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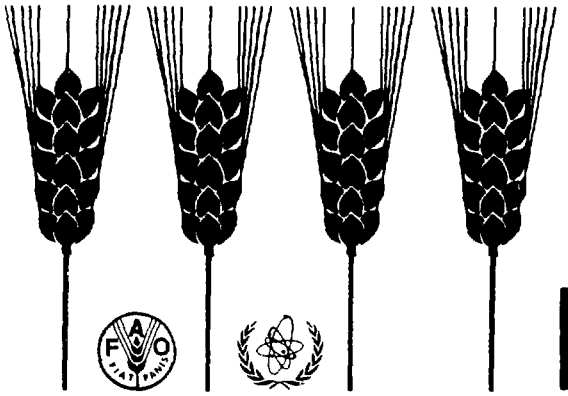

Mutation Breeding Newsletter

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IOSIF ABRAMOVICH RAPOPORT (1912 - 1990)

On December 31, 1990 an outstanding geneticist and scientist, Iosif Abramovich Rapoport passed away. He was a remarkably brave man, persistent and firm of purpose. I.A. Rapoport was born in 1912 in Chernigov, Ukrain. In 1930 he entered the Biological Faculty of the Leningrad University and graduated with honours. In 1939 he defended his candidate thesis at the Institute of Experimental Biology, headed by N.K. Koltchov in Moscow. The work of the young scientist was highly appreciated by N.I. Vavilov. In 1943, while in Moscow recovering from his war injuries, Dr. Rapoport defended his Doctor of Science Thesis before returning to the front. After the second world war Dr. Rapoport continued his work at the Institute of Cytology, Histology and Embryology. Three years of work at this Institute (1945-1948) led him to the discovery of such powerful chemical mutagenes as dimethyl sulphate, ethylenimine, diazomethane and various epoxides.

In 1948 Dr. Rapoport was barred from work on genetics and was thus forced to be engaged in work having little in common with genetics. Only in 1957 could he return to his preferred work. Dr. N.N.Semenov, who became a Nobel Prize winner in physics at that time, highly appreciated the works of I.A. Rapoport and invited him to his Institute of Chemical Physics. Dr. Rapoport became Head of the Laboratory and later the Department of Chemical Genetics, where he continued his work until his death in 1990. In his investigations he emphasized the mechanisms of chemical mutagenesis and the search for new effective mutagens with different genetic effects.

In 1965 Dr. Rapoport organized the Center of Chemical Mutagenesis at the Institute of Chemical Physics of the USSR Academy of Sciences. At this Center he combined fundamental genetic investigations with the practical work of plant breeders - thus giving rise to a new scientific-practical trend of work: mutation breeding on the basis of chemical mutagenesis. The main task of this Center was to breed new highly productive and resistant varieties of agricultural plants. The cooperation of geneticists and plant breeders, which was once a dream of N.I. Vavilov, was proven to be highly fruitful: 131

mutant varieties of main agricultural crops have been officially released to date. The Department headed by Dr. Rapoport worked in cooperation with different institutions from foreign countries. For his valuable service Dr. Rapoport was awarded honorary membership of the Indian Society of Genetics and Plant Breeding (1991).

(Contributed by SALNIKOVA, T.V., Laboratory of Chemical Mutagenesis of Higher Plants, Department of Chemical Genetics, Institute of Chemical Physics, Russian Accademy of Sciences, Moscow 117977, Russia)

MUTATION BREEDING OF *Musa* sp. (BANANA,PLANTAIN)

Vegetative propagation of *Musa* maintains the heterozygotic constitution of edible forms. This genetic nature is suitable for the application of mutation techniques. Mutation breeding aims at altering one or only a few characteristics of a generally acceptable cultivar, but otherwise retaining the original genotype almost unchanged. This approach might be particularly important for sterile *Musa* species where there is no sexual reproduction that could lead to genetic variation.

In vitro shoot tip culture has been used as a system for mutation induction in banana and plantain. The shoot tips, composed of a meristematic dome with two pairs of leaf primordia, were excised from *in vitro* proliferated buds and irradiated with gamma rays from a ^{60}Co source. Differences in radiosensitivity were dependent on ploidy level and hybrid constitution of the A and B genome. The diploid clone 'SH-3142' (AA) was most sensitive to gamma irradiation, while the tetraploid 'SH-3436' (AAAA) expressed the lowest level of radiation damage among seven clones tested. The recommended doses are 25 Gy for diploids, 35 Gy for triploids AAA, 40 Gy for AAB and ABB, and 50 Gy for tetraploids AAAA [1].

The optimal response of cultured shoot tips to the chemical mutagen ethylmethanesulphonate (EMS) in both diploid ('SH-3362') and triploid ('Grand Nain') clones was achieved after 3h incubation with 24.67 mM (0.2%) mutagen. Two percent dimethylsulfoxide (DMSO) enhanced the uptake of EMS into the apical meristematic dome, leaf primordia and corm tissue. Accumulation of the mutagenic component in the shoot-tip explant is important for mutation induction, since many adventitious buds are initiated from the meristematic tissue. Such buds have become a source for potential mutant plants regenerated *in vitro* after chemical mutagenesis [2].

Adventitious buds which proliferated from the shoot tip base were subcultured to the next vegetative propagation cycle. Histological observation suggested that these buds are differentiated from single or a few superficial cells of a rhizome [3]. No callus formation was involved in the bud regeneration and shoots were propagated into the fourth vegetative cycle (M_1V_4). Rooted plants were transplanted into soil. The *in vitro* mutation breeding system is schematically presented in Figure 1.

The mutant clone 'GN-60A' was induced by gamma irradiation from the dessert banana cultivar 'Grand Nain'. The mutant plant showed differences in early flowering and fruiting habit and in the zymograms of soluble proteins and esterase isozymes. DNA amplification fingerprinting (RAPD) was used for identification of specific banding pattern characteristics. The single mutant plant was micropropagated and its vegetative progeny is being testing in Fundacion Hondurena de Investigacion Agricola (F.H.I.A.), Honduras and Department of Primary Industry (D.P.I.), Queensland.

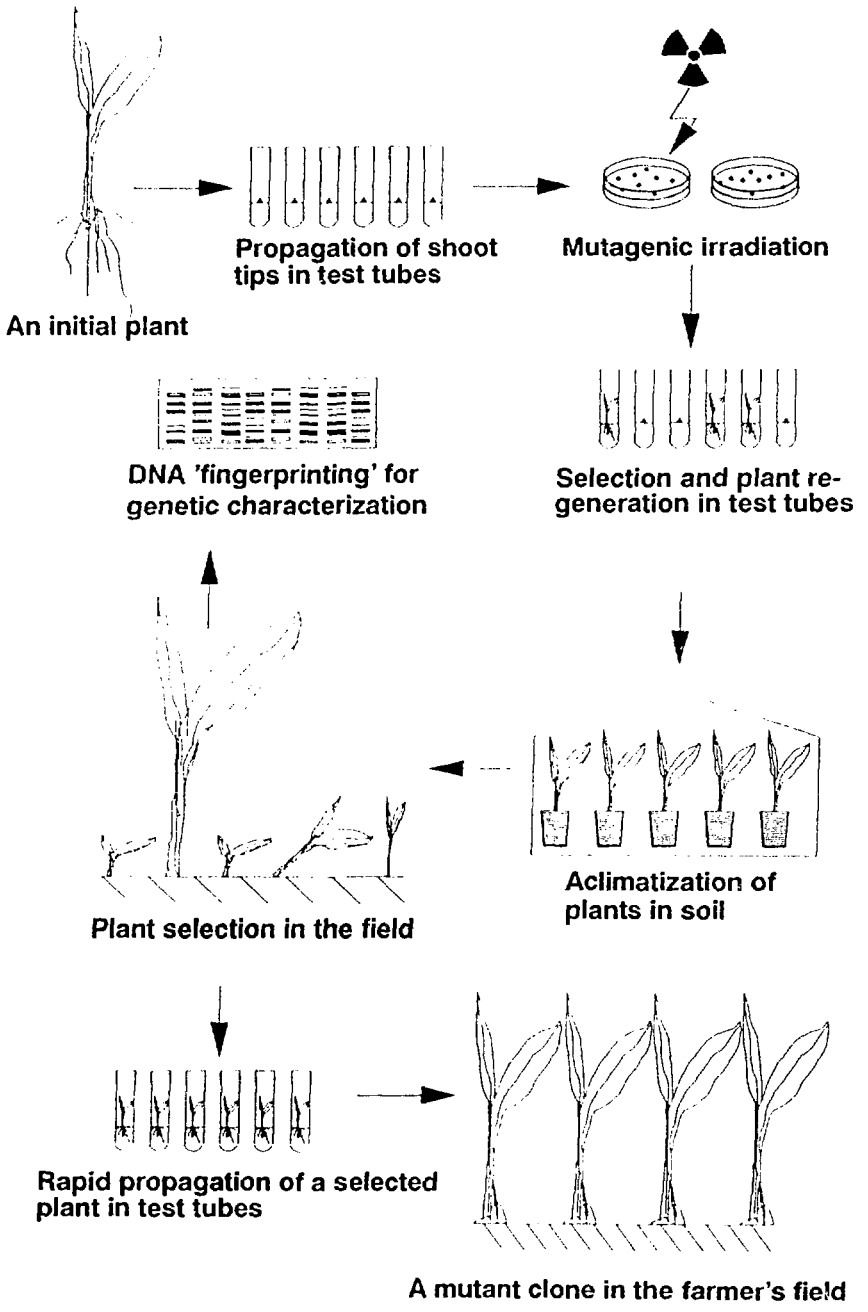

Figure 1. Schematic representation of *in vitro* mutation breeding technology in *Musa* (banana, plantain).

In Honduras, about 20% of the plants are superior for one or several characters compared with the control variety 'Grand Nain'. There are plants with early flowering habit, with cylindrical fruit bunch, with high quality of fruits and plants which yielded bunches of 55 kg in contrast to 32 kg of the average 'Grand Nain'. Generally, plants of the mutant clone are shorter (important character for wind resistance) than the original cultivar.

Two clones derived from 'GN-60A' were tested in Queensland. Clone 'FC GN#1' is 17 days earlier than 'Grand Nain' control, while 'FC GN#2' is 40 days earlier in flowering and 39 days earlier for harvest. Other subclones are now in field tests in Queensland.

Putative mutant clones were produced from other cultivars of banana and plantains for field testing in various Member States of the IAEA: 'Williams' (AAA); 'Agbagba' (AAB); 'Pisang Mas' (AA); 'Pisang Rastali' (AAB); 'Burro CEMSA' (ABB); 'Parasido al Rei' (AAA).

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MUTATION BREEDING PROGRAMME PRODUCES A PLANT WITH POTENTIAL FUSARIUM WILT (RACE 4) RESISTANT CAVENDISH VARIETY

Over 20 000 plants have now been evaluated in the field at race 4 screening site and nursery at Wamuran in south-eastern Queensland. Half of these were composed of 368 accessions collected from both local and overseas germplasm collections and breeding programmes. The remainder were gamma-irradiated plantlets.

Of the accessions screened, 'Dwarf Parfitt' is the only Cavendish-type banana that has shown a high level of resistance to race 4 in this experiment. Unfortunately, this variety has no commercial value in its own right since its average height at bunching is 1.0 m and plants are exremely prone to choking - rarely does the bunch emerge fully from the throat. Following tissue culture and gamma irradiation of 'Dwarf Parfitt', a population of plants was produced which possessed improved characteristics. Plants were larger at bunching (1.8 m with plant crop), earlier to bunch (16 months for harvest) and were apparently more cold tolerant than standard Cavendish varieties. More important, they also appear to retain the resistance to race 4 shown by the mother plant, 'Dwarf Parfitt'.

Leaves of standard Cavendish varieties are typically more yellow following winter (photoinhibition - induced chlorosis) and carry fewer photosynthetically-competent leaves. We have speculated that the 'weakened' Cavendish varieties are therefore most susceptible following winter and unable to prevent invasion of the fungus into the corm during the spring when the disease can

reach almost epidemic proportions. A replicated field planting of these putative mutants was currently established, with some well-known standard varieties, and the physiological features of these plants will be examined, particularly as they may relate to resistance to Fusarium wilt.

A technique for the induction of tetraploid plants from a micropropagated diploid clone, 'SH-3362', has been successfully developed. Colchicine was applied to actively growing shoot tips *in vitro*. Of the shoot tips treated, over 30% were induced to the tetraploid level. The optimum treatment was 0.5% w/v colchicine applied for 2 or 4 hours. The use of DMSO was also investigated with the colchicine treatment because it increases cell permeability and therefore absorption of colchicine. The optimum treatment was 0.5% w/v colchicine with 2% w/v DMSO applied to shoot tips for two hours. Tetraploid plants were more robust with thicker pseudostems, roots, and broader leaves than the diploids and could be first selected on these morphological characteristics. Stomatal lengths of diploid banana plants growing *in vitro* were significantly smaller than the tetraploids and were used as a more reliable indicator of ploidy level. The mean stomatal length of the diploid was 16.0 μm, whereas the tetraploid was 26.9 μm. A root tip squash technique using carbol fuchsin was also developed for positive confirmation of ploidy change by chromosome counts.

During micropropagation, and even after field establishment, some of the tetraploids reverted to the diploid form. However, at least 12 tetraploids have been established in the field and have retained their tetraploid features for over 2 years, the suckers also remaining tetraploid. The plants are characterized by their large, dropping leaves (petioles tend to break easily in the wind), their larger stature and they produce fewer suckers. As with 'SH-3362', these plants are very susceptible to cold damage. Of the plants grown in race 4 infested land, none have succumbed to the disease. Micropropagated tetraploid plants have been sent to Fundacion Hondurena de Investigacion Agricola (F.H.I.A.) for further evaluation in their breeding programme.

(Contributed by SMITH, M.K., S.D. HAMILL, P.W. LANGDON and K.G. PEGG, Queensland Department of Primary Industries, Maroochy Horticultural Research Station, P.O. Box 5083, SCMC, Nambour, Q. 4560. *Queensland Department of Primary Industries, Division of Crop Protection, Meiers Road, Indooroopilly, Q. 4068.)*

"FATOM-1" - AN EARLY-FLOWERING MUTANT DERIVED FROM MUTATION INDUCTION OF GRAND NAIN, A CAVENDISH BANANA

Genetic improvement of banana cultivars has always been difficult due to the absence of sexual reproduction to generate genetic recombination. Hence, mutation induction based on *in vitro* techniques is particularly important for banana improvement because all commercial cultivars are vegetatively propagated. Through mutation induction, by gamma irradiation of *in vitro* cultured meristem of a popular Cavendish banana (Grand Nain), Novak *et al.* [1] of FAO/IAEA have selected an early-flowering mutant (designated GN-60/A) in the M_1V_4 generation. This mutant was reported to grow vigorously and began flowering after 9 months in comparison to 15 months for the non-irradiated control also grown in the greenhouse at the Seibersdorf Laboratories (Austria). It also showed differences in the zymorgrams of soluble proteins, esterase isozymes and DNA molecular markers [2].

A total of 27 tubes of axenic GN-60/A ramets (clonal progeny of a single plant) were kindly supplied by the FAO/IAEA. Of these, 22 plants were established and evaluated in the field of the United Plantation Bhd. in Malaysia.

The plants grew vigorously and produced an average of 10 leaves over a period of 4 months (i.e. from the 3rd to 6th month after field planting). Inflorescence emergence (spiking) occurred 24 weeks after field planting and 55% of the plants flowered within 26 weeks. Harvesting was done 11 weeks later. The same earliness was observed in a vegetatively propagated progeny of selected individuals. The plants specially selected for earliness also showed high yielding capacity (average weight of bunch was 26 kg/plant in the second harvest), short stature, good bunch characteristics and flavour. Under similar management and field conditions in the United Plantation Bhd., a standard Cavendish cultivar 'Williams' yielded an average of 23 kg/plant at a planting density of 1900 plants/ha. These early- flowering plants were micro-propagated for planting on a commercial scale in the United Plantation Bhd. The selected material has been named "FATOM-1".

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INDUCTION OF MUTATIONS IN OATS

Treatments of oat seeds (presoaked 4-6h) with EMS (0.1 and 0.2% for 2h) + 1×10^3 M sodium azide for 1h, have proven highly effective. Literally hundreds of semidwarf mutants have been isolated from M_2 and M_3 populations. Of particular interest, a high number of M_4 homozygous and heterozygous M_3 progenies from M_2 semidwarfs suggest that many induced semidwarf mutants are dominant as is a new semi-compact panicle mutant. Moreover, it was possible to select semidwarf and other mutants with normal peduncles, unlike the disproportionately shortened peduncle associated with DW6. Some semidwarf mutants have associated changes in grain shape and size. We are currently increasing seed lots of several semidwarf mutant lines from a highly barley yellow dwarf virus (BYDV) tolerant, low groat hair, high hulless percentage line (AB 3073) toward possible cultivar releases. In these, only the plant height has been reduced; hulless percentage and reduced groat hairs traits are similar to those of AB 3073, while groat size may be greater in some lines, and other plant features appear unchanged. The groat size variation may have been present in original mutagenized population. It is expected that yields will prove acceptable for commercial production. Replicated yield trials are in progress. The reduced hair hulless oats should have improved handling and storage properties, and be more attractive for animal feed and industrial applications. Genetic and other analyses of selected semidwarf mutants are in progress via the cooperation of Drs. Darrell Wesenberg, USDA, Aberdeen and Vern Burrows, Agriculture Canada.

(Contributed by ***KONZAK C.F.****, NW Plant Breeding Co., Pullman, WA, USA)*

IAPAR 57, A NEW BEAM (*Phaseolus vulgaris* L.) CULTIVAR IN BRAZIL RESISTANT TO GOLDEN MOSAIC VIRUS DISEASE OBTAINED THROUGH CROSS BREEDING USING AN INDUCED MUTANT

As reported earlier [1], a bean mutant 'TMD-1', with a low incidence of golden mosaic virus disease, was obtained in Brazil by EMS seed treatment. This mutant was included in several cross-breeding programmes [2]. As a result of crosses carried out by Instituto Agronômico do Paraná (IAPAR) located in Londrina, Paraná State, a cultivar resistant to golden mosaic virus disease was released in 1992. This cultivar, 'IAPAR 57', originated from the cross of lines 'MD 632' x 'BAC 32'. The line 'MD 632' was obtained through a single cross where 'TMD-1' was one of the parents. 'IAPAR 57' is the first resistant cultivar to golden mosaic virus released in Brazil and is recommended to be cultivated in regions of Paraná State where the incidence of the disease is very high. This cultivar (as the mutant 'TMD-1') belongs to the 'Carioca' group, one of the most widely cultivated in Brazil, having erect plant type, 32 to 87 days of cycle, cream seed coat with brown stripes and white flowers. The yield of the susceptible cultivars, under high incidence of the disease, is only 400 kg/ha while mutant variety 'IAPAR 57' is yielding around 1400 kg/ha under the same conditions. Seed samples and additional information can be obtained from A. Bianchini, IAPAR.

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(Contributed by TULMANN NETO, A., A. ANDO*, A.S. COSTA**, and A. BIANCHINI***, *CENA, C.P. 96 13400, Piracicaba, S.P.; **IAC, C.P. 28, 13001-Campinas - SP.; ***IAPAR, C.P. 1331, 86001 Londrina-PR, Brazil)*

EARLY MATURING, SHORT-CULM AND FINER GRAIN RICE MUTANTS FROM LOCAL VARIETIES OF MYANMAR

The local varieties 'Paw San Bay Gyar' and 'Shwe Chay Chin' are extensively grown in the delta region of Myanmar. The former is distinguished for better eating quality and the latter for superior milling quality. About 60% white rice is obtained by milling 'Shwe Chay Chin' paddy compared to only about 45-50% of other varieties. Both the varieties are late maturing and susceptible to lodging due to tall plant height. Yield reduction results if monsoon rain stops earlier than normal time causing moisture stress conditions during flowering or grain-filling stages. Lodging is a perennial problem and is aggravated under high fertility or windy conditions. A mutation breeding programme was started to alleviate these problems.

Dry seeds of the varities were irradiated with 30 and 40 kR doses of gamma-rays and mutants were selected in M_2 generation on the basis of early

maturity and reduced plant height. Two mutants, one from each variety, were selected for their fortuitous combination of early maturity and reduced plant height. The mutants (one in M_2 and the other in M_4) were grown in 1989 along with their respective parental cultivars and the following agronomic data were collected (Table 1).

Table 1. Agronomic characteristics of mutants and their parents

Cultivar/ Mutant	Days to maturity	Plant height	100 grain wt. (g)	L/B ratio of grain	Yield/plant (g)
Paw San Bay Gyar	189	170	26.9	2.3	-
Mut. PSBG-1 (M_2)	141	138	24.7	2.8	-
Shwe Chay Chin	173	155	22.5	2.5	103
Mut. SCC-1 (M_4)	132	155	24.9	2.7	106

The mutants were 41-48 days earlier and 32-40 cm shorter than the parental cultivars. Mutant 'PSBG-1' has slightly smaller 1000 grain weight while the mutant 'SCC-1' has slightly larger grain weight than the parents. Grains of both the mutants are finer than the respective parental cultivars. The M_4 mutants are in yield assessment trials.

(Contributed by HLA SHWE*, *and* M.A.Q. SHAIKH**, **Seed Division, Myanmar Agriculture Service, Gyogon, Insein, Yangon, Myanmar and* **Bangladesh Institute of Nuclear Agriculture, Mymensingh, Bangladesh)*

GAMMA RAYS INDUCED EARLY FLOWERING MUTANT OF CELERY (*Apium graveolens* L. var. *dulce*)

Celery (*Apium gravealens* L.) is an important aromatic plant, well known for its seed oil which finds extensive use in flavouring food products, high grade perfumery as well as in several formulations of Indian medicine. India is the principal exporter of this crop to the world market, exporting approximately 3700 tons cf celery seed annually. Indian celery is a long duration crop taking between 190-210 days to mature. To reduce the cost of cultivation, it was found desirable to produce an early flowering/maturing plant type. With this view a mutation breeding programme was started and we reported a celery mutant, 20-25 days early flowering, which was isolated from gamma rays irradiated population.

Dry seeds of celery strain "RRL-85-1", a diploid with $2n = 22$, were irradiated with 10-30Kr gamma-rays. Immediately after irradiation the seeds were sown in earthern pots. The six to eight week old seedlings were transplanted to the field, M_1 generation was raised using standard agricultural practices. The seeds of M_1 and control plants were grown bulked-treatment wise. Selection for early types were made in M_3 and M_4 generations. The breeding behaviour of early flowering mutants was confirmed in the subsequent generation. Mutant with earliness by 20-25 days over the control was selected. The early flowering mutant exhibited a long flowering period and differed considerably from the parental strain in various morphological characters (Table 1).

Table 1: Comperative morphological data of early flowering celery (*Apium graveolens* L., var. *dulce*) mutant and parental strain 'RRL-85-1'.

Character	Parental strain		Early flowering mutant	
	Mean	Range	Mean	Range
Plant height (cm)	151.8	138.0 - 175.0	123.8	108 - 140
Leaf length (cm)	4.4	2.9 - 6.5	4.9	4.6 - 4.8
Leaf width (cm)	4.1	2.7 - 5.9	3.7	3.5 - 3.9
No. of leaves/plant	33.7	30.0 - 37.0	16.8	14 - 19
No. of branches/plant	9.8	7.0 - 13.0	9.0	7 - 11
No. of umbels/plant	297.1	223.0 - 357.0	303.8	160 - 398
No. of umblets/umbel	11.5	80 - 17.0	13.8	9.0 - 16
Stem thickness	7.1	5.3 - 8.0	3.5	3.0 - 4.2
Days taken to flowering	145	140 - 150	190	100 - 125
Days taken to maturity	200	190 - 210	175	170 - 180
Seed yield/plant	7.2	7.0 - 8.0	5.1	170 - 180
Oil content	2.1	2.0 - 2.2	2.0	2 - 2.1

(Contributed by **CHOUDHARY, D.K.** *and* **B.L. KAUL,** *Regional Research Laboratory, Canal Road, Jammu Tawi-180001, India)*

MUTAGEN INDUCED DWARF MUTANT IN CELERY (*Apium graveolens* L.)

The present study deals with the induction of dwarf mutant of celery (*Apium graveolens* L, var. *dulce* strain "RRL-85-1") by ethyl methanesulphonate (EMS) which is likely to play an important role in the breeding of new varieties of this important medicinal and aromatic plant. Seeds of celery strain 'RRL-85-1', a diploid with a chromosome number of $2n = 22$, were presoaked in distilled water for 45h and then treated with freshly prepared solutions of EMS (0.2%, 0.4%, 0.6%; pH 6.8) for 8h, at 20 ± 1°C. Treatments were terminated by washing the treated seed for 10 minutes in distilled water. Parallel controls were maintained in distilled water. Treated and control seeds were subsequently planted in earthern pots for raising the seedlings. Six to eight week old seedlings were transplanted in the field. M_1 generation was raised using standard agricultural practices. At maturity, M_1 plants were harvested separately. Seeds thus collected from M_1 plants were used to raise M_2 generation. M_2 plants were screened for chlorophyll mutations and other morphological variants.

In the present study, no chlorophyll mutations were observed, however, one dwarf mutant was detected following treatment with EMS (0.2%) which exhibited delayed flowering and maturity. Seeds of this mutant were collected and its breeding behaviour confirmed in M_3 generation. The data regarding different morphological characters studied in the dwarf mutant are presented in Table 1. It is evident that the mean values of most of the characters of this mutant decreased in comparison to control. Besides, this mutant exhibited delayed flowering and maturity.

The celery type under cultivation, is a tall profusely branching herb, reaching a height of nearly 1.5 - 2 m. Hence, it is greatly susceptible to lodging, which, apart from being conducive to seed shattering, is also a limiting factor in the use of fertilizers. A dwarf plant type in this case can prove very helpful in improement of this crop. The identificated dwarf mutant can serve as a starting material for cross breeding with a view to develop lodging resistant varieties.

Table 1: Comperative morphological data of dwarf mutant and parental strain 'RRL-85-1' of celery (*Apium graveolens* L. var. *dulce*)

Character	Parental strain		Dwarf mutant	
	Mean	Range	Mean	Range
Plant height (cm)	151.8	138.0 - 175.0	38.8	27.7 - 58.4
Leaf length (cm)	4.4	2.9 - 6.5	2.4	1.7 - 2.4
Leaf width (cm)	4.1	2.7 - 5.9	1.6	1.3 - 2.1
No. of leaves/plant	33.7	30 - 37	17.2	5 - 26
No. of branches/plant	9.8	7 - 13	9.6	8 - 12
No. of umbels/plant	297.1	223 - 357	106.0	20 - 180
No. of umblets/umbel	11.5	8 - 17	6.4	5 - 7
Stem thickness	7.1	5.3 - 8.0	5.3	3.3 - 5.5
Seed yield/plant	7.2	7.0 - 8.0	2.2	2.0 - 3.0
Days to flowering	145	140 - 150	185	180 - 190
Days to maturity	200	190 - 210	233	230 - 240

(Contributed by ***CHOUDHARY, D.K.*** *and* ***B.L. KAUL,*** *Regional Research Laboratory, Canal Road, Jammu Tawi-180001, India).*

PERFORMANCE OF MUNGBEAN MUTANT UNDER FARMING SYSTEM RESEARCH (FSR) IN PAKISTAN

Mungbean (*Vigna radiata* (L.) Wilczek) is a major pulse crop grown during the spring season in Sind Province, Pakistan. Not much attention has been given to its improvement in the past and accordingly its average grain yield is very low (476 kg/ha). The main reasons for low productivity are shortage of improved varieties, poor response to fertilizer and poor agronomic practices. To overcome these constraints, the development of high yielding varieties, suitable fertilizer scheduling and improved agrotechniques can lead to an increase in mungbean yield.

In order to introduce and demonstrate improved production technology to farmers on their own farms, farm trials were conducted in the spring of 1988, under Farming System Research with the close cooperation of Sind Agricultural University, Tandojam and Pakistan Agricultural Research Council, Islamabad. The trial was laid out at six different locations at Hala, District Hyderabad. The mungbean mutant NM 20-21 and local variety were used in this trial. Nitrogen and P_2O_5 were applied in the form of DAP at the rate of 22 and 57 kg/ha respectively at sowing time and seeds were treated with *Rhizobium* inoculum. Details of treatments are shown in Table 1.

The mungbean mutant (NM 20-21) established its superiority over the local cultivar in all treatments (Table 1). The mutant line with combined treatment of fertilizer and *Rhizobium* produced significantly higher grain yield (1319 kg/ha). Biological yield showed non-significant differences while harvest index was found to be significantly different with maximum values produced by the mung mutant. Impact of fertilizer was prominent on the mung mutant. The increased grain yield due to fertilizer application was 61.34%. The grain yield increase shared by the mutant variety and *Rhizobium* inoculum application was 26.92% and 11.73% respectively. The mutant (NM 20-21) produced 24.65% more grain yield as compared to local cultivar under farmer practices. The mutant line, because of its short stature and determinate growth habit, gave a better response to fertilizer and produced a

Table 1: Performance of mung mutant and local cultivar in different treatments during spring 1988

Treatments		Maturity period (days)	Biological yield (kg/ha)	Grain yield (kg/ha)	Harvest index (%)
T_1	NM 20-21 + Inoculum -Fertilizer	70	3528	1000 B	28.34 A
T_2	NM 20-21 + Inoculum -Fertilizer	70	4231	1258 A	29.73 A
T_3	NM 20-21 + Inoculum -Fertilizer	70	4481	1319 A	29.44 A
T_4	NM 20-21 + Farmer practices	70	3700	996 B	26.92 A
T_5	Local cultivar + Inoculum -Fertilizer	100	4569	942 B	20.62 B
T_6	Local cultivar + Farmer practices	100	4283	799 B	18.66 B
LSD_1			-	224.3438	4.4788

Contribution of different factors:

Total yield increase	(T3-T6) = 1319-799 = 520 kg/ha
Increase due to fertilizer	(T3-T1) = 1319-1000 = 319 kg/ha = 61.34%
Increase due to *Rhizobium*	(T3-T2) = 1319-1258 = 61 kg/ha = 11.83%
Increase due to improved mungbean	(100-(61.34+11.73)) = 26.92%
Increase due to mutant line in Farmer practices	(T4-T6) = 996-799 = 197 kg/ha = 24.65%

significantly higher yield (P7.01) than the indeterminate local cultivar. In the local cultivar, vegetative growth accelerated with the application of fertilizer indicating the translocation of photosynthates toward growth instead of their diversion to sink (yield components).

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CHEMICAL MUTAGENESIS FOR CROP BREEDING - ACHIEVEMENTS IN THE FORMER USSR

Chemical mutagenesis is inseparably linked with the name of I.A. Rapoport. In 1960 a team of geneticists headed by Dr. Rapoport initiated the testing of known chemical mutagens and the search for new ones. In the course of their work they demonstrated the high efficiency of some mutagens and described the effect of a great number of new ones such as ethylenimine dimmer, N-nitroso-N-dimethyl- and N-nitroso-N-diethylurea, N-nitroso-N-ethylenurea, N-nitroso-N-methylmethoxyamine. Effective methods of chemical mutagenic treatment were also developed for various plant material (seeds,

pollen, tubes, bulbs, buds, grafts, etc.) with water solutions or with gaseous phase of chemical mutagens, and with water solutions of chemical mutagens supplemented with organic solvents. Similarly, the exposure time to chemical mutagens for most plant species cultivated on the territory of the former USSR has been determined.

The Department of Chemical Genetics has been the center for chemical mutagenesis since 1965. The synthesis of chemical mutagens, treatment of plant material as well as scientific consultations, annual conferences and publication of "Chemical Mutagenesis" series (25 books) are among the main activities of this Center. The cooperation of geneticists from the Institute of Chemical Physics with plant breeders is on the basis of research contracts. By 1992 more than 200 such contracts were issued.

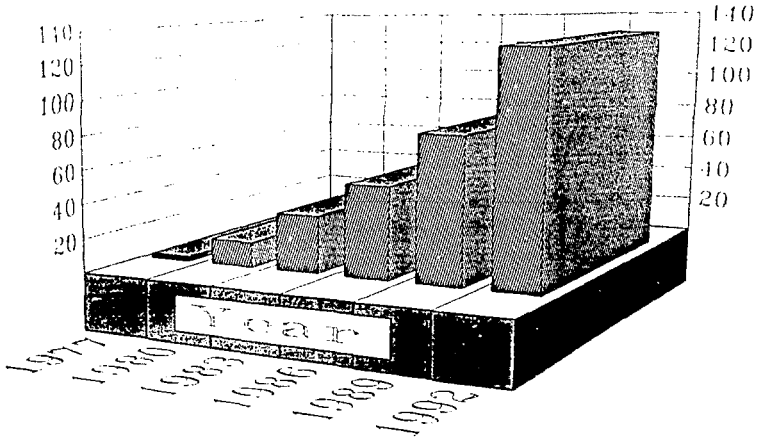

Figure 1. Cumulative number of released and introduced mutant cultivars obtained by chemical mutagenesis in the former USSR.

The intensively developed theoretical basis of chemical mutagenesis led to significant achievements in mutation breeding in the former USSR (Fig. 1). By 1992, 366 mutant varieties of crop plants had been obtained using chemical mutagens of which 134 varieties have been introduced: 31 wheat varieties, 17 barley, 3 oats, 12 maize hybrids, 1 sorghum variety, 2 millet, 4 buckwheat, 6 rice, 6 pea, 2 bean, 1 vetch, 1 plavine, 4 soybean, 12 lupine, 4 faba bean, 1 esparcet, 2 sudan-grass, 1 brome-grass, 4 mangle-wurzel, 1 kale, 1 amarant, 1 sunflower, 2 rapeseed, 1 castor-bean, 1 chamomile, 4 tobacco, 3 flax, 1 pepper, 1 tomato, 1 lettuce, 1 onion, 1 cucumber, 1 raspberry.

Some mutant varieties are distinguished by their unique character. For instance, the sunflower mutant variety 'Pervenets' has improved oil quality making it similar to olive oil.

At present, mutant varieties of winter wheat, spring and winter barley, white lupine and maize hybrids make up over 25% of the total number of cultivated varieties of these crops. In some regions of Russia (Krasnodar, Kuban, Stavropol) and the Ukraine, mutant varieties of these crops are cultivated exclusively.

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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 cultivar	Country and date of release (or approval) Name of principal worker(s) and institute	Mutagenic treatment (parent variety) or cross with mutant or with mutant derived variety	Main character improved
Fagopyrum esculentum **Gili (buckwheat)**			
Chernoplodnaya	USSR, 1980 Gorina, E.D. *et al.*, Byelorussian Agriculture Research Institute, Jodino	EI, 0.05% [Yubileinaya 2]	earliness, lodging resistance, seed size
Kurskaya 87	USSR, 1991 Kursk and Orel State Regional Agriculture Stations	cross line Orbita x DOV 1 (MNH induced mutant)	cooking quality
Skorospelaya 86	USSR, 1990 Fesenko, N.V. *et al.*, All Union Research Institute of Legum. and Groat Crops, Orel; State Regional Agriculture Station, Orel	cross Temp 411 x Chernoplodnaya	earliness, cooking quality
Glycine max **L. (soybean)**			
Luchezarnaya	USSR, 1990 Fomin, V.S. *et al.*, Agric. Res. Inst. Black Earth Zone; State University, Voronej	MNH	earliness
Mageva (Lastochka-out)	USSR, 1991 State Regional Experim. Station, Rjazan	chemical mutagen	earliness, disease resistance
Prikarpatskaya 81	USSR, 1991 Borejko, A.M. *et al.*, State Agric. Exp. Station "Ivano-Francovsk"	ENH, 0.025% [Kirovogradskaya 2]	disease resistance, (bacteriosis, *ascochytosis*, peronosis)

Name of cultivar	Country and date of release (or approval) Name of principal worker(s) and institute	Mutagenic treatment [parent variety] or cross with mutant or with mutant derived variety	Main character improved
***Hordeum vulgare* L. (barley)**			
Perelom	USSR, 1990 Shevtsov, V.M. *et al.*, Krasnodar Agriculture Research Institute	cross Nadja x Kaskad	lodging resistance
Skorokhod	USSR, 1991 Shevtsov, V.M. *et al.*, Krasnodar Agriculture Research Institute	cross Meteor x 57 M13 (DENH induced mutant)	earliness, lodging resistance
Tuteishy	USSR, 1992 Byelorussian Agriculture Research Institute, Jodino	cross 5/811(KM1192 x Atos) x 11/811; (11/811 from cross Intensivnyi x HVS 91/76)	lodging resistance yield
Veras	USSR, 1992 Byelorussian Agriculture Research Institute, Jodino	cross, line Intensivnyi x Atos (mutant of Nadja after 0.015% MNH treatment)	lodging resistance, foliage yield
VITIM	USSR, 1989 Burjatskii Agriculture Research Institute	cross SP 587 x Pallydum 394 (DMS induced mutant)	lodging resistance, grain quality
***Lathyrus sativus* L. (plavine)**			
Poltavskaya 2	USSR, 1980 Chekalin, N.M. *et al.*, Poltava Agriculture Institute	ENH, 0.01%	drought, disease and insect resistance
***Lupinus albus* L. (white lupin)**			
Olezhka	USSR, 1989 Golovchenko, V.I. Ukrainian Agriculture Research Institute, Kiev	ENH, MNH [Kievskii mutant]	alkaloid content, earliness

Sinii parus	USSR, 1991 Golovchenko, V.I. *et al.*, Ukrainian Agriculture Research Institute, Kiev	cross mutant x mutant (both after 0.01% MNH treatment of var. [Pishchovoi])	lodging resistance, protein content, seed productivity
Slavutich	USSR, 1980 Golovchenko V.I. *et al.*, Ukrainian Agriculture Research Institute, Kiev	cross M-70VA x VI-M-70-S (chemical mutagens)	alkaloid content, earliness, disease resistance
Solnechnyi	USSR, 1980 Golovchenko, V.I. Ukrainian Agriculture Research Institute, Kiev	chemical mutagen	alkaloid content, disease and insect resistance
Ukrainskii	USSR, 1981 Golovchenko, V.I. *et al.*, Ukrainian Agriculture Research Institute, Kiev	MNH, EI and DMS (repeated)	alkaloid content
Vympel	USSR, 1982 Soloduk, N.V. *et al.*, Ukrainian Agriculture Research Institute, Kiev; Res. Ins. Agr and Cattle Breeding West Region	EI [Rannespelyi 31 uluchshen]	earliness
***Oryza sativa* L. (rice)**			
Malysh	USSR, 1982 Kudinov, K.A. *et al.*, All Union Rice Research Institute Krasnodar	EMS, 0.5%; 20h [Sirayuki]	earliness, threshability, seed retention
Mutant 428	USSR, 1989 Necrasov, N.Ya. *et al.*, Ukrainian Rice Selection Research Institute	MNH, 0.02% [Fanu x KUR-127] (hybrid seed treated)	lodging resistance, cooking quality
Nucus 2	USSR, 1986 Uzbek Rice Research Institute	cross Corbetta x Karlyk Shylovskogo (ENH induced mutant)	shortness, lodging resistance, yield
Zolotistyi	USSR, 1989 Kuban Agriculture Institute Krasnodar	ENH [Rossiiskii]	cooking quality

Name of cultivar	Country and date of release (or approval) Name of principal worker(s) and institute	Mutagenic treatment [parent variety] or cross with mutant or with mutant derived variety	Main character improved
Panicum miliaceum **L. (millet)**			
Kharkovskoe 57	USSR, 1987 Konstantinov, S.I. *et al.*, Ukrainian Research Inst. of Plant Breeding, Selection and Genetics, Kharkov	MNH, 0.025% [Kharkovskoye 37]	cooking quality
Lipetskoe 19	USSR, 1985 Kaljagin, Yu.S. *et al.*, Union Institute of Agriculture, Black Earth Zone, Voronej; State Agriculture Research Station, Lypetzkoye	DMS, 0.04% [line No. 947]	cooking quality
Phaseolus vulgaris **L. (bean)**			
Mukhranula	USSR, 1982 Teodoradze, S.G. *et al.*, Georgian Agriculture Research Institute	EI, 0.015% [Mukhranula 4]	earliness (30 days)
Svetlaya	USSR, 1992 Grytchenko, R.I. *et al.*, Institute of Cytology and Genetics Siberian Division 630090 Lavrentiev, 12 Novosibirsk	MNH, 0.006% [Shchedraya]	yield, protein content
Pisum sativum **L. (pea)**			
Bitug	USSR, 1990 Agriculture Research Institute Black Earth Zone, Voronej	cross Orphei x Smaragd	seed smoothness, seed size

Orphei	USSR, 1989 Fomin, V.S. *et al.*, Agriculture Research Institute Black Earth Zone, Voronej	chemical mutagen	earliness
Samara	USSR, 1992 Ukrainian Agriculture Research Institute, Kiev	chemical mutagen [Arvika]	seed shedding resistance, disease resistance, (for forage)
Tatarstan 2	USSR, 1989 Evdokimova, T.G. *et al.*, Tartar Agriculture Research Institute, Kazan	ENH, 0.05% [Ahalkalakskii mestnyi x Ramenskii 77] (hybrid seeds treated)	earliness (for forage)

***Triticum aestivum* L. (wheat)**

Bel'chanka 5	USSR, 1992 Postalaty, A.A. *et al.*, Moldavian Crop Research Institute, Tiraspol	cross (Sava NS-611 x Odesskaya 51) x Odesskaya polukarlikovaya	lodging resistance, seed retention, disease resistance
Birlik	USSR, 1989 Puchkov, Yu.M. *et al.*, Institute of Genetics and Plant Breeding Baku, Azerbaijan; Krasnodar Agriculture Research Institute, Krasnodar	cross Jubilejnaya x Polukarlikovaya 49	lodging resistance, drought resistance, baking quality
Eritrospermum 103	USSR, 1982 Syminel, V.D. *et al.*, Kishinev Agriculture Institute Experimental Stat., Kishinev	gamma rays, EI [Lutestsens 62]	earliness, lodging resistance, winter hardiness
Dnestryanka	USSR, 1989 Untila, I.P. *et al.*, Moldavian Crop Research Institute	cross (Donskaya ostistaya x Kavkaz) x Odesskaya polukarlikovaya	shortness, lodging resistance, seed size
Inna	USSR, 1991 Sanduhadze, B.I. *et al.*, Res. In. Union "Podmoscovie" Moscow Region; State Agriculture Experimental Station, Rjazan	cross Nechinovskaya 86 x Zarja	lodging resistance, winter hardiness

Name of cultivar	Country and date of release (or approval) *Name of principal worker(s)* and institute	Mutagenic treatment [parent variety] *or cross with mutant* or with mutant derived variety	Main character improved
Kazanskaya 84	USSR, 1992 Tartar Agriculture Research Institute, Kazan	MNH, 0.01% [Velutinum 97 x Albidum 114]	winter hardiness, disease and insect resistance
Kharkovskaya 90	USSR, 1991 Yelnikov, N.I. *et al.*, Ukrainian Research Institute of Plant Breeding, Selection and Genetics, Kharkov	cross Ahtyrchanka x Polukarlikovaya 49	lodging and insect resistance, winter hardiness
Khersonskaya 86	USSR, 1991 Orluk, A.P. Ukrainian Research Institute of Irrigational Agriculture, Kherson	cross Obrii x Odesskaya polukarlikovaya	lodging resistance, seed retention, insect resistance
Lutestsens 7	USSR, 1991 Morgun, V.V. *et al.*, Institute Plant Physiology Ukrainian Acad. Sci., Kiev	cross, (Hohentrurmer 4891-67 x Mutant MK-62) x Kijanka (MK-62 - DES induced mutant)	seed retention, seed size, baking quality
Meshenskaya	USSR, 1989 Ionov, E.F. *et al.*, Tartar Agriculture Research Institute, Kazan	MNH, 0.01% [(Chernomorskaya x Mironovskaya jubilejnaya)] hybrid seed treated	winter hardiness, disease resistance, baking quality
Moskovskaya 70	USSR, 1991 Sanduhadze, B.I. *et al.*, Res. In. Union "Podmoscovie" Moscow Region; State Agriculture Exp. Station, Rjazan	*cross* (/Mironovskaya 808 x Krasnodarskii karlik 1/ x Mironovskaya 808) x Zarja	*lodging resistance*
Moskovskaya nizkosteb.	USSR, 1990 Varenitza, E.T. *et al.*, Res. In. Union "Podmoskovie" Moscow Region; State Agriculture Exp. Station, Rjazan	cross (Mironovskaya 808 x Krasnodarskii karlik 1) x Zarja	lodging and drought resistance

Mriya Khersona	USSR, 1989 Orluk, A.P. *et al.*, Ukrainian Research Institute of Irrigational Agric., Kherson	cross (Odesskaya polukarlikovaya x Khersonskaya 170) x Odesskaya polukarlikovaya	lodging resistance, earliness, disease resistance
Nechinovskaya 52	USSR, 1990 Sanduhadze, B.I. *et al.*, Res. Ind. Union "Podmoscovie" Moscow Region; State Agriculture Exp. Station, Rjazan	cross Mironovskaya 808 x Krasnodarskii karlik 1	lodging resistance, seed retention
Nechinovskaya 86	USSR, 1991 Sanduhadze, B.I. *et al.*, Res. Ind. Union "Podmoscovie" Moscow Region; State Agriculture Exp. Station, Rjazan	cross Mironovskaya 808 x Krasnodarskii karlik 1	lodging resistance, yield
Omskaya ozimaya	USSR, 1989 Rutz, R.I. *et al.*, Siberian Agriculture Research Inst., Omsk; All Union Plant Breeding Institute Moscow Division	EI, 0.01%	winter hardiness, seed retention, drought resistance
Pitikul	USSR, 1982 Untila, I.P. *et al.*, Moldavian Crop Research Institute	cross Krasnodarskii karlik 1 x Odesskaya 51 (mutant line induced with ENH)	lodging and disease resistance, seed size
Polukarlik 3	USSR, 1985 Didus V.I. *et al.*, Ukrainian Res. Inst. Plant Breeding, Selection and Genetics, Kharkov	cross Krasnodarskii karlik 1 x Mironovskaya 808 x Kharkovskaya 63-1	lodging resistance, seed size, winter hardiness
Progress	USSR, 1984 Kirychenko, F.G. *et al.*, All Union Inst. Plant Breeding and Genetics, Odessa	cross Krasnodarskii karlik 1 x Odesskaya 16	lodging resistance, earliness, seed size
Sibirskaya niva	USSR, 1992 Rutz, R.I. *et al.*, Siberian Agriculture Research Inst. Omsk; Institute of Chemical Physics, RAS, Moscow	EI, 0.01% [PPG-186]	winter hardiness, lodging resistance

Name of cultivar	Country and date of release (or approval) Name of principal worker(s) and institute	Mutagenic treatment [parent variety] or cross with mutant or with mutant derived variety	Main character improved
Skifyanka	USSR, 1992 Puchkov, Yu.M. *et al.*, Krasnodar Agriculture Research Institute, Krasnodar; Northern-Kuban Agriculture Exp. Station	chemical mutagen [sel. from Spartanka]	baking quality, lodging resistance, seed size
Spartanka	USSR, 1988 Puchkov, V.M. *et al.*, Krasnodar Agriculture Research Institute, Krasnodar	cross Lutescens 1673h75 x Pavlovka x mutant line	lodging resistance, yield (double)
Yubileinaya 75	USSR, 1992 All Union Inst. Selection Odessa	cross (/TR 114/65A x Priboj/ x Odesskaya polukarlikovaya) x (Lerma Roho x Kavkaz)	seed size, disease and insect resistance
Yunnat odesskii	USSR, 1989 Kirichenko, F.G. *et al.*, All Union Plant Breeding and Genetics Institute, Odessa	cross Odesskaya polukarlikovaya x Chika	lodging resistance, seed size, disease resistance
***Sorghum durra* Stapf (durra)**			
Volzhskoye 4	USSR, 1989 Kostina, G. and Ichin, A. Saratov Agric. Inst. and All Union Res. Inst. of Sorghum Crops	cross mut. of [Efremovskoye 2] x mutant of [Volgskoye 2] hybrid seed treated	shortness, threshability

***Zea mays* L. (maize)** (H = hybrid)

Hybrid ChKG 280 MV	USSR, 1992 Res. Indust. Union Elyta Cherkassy; Inst. Plant Physiology and Genetics UAS; All Union Res. Inst. Plant Protec.	cross P 346 M x P 502 M (chemomutants)	disease and insect resistance, yield
Kollektivnyi 95 M (H)	USSR, 1992 Morgun, V.V. *et al.*, Institute of Plant Physiology and Genetics Ukrainian Acad. Sci., Kiev	cross ChK 2T x ChK 3 3T x ChKR 8 (all 0.04% NENG induced mutants)	earliness, disease resistance
Kollektivnyi 100 TV (H)	USSR, 1988 Morgun, V.V. *et al.*, Institute of Molecular Biology and Genetics, Ukrainian Acad. Sci., Kiev	cross Drujba x (ChK 2TV x ChK 3DTV) (both NENG induced mutants)	earliness
Kollectivnyi 210 (H)	USSR, 1982 Zaika, S.P. *et al.*, Ukrainian Agriculture Research Institute	cross with mutant line	earliness, yield
Kollektivnyi 225 MV (H)	USSR, 1990 Ukrainian Agriculture Research Institute Inst. Molecular Biology and Genetics, UAS, Kiev; State RAS, Chercassi	cross with mutant line (0,04% NENG induced mutant)	earliness, lodging resistance
Kollektivnyi 244 MV (H)	USSR, 1986 Chuchmy, I.P. *et al.*, State Regional Agriculture Station, Chercassi; Inst. Molecular Biology and Genetics UAS; Ukrainian ARI, Kiev	cross Pionneer 3978 x Shindelmayzer MV (chemical mutagen induced mutant)	yield
Krasnodarskii 303 VK	USSR, 1984 Smirnova, A.B. *et al.*, Krasnodar Agriculture Research Institute	cross W 64 waxy x Cr 25 waxy (MNH induced mutant)	lodging resistance
Yubileinyi 60 (H)	USSR, 1982 Chuchmy, I.P. *et al.*, State Regional Agriculture Station, Chercassi	cross Mir x Chk 218 MV (ENH induced mutant)	stiffness, disease and insect resistance

Name of cultivar	Country and date of release (or approval) Name of principal worker(s) and institute	Mutagenic treatment (parent variety) or cross with mutant or with mutant derived variety	Main character improved
Yubileinyi 60 MV (H)	USSR, 1986 Chuchmy, I.P. *et al.*, State Regional Agriculture Station, Chercassi; Inst. Molecular Biology and Genetics UAS; Ukrainian ARI, Kiev	cross Mir M x ChK 218 MV (ENH induced mutant)	earliness
***Vicia faba* L. (faba bean)**			
Prikarpatskie 4	USSR, 1986 Borejko, A.M. *et al.*, State Agr. Exp. Stn. "Ivano-Frankovsk"	ENH, MNH, DES, DMS, EI (repeated treatment) (Prikarpatskie 2)	yield
Severinovskie 1	USSR, 1992 Ukrainian Agriculture Research Institute, Kiev	MNH (KYU-82 x Fribo) (hybrid seeds treated)	protein content, yield
***Vicia sativa* L. (vetch)**			
Nechinovskaya 84	USSR, 1989 Res. Industrial Union "Podmoscovie" Moscow Region, State Agriculture Experimental Station, Sumy	DES, 0.01%, 12h (VIR K-33583)	leaf size, yield of biomass

EXPERIMENTAL MUTAGENESIS AND BARLEY BREEDING FOR EARLINESS

Previous reports have been made on the early winter barley variety 'Skorokhod' released on the North Caucasus and some areas of the Ukraine [1]. It may be considered as a transgression in earliness, frost resistance and productivity. As for spring barley breeding, a rather early mutant variety 'Temp' has been obtained after selection from M_2 ('Krasnodar 35' treated with N-nitroso-N-ethylurea (ENH) 0.05% - 6h). The original mutant plant heads 5 days earlier than the parent variety. 'Temp', released at Krasnodar and Stavropol Territories, proved to be very useful for "repairing" winter wheat and winter barely fields after their poor overwintering in order to restore plant density to a normal level in early spring.

From the cross of two mutant varieties 'Trumph' and 'Temp' some promising recombinants have been found, including the released variety 'Kaskad' which became one of the parental forms for the more productive variety 'Perelom'. In spite of high yielding capacity of the new varieties they were not widely introduced into practice and early maturing variety 'Temp' is still more popular in the Krasnodar Region. Farmers are rather reluctant to use pesticides for pest control and especially against the cereal leaf beetle (*Oulema melanopus*), which can reduce barley yield from 10 to 40%. Due to its extreme earliness the mutant variety is able to escape the attack of the dangerous pest. From an agronomic point of view earliness is a very valuable character, but is negatively correlated with productivity. Additionally, early genotypes with high rate of initial growth, as a rule, have rather tall straw conditioning increased lodging.

The only way to increase the yield of spring barley was to improve stem resistance to lodging without changing the excellent adaptability and other desired traits of variety 'Temp'. This dilemma was successfully solved by chemical mutagenesis. As a result of seeds treatment of line 'K-139' ('Trumph' x 'Temp') with N-nitroso-N-methylurea (MNH) 0.05% - 18h a new spring barley variety 'Mamluk' has been developed (Tab. 1).

Table 1: Performance of barley mutant variety 'Mamluk' in advance trials

Variety	Yield (q/ha)						Resis. to lodging score (1-9)	1000 kernel weight (g)
	1988	1989	1990	1991	1992	mean		
	Krasnodar Res. Inst. of Agriculture							
Temp	39.3	45.5	51.0	37.0	47.1	44.0	5	45.6
Mamluk	44.2	51.6	54.3	40.2	53.9	48.8	8	51.2
LSD 0.05	3.2	2.9	2.7	2.9	3.0			
	North-Cuban experiment station							
Temp	43.6	57.1	56.7	39.6	42.3	47.8	6	46.4
Mamluk	48.3	62.8	60.6	46.3	50.1	53.6	8	52.3
LSD 0.05	3.4	3.1	3.0	3.2	3.4			

'Mamluk' is two days earlier than the check variety 'Temp'. That is very important for areas near villages, rivers and resort zones where application of pesticides is forbidden. Due to a good resistance to lodging,

large grain size and tolerance to diseases 'Mamluk' outyielded check variety over 10-12%. It was released in the North Caucasus and is promising for some areas of Russia and Ukraine.

REFERENCES

[1] Shevtsov, V., T. Kuznetsova and T. Paveleva, 1991. Results of experimental mutagenesis for barley improvement in the North Caucasus. In: Plant Mutation Breeding for Crop Improvement. Vol. 1, IAEA, Vienna, pp. 149-154.

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NEW FAO/IAEA CO-ORDINATED RESEARCH PROGRAMMES
IN
PLANT BREEDING AND GENETICS SECTION

TITLE: CO-ORDINATED RESEARCH PROGRAMME ON INDUCED MUTATIONS FOR SESAME IMPROVEMENT

SCIENTIFIC PACKGROUND:

Sesame is one of the world's most important oil seed crops, grown preferentially in developing countries by small holders. It is relatively tolerant to high temperature and moisture stress and usually grown with low inputs. Its seeds contain ca. 50% oil of excellent quality and 25% protein. So far little research has been devoted to sesame to improve its productivity. FAO convened two expert consultations in 1980 and 1984 assessing constraints and making recommendations to overcome them. One of the recommendations was to stimulate sesame breeding by making use of new genetic variability created through mutation induction.

SCOPE AND GOAL:

- Induced mutations would be required to make the alterations in plant architecture and fruit structure conducive to higher yield and reduction of grain losses at harvest. Also disease resistance needs to be improved.
- The co-ordinated research programme should foster research or mutagenesis with varieties of sesame of different origin and genetic background, the selection of desired types and their use in cross breeding. Limited experience exists so far in Venezuela, Israel, Korea and Egypt.

IMPLEMENTATION AND DURATION:

This programme can be implemented from 1993 onwards. The duration of the programme is planned for 5 years, with a review after 3 years.

TITLE: COORDINATED RESEARCH PROGRAMME ON *IN VITRO* TECHNIQUES FOR SELECTION OF MUTANTS ADAPTED TO ADVERSE ENVIRONMENTAL CONDITIONS

SCIENTIFIC BACKGROUND:

In many developing countries, large areas of cultivated land are located in regions with unfavourable eco-climatic conditions for plant growth and development. Plant yield and quality are severely reduced in adverse environment such as drought, heat, cold, freezing, soil salinity and low pH. Soil salinity is a major problem in crop production.

Breeding of improved cultivars is an effective method to assure increased productivity and quality of crops. In conditions of limited inputs, breeding suitable cultivars is often a key component in developing adapted varieties. Mutation breeding and *in vitro* culture technologies can be used for complementing the conventional plant improvement procedures for speeding the breeding and multiplication of desired genotypes. These technologies are particularly useful in the improvement of vegetatively propagated plants in which either there is no seed set or the seed progenies are highly heterogenous and do not reproduce true to type.

Plant and cell tissue culture techniques allow mutagenesis of large populations of cells and regenerated plants with physical and chemical mutagens in a small space. Thus, it is possible to grow millions of cells in a petri-dish or in a flask, and irradiate and multiply them on defined media to regenerate plants. In some cases, the regenerating cells, somatic embryos and plantlets can also be subjected to heat, cold and freezing for selection of the desired variants. The plants obtained from such cultures can then be tested in the field.

Tolerance to drought is a complex character. However, selection for traits such as a deep rooting system, waxy cuticle, reduced leaf-area, stomata number, short plant height, reduced net photo-respiration and high net photosynthesis under elevated temperatures and reduced water supply, early flowering and maturity can help to produce drought tolerant or escaping genotypes. Recent studies suggest that salt tolerance in some cultivars is linked to the presence of inducible genes, and like heat-shock proteins, stress tolerance in plants may be linked to the switching-on of the inducible genes. However, nothing is known about the possibility to mutate such genes in the stress non-tolerant genotypes.

A large number of vegetatively propagated plants such as cassava, potato, sweet potato, yams, sugar cane, garlic and plantain which are major food crops in the developing countries suffer from stress caused by drought and salinity, often in conjunction with high temperature. These crops are ideal for *in vitro* induced mutations, and *in vitro* mass propagation. In some of them, such as banana, garlic, sugarcane and cassava, somatic embryogenesis has been demonstrated. *In vitro* irradiation of axillary and apical meristems, somatic embryos and regenerative cell suspensions of such plants can be used for producing large numbers of mutants, which can then be subjected to the conventional field selection. The selected mutants can be rapidly multiplied through micro- propagation for large scale testing, and release to the growers. Thus, *in vitro* mutagenesis and *in vitro* propagation can be integrated into the conventional selection to speed up breeding of vegetatively propagated plants.

OBJECTIVES:

- To develop and adapt suitable *in vitro* techniques to induce mutations in cell suspension cultures, somatic embryos and bud cultures in the important vegetatively propagated food plants, such as cassava, yam, potato, sweet potato, sugarcane, garlic and plantain to benefit the developing countries.
- To develop procedures for *in vitro* irradiation, and rapid separation of mutated and non- mutated sectors from multi-cellular explants,

such as axillary.apical meristems, by subsequent *in vitro* propagation.

- To improve and develop protocols for *in vitro* selection of induced salt-tolerant mutants based on medium manipulation.
- To adapt micropropagation techniques for large scale *in vitro* multiplication of the selected mutants for release to the end-users (farmers, growers).

IMPLEMENTATION AND DURATION:

This programme can be implemented from 1993 onwards. The duration of the programme is planned for 5 years, with a review after 3 years.

TITLE: CO-ORDINATED RESEARCH PROGRAMME ON RADIATION INDUCED MUTATIONS AND OTHER ADVANCED TECHNOLOGIES FOR THE PRODUCTION OF CROP MUTANTS SUITABLE FOR ENVIRONMENTALLY SUSTAINABLE AGRICULTURE

SCIENTIFIC BACKGROUND:

During the last thirty years, the increase in agricultural production was achieved mainly through the use of the most suitable areas with fertile soil and sufficient amounts of water. In such areas, high input agriculture has significantly contributed to increased production. Intensive methods of agricultural production with high levels of nitrogen fertilizers and pesticides have led to the degradation of the environment and in some extreme situations to the production of polluted food. Additionally, rapid growth of the world's population has increased the necessity for the use of marginal lands, where adverse soil and climatic conditions are serious problems for food production. In ecological terms, marginal areas are even more sensitive and easily undergo ecological destabilization. Under these conditions, the system approach in agriculture is necessary, in which environmental protection has high priority. Sustainable systems of food production and land use seem to be the best solution for environment friendly agriculture. According to the FAO "sustainable agriculture involves the successful management of natural resources to meet changing human needs without damaging the environment and the natural resource base". Implementation of such systems will require new crop management practices and crop rotations. The new rotation systems should, without subsidies, secure maximum stable yield, maintain or enhance soil quality and productivity and should not generate adverse effects on the wholesomeness of the food or the environment.

Introduction of sustainable agriculture will be conditioned on new plant ideotypes which will be developed for the main crops and on new crops that will become available for various rotation systems. A balance between cultivation of staple foods and cash crops should be considered, depending on the economic situations. In developing countries a high priority should be given to basic food crops. New rotation systems have to be established for various ecological zones with their main objective to increase recycling of organic matter and to promote biological fixation. These requirements for new crops suitable for sustainable agriculture can only be realized if suitable crop varieties are bred. These should be varieties with a much shorter growing period, suitable for rotation, increased tolerance or resistance to diseases and pests as well as to drought and salinity and other adverse soil and climatic conditions. Among them aluminium tolerance and tolerance to low content of available phosphorous are the most important. Nitrogen fixing legumes or grasses rebuilding soil structure will become a necessary component of almost all rotation systems. New varieties should be developed for strong-rooted crops such as pigeonpea, alfalfa and chickpea, suitable for use as short

duration rotation crops. Similarly, various plant species should be investigated for their suitability as companion crops in multicropping systems for tropical and subtropical zones. It should be noted that existing variation in most crops being considered is not sufficient or not easily available for breeding programmes. Nevertheless, almost all these new breeding objectives may be achieved with the use of induced mutations and related modern biotechnologies. New, desired variability generated with radiation techniques in "neglected" crops can be successfully used in breeding programmes. Additionally, new technologies such as molecular markers, in combination with *in vitro* techniques (doubled haploids, somatic embryogenesis, protoplast culture) can significantly speed up these breeding programmes. Indeed, only with application of modern biotechnology can the whole programme of implementation of sustainable agricultural production be achieved in the foreseeable future.

OBJECTIVES:

- To undertake research on new plant biotypes of the major crops and develop plant materials with characters suitable for cultivation under sustainable agricultural systems.
- To develop in "neglected" traditional plant species mutants with desired characters and develop a strategy for their utilization under rotation systems for various ecological zones.
- To develop simple *in vitro* culture methods for mutagenesis and genetic purification and multiplication of new "sustainable genotypes"
- To use molecular markers as a tool facilitating early detection of mutants/recombinants and selection of desired genotypes.
- To induce mutations in model plant species and utilize them for study of sustainable genotype/environment relationship and as potential gene sources for crop plant improvement.
- To enhance regional and interregional co-operation in the field of radiation induced mutations and related biotechnology for rapid implementation of "sustainable genotypes".
- The programme should be continued for 5 years with an interim review after three years.

IMPLEMENTATION AND DURATION:

The programme should be initiated in 1993. The duration of the programme is planned for 5 years, with a review after 3 years.

ERRATUM

MBNL No. 38 (1991) page 6: should be "*contributed by **Singh, R. K.**...*" instead "*Singh, R.H.....*".

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*Please note that information on 'Fractionated x-ray doses for in vitro mutagenesis', published in Agricell Report 16(6):46 was prepared by editor - not by Dr. F. **Walter** (see MBNL 39:45). In this issue we listed three original papers of the author, related to in vitro mutagenesis.*

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RICE GENOME RESEARCH PROGRAM (RGP)

coordinated by

NATIONAL INSTITUTE OF AGROBIOLOGICAL RESOURCES

SOCIETY FOR TECHNO-INNOVATION OF AGRICULTURE, FORESTRY AND FISHERIES

Newsletter "RICE GENOME" launched

The Rice Genome Research Program (RGP) has produced the first issue of its Newsletter, titled "Rice Genome". The newsletter aims to inform all researchers interested in mapping and analyzing plant genomes. The main objective is to enhance international cooperative research efforts for rice genome analysis and for the isolation and utilization of useful rice genes in plant breeding and biotechnology.

Background

The Rice Genome Research Program (RGP) started on October 1, 1991. It is managed by the National Institute of Agrobiological Resources (NIAR) and the Society for Techno-innovation of Agriculture, Forestry and Fisheries (STAFF). The main center of research activity is at NIAR in Tsukuba City near Tokyo. The first stage of RGP lasts for seven years.

The main objectives of the first stage are to provide a physical map with DNA clones and a linkage map with genetic and RFLP markers and conventional genetic markers in at least 2000 positions. In addition, CDNA catalogues will be made from different organs of rice for isolation of agronomically important genes. Funding is provided by the Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan, and the Japan Racing Association (JRA).

The newsletter "Rice Genome"

The first issue of the newsletter "Rice Genome" (Number 1, vol. 1, July 1992) contains articles on the following topics:

- an overview of the Rice Genome Research Program
- the current strategy of CDNA cataloging
- RFLP linkage mapping
- physical mapping and chromosome mapping

In addition, information is given on how to request DNA clones (cDNA and RFLP landmarkers). The newsletter is available free of charge. To have your name added to the mailing list, send your name and address to the address below. Please indicate also the source of this announcement.

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News items and articles on rice genome mapping and analysis from the international research community are welcome.

FUTURE EVENTS

1993

	New information on ESNA meeting !
5-9 September	ESNA - The European Society for New Methods in Agriculture Halle (Saale), Germany Contact: Mrs. Christine Grahn, Institute for Social Medicine and Epidemiology of the German Federal Health Office Aussenstelle Leipzig Permoserstrasse 15 0-7050 Leipzig, Germany FAX: 49 (341) 235-2313
20-24 September	FAO/IAEA RCM on "Improvement of Basic Food Crops in Africa Through Plant Breeding, Including the Use of Induced Mutations" Nairobi, Kenya Contact: Dr. B.S. Ahloowalia Plant Breeding & Genetics Section IAEA, Joint FAO/IAEA Division Wagramerstrasse 5 P.O. Box 100 Vienna A-1400, Austria FAX: (43)1-234564
9-21 October	Plant Biotechnology: Tissue Culture and Beyond Cairo, Egypt Contact: Ms. Diana Viti ICGEB, Padriciano 99 34012 Trieste, Italy FAX: 39-40-226555
1-21 November	Applications of the New Biotechnologies to Agriculture Buenos Aires, Argentina Contact: Ms. Diana Viti ICGEB, Padriciano 99 34012 Trieste, Italy FAX: 39-40-226555
16-20 November	The 7th SABRAO General Congress Toward Enhanced and Sustainable Agricultural Productivity in the 2,000s: Breeding Research and Biotechnology Taipei, Taiwan Contact: Dr. S. C. Hsieh Taichung District Agricultural Improvement Station, Tatsuen, Changhua, Taiwan, 52501, R.O.C. FAX: 886-4-852-5841

22-24 November	Industrial Crops and Products Pisa, Italy Contact: Conference Secretary Mayfield House 256 Banbury Road Oxford OX2 7DH, UK FAX: 44 (0) 865-310981

1994

21-27 February	World Soybean Research Conference V Bangkok, Thailand Contact: Mr. Ananta Dalodom Conference Secretariat Department of Agricultural Extension 2143/1 Phaholyotin Road Chatuchak, Bangkok 10900, Thailand FAX: (66) (2) 5796635
15-18 March	EUCARPIA - Evaluation and Exploitation of Genetic Resources - Pre-breeding Clermont-Ferrant, France Contact: Congress Secretariat EUCARPIA - Ressources Genetiques GEVES-INRA - Domaine de Crouelle F-63039 Clermont-Ferrand CEDEX 02, France FAX: (33) 73 62 4453
10 April - 15 July	23rd International Potato Course: Production, Storage and Seed Technology Wageningen, The Netherlands Contact: R.F. van de Weg International Agricultural Centre P.O. Box 88 6700 AB Wageningen, The Netherlands FAX: +31 8370-18552
11-14 September	The Methodology of Plant Genetic Manipulation Cork, Ireland Contact: Prof. A.C. Cassells EUCARPIA Conference Office Department f Plant Science University College, Cork, Ireland FAX: +353 21 274420

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LAST BUT NOT LEAST

This Newsletter is distributed free of charge. To have your name added to our mailing list, please send your request to the address shown on the back cover. In addition to your full name, request should indicate the detailed name of your institute, university or plant breeding station. Please note that if a copy is available in your library, a duplicate cannot be sent.

Please submit your contribution to the Mutation Breeding 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 speculations. The length of contributions should not exceed 2-3 double-spaced typewritten pages including tables. We regret that for technical reasons photographs cannot be accepted. References to publications containing a more detailed description of methods for evaluation of findings are welcome but should generally be limited.

Miroslaw MALUSZYNSKI

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