Mutation Breeding Newsletter

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Report from the FAO/IAEA Plant Breeding and Genetics Section

Among the highlights of our work in 1983 were two training courses. At the FAO/IAEA Agricultural Biotechnology Laboratory Seibersdorf we held the 2nd Training Course on the Induction and Use of Mutations in Plant Breeding. Another International Training Course on Induced Mutations in Plant Breeding with Special Attention to Cross-pollinating Plant Species was organized at the Institute of Genetics, Bulgarian Academy of Sciences, Sofia. The course was followed by a Study Tour on Plant Breeding and Mutation Research in the Ukranian SSR, the Byelorussian SSR and the USSR. Forty-two trainees from 30 countries participated in these training programmes. In addition IAEA supported training of 20 plant breeders from developing countries and provided advice to crop improvement programmes in Brazil, Indonesia, Malaysia, Panama, Peru, Mongolia, Thailand, Venezuela and Zaire.

Within the frame of the IAEA Research Contract Programme, we continued our emphasis on genetic improvement of grain legumes and on broadening the genetic base of semi-dwarf cereals. A group of rice breeders was taken into contract for evaluating semi-dwarf mutant germ plasm of rice in order to provide short straw gene sources alternative to DGWG. The group met 24-28 October at the International Rice Research Institute in Los Banos (Philippines) to review the situation and plan the next steps.

In spite of rather stringent financial limitations we felt that we should include in-vitro culture technology in our programme. A number of scientists from developed countries volunteered to assist us without financial support in the task to develop the appropriate technology for in-vitro mutation induction and mutant selection and for other applications of in-vitro technlogy in connection with mutation breeding programmes. Guidelines were developed at a first research co-ordination meeting, 31 October - 4 November in Vienna. The Seibersdorf Laboratory is taking an active part in this programme, guided by the advice of Dr. Frantisek Novak from the Institute of Experimental Botany, Czechoslovak Academy of Sciences, Olomouc. As many developing countries are concerned about the limitations for increasing crop production by insufficient availability or too high costs of nitrogen fertilizers we called upon a group of consultants to advise us on the potential for increasing symbiotic nitrogen fixation of grain legumes by mutation breeding.

In 1984, provided that financial resources improve, we intend to resume active work on vegetatively propagated crop plants with particular emphasis on root and tuber crops. We also hope to implement the recommendations of an advisory group on the use of induced mutations for the improvement of oil seeds and other industrial crops (November 1980, Vienna) by starting a co-ordinated research programme in this field.

Till August 1983, we enjoyed having with us Calvin Konzak (Pullman, USA) on a one year sabbatical leave. In March 1983, Miroslaw Maluszynski (Professor of Genetics, University of Kattowice, Poland) joined our Section, so that our current staff is as follows:

Section Head:	Dr. Alexander Micke (FRG)
Section Staff:	Dr. Basilio Donini (Italy)
	Dr. Miroslaw Maluszynski (Poland)
Laboratory Staff:	Dr. Thorsten Hermelin (Sweden)
	Dr. Stefan Daskalov (Bulgaria)
	Dr. Helmut Brunner (Austria)
	Dr. Frantisek Novak (CSSR) (under Special Service Agreement)
	Dr. Sergio Lucretti (Italy)(under Special Service Agreement)

ANNOUNCEMENT

FAO and IAEA are planning to organize in August/September 1985 an International Symposium on Nuclear Techniques and In-vitro Culture for Plant Improvement at the Vienna International Centre, followed by a 2-3 weeks training course. The Symposium intends to review the advantages and limitations of in-vitro culture technology for mutation breeding in terms of mutation induction and mutant selection. Among topics of discussion could also be the use of in-vitro culture for quick multiplication of mutants, for dissolving chimera, for reassessing the mutation spectra derived from different mutagens and original genotypes, for studying endosomatic differentiation. The avoidance of in-vitro mutations for the sake of germ plasm preservation may also be considered. We expect a lot of interest in the technology of in-vitro mutant selection (cells, callus, tissue, plants) and presume that in that context isotope tracers (15N, 14C, 32P, etc.) could play an important role.

Participation would require governmental nomination. Interested scientists may write to the Plant Breeding and Genetics Section, Joint FAO/IAEA Division, P.O. Box 100, A-1400 Vienna, to obtain the necessary forms and additional information.

"Mahadev" (TJ-40) a high fibre yielding tossa jute mutant variety

Genetic variability in both *Corchorus capsularis* and *C. olitorius* has recently been widened significantly by induced mutations and a number of mutants are available for use in crop improvement. Inter-mutant hybridization at our Research Centre involving induced mutants of the *olitorius* (tossa jute) var. JRO 632 led to five promising strains. In the advanced trials of the All India Coordinated Jute Research Project at different locations for three years a 10-49% increase in fibre yields of the five strains over the best check variety was observed. One of these mutant strains, TJ-40, derived from a cross between mutants "virescent" and "involute leathery", consistently outyielded the check varieties in subsequent trials in farmers' fields in Orissa State (Table). It is characterized by larger leaf size. Its fibre quality is comparable to the parent and the other three check varieties.

In view of its superior performance, this strain has been released under the name "Mahadev" for cultivation in Orissa by the State Variety Release Committee. In *C. capsularis* jute, high yielding mutant varieties have already been released in India and Bangladesh. But this is the first mutant variety of *C. olitorius*.

Table: Performance of TJ-40 in the adaptive trials in Orissa*

Fibre yield g/ha (q = 100 kg)

Variety		1979 (Mean of 3 locations)		1980 (Mean of 5 locations)	1981 Mean of 3 locations
TJ 40		31.43		28.72	23.60
JRO 632 (Parent)		25.44		20.89	19.14
JRO 524	] Check	28.26		24.97	22.31
JRO 7835	] varieties	28.62		25.08	23.61
JRO 878	]	26.49		24.32	21.56
			F. Test	H.S.	H.S.
			SE	1.085	0.37
			C.D.	3.201	1.11

*Conducted by U.N. Dikshit, Jute Breeder, Kendrapara, Orissa.

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(Contributed by N.S. Rao, D.C. Joshua and R.G. Thakare, Biology and Agriculture Division, Bhabha Atomic Research Centre, Bombay, India).

New Mutant Soyabean variety "Boriana"

Investigations at the Institute of Genetics of the Bulgarian Academy of Sciences in experimental mutagenesis of pea and soya indicate that the combined application of physical and chemical mutagens increases the frequency of induced mutations and widens their spectrum. Seeds of the American variety Beeson (12% moisture) were treated with -rays of 5,10 and 15 krad, and immediately afterwards for 4h with 0.1% EMS. In M_2 an early ripening mutant was discovered. The new variety "Boriana" was created directly from it.

Varieties introduced to Bulgaria usually require 150 days of vegetation and are not well adapted to our climate. If they ripen only in the second half of October under low temperature conditions they give a very poor yield. The new variety has a vegetation period of 105-110 days and ripens 30 days earlier than the parent variety Beeson. The protein content of the seeds is 35.7%, 5.5% higher than in the parent variety, and the fat content is 13%. The fatty acid composition is changed somewhat in favour of palmitic, linolic and linolenic acids. The variety is more resistant to lodging and when irrigated reaches a yield of 4000 kg/ha. Because of its early ripening the variety allows sowing the subsequent winter wheat crop 30 days earlier and thus contributes to higher wheat yield. When cultivated on mellow soil and manured, the protein content of the seeds can reach 40%. The first pods are formed about 12 cm above the ground, which makes mechanized harvest possible. The pods don't split and the seeds don't shatter.

General characteristics:

Plant height:	75 cm, medium hairy and medium thick, leaves non-glossy and dark green
Flower:	a raceme with a green calyx, purple petals with 10 stamina
Pods:	2 or 3 per node, medium size, beige when ripe
Seeds:	Medium large 172g/1000, oval, beige, with a smooth surface. The colour of the navel changes from grey to black

The qualities of early ripening and high protein content are added to the productive variety Beeson. The utilization of the variety in agriculture ensures earlier harvest, stable yield, and higher grain quality for industrial processing and feeding.

(Contributed by A.M.P. Gecheva, Institute of Genetics, Bulgarian Academy of Sciences, Sofia 1113, Bulgaria).

High yielding mutant variety of rice in Sri Lanka

The traditional and popular rice varieties of Sri Lanka are of high quality but tall and susceptible to lodging at high fertilizer levels. To rectify this defect, mutation induction experiments were undertaken of the Agricultural Research Station Maha-Illuppallama since 1967 in cooperation with FAO and IAEA. The indica varieties H-4, H-7, H-8 and Pachchaiperumal 2462/11 were subjected to treatments with gamma rays, neutrons or EMS [1].

Among a number of promising dwarf mutants, the mutant MI-273(m) from H-4 irradiated with 35 kR gamma rays gave the highest yields. Most short culm mutants reported show a reduction in panicle length, number of grain per panicle and grain size, but a higher tillering. In MI-273(m), however, an almost 50% reduction in culm length and a 32% increase in panicle number were not accompanied by reduction of panicle length, number of grain or grain size [2]. The shorter culm length is due to shorter internodes, not a reduced number of internodes. While other short culm mutants (including a spontaneous one) possess a smaller flag leaf, MI-273(m) retained the area of the three upper leaves of H-4. Genetic analysis of the mutants led to conclude that short culm was dependent upon four different loci with different degrees of recessiveness. In multi-location trials under high fertilizer levels, the mutant MI-273(m) yielded considerably better than H-4 and IR-8. CCC treatment reduced plant height and increased tiller number of both H-4 and its dwarf derivative MI-273(m), but delayed flowering.

MI-273(m) was released for general cultivation in Sri Lanka in 1972. It is preferred by farmers in the Northern and Uva provinces. It is particularly popular in the Badulla district of the Uva province and in the Kekulan areas of Vavuniya and Jaffna districts, which are suffering from occasional drought. Since farmers were familiar with H-4, they used to call the mutant variety "Kota H-4" which means "short H-4". Therefore, in 1982, the Department of Agriculture, Sri Lanka, re-named the variety as "H-4 dwarf mutant". The variety is very suitable for mechanical harvesting and shows only negligible shattering in late harvesting.

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[2] GANASHAN, P. (1971): Evolution of new rice varieties by radiation-induced mutations in H-4 and H-8 rice varieties. In: Rice Breeding with Induced Mutations III. IAEA Techn. Report Series No. 131, 19-28.

(Extracted from P. Ganashan and W.J. Whittington (1983): The evolution of high yielding induced rice mutant in Sri Lanka, and the evaluation of some of its important characteristics. Poster presented in session P-IV D of the 15th International Congress of Genetics, New Delhi).

Induced mutations in fenugreek (*Trigonella foenum graecum* L.)

Trigonella foenum graecum L. is a fast growing leguminous plant, adapted to the hot-dry climate and poor soils of Southern Italy. Its cultivation as fodder plant is limited because of the aromatic flavour derived from coumarins which is transferred to milk, meat and eggs.

In order to obtain mutants with little or no coumarins, and eventually to improve the agronomic value of this crop, a mutation experiment has been undertaken, using a local Sicilian population.

Seeds were irradiated with rays at doses of 15 and 20 kR. M_1 plant survival was 6.8% and 2.4%, respectively, compared to 41.5% of the control. While the control plants produced 100 to 200 seeds, most M_1 plants set only 6-20 seeds. The number of branches per plant was also remarkably reduced in M_1 plants. 49.8% of the 15 kR progenies and 38.2% of the 20 kR progenies segregated for visually recognizable mutations.

The M_2 generation was grown as M_1-plant-branch progenies. The frequency of mutations among M_2 plants coming from different M_1 branches (Table) indicates that the first formed branches carry more mutations than the later ones, probably because of chimerism, and therefore, should be preferred in the harvest.

Many leafy, erect and late types of potential agronomic interest were found. A wide variability was induced in size, colour and shape of the seeds. As to the presence of coumarin-like substances, the analyses will be carried out in M_3.

Frequency and types of M_2 mutants derived from different branches of M_1 plants

M_1 branches	M_2 plants Total No.	M_2 plants Mutated No.	%	Mutant phenotypes leafy	dwarf	erect	early	late	reflowering
First	503	177	35.19	22	9	44	19	82	1
Second	420	172	40.95	31	12	49	7	72	1
Third	291	73	39.86	8	2	21	3	38	1
Fourth	193	56	29.01	9	5	17	5	20	0
Fifth	159	50	31.44	5	2	15	2	26	0
Main	1190	354	29.75	58	22	82	31	157	4
Total	2756	882	32.00	133	52	228	67	395	7

(Contributed by F. Calcagno, G. Gallo, I. Raimondo, G. Venora - Stazione Sperimentale di Granicoltura per la Sicilia, Caltagirone and L. Rossi, A. Sonnino, ENEA, Casaccia, Rome).

Mutation Breeding of cabbage, tomato and bean in Bulgaria

Mutant Breeding in Cabbage - The programme was initiated in 1966 to obtain a mutant with a high stalk suitalbe for mechanized harvesting. As a result of gamma irradiation of dry seeds with 90 krad the mutant 20^{P-2} has been obtained from cv. Kjose 17. It has an outer stalk of about 25 cm and a well formed cabbage head. Mechanized harvesting, however, requires also outer stalk uniformity. Lines with uniform stalk height have been established through inbreeding of the mutant 20^{P-2}. Cabbage head formation and outerstalk uniformity in F_1 were very good when this mutant was crossed with other cultivars. Mutant 19^{P-2} is characterized by longistyly at the budding stage, gofered petals and semi-sterility. Cabbage heads are of medium size, flattened-round and firm. Rosette leaves are strongly gofered. Cytological investigations indicated that this mutant possesses an exchange of segments between four non-homologous chromosomes. Rings of four chromosomes were already observed in pollen mother cells of Kjose 17 (check). Longistyly (combined with recessive markers expressed in the generative and vegetative phase), self-incompatability and good combining ability make the mutant 19^{P-2} suitable for heterosis breeding and seed production. In free joint flowering of 19^{P-2} with cv. Balkan about 90 - 95% F_1 hybrids have been obtained. We were satisfied with this per cent, the more so as the gofered petals and leaves of 19^{P-2} are a good genetic marker. The F_1 hybrids exhibited a very good heterosis for yield and better concentrated head development. They are less attacked by Peronospora.

Mutation Breeding in Tomato - The main task has been to create mutants of determinate habit and high content of soluble dry matter in the fruits. Determinated cultivars use to have a low content of soluble dry matter in the fruits. Line XXIV^a has high content of soluble dry matter in the fruit (8.0%), a fruit size of 40-50 g, and undeterminate habitus. Dry seeds from this line were irradiated with 20-30 krad (^{60}Co gamma rays).

Mutant 12/13 has semi-determinate habit (develops inflorescences after one or two leaves). The fruit has 7,0 - 7,5% soluble dry matter and an average weight of 40 g. We discovered longistyly as well as pollen sterility in this mutant.

Mutant 43/10 has a small determinate bush. Its fruits are oval, with soluble dry matter of 8,0% and a weight of about 40g of the world collection with determinate habitus and were tested for high dry matter content in the fruits at the Mounfavet Vegetable Breeding Station in France. Mutant 43/10 showed the highest content of dry matter in the fruit.

Mutant 77 is a semi-dwarf. Its fruits are small (20 g) with soluble dry matter content of about 10%.

Mutant 12/6-17 possesses a lateral suppressor.

Mutant 95/9 - (sha) has short stamina which dehisce on the outside (1).

Mutant 12/14 - has larger fruits, 100 - 130 g, with 7,0 - 7,5% soluble dry matter, but the plant habit is undeterminate. Triploid and tetraploid forms have also been obtained.

Mutation Breeding in Bean

The main task has been to obtain resistance against Xanthomonas phaseoli (E.F. Smith) Clowson - the cause of one of the economically most important diseases of beans in our country. Several races of the pathogen have been identified in Bulgaria and among the world collection there was no satisfactory resistance. Therefore, the development of resistant material by induced mutations appeared mandatory. The variety "Zaria" was used for the experiment. In M_2 20160 plants from 8 krad and 7456 from 10 krad irradiation have been screened in the field. The seeds were sown in a three-rowed band, the middle row inoculated with a mixed bacterial culture from all races of Xanthomonas phaseoli spread in our country. The environment conducive for infection has been maintained by regular sprinkling of the crop. In addition, the plants were inoculated twice during the vegetation period by infiltration under 2.3 kg/cm^2 pressure with a bacterial suspension of 10^6 cells/ml. Forty-three M_2 plants didn't show any symptoms of Xanthomonas infection under these conditions. After the inoculation of M_3 according to the method of Schuster only one mutant progeny, A-8-40, showed resistance to all races of Xanthomonas phaseoli spread in Bulgaria. The mutant A-8-40 does not differ in morphology and yield from the original variety, only its pods are more flat.

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(Contributed by L. Zagorcheva, Maritza Institute for Vegetable Crops, Plovdiv, Bulgaria).

Induced plant type mutants in tall indica rice

Many high yielding short culm varieties, derived from TN1 and IR8, are succeptable to pests and diseases and not well adapted to the agro-ecological conditions of Kerala. In the process of recombination breeding to transfer the Dee-geo-woo-gen dwarfing gene, several undesirable genes responsible for poor adaptability to warm humid tropical, conditions and for succeptibility to pests and diseases seem to have been transferred. The adapted tropical tall indica varieties of the state are lodging and not high yielders. But many of them have been identified as genetic sources for adaptability and resistance. Therefore the rice breeders have embarked upon programmes aimed at alternative dwarfs with the genetic base of the adapted tall indicas.

With this objective, mutations were induced in the three local tall indica varieties, Ptb.9, Ptb.28 and Ptb.10. Ptb.9 is a medium duration variety with thick culm and tolerance to water-logged condition, Ptb. 28 is a short duration, upland, drought resistant variety and Ptb.10 is a short duration widely adapted variety suitable for the well drained low lands. Seed samples were treated with 0.5 to 1.5% EMS for 8 hrs. or irradiated with 10 to 40 krad gamma rays. The M_2 generation was raised as panicle progenies, 35 mutants (14 from Ptb. 9, 10 from Ptb. 28 and 11 from Ptb. 10) were identified and confirmed in the M_3 generation. They are dwarf to semi-dwarf, less lodging and a large number of them exhibit the improved plant type characters responsible for high yield as conceived by Jennings [1].

Since the tall indicas used as parents are well adapted to the local environmental conditions including pests and diseases, the mutants induced are expected to retain these desirable features. Nine mutants left after further selection will be further evaluated and subjected to genetic analysis in relation to the dwarfing gene to establish their genetic identity. The salient features of these mutants and their parents are presented in the table.

Table: Characters of varieties and mutants

Variety/ Mutant	Plant type	Duration (days)	Plant height (cm)	Leaf length (cm)	Leaf bredth (cm)	No. of pan. per plant	No. of grains per pan.
Ptb.9	Open	130	138	56	0.9	6	79
M.2	Compact	115	94	30	1.1	9	119
M.6	Compact	120	88	34	1.4	10	141
M.14	Compact	120	95	34	1.3	12	138
Ptb.28	Open	115	135	52	1.1	4	87
M.102	Compact	110	93	34	1.2	8	148
M.107	Compact	115	92	38	1.2	9	141
M.111	Compact	110	95	34	1.1	12	116
Ptb.10	Open	92	122	48	0.8	5	72
M.202	Compact	89	89	33	0.9	9	94
M.207	Compact	93	91	30	1.1	11	98
M.210	Compact	95	91	33	1.3	10	187

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

Induced mutant of potato variety "Early rose" resistant to *Synchytrium endobioticum* Schilb.

"Early rose" is an old potato variety from the USA. This variety has high cooking qualities and good looking tubers. In 1931 this variety was introduced. In the USSR, in the forties, 16 synonymous cultivars of "Early rose" were known in the USSR, which proves the great popularity of this variety.

The greatest drawback of "Early rose" is its susceptibility to black scab caused by *Synchytrium endobioticum* Schilb. For this reason the variety in our days is grown only in private gardens. In order to obtain a resistant "Early rose" without disturbing other valuable properties of this variety, mutation breeding was undertaken at the Plant Breeding Station Priekuli of the Latvian Scientific Research Institute of Agriculture and Agricultural Economy. Later the work was continued at the Latvian Agricultural Academy and at the Collective Farm "Padomju Latvija" Riga district, Latvian SSR.

Tubers of "Early rose" were irradiated with 2000, 4000 or 6000 R gamma-rays at the IRT-2000 reactor of the Academy of Sciences of the Latvian SSR. Besides that, tubers were treated 15 min. with 0.6 and 1.0% ethylenimine solution in a vacuum-dessiccator.

Within the vegetative progeny of tubers treated with mutagenes, clones were selected having improved traits, such as increased number of tubers per plant, smoother surface of tubers with more oval form and tiny eyes. The first testing of selected clones for resistance to *Synchytrium endobioticum* Schilb. was carried out in 1982. One black scab resistant form was identified from among 7 clones obtained from gamma-irradiation with 6000R; the resistance was confirmed in 1983. In this year another black scab-resistant form was isolated from among 6 clones, derived from the treatment with 0.6% ethylenimine. Further examination and propagation of black scab-resistant forms is under way.

(Contributed by S. Saulite, The Collective Farm "Padomju Latvija", Riga District, Latvian SSR.)

Energy saving maize hybrids from mutant crosses

The water release capacity of maize grain at harvest time is economically important when artificial grain drying is required. At the Crop Growing and Ecological Institute of the University of Agricultural Sciences, Debrecen (Hungary), maize mutant lines were selected after gamma irradiation, which when used in hybridization led to very positive characteristics of hybrids:

A shorter vegetation period and the heat sum required for achieving 35-28% grain moisture reduced. Longer generative phase with improved rate of nutrient conversion.

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Novenytermeles Tom. 32 No. 1, 1-12 (in Hungarian with English summary)

Evaluation of early maturing rice mutants

Seven early maturing mutants were selected from the local, popular variety "Nizersail", after treatments with gamma-rays or ethyl-methane sulfonate (EMS), in M_8 and M_9 generations. They were examined in a comparative trial with the mother variety "Nizersail" and the check variety "BR_4" in two consecutive aman seasons [July to December] during 1980 and 1981 at three locations.

Strains/ variety	Days to maturity (from trans-planting	Plant height (cm)	1000 grain wt (g)	Yield (kg/ha)	Relative yield	Yield per day
Mut. NS1	106	140	18.44	4220a*	117.7	38.91
Mut. NS2	99	122	20.04	3582b	100.0	36.18
Mut. NS5	104	91	20.20	4371a	121.9	42.03
Mut. NS8	105	93	20.53	4271a	119.1	40.68
Mut. NS9	108	88	19.83	4261a	118.8	39.45
Mut. NS11	107	90	20.36	4240a	118.2	39.63
Mut. NS18	110	87	21.39	4320a	120.5	39.27
Nizersail (mother)	116	131	18.38	3586b	100.0	30.91
BR4 (check)	115	111	21.75	4642a	129.4	40.39

* values with same letters do not differ significantly at 5% level of probability

The results indicate that all the mutants gave significantly higher yield than the mother variety "Nizersail", except "Mut. NS2", which matured 17 days earlier but gave the same yield.

(Contributed by Miah A.J., Mansur M.A., Azam M.A. and Akand H.R. Plant Breeding Division, Insittute of Nuclear Agriculture, P.O. Box 4, Mymensingh, Bangladesh).

Improvement of Mungbean Mutant by Cross-Breeding

In 1964 a multifoliata leaf mutant in mungbean was found by Santos [1] after EMS treatment of seeds. The mutant had lower yield, poor seedling vigour, smaller seeds and matured later compared to its parent variety. The mutant as such had no economic value. However, the mutant possessed reduced cleistogamy which offered possibilities for cross breeding.

To develop a large-seeded multifoliata line with higher yields the mutant was crossed with CES 14, a large-seeded mungbean variety developed by the College of Agriculture, University of the Philippines and with MG50-10A, another large seeded mungbean variety developed by the Bureau of Plant Industry. The cross multifoliata x CES 14 did not produce desirable results. But in F_7 of the cross multifoliata x MG50-10A a large-seeded, productive multifoliata line with shiny yellow seed coat was obtained. Comparative trials to determine the performance of the mutant and the large-seeded multifoliata segregant were carried out 1977-82. The results are summarized below:

	Original Parent	Mutant	Large-seeded multi-foliata
Days to first flower	36	43	45
Days to first mature pod	51	59	62
Plant height (cm)	67	61	71
Pods per plant	11	11	8
Seeds per pod	12	11	8
Pod length (cm)	7	7	9
100-seed weight (g)	39	34	61
Yield (kg/ha)	800	600	1000

The increase on the yield of the large-seeded multifoliata is obviously due to the increase in seed size and pod length.

From the cross we selected 5 lines. These are presently multiplied for national yield trials.

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(Contributed by Alfonso O. Grafia and Ibarra S. Santos, Agricultural Research Division, PAEC, Atomic Research Centre, Diliman, Quezon City, Philippines)

Higher yielding tomato strains by cross breeding with the mutant "Anobik"

A dwarf, bushy, non-lodging and determinate type tomato mutant, named "Anobik" was obtained from a gamma-ray treated local cultivar. It has an increased number of fruits but their size is smaller and therefore not attractive to the consumer. However, because more "Anobik" plants can be accommodated per unit area of land, to obtain higher yields. Crossing initiated in 1977 between this mutant and the recommended variety "Oxheart" aimed at recombinants with high number and big size of fruits.

The F_2 presented wide range of variability in shape, size and yield of fruits. Selections were made in the F_2 and in the F_3 generation. The strains A(1), A(2) and A(4) are of medium height, determinate in growth, with larger no. of fruits and higher yields. The strain D(10) is short and determinate but bears "Oxheart" type fruits.

The plants of D(10) are shorter than A strains and taller than E(6). The plants of E(6) are dwarf, determinate and earlier maturing by 10 to 15 days. Preliminary yield assessment in F_4 generation promised yield increases from 28% to 44%.

In F_5 the strains were examined in a micro-plot yield trial with three replications. All strains were shorter than "Oxheart", some have more fruits, some even bigger fruits and higher yields (Table). The strain D(10) seems more tolerant to tomato mosaic virus (TMV) and bacterial wilt. The cross breeding with the mutant "Anobik" seems very promising.

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Table 1. Fruit yield in F_4 (mean of 10 plants) and results from field trial in F_5 (mean of 45 plants)

	F4		F5			
Variety/ strain	Yield/plant (kg)	% increase over higher yielding	Plant height (cm)	No. of fruits/ plant	Mean wt. of single fruit (g)	Fruit yield/ plant (kg)
A (1)	2.6	44	82.0	15.8	108.0	1.7 ab*
A (2)	2.5	39	80.0	21.6	93.5	2.0 a
A (4)	2.6	44	91.0	17.6	101.6	1.8 ab
D (10)	2.3	28	62.5	16.5	91.6	1.5 b
E (6)	2.6	44	58.0	18.2	57.6	1.0 c
Oxheart (parent)	1.8	--	151.5	15.5	99.0	1.5 b
Anobik (parent)	1.3	--	50.5	33.0	40.1	1.3 bc

* common letters indicate difference not significant at 1% level of probability.

(Contributed by Shaikh, M.A.Q., Khanum, S. and Majid, M..A., Plant Genetics Division, Institute of Nuclear Agriculture, P.O. Box No. 4, Mymensingh, Bangladesh).

Mutation breeding in wheat by mutation induction of hybrids

We found induced mutagenesis combined with hybridization very effective (SAVOV, 1969, 1973).

In a more recent study the following hybrid combinations were used: Aurora x 1520, Kaukaz x 1520, Skorospelka-35 x 1520, Aurora x Pshenichno-pireen hybrid-186, Odesskaja-51 x Aurora, and Odesskaja-51 x Belocerkovska-198. Usually 150 F_1 hybrid seeds and 800 F_2 seeds, obtained from individually harvested F_1 plants, were irradiated at doses of 5, 10 or 15 krad - rays. Moisture content of the seeds was 12,5 - 13%.

The results obtained show that irradiation of hybrid seeds with gamma rays increased variability of plant height (Table 1).

Table 1: Plant height variation in M_2 derived from F_1 irradiation

Hybrid	Irradiation dose (krad)	Plant Height Mean (cm)	Plant Height Variation (cm)	CV	Short culm forms %
F_2 (Aurora x 1520)	control	98.8	76-114	9.2	0
"	10	90.2	61-130	16.0	0.7
"	15	93.5	66-117	13.8	0.5
F_2 (Kaukaz x 1520)	control	100.0	73-120	10.3	0
"	10	98.0	73-121	12.5	0
"	15	85.0	52-116	15.9	0.7
F_2 (Skorosp.-35 x 1520)	control	89.5	77-98	6.6	0
"	10	88.0	72-96	7.5	0
"	15	85.3	68-105	13.8	3.5
F_2 (Aurora x PPH*186)	control	95.5	75-114	6.5	0
"	5	97.8	71-117	13.1	0.1
"	10	91.4	73-123	16.0	0.5
F_2 (Odesskaja-51-Aurora)	control	91.6	76-103	6.2	0
"	5	87.9	63-114	12.1	0.4
"	10	84.6	63-105	12.3	0.7
F_2 (Odesskaja-51 x Belocerkovska-198	control	100.7	90-114	5.2	0
"	5	97.3	80-112	7.6	0
"	10	80.4	66-102	11.0	1.6

Also for spike length irradiated materials had a higher variation coefficient.

When F_2 seeds were exposed to irradiation we observed likewise an increase in the variability. (Table 2)

Table 2: Plant height variation in M_2 derived from F_2 irradiation

Hybrid	Irradiation dose (krad)	Plant Height Mean (cm)	Plant Height Variation (cm)	CV	Short culm forms %
F_3 (Aurora x PPH-186)	control	93.5	79-110.5	7.6	0.5
"	5	87.8	64-109.0	13.2	8.4
"	10	96.5	64-121.0	14.3	1.4
F_3 (Odesskaja-51 x x Aurora)	control	83.5	57-97	9.9	8.3
"	5	77.7	63.5-94.5	10.5	7.9
"	10	73.5	47-89	10.8	12.6
F_3 (Odesskaja-51 x Belocerkovska-198)	control	95.4	79.5-108.5	9.7	0.6
"	5	83.9	71-107	9.7	5.3
"	10	92.0	67-117	15.9	2.6

Another criterion that indicates an advantage of irradiation of hybrid seeds is the occurrence of short-culm forms. From crossing the varieties Aurora and Odesskaja-51 to the tall varieties Pshenichno-pireen hybrid-186 and Belocerkovska-198 almost no short forms were observed in the control. With irradiation, however, short-culm segregants were obtained rather frequently.

Also mutant forms with upright leaves not found in the parental varieties and in the control hybrid populations were obtained after hybrid irradiation.

From irradiation of F_2 seeds of the crosses no. 170 x Mexipak and no. 175 x Mexipak, particularly valuable materials for breeding purposes were obtained, i.e. forms with short and firm culm, upright leaves, productive spikes and good resistance to powdery mildew and rusts.

REFERENCES

SAVOV, P., Influence of gamma rays on the variability of different common wheat cultivars and their hybrids. Genetics and Plant Breeding (Bulg. with Engl. Summary) (1969) no. 6.

SAVOV, P., Results obtained after irradiation of some hybrid combinations of common wheat. Sci. Session of the Institute of Genetics, Sofia, 1971 (Bulg. with Engl. Summary) (1973).

(Contributed by Savov, P., Institute of Genetics, Sofia, Bulgaria.)

Book Review

Isozymes in Plant Genetics and Breeding. Two volumes
Edited by Steven D. Tanksley and Thomas J. Orton.
Elsevier Sciences Publishers 1983, Amsterdam, Pp. 516 and 472.
Price: Dfl. 500
In the USA/Canada the book is available from Elsevier Science Publishing Co. Inc., P.O. Box 1663, Grand Central Station, New York, NY 10163,
Price: US $113.

We welcome, with true appreciation, a very interesting book on plant isozymes written by outstanding scientists. The book structure is well conceived. The editors compiled, in five sections of Vol. 1A, the basic information regarding possibilities of using isozymes techniques in plant genetic research as well as in plant breeding. Vol. 1B gives a very comprehensive review of the application of these possibilities in many crop species.

Plant breeders can find such interesting problems as use of isozymes in gene dosage studies, detection of alien genetic material from wild species or their applications in breeding of cross polinated crops and what is especially important in disease resistance breeding. The breeders who are interested in in-vitro techniques could find the applications of izosymes techniques for studying the problems of pollen gene expression or for detection of somatic variation. For plant breeders with experience in the application of izosymes technology for practical plant breeding a very condensed review about the current status of these investigations in different species will be very interesting. The many references attached to all papers make the book useful also for beginners.

Although the price is rather high this book will be very useful in modern plant breeding laboratories.

Short petiole mutant in soybean

Soybean plants with short petioles (socalled sessile leaves) would allow a canopy with better light penetration which in turn might delay senescence of lower leaves and perhaps increase the potential of grain yield and nitrogen fixation. Such a mutant has been obtained by Tattersfield. The trait is simply recessive inherited. Advanced lines seem promising in terms of yielding capacity (pers. com.).

Reference
Soybean Genetics Newsletter 1979

Bush type mutant of winged bean (*Psophocarpus tetragonolobus* (L.) DC)

A Trivandrum local cultivar was subjected to gamma irradiation (10-50 krad). 12 krad was the most suitable dose for fertile mutants. Many mutants of bush type architecture with varying degree of earliness were obtained. Many are without vines or with few vines. The plants produce 5-6 pods with 5-6 seeds each. Except for the changed plant architecture there are few changes in pod or seed characteristics. The work has been supported by the Bhabha Atomic Research Centre, Bombay.

(Reported by G. Shivashankar, Dept. of Agricultural Botany, University of Agricultural Sciences, Bangalore, India, in "The Winged Bean Flyer", Vol. 4, No. 2, Dec. 1982).

LIST OF VARIETIES

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 varieties 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 variety does not imply its recommendation by FAO/IAEA.

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment [parent variety] or mutant crosses (mutant underlined)	Main improved attributes of variety
Cajanus Cajan (pigeon pea)			
Trombay Vishakha-1	Maharashtra, India, 1976 S.E. Pawar, R.G. Thakare, D.C. Joshua, BARC, Bombay	fast neutrons, 1972 [T-21]	35% increase in seed size with other characters (yield, maturity time, disease reaction) equal to original variety
Chrysanthemum morifolium			
Basanti	India, 1979 M.N. Gupta, H.M. Jugran National Botanical Research Institute, Lucknow	gamma rays, 2x1.5 krad, 1976, suckers [E-13]	yellow instead of mauve flower colour
Alankar	India, 1982 M.N. Gupta, S.K. Datta National Botanical Research Institute, Lucknow	gamma rays, 1.5 krad 1978, rooted cuttings [D-5]	spanish orange instead of magnolia purple flowers
Man Bhawan	India, 1982 M.N. Gupta, S.K. Datta National Botanical Research Institute, Lucknow	gamma rays, 1.5 krad 1978, rooted cuttings [Flirt]	bicoloured red and yellow instead of red flowers

<u>Cicer arietinum</u> (chickpea)			
CM 72	Pakistan, 1983, M. Ahsanul Haq, A. Shakoor, M. Sadiq, Mahmudul Hassan Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan	gamma rays, 15 Krad, 1974 [6153]	Resistant against chickpea blight (<u>Ascochyta rabiei</u>) high yield
<u>Corchorus olitorius</u> (jute)			
Mahadev TJ.40	Orissa, India, 1983 N.S. Rao, D.C. Joshua and R.G. Thakare Biology & Agril. Divn. Bhabha Atomic Research Centre Bombay	thermal neutrons, 1968 Cross, <u>Virescent</u> x <u>Involute leathery</u> [JRO 632]	high fibre yield
<u>Dianthus caryophyllus</u> (carnation)			
Enzett Barther Frühling	GDR, 1974 W. Hentrich, Inst. für Züchtungsforschung, Dornburg M. Glawe, VEG Saatzucht Zierpflanzen, Barth, GDR	EMS 2.5%, 1967 [Arthur Sim]	Instead of white flowers with red stripes the new variety has pink flowers with red stripes and white spots 1980: 9.1% of carnation area in GDR
Enzett Folklore	GDR, 1974 W. Hentrich, Inst. für Züchtungsforschung, Dornburg M. Glawe, VEG Saatzucht Zierpflanzen, Barth, GDR	EMS 2.5%, 1967 [William Sim]	more pronounced red flower colour, long, stiff stems, less branching, petals more indented 7.4% more yield 1980: 9.1% of carnation area in GDR
Dione	GDR 1977 W. Hentrich, Inst. für Züchtungsforschung, Dornburg M. Glawe, VEG Saatzucht Zierpflanzen, Barth, GDR	EMS 2.5%, 1967 [William Sim]	pink instead of red flower colour, otherwise similar to William Sim 1980: 7.3% of carnation area in GDR

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment [parent variety] or mutant crosses (mutant underlined)	Main improved attributes of variety
Glycine max (soybean)			
Boriana	Bulgaria, 1981 A. Mehandjiev, P. Gecheva Inst. of Genetics Bulg. Academy of Sciences Sofia	seeds, 12% moisture -rays, 10 krad followed by 0.1% EMS 4h 1976 [Beeson]	Maturing in 105-110 days, 30 days earlier than "Beeson" protein content 5% higher, yield 4000 kg/ha or 6% higher than Beeson
Gossypium hirsutum (cotton)			
NIAB-78	Pakistan, 1983, Rana M. Saeed Iqbal M. Boota Chaudhry, Mohammad Aslam Akbar Ali Bandesha Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan	F_1 irradiated, 30 kR (gamma rays) [Deltapine x Ac134]	High yield. Early maturity. Medium stature with 0-2 monopodial
Oryza sativa (rice)			
Atomita - 2	Indonesia, 1983 M. Ismachin Kartoprawiro, Mugiono Suwarno, Giman Sujono Tatang Rustandi Centre for Appl. of Isotopes and Radiation BATAN, Jakarta	gamma radiation 20 krad, 1974 [Pelita I/1]	salt tolerant, early maturing, resistant to BPH Brotype 1, better resistance to blast
Calpearl	USA, 1981 C.H. Hu N.F. Davis Drier 2 Elevator Firebaugh CA 93622	Calrose 76 x (Earlirose x IR1318-16)	more stiff culm and better lodging resistance than Calrose 76. 10% higher yield than Calrose 76 derivatives of comparable early maturity.

<u>Pennisetum typhoides</u> (pearl millet)			
Pusa 46	India, 1982 IARI, New Delhi	irrad. of [hybrid J104 x K559]	Both parents of original hybrid are susceptible to downy mildew. After irradiation, the resistant line M46 was selected which is used as male parent for the Hybrid Variety Pusa 46
<u>Rosa sp.</u>			
Saroda	India, 1983 M.N. Gupta, S.K. Datta P. Nath National Botanical Research Institute, Lucknow	gamma rays, 3 krad 1978, bud wood [Queen Elizabeth]	very light pink instead of carmine rose flowers
Sukamari	India, 1983 M.N. Gupta, S.K. Datta National Botanical Research Institute, Lucknow	gamma rays, 3 krad 1979 bud wood [America's Junior Miss]	almost white instead of coral-pink flowers
Tangerine Contempo	India, 1983 M.N. Gupta, S.K. Datta National Botanical Research Institute, Lucknow	gamma rays, 3 krad 1980, bud wood [Contempo]	tangerine orange flowers with yellow eye instead of orange flowers with yellow eye
Yellow Contempo	India, 1983 M.N. Gupta, S.K. Datta B.K. Banerji National Botanical Research Institute, Lucknow	gamma rays, 3 krad 1980, bud wood [Contempo]	yellow flowers instead of orange with yellow eye
Golden Geos	Fed. Rep. of Germany, 1981 Satory, Marie Federal Res. Center for Horticultural Plant Breeding D-2070 Ahrensburg propagated by W. Süptitz D-2000 Hamburg 54	x-rays, 1.8 krad Unrooted cuttings, 1980 pot-chrysanthemum [Geos (white)]	Yellow flower colour

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment [parent variety] or mutant crosses (mutant underlined)	Main improved attributes of variety
Dark Mario	Fed. Rep. of Germany, 1983 W. Süptitz D-2000 Hamburg 54 in co-operation with the Federal Research Center for Horticultural Plant Breeding, D-2070 Ahrensburg	x-rays, 1.8 krad Unrooted cuttings, 1982 [Mario (pink)]	Dark pink flower colour
Orange Mario	Fed. Rep. of Germany, 1983 W. Süptitz D-2000 Hamburg 54 in co-operation with the Federal Research Center for Horticultural Plant Breeding, D-2070 Ahrensburg	x-rays, 1.8 krad Unrooted cuttings, 1982 [Mario (pink)]	Orange flower colour
Secale cereale (rye)			
Donar	GDR, 1981 L. Wölbing Inst. f. Getreide Züchtung VEG Pflanzenproduktion Petkus	ISO-PMS, seeds [Petkuser Winterroggen Stamm 267/70]	20-25 cm shorter culm, better lodging and sprouting resistance
Pollux	GDR, 1981 L. Wölbing Inst. f. Getreide Züchtung VEG Pflanzenproduktion Petkus	ISO-PMS, seeds [Petkuser Winterrogen Stamm 267/70]	20-25 cm shorter culm better lodging resistance

<u>*Vigna radiata*</u> (mungbean)

NIAB Mung-28	Pakistan, 1983, Ilyas Ahmad Malik, M. Sadiq, M. Ahsanul Haq, Ghulam Sarwar, Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan	gamma rays, seeds, 20 krad, [Pak 17]	Early and uniform maturity, high yield
Pant Moong 2	Uttar Pradesh, India, 1982 D.P. Singh, B.L. Sharma, Dept. of Plant Breeding, G.B. Pant Univ. of Agric. & Techn., Pantnagar 263141, India	gamma rays, 10 kR, 1976 [ML 26]	Moderately resistant to mungbean yellow mosaic virus, higher yield
			Hybrid Variety Pusa 46
		seed weight 172 g/1000	
TAP-7	Maharashtra, India, 1982 S.E. Pawar, R.G. Thakare BARC Bombay B.T. Khadilkar, K.B. Wanjari, A.R. Kshirsajar, G.R. Fulzele, Pulses Research Unit Punjabrao Krishi Vidyapeeth Akaya, Maharashtra	gamma rays, 1975 [S-8]	5-7 days earlier maturity, Fairly tolerant to powdery mildew and leaf spot disease 23% higher yield than cv Kopergaon

IAEA EXPERTS AND CONSULTANTS 1983

Ammirato, P.V. (USA)	IAEA
Atanassov, A. (Bulgaria)	IAEA
Gaul, H. (FRG)	Kinshasa (Zaire)
Iwamoto, M. (Japan)	Bangkok (Thailand)
Kartha, K.K. (Canada)	IAEA
King, P.J. (Switzerland)	IAEA
Koch, E. (FRG)	Chiang Mai (Thailand)
Kool, A.J. (Netherlands)	IAEA
Mikaelsen, K. (Norway)	Jakarta (Indonesia
Murty, B.R. (India)	Maracaibo (Venezuela)
Nuti-Ronchi, V. (Italy)	IAEA
Shanmugasundaram, S. (AVRDC)	Jakarta (Indonesia)
Tulman-Neto, A. (Brazil)	Manan (Brazil)
Yankulov, M.T. (Bulgaria)	Darhan (Mongolia)

IAEA FELLOWSHIP TRAINING 1983

Aslam, M. (Pakistan)	USA
Bornemisza, G. (Hungary)	IAEA
Chaudhry, M.B. (Pakistan)	IAEA
Drömer, F.E. (Uruguay)	IAEA
Furedi, J. (Hungary)	FRG, Switzerland, IAEA
Ghandi, R. (Malaysia)	IAEA
Hassan, S. (Pakistan)	IAEA
Jalaluddin, M. (Bangladesh)	Pullman, Wash. (USA)
Kim, Y.W. (R. of Korea)	USA
Kwon, S.H. (R. of Korea)	IAEA
Lingumbwanga, E. (Zambia)	IAEA Laboratory Seibersdorf
Mensah, R.A. (Ghana)	Vienna (Austria)
Mugiono, P.S. (Indonesia)	IRRI, Philippines
Neves Carneiro, M.F.L.I. (Portugal)	Angers, France
Nimako-Bruce, A. (Ghana)	Knoxville, Tenn. (USA)
Ryo, I.S. (R. of Korea)	Netherlands, Sweden, IAEA
Roy, M.K. (India)	FRG
Sarigabutr, A. (Thailand)	Davis, CA (USA)
Shafi Ali, A. (Egypt)	Pullman, Wash. (USA)
Shamsuzzaman (Bangladesh)	Canberra, Australia

Second FAO/IAEA Training Course on Induction and Use of Mutations in Plant Breeding at the FAO/IAEA Agricultural Biotechnology Laboratory Seibersdorf, 6 April - 19 May 1983

Participants:

Willy Navarro Alvarez (Costa Rica)
Zdenck Ohoutka (CSSR)
Abdel Shafy Rajab (Egypt)
Gelefu Bejiga (Ethiopia)
Zoltan Kertez (Hungary)
Yong Uk Shin (Rep. of Korea)
Hassan Mat Daud (Malaysia)
Rosa Maria Ruiz Arias (Mexico)
Jwala Bajracharja (Nepal)
Said Hassan (Pakistan
Nardo Garcia (Philippines
Tomasz Czerwinski (Poland)
H. Nihal de Silva (Sri Lanka)
Ahmed Ali Geneif (Sudan)
Moh. Walid Tawil (Syria)
Charles M. Busolo-Bulafu (Uganda
Borut Bohanec (Yugoslavia)
Edward Lingumbwanga (Zambia)

FAO/IAE Interregional Taining Course on Induced Mutations in Plant Breeding with Special Attention to Cross Pollinating Plant Species
16 May - 18 June
at Sofia (Bulgaria)
and
FAO/IAEA Study Tour on Plant Breeding and Mutation Research in the Ukranian SSR, the Byelorussian SSR and the USSR
19 June - 4 July 1984

Participants:

Manik Lal Das (Bangladesh)
Aksenia Aleszieva (Bulgaria)
Velitchka Rodeva (Bulgaria)
Dimitar Djilianov (Bulgaria)
Zang Mingxian (R.Rep. of China)
Mohii El-Din M. El Mandoh (Egypt)
Hirut Kebede (Ethiopia)
Oua N'Diaye (Guinea)
K. Vasudevan (India)
Lukman Umar (Indonesia)
Mak Chai (Malaysia)
Martin Angula (Namibia)
Teofilo Eugenio (Philippines)
Zbigniew Broda (Poland)
Ahmed Mohamed Barre (Somalia)
Ranjith Pathirana (Sri Lanka)
Gaafar Hussein Mohamed Ali (Sudan)
Samar Abed (Syria)
Prasit Jaisil (Thailand)
Hasan Gülcan (Turkey)
Nelson Wopuni M. Wanyera (Uganda)
E. Drömer Fernandez (Uruguay)
Nguyen Xuan Hong (Vietnam)
Gordana Surlan (Yugoslavia)

FUTURE EVENTS
1985

International Rice Genetics Symposium
April, IRRI, Los Banos, Philippines

5th SABRAO Congress
April, Bangkok, Thailand

FAO/IAEA International Symposium on Nuclear Techniques and In-vitro Culture for Plant Improvement
19-23 August, Vienna - followed by a two weeks training course.

EUCARPIA Section on Mutation and Polyploidy Conference on "Genetic Manipulation in Plant Breeding"
8-13 September, Berlin (West)

NEW PUBLICATIONS

Progress in Mutation Breeding
Gamma Field Symposia No. 20, 1981
Institute of Radiation Breeding, NIAS-MAFF Ohmija
Naka, Ibasaki, Japan

Induced Mutations for Improvement of Grain Legume Production III
Proceedings of a research co-ordination meeting, Seoul (Republic of Korea)
4-8 October, 1982
IAEA - TECDOC 299, IAEA Vienna 1983

Nitrogen fixation by grain legume-rhizobium symbiosis

A Consultants Meeting on Mutation Breeding for Improved Nitrogen Fixation in Grain Legumes was held by the Joint FAO/IAEA Division, 26 to 30 September 1983 at the Vienna International Centre.

The cost and restricted availability of nitrogen fertilizer pose a serious problem for agricultural production in some developing countries. Biological nitrogen fixation can reduce this problem. Some genetic variability exists in both the plant (macrosymbiont) and the bacteria (microsymbiont). Where the desired genotypes are not found, mutation induction may be employed. Of particular importance would be the use of mutation induction to eliminate the regulatory system that blocks further nitrogen fixation, once nitrogen is available in the soil.

Increasing the yield as well as the nitrogen fixation capacity in grain legumes will require breeding for improvement of the host - *Rhizobium* symbiosis in addition to the improvement of agronomic characteristics, of resistance to pests and diseases, etc. The problems will best be tackled by research teams, which should include a plant breeder, a microbiologist, and possibly a plant physiologist, an agronomist and a plant pathologist. N_2 fixation breeding programmes must be handled within established plant breeding programmes, where the expertise in dealing with inter-related breeding objectives exists.

Initiation of a co-ordinated research programme to increase grain legume yields by utilizing nitrogen derived from atmosphere rather than fertilizer nitrogen is now being considered at the Joint FAO/IAEA Division. Anyone interested is invited to write to Dr. G. Hardarson, FAO/IAEA Agricultural Biotechnology Laboratory, P.O. Box 100, A-1400 Vienna (Austria).

Mutation Breeding Newsletter
Joint FAO/IAEA Division of Isotope and Radiation Applications
of Atomic Energy for Food and Agricultural Development

International Atomic Energy Agency
Vienna International Centre
P.O. Box 100
A-1400 Vienna, Austria

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