico Joaquin, M.T.	Guatemala
Ramirez Guzman, M.C.	Colombia
Rivadeneira, M.E.	Ecuador
Seemann Fahrenkrog, P.	Chile
Silveira Mairesse, L.A.	Brazil
Suarez Cretelo, E.	Cuba

NEW PUBLICATIONS

Utilisation of genetic resources: suitable approaches, agronomical evaluation and use
FAO Plant Production and Protection Paper No. 94
FAO Rome 1989

Adaptive Potential of Cultivated Plants (Genetic and Ecological Bases)
by Alexander A. Zhuchenko
"Shtiintsa" Publishing House, Kishinev 277018
USSR, 1988 ISBN 5-376-00458-9

Groundnut
(2nd Edit., 593pp. ca. US$ 12.-)
Indian Council of Agricultural Research, Pusa, New Delhi 110 012, 1990

Gene Banks and the World's Food
(Edit. D.L. Plucknett, N.J.H. Smith, J.T. Williams, N.M. Anishetty)
Princeton Univ. Press, Princeton N.J. (USA) 1987

Genetic Engineering of Crop Plants
(Edit. G.W. Lycett and D. Grierson)
Butterworths, London 1990. ISBN 0-408-04779-9

Plant Mutation Breeding for Crop Improvement
(Proceedings of FAO/IAEA Symposium Vienna June 1990) ca. 750 pages
STI/PUB/842
available in January 1991

Economic and agricultural impact of mutation breeding in fruit trees
by P. Spiegel-Roy
Mutation Breeding Review No. 5
FAO/IAEA Vienna May 1990. ISSN 1011-2618

Mutation breeding for quality improvement - A case study for oil seed crops
by G. Röbbelen
Mutation Breeding Review No. 6
FAO/IAEA Vienna July 1990 ISSN 1011-2618

Induced mutations for crop improvement
by A. Micke, B. Donini, M. Maluszynski
Mutation Breeding Review No. 7
FAO/IAEA Vienna June 1990. ISSN 1011-2618

Plant domestication by induced mutation
(Proceedings of an FAO/IAEA Advisory Group Meeting, Vienna November 1986)
IAEA Vienna 1989. ISBN 92-0-111089-8

Improvement of crops in Africa through the use of induced mutations
(Report of an FAO/IAEA Regional Seminar, Lusaka, Zambia, June 1988)
IAEA-TECDOC-496, IAEA Vienna 1989

Review of advances in plant biotechnology, 1985-88
Edit. A. Mujeeb-Kazi and L.A. Sitch
(Proceedings of the 2nd International Symposium on Genetic Manipulation in Crops, held at CIMMYT 29-31 August 1988)

Lathyrus and Lathyrisum
(Proc. Int. Symp. 9-13 Sept. 1985, Pau, France)
Edit. A.K. Kaul and D. Combes
Third World Medical Research Foundation, 444 Central Park West, New York, N.Y., 10025, USA, 1986, US$ 59.-

The Grass Pea, Threat and Promise
(Proc. of Internal Network)
Third World Medical Research Foundation, New York, 1989, ISBN 0-9617775-2-4, US$ 50.0

FUTURE EVENTS

1990

8-12 October	1st International Congress on New Industrial Crops and Products, Riverside CA, USA Contact: Cindi McKernan Department of Botany and Plant Sciences University of California Riverside, CA 92521 (USA)
15-16 November	New Trends in Barley Quality for Malting and Feeding Barcelona, Spain Contact: IRTA Passeig de Gracia, 44 08007 Barcelona (Spain)

1991

3 April - 16 May	10th FAO/IAEA Seibersdorf Mutation Breeding Training Course, Seibersdorf (Austria) Applications: IAEA Training Courses Section, P.O. Box 100, A-1400 Vienna (Austria)
14 - 18 April	20th World Congress of the International Society for Fat Research, The Hague, The Netherlands Contact: A.G. Hinze P.O. Box 114 3130 AC Vlaardingen (The Netherlands)
19-20 April	International Symposium on Plant Biotechnology and its Contribution to Plant Development, Multiplication and Improvement Palexpo, Geneva, Switzerland Contact: Dr. J.M. Mascherpa Department of the Interior Agriculture and Regional Problems University of Geneva (Switzerland)
22-26 April	FAO/IAEA Seminar for Middle East and Mediterranean Regions on the Use of Induced Mutations for Crop Improvement Zaragossa (Spain) Contact: Plant Breeding and Genetics Section Joint FAO/IAEA Division P.O. Box 100 A-1400 Vienna (Austria)

20-24 May	International Symposium on Tropical Fruits "Frontier in Tropical Fruit Research" Pattaya, Thailand. Organised by the International Society for Horticultural Science Contact: Dr. Suranat Subhadrabandhu Horticulture Department Kasetsart University Bangkok 10900 (Thailand)
26-30 May	EUCARPIA Symposium on Genetic Manipulation in Plant Breeding Reus/Salou (Tarragona), Spain Contact: Dr. F. Garcia-Olmedo EUCARPIA Symposium E.T.S. Ingenieros Agrónomos E-28040 Madrid (Spain)
7-11 July	9th International Congress of Radiation Research Toronto, Canada Contact: 9th ICRR 1891 Preston White Drive Preston VA, 22091 (USA)
9-11 July	8th International Rapeseed Congress Saskatoon, Canada Contact: J.M. Bell 118 Veterinary Road Saskatoon, Saskatchewan, S7N 2R4 (Canada)
29-31 July	TRITICEAE. International Symposium on - Evolutionary pattern - Classification - Genetic resources - Breeding potentials Helsingborg, Sweden (following 6th Barley Gen. Symp.) Contact: Ole Seberg The Botanical Laboratory University of Copenhagen Gothersgade 140 DK- 1123 Copenhagen K (Denmark)

1992

1-3 June	1st European Conference on Grain Legumes, Angers, France Contact: UNIP 12 Avenue George V F-75008 Paris (France)
14-22 July	1st International Crop Science Congress Ames, Iowa, USA Contact: F. Frey Agronomy Department Iowa State University Ames, IA, 50011 (USA)

AWARD

Dr. Alexander Grobman has been awarded the "World Seed Prize 1990" by the "Federation Internationale du Commerce des Semences" in recognition of his important work for the use of improved seed for increased food production, particularly in Latin America.
Congratulations!

Please note ...

We still have a few spare copies of back issues as well as the Newsletter index for Nos. 1-10 and 11-20. Please let us know what you would like to have.

A. Micke

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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International Atomic Energy Agency
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A-1400 Vienna, Austria

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