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Mutation Breeding Newsletter

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Report from the FAO/IAEA Plant Breeding and Genetics Section

During 1980, the Coordinated Research Programme on Improvement of Vegetatively Propagated Crops and Tree Crops through Induced Mutations was terminated following a final meeting of programme participants in Coimbatore, India (11 - 15 February). This does not mean that all activities concerning this important group of cultivated plants are finished, but for the time being the limited financial resources will have to satisfy other priorities. A new Coordinated Research Programme was implemented to evaluate available mutant stocks of semi-dwarf plant type as cross-breeding material in cereals. A first meeting to plan and coordinate the work will be held in Vienna, 2 - 6 March, immediately preceding the FAO/IAEA Symposium on Induced Mutations as a Tool for Crop Plant Improvement. Following the symposium, we are planning to have a consultation on the possibilities to induce mutations in hereditary cell elements outside the nucleus. Another area of potential future activity is the use of mutation induction to obtain in oil seeds and other industrial crop plants desired alterations in composition of chemical compounds, in plant architecture, in total biomass production and in a number of other characteristics, that are important from agronomical or industrial point of view. This matter has been discussed by a group of invited experts, 17 - 21 November 1980 in Vienna.

The longer term programme for protein improvement in cereal grains, initiated in 1968, has reached its final phase focussing at the agronomical, genetical and nutritional evaluation of mutants and mutant-cross derived lines. Work plans for 1980-82 were decided upon at a meeting in Cyprus, 14 - 19 April 1980. Close cooperation has been established for this evaluation phase with a programme supervised by the FAO Plant Production and Protection Division, having similar objectives but utilizing naturally available high protein germplasm.

3 November - 5 December 1980, the first Regional Training Course on the Use of Induced Mutations in Plant Breeding was organized at Maracaibo,

Venezuela, attended by 19 scientists from Latin American countries. It will be followed-up in 1982 by a Regional Seminar to be held at the Agricultural University La Molina, Lima (Peru). An Interregional Training Course on the Application of Nuclear Techniques in Agriculture was hosted by the Timiryazev Agricultural Academy, Moscow (USSR), 1 September - 30 November 1980. It included a series of lectures on radiation genetics and mutation breeding.

Following the return of Dr. A. Brunori to his home country at the end of 1979, we were able to recruit Dr. Stefan Daskalov from the Institute of Genetics Sofia (Bulgaria) to work at the IAEA Laboratory Seibersdorf for a period of ca. 1 year. Dr. Knut Mikaelsen retired on 31 October 1980 after almost 20 years of service in FAO and IAEA. He has been with the Plant Breeding Section almost from the beginning and has essentially established the plant mutation research at the IAEA Laboratory. Many of the Agency's technical assistance projects in developing countries (such as in Brazil, Indonesia, Pakistan, Peru, Thailand and Venezuela) had the benefit of his experience. (His present address is: Skogveien 5, N-3250 Larvik, Norway). Dr. Basilio Donini from the CNEN Research Centre, Casaccia (Italy) has taken over his position and duties. It is a great pleasure to have Dr. Björn Sigurbjörnsson (Iceland) assisting again the Section's programme, unfortunately only for a limited period.

The staff of the Section currently consists of:

Section Head:	Dr. Alexander Micke (FRG)
Section Staff:	Dr. Takeshi Kawai (Japan) Dr. Basilio Donini (Italy) Dr. Björn Sigurbjörnsson (Iceland) (till April 1981)
Laboratory Staff:	Dr. Thorsten Hermelin (Sweden) Dr. Stefan Daskalov (Bulgaria) Dr. Helmut Brunner (Austria)

We wish all the readers of the Mutation Breeding Newsletter success in their work and satisfaction in their life.

RESEARCH NEWS

Mutation breeding of apple at Long Ashton, UK

Apple trees are, in theory, ideal subjects for mutation breeding. They are highly heterozygous, so induced mutations may appear phenotypically without the necessity for a selfed seed propagated generation. Healthy clones are uniform, which makes the selection of mutants easy. A new mutant can be easily multiplied through vegetative propagation.

The apple industry in Britain is very conservative which, while making the acceptance of an entirely new cultivar more difficult, eases the introduction of mutants of traditional cultivars. Despite their popularity with the consumer all the commonly grown apple cultivars have defects from the growers point of view, many of which should be amenable to mutagenesis (Table 1).

Table 1. Some defects in popular apple cultivars grown in the UK which could be alleviated by mutation breeding

Cultivar	Defect
Cox's Orange Pippin	Low fertility. Poor skin colour. Short harvest period. Small fruit. Disease susceptible.
Bramley's Seedling	Too vigorous. Uneven shaped fruit.
Crispin (Mutsu)	Too vigorous. Fruit too large.
Holstein	Too vigorous. Fruit too large.
Tydemans Worcester	Too much bare wood.
Discovery	Slow to start cropping.
Golden Delicious	Russet under U.K. conditions.
Kidd's Orange Red	Poor skin finish.
Spartan	Poor skin colour.

Dormant graftwood of a selected, virus-free clone of the scion cultivar to be treated is collected in the winter. This material, termed the MV_1 generation, is subjected to radiation under controlled conditions, normally immersed in water. The treated material is then grafted onto pot-grown, virus-free clonal rootstocks (normally MM106 as it produces most uniform plants) and grown in a cold glasshouse to ensure maximum survival. Shoots produced from surviving grafts are called MV_1 generations, and show damage or growth reduction dependent upon dose and type of radiation used. By August the MV_1 shoots are mature enough to be used as budwood. Buds are grafted onto field-grown clonal rootstocks (again normally MM106). These buds form the MV_2 generation, which is the main population subjected to selection. Vegetative mutant characters, such as dwarf growth and foliage changes, can be selected from the one-year-old (maiden) trees. For selection of fruit characters the young trees must be transplanted to a semi-permanent orchard site. Selected plants from the MV_2 generation are propagated again by summer budding to produce the MV_3 generation. This provides a check on the stability and reality of the mutations, helps identify mericlinal chimaeras and, where the MV_3 trees are stable and uniform, provides material for replicated trials. These replicated MV_3 orchard trials are medium to long term i.e. five to ten years, as promising mutants have to be compared carefully with the standard tree of the original cultivar (produced alongside the MV_3 trees). Clones selected from the MV_3 orchards (about one percent of the mutants found) are then repropagated on a large scale (hundreds of plants) to produce a MV_4 population of each clone. Good uniform clones go forward to final commercial trials, on Ministry of Agriculture Experimental Horticulture Stations, at the National Fruit Trials and on commercial growers farms.

In fruit breeding programmes it is impossible to wait for the results of one experiment before starting the next, so for the past eleven years some irradiation treatments have been carried out every year, and every stage of the programme is in progress at the same time. Eighty-three separate irradiation experiments using 15 different cultivars of apples as well as apple rootstocks, pear, plum, cherry and soft fruit cultivars and ornamental shrubs and trees have been undertaken. The initial treatments have been given to populations ranging from tens to hundreds of scions or cuttings. The main apple cultivars irradiated and the number of scions involved are listed in Table 2.

Table 2. Number of scions of apple cultivars treated in the Long Ashton Mutation Breeding Programme

Cultivar	No. of scions irradiated
Cox	862
Bramley	444
Queen Cox	420
Crispin (Mutsu)	593
Spartan	365
Malling Kent	364
Suntan	391
Golden Delicious	144
Gala	140
+ six other cultivars < 100 each	480
	4214

The aim in our programme is to apply a dose of radiation which reduces growth to about 50% of the control in the MV_1 generation but lets all scions survive. Thus from propagating the MV_1 shoots, very large MV_2 populations can result, for instance some 20,000 MV_2 Cox and Queen Cox trees have been examined, and 6,000 of Bramley's Seedling. Altogether there are at present over 15,000 MV_2 trees planted and available for selection, mostly in commercial growers' orchards. As the majority of the plants are not seriously affected by the radiation treatment, growers have, in general, been pleased to take the one-year-old trees. The trees remain the property of the research station, but all fruit in excess of experimental needs (normally only a few samples are needed) is the property of the grower.

The trials of MV_3 clones on the station at present include some 3,500 apple trees of about 500 mutant clones. This does not represent the entire yield of mutants from the trials listed in Table 2, as many MV_2 populations have yet to yield their full quota of mutants, and other mutants have already been discarded.

The best clones from these trials are further multiplied to produce trees for commercial trials (MV_4). So far this stage has only been reached for mutants of Cox's Orange Pippin and Bramley's Seedling originating from irradiations in 1969 to 1971.

It has been found that selection for greater damage in the MV_1 generation can lead to a higher number of mutants in later generations, but also that the more severe mutations are less likely to be of commercial interest.

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(Contributed by C.N.D. Lacey and A.I. Campbell, Long Ashton Research Station, Bristol, Avon, England).

Induction of Ascochyta blight resistant mutants in chickpea

Chickpea (Cicer arietinum) is the most important edible legume crop of Pakistan and is grown on an area of 970 000 ha with an annual production of 541 000 t. The average yield is only 550 kg/ha . The low yield may be due to excessive vegetative growth and poor harvest index but the most important limiting factor is the occurrence of blight disease caused by the fungus Ascochyta rabiei (Pass) Lab. Epiphytotics of blight can totally wipe out the crop with catastrophic suddenness, thus severely affecting the stability of chickpea production. It, therefore, seems imperative to evolve varieties of chickpea which are resistant to this disease. Genetic resistance against blight is scanty in the germplasm screened so far. Consequently, efforts were made to induce mutations in local varieties of chickpea. Local cultivars of chickpea "C 727" and "Punjab 6" were irradiated with 10 and 20 kR of gamma rays. In previous experiments, cultivars "C 727", "Sindki", "Thal Mankeva" and "6153" had been treated with gamma rays or EMS.

During 1978-79, 20,000 M_2 single plant progenies of "C 727" and "Punjab 6" together with 208 true breeding advanced mutant lines in M_5 generation of chickpea cultivars "C 727", "Sindhi", "Thal Mankera" and "6153" as well as 23 pure line/cultivars were screened at Faisalabad under artificial and at Attock under natural epiphytotic conditions. At Faisalabad and Attock, eight and six mutant lines respectively, showed varying degrees of resistance against blight. Only two mutant lines viz. CM 68 and CM 72 (both resulting from gamma irradiation of 6153 cultivar with 15 kR exposure) showed resistant reaction at both the locations, however no mutant line/cultivar showed immunity against blight. Mutant CM 68 and CM 72 were again tested during 1979-80 to confirm their resistance and they proved resistant to blight at Faisalabad under artificial epiphytotic conditions and also withstood the onslaught of blight epidemic at Attock and Islamabad, while all other mutant lines and parent cultivars were totally wiped out from the fields. During summer 1980, the resistant mutant lines were grown as an off-season crop at summer nursery Kaghan to reconfirm the resistance. At Kaghan (situated at a height level of 1,900 meters above sea level) environmental conditions were quite conducive for the development of blight epidemic and the last years debris broadcasted in the field provided enough spores for the build-up of the disease. In addition, the crop was daily sprayed with the inoculum of Ascochyta rabiei for three days at the start of pod formation stage. Both the mutant lines once again proved resistant to blight while all other chickpea lines were almost destroyed due to blight epidemic.

Table 1. Performance of disease resistant mutant lines and the parent cultivar under disease-free conditions 1979-80 at NIAB, Faisalabad.

Line	Average plant height(cm)	Average number of branches/ plant	Average number of pods/plant	Average number of grains/ plant	100 grain wt. (g)	Average yield/ plant (g)
CM 68	87.2	9.9	137±11	164±11	17.5	26.0±2.2
CM 72	84.2	9.0	157±9	181±11	17.1	27.0±2.1
6153 (Parent)	87.0	11.1	145±11	167±12	18.1	30.8±2.2

Table 2. Performance of disease resistant mutant lines and the parent cultivar under diseased conditions 1979-80 at NIAB, Faisalabad.

Line	Average plant height(cm)	Average number of branches/ plant	Average number of pods/plant	Average number of grains/ plant	100 grain wt. (g)	Average yield/ plant (g)
CM 68	88.9	8.8	99±5	112±5	16.4	17.3±0.9
CM 72	84.1	9.3	115±10	123±10	14.9	20.49±1.8
6153 (Parent)	88.7	11.0	-	-	-	-

The mutant lines CM 68 and CM 72 have similar plant height, flower colour and maturity period as the parent cultivar 6153. However, the seed surface, seed size and seed coat colour is changed. The parent cultivar has smooth, bold and pinkish seed while both the mutants have wrinkled small end brown seed.

Under disease free conditions the parent cultivar produced 30.8 seeds per plant compared to 26.0 and 27.0 g per plant of mutants CM 68 and CM 72 respectively (Table 1). But under diseased conditions nothing was left in the field to harvest from the parent cultivar while mutant CM 68 and CM 72 yielded 17.3 and 20.49 g seed per plant respectively (Table 2). The seed of these mutant lines will be multiplied for their possible use as commercial varieties and in hybridization programmes.

(Contributed by M.A. Haq, A. Shakoor, M. Sadiq and Mahmud-ul-Hassan, Nuclear Institute for Agriculture and Biology, Faisalabad, Pakistan).

Breeding for higher grain yield in bread wheat

In bread wheat negative correlations between grain weight, number of seeds per spike and the number of effective earheads (ear bearing tillers) are known to limit grain yields. An effort was made to modify these negative correlations with the help of induced variability. A preliminary study showed that some of the M_2 families do show a significant weakening of one or more of these negative correlations.

Three different mutagens, hydroxylamine, nitrosomethylurethane and gamma rays were employed treating 1000 seeds with each of these mutagens as shown in Table 1. Sonalika and Arjun-two of the highest yielding recommended varieties of spring wheat in this country were included in the study. Two hundred M_2 families from each of the treatments were raised along with the controls. Fifteen plants (or less) taken from a competitive stand in each family were scored for quantitative characters like the number of grains per spike, number of effective tillers, 100 kernel weight and single plant yield. These values were used to estimate family means and variances. Some of the M_2 families showed a large variance and they were found to be segregating for one or more characters. Attention was focussed on those M_2 families in which many of the scored plants showed an improvement either in seed weight or number of seeds per spike or both. Some of these plants showed a grain yield which was higher compared to that of the corresponding control plants.

Table 1. Details of mutagenic treatments to seeds

Treatment	Duration of pre-soaking	Conc./dose	Duration of treatment	pH
Hydroxylamine	7 h	0.04 M	20 h	7.00
Nitrosomethyl-urethane	7 h	0.03%	1 h	-
Gamma rays	Dry seeds	25 kR	2400 R/min	-
Control	-	-	-	-

The process of screening in this way was continued in the M_3 and M_4 generations. The selected plants from M_4 generation within a family were bulked to raise M_5 in a randomised block design for further evaluation.

The more promising of the M_5 families were advanced to M_6 generation. Twenty-six M_6 families of the variety Sonalika and twenty-four of Arjun were tested in a replicated trial with a plot size of six rows of six meters each. In each case the control was provided by the non-treated seeds of the parental variety, which has continued to show a high degree of uniformity.

Observations on number of spikelets per ear, number of seeds per ear, number of tillers per m^2, 1000 seed weight and plot yield were recorded in all the three replications. These observations are presented in Table 2.

It will be seen that both for yield as well as for other characters some of the families show an improvement over the control. Two of the M_6 families of Sonalika and one of Arjun have shown a significantly higher grain yield than the parental variety, as can be seen from Table 3.

Table 2. Observations on mutant families and control in M_6

Families	No. of families	Inter family range for mean				
		No. of spikelets/ ear	No. of seeds/ ear	1000 seed wt. (g)	No. of tillers/ m^2	Plot yield (kg)
			SONALIKA			
Mutants	26	14.1-17.1	41.1-48.5	41.0-50.1	405.0-515.6	2.23-2.85
Control	1	15.2	41.7	46.9	455.0	2.36
C.D. at 5%	-	1.02	4.51	2.63	-	0.33
			ARJUN			
Mutants	24	17.4-19.9	45.5-56.1	26.5-34.8	525.3-662.3	1.83-2.73
Control	1	19.2	49.2	32.5	582.3	2.23
C.D. at 5%	-	1.44	4.2	2.26	-	0.40

The contribution to higher grain yield in the mutant families S-124 and A-216 appears to be a function of increased 1000 seed weight and increased number of seeds per spike respectively. In case of S-102, the cumulative effect of small increase in several components may have contributed to higher grain yield.

The study does indicate the possibility of overcoming yield barriers which are beginning to be establised in our important cereal crops, provided suitable screening techniques are adopted.

Table 3. Observations on high yielding mutants and control in M_6

Family	No. of spikelets/ ear	No. of seeds/ ear	1000 seed wt. (g)	No. of tillers/ m^2	Plot yield (kg)
		SONALIKA			
Mutant S-102	15.97	44.00	49.1	478.7	2.85
Mutant S-124	15.50	41.70	50.1	439.0	2.81
Control	15.24	41.70	46.9	455.0	2.36
C.D. at 5%	1.02	4.51	2.63	-	0.33
		ARJUN			
Mutant A-216	19.73	53.60	30.4	616.7	2.73
Control	19.10	49.16	32.5	582.3	2.23
C.D. of 5%	1.44	4.20	2.26	-	0.40

(Contributed by K.G. Khamankar and H.K. Jain, Division of Genetics, Indian Agricultural Research Institute, New Delhi - 110012, India).

Genetic analysis of the earliness of the early-maturing mutants in indica rice

The use of mutants in cross-breeding has been proved to be an effective way to develop high yielding varieties in recent years in China. For the optimal use of mutants, it is essential to know the genetic behaviour of the mutants before and during their use as parent materials in plant breeding programme.

Three homozygous lines of early-maturing mutants 1-2-20, 1-2-24 and 1-2-18 from indica rice induced with cobalt-60 gamma rays were chosen for this investigation. They were obtained in 1976 from the same initial variety Kwangluai 4, a leading early rice variety in the Yangtze valley. Mutants 1-2-20 and 1-2-24 ripen ten days earlier and 1-2-18 five days earlier than the parent variety.

Plants from all the three mutant lines were crossed to Kwangluai 4. For the early rice, the heading date is always closely correlated to the ripening date, so the former date is usually used in rice breeding practice as a criterion to determine in advance the ripening date. In 1978, observations and studies were made on the frequency distributions of the heading date of P_1, P_2, F_1 and F_2 population from these three crosses. The early-maturing plants isolated from these three F_2 population were grown separately in 1979 to examine the stability of early maturity of the selected lines.

It was found in the experiment that all the three early-maturing mutants resulted from simple recessive gene mutation as had been previously reported by other authors in studies with japonica rice, but the alleles of the late-maturing parent variety showed semidominance with an apparent dose effect on the delay of heading date. The extent to which the heterozygous progenies deferred their maturity is obviously in direct proportion to the number of dominant genes possessed.

The three early-maturing mutant lines could be classified into three different groups according to their genotypes. The first group represented by 1-2-20 contains those mutants each carrying a pair of recessive mutated genes that control early maturity. Each of the mutants from the second group represented by 1-2-24 has two pairs of independent recessive genes with simple additive effect on early maturity. The third group represented by 1-2-18 contains the mutants that also possess two pairs of independent recessive mutated genes each, but the dose effect of the dominant genes on late maturity of the heterozygous genotypes are irregular. The heading date of most heterozygotes with a single dominant gene in F_2 generation was the same as that of the initial early-maturing mutants. The heading date frequency distribution of F_2 population from the third group showed a positive skewness. The third mutant is not considered desirable parent material for the use in rice cross-breeding.

(Contributed by Gao Mingwei, Zhejiang Agricultural University, Hangzhou, Zhejiang, People's Republic of China).

Variability induced by gamma rays in sorghum

Experiments were conducted at the College Farm, N.M. College of Agriculture, Navsari Campus of Gujarat Agricultural University during the kharif 1977 as M_1 generation and kharif 1978 as M_2 generation, for the study of variability induced by gamma radiation in sorghum

(*Sorghum bicolor* (L.) Moench). Three local improved varieties of sorghum: Surat-1, G.J.108 and B.P.53 were exposed to gamma ray doses by 10, 20, 30 and 40 kR at the Bhabha Atomic Research Centre, Trombay.

For both the M_1 and M_2 generations, variability showed significant increases in all the characters studied. Variety G.J.108 was found to be more sensitive to gamma radiation, variety B.P.53 was fairly resistant. Maximum M_1 sterility was observed in Surat-1, followed by G.J.108 and B.P.53. Chlorophyll variants were recovered only in the irradiated population of the variety G.J.108 in M_2 generation. These chlorophyll variants were albino and xantha, the albino type being more frequent.

(Contributed by P.V. Vadher, K.B. Desai and S.N. Badaya, Gujarat Agricultural University, India).

Mutation rates following combined mutagen treatment of peas (N_f + NEU)

At the Plant Experiment Station in Wiatrowo, genetical and breeding experiments are carried out with leguminous crops, mainly with peas and lupins (albus, luteus and angustifolius). In these crops, we also use mutagenesis to make progress in breeding. Therefore, we carried out experiments on improvement of mutation rate and mutation spectrum. In 1978 we started with preliminary dose response tests for combined treatment in pea (Pisum Newsletter 11, 1979). After chlorophyll mutation tests on M_2 seedlings "the best" varieties and doses were chosen. Two varieties, "Paloma" and "Kaliski" were treated by "the best" combined dose of N_f and NEU and, for comparison, separately with N_f and NEU. The main experiment in which we looked for mutations consisted of 2 varieties x 3 doses x 500 families x 10 seeds from family = 30 000 M_2 seeds. The table gives our estimate of the mutation rate. The varieties differed markedly in their response, from Kaliski we obtained 400 mutations and from Paloma 914. The number of mutations was much higher than the number of M_2 families with mutations. This means that in a particular M_2 family there were plants carrying several mutations. Accordingly, we conclude that combined mutagen treatments can be a way for increasing mutation rates. It would be valuable to know the effect of combined treatments upon the mutation spectrum.

Mutation rate after combined treatment of pea seeds with N_f and NEU

Variety	Treatment dose	M_2 families with mutations		Mutated M_2 plants			Independent mutation cases
		number	%	number	%	in one M_2 family	
Paloma	200r	71	14.2	127	2.54	1.79	77
	200r/0.014%	281	56.2	653	13.06	2.32	432
	0.014%	260	52.0	590	11.80	2.27	406
Kaliski	350r	77	15.4	149	2.98	1.94	90
	350r/0.014%	119	23.8	272	5.44	2.28	159
	0.014%	109	21.8	247	4.94	2.27	150

(Contributed by W.K. Swiecicki, Plant Experiment Station, Wiatrowo, Poland).

Symbiotic dinitrogen fixation by mutant lines of field bean (*Vicia faba* minor)

The interest in biological N_2-fixing systems is increasing worldwide due to uncertain availability and high cost of nitrogen fertilizers. We undertook a study to evaluate various field bean mutant lines (a) selected for improved yield components showing highly significant correlations to yield in path coefficient analyses (micromutations) or (b) showing visibly altered traits (macromutations). Details of the breeding procedure were given in (1). The amount of % N derived from symbiotic fixation was estimated using ^{15}N tracer techniques (2). The evaluation of the mutants in terms of N fixation was based upon the mother variety "Wieselburger" as control and barley as a non-fixing standard. "Legosin" was added in a suspension as inoculum to the soil. Labelled ammoniumsulphate with 5% ^{15}N atom excess was applied at a rate of 20 kg/ha.

Plots were harvested when seeds of the legume crop were fully developed (physiological maturity). No leaf shedding nor seed shattering was noticable at that time.

Mutant lines are compared in Table 1. as to their yield of straw, of pods and of nitrogen, and the amount of N_2 fixation. Harvest indices for crop and nitrogen-yield were calculated. Obviously, crop yield and nitrogen yield is improved for some mutant lines in comparison with their respective controls. Symbiotic nitrogen fixation was usually increased for mutants with higher crop yields. A comparatively small variability was found for % N derived from fixation (range between 91-82%) with a variation coefficient of 5,4%, while total amount of N fixed by symbiosis varied between 299 and 189 kgN/ha with a C.V. of 15,3%. Mutants 3, 5, 14 and 28 were were significantly different from their mother cultivar Wieselburger for the amount of fixed nitrogen, but no significant difference was observed for % N derived from fixation. All the mutant lines possess a similar but high N_2 fixation capacity, correlated closely with crop yield.

We are inclined to conclude that if field bean breeders select for high yield, this may lead also to good symbiotic nitrogen fixation yields provided that Rhizobium/host symbiosis is not impaired for other reasons.

Nitrogen yield of faba beans exceeded cereals two to three fold, confirming that faba bean is an excellent source of nitrogen and nitrogenous compounds through its symbiotic N_2 fixation.

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(Contributed by H. Brunner, F. Zapata, IAEA Laboratory, Seibersdorf, Austria).

Table 1. Yield, nitrogen yield and symbiotic nitrogen fixation for *Vicia faba* mutants (Based on dry matter)

	Crop yield (t/ha) straw	pods	total	HI[1)]	Nitrogen yield (kg/ha) straw	pods	total	% of total N in pods and seeds	Amount of fixed nitrogen kg/ha	% of total N
I. Mutants selected for improved yield components										
1	4,3	5,8	10,2	57,6	80,5	209,8	290,3	72,3	258	88,9
3	4,7	6,5	11,2	58,0	93,3	218,0	311,3	70,0	281[x]	90,3
4	3,6	5,2	8,8	59,0	70,5	184,8	255,3	72,4	234	91,7
5	4,5	6,4	10,9	58,9	84,8	234,8	319,6	73,5	276[x]	86,5
6	3,8	5,6	9,4	59,7	84,0	197,0	281,0	70,1	251	89,3
11	4,2	6,0	10,2	58,8	77,0	206,3	283,3	72,8	243	85,8
15 best selected control	4,1	6,2	10,2	60,4	80,3	214,8	295,1	72,8	271	91,8
"Wieselburger" (mother variety)	4,0	5,3	9,3	56,8	79,5	192,0	271,5	70,7	245	90,4
II. Mutants with morphological changes										
4 short, early	3,4	6,2	9,6	64,3	73,5	215,3	288,8	74,6	252	87,3
14 changed canopy structure	4,9	6,5	11,4	57,2	100,1	236,0	336,1	70,2	297[x]	88,4
17 short	3,9	5,5	9,4	58,5	77,5	190,3	267,8	71,1	228	85,1
28 lancet leaves, upright	4,9	6,6	11,5	57,3	92,5	233,0	325,5	71,6	279[x]	85,7
31 purple flower	3,0	4,9	7,9	61,9	54,0	176,5	230,5	76,6	188	81,6
86 short small leaves	3,4	5,8	9,3	62,8	69,5	207,0	276,5	74,9	247	89,3
103 non-shattering pods	4,1	5,9	10,4	57,2	73,8	220,8	294,6	75,0	245	83,2
"Wieselburger" (mother variety)	4,1	5,4	9,5	57,0	83,8	194,7	278,5	69,9	253	90,8

1) Harvest index, H.I.: Percent pod weight among total dry matter yield.

x = P 0,05 compared with Wieselburger

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
Brassica juncea			
RLM 514	1980 India K.S. Labana Dept. of Plant Breeding Punjab Agric. Univ. Ludhiana	200 kR gamma-rays, 1969 (RL 18)	higher grain yield, 22% over national check variety "Varuna", bold grain size, early maturity, high oil content, shattering resistant. 11% less erucic acid
Oryza sativa			
Yuan-feng-tsao	People's Republic of China		45 days earlier ripening than parent cultivar yields 10% more than other early varieties 14% higher lysine content than in common improvement varieties
Miyanishiki	1978 Japan H. Uchiyamada et al. Miyzaki Agr.Exp.St.	<u>Kanto 79</u> (gamma ray induced short culm mutant of Koshihikari) x Todorokiwase, 1970	early heading, short culm, improved lodging resistance

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
Phaseolus vulgaris			
Giza 80	1980 Egypt H.A.S. Hussein, I.A. Disouki Dept. of Genetics Fac. of Agriculture University of Cairo, Giza	10 kR gamma-rays air dry seeds, 1973 (Fin de Villeneuve)	rust resistant, 12% higher yield, higher TGW, white seed coat, higher protein content cooking time for dry seeds reduced
Sesamum orientale			
Kalika (BM 3-7)	1980 India B.S. Panda, M.I. Tanki, K.C. Mohapatra	1% EMS, presoaked seeds 6h, room temperature, 1974 (Binayak)	dwarf, compact branched type increased no. of seeds per capsule, increased yield by ca. 15%
Zea mays			
CE 200	1979 CSSR O. Kopecký, F. Damborský Plant Breeding Station Čejč of Cereal Research and Breeding Institute Kroměříž	chronic gamma irradiation, 1968 (synthetic population) selected inbred line Rt 10 used in 3-way cross to establish CE 200 Hybrid	high yield, early maturity (FAO 230) good stalk quality
CE 268	1979 CSSR O. Kopecký, F. Damborský Plant Breeding Station Čejč of Cereal Research and Breeding Institute Kroměříž	chronic gamma irradiation, 1968 (synthetic population) selected inbred line Rt 58 used in single cross to establish CE 268 hybrid	yield, stalk quality, stalk disease resistance (FAO 280) 1980 cultivated on 2000 ha

CE 330	1979 CSSR O. Kopecký, F. Damborský, M. Lucký Plant Breeding Station Čejč of Cereal Research and Breeding Institute Kroměříž	chronic gamma irradiation, 1967 (synthetic population) selected inbred line Rt 54 used in modified single cross to establish CE 330 hybrid	yield, plasticity, short stalk, stalk quality (FAO 330) 1980 cultivated on 2000 ha
<u>Malus pumila</u> McIntosh 8F-2-32	1970 Canada K.O. Lapins Canadian Department of Agric. Research Station Summerland, B.C.	shoots, γ-rays (McIntosh)	improved skin colour; resistance to Podosphaera leucotricha and Venturia inaequalis
Lysgolden (Goldenir)	1970 France L. Decourtye, B. Lantin INRA, Angers	dormant trees, 5 krad γ-rays, 1963 (Golden Delicious)	fruit free of russetting; yield somewhat reduced
Belrène	1970 France L. Decourtye, B. Latin INRA, Angers	growing shoots, 1% EMS, 1961 (Reine des reinettes)	earlier maturing, more coloured and bigger fruit; yield somewhat reduced
Blackjoin BA 2 520	1970 France L. Decourtye, B. Latin INRA, Angers	Dormant trees, 5 krad γ-rays, 1963 (Jonathan Blackjoin)	improved and more regular red coloured fruit
<u>Ribes</u> Westra	1968 Germany Fed. Republic R. Bauer, Max Planck Inst. für Züchtungsforschung Köln-Vogelsang	1.5 kR X-rays, 1949 (Westwick Choice)	strong erect habit
<u>Achimenes</u> Cupido	1973 The Netherlands C. Broertjes Assoc. Euratom-ITAL Wageningen	leaves, 2-4 krad X-rays or 1-2 krad fast neutrons, 1968 (Paul Arnold)	compact; sturdy; freely flowering

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Orion	1973 The Netherlands C. Broertjes Assoc. Euratom-ITAL Wageningen	leaves, 2-4 krad X-rays or 1-2 krad fast neutrons, 1968 (Paul Arnold)	early flowering; large flower; sturdy but higher plant
Flamingo	1977 The Netherlands C. Broertjes Assoc. Euratom-ITAL Wageningen	leaves, 3 krad X-rays, 1975 (Tango)	good growth habit, somewhat more compact; flowers stand out better
Lollipop	1977 The Netherlands C. Broertjes Assoc. Euratom-ITAL Wageningen	leaves, 1 krad fast neutrons, 1975 (Tango)	compact; typical pink flower colour, somewhat fringed
Pink Attraction	1977 The Netherlands C. Broertjes Assoc. Euratom-ITAL Wageningen	leaves, 2.5 krad X-rays, 1975 (autotetraploid from of cv. Repelsteeltje)	compact, regular growth habit with dark green foliage; rather small flower with attractive pink colour
<u>Alstroemeria</u>			
Harmony stabrons	1972 The Netherlands M.C. van Staaveren Aalsmeer*	X-rays, 1968 (Regina)	bronze flower colour
Rosita stareza	1972 The Netherlands M.C. van Staaveren Aalsmeer*	X-rays, 1968 (Regina)	pink flower colour

Zebra stazeb	1975 The Netherlands M.C. van Staaveren Aalsmeer*	X-rays, 1968 (Orchid fl)	heavily striped flower
Harlequin	1973 The Netherlands A. Wülfinghoff, Rijswijk*	X-rays, 1970 (Paringo's Charm)	orange-yellow flower colour
Rosali staliro	1975 The Netherlands M.C. van Staaveren Aalsmeer*	X-rays, 1971 (Starosa)	pink flower colour
Capitol	1977 The Netherlands A. Wülfinghoff, Rijswijk*	X-rays, 1972 (Carmen)	salmon-pink flower colour
Fanfare	1977 The Netherlands A. Wülfinghoff, Rijswijk*	X-rays, 1972 (Carmen)	red flower colour
Result	1977 The Netherlands A. Wülfinghoff, Rijswijk*	X-rays, 1972 (Carmen)	bright red flower colour
Trident	1977 The Netherlands A. Wülfinghoff, Rijswijk*	X-rays, 1972 (Carmen)	pink flower colour
Valiant	1977 The Netherlands A. Wülfinghoff, Rijswijk*	X-rays, 1972 (Carmen)	light red flower colour
Zenith	1977 The Netherlands A. Wülfinghoff, Rijswijk*	X-rays, 1972 (Carmen)	orange-red flower colour
<u>Begonia</u>			
Enchantress (Improved Aphrodite Rose)	1974 USA Mikkelsens Inc., Ashtabula Ohio	γ-rays, 1972 (Aphrodite Rose)	ruffled flower, light rose rose; propagates by leaf cuttings
Fantasy	1975 USA Mikkelsens Inc., Ashtabula Ohio	γ-rays, 1972 (Aphrodite Rose mutant)	upright, compact slow growing; leaf propagated, deep rose-red colour

* In co-operation with the Association Euratom-ITAL, Wageningen

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Aphrodite Joy	1974 USA Mikkelsens Inc., Ashtabula Ohio	γ-rays, 1972 (Aphrodite Rose)	bright pink ruffled flowers; more vigorous and larger flowers than cv. Aphrodite Pink
Aphrodite Twinkles	1974 USA Mikkelsens Inc., Ashtabula Ohio	γ-rays, 1972 (Aphrodite Rose)	dwarf, compact, slow growing, upright, pink flowers
Elegance	1975 USA Mikkelsens Inc., Ashtabula Ohio	γ-rays, 1972 (Aphrodite Rose mutant)	very large double flowers, pink; very ruffled edges; propagates by leaf cuttings, except during summer
Red Elegance	1975 USA Mikkelsens Inc., Ashtabula Ohio	γ-rays, 1972 (Aphrodite Rose mutant)	very large double flowers, pink; very ruffled edges; propagates by leaf cuttings, except during summer
Rose Elegance	1975 USA Mikkelsens Inc., Ashtabula Ohio	γ-rays, 1972 (Aphrodite Rose mutant)	large rose-red double flowers; ruffled tepals; vigorous
Aphrodite Peach	1974 USA Mikkelsens Inc., Ashtabula Ohio	γ-rays, 1972 (Aphrodite Rose)	peach coloured flowers, very floriferous, small foliage; short, compact; self branching; extremely high bud count on leaf cuttings
Mikkel Limelight	1974 USA Mikkelsens Inc., Ashtabula Ohio	fast neutrons, 1973 (Aphrodite Rose mutant)	very vigorous grower, large white flowers; propagates by leaf cuttings

Flambeau	1976 USA Mikkelsens Inc., Ashtabula Ohio	fast neutrons, 1973 (Aphrodite Red)	bright red double flower; propagates very well by leaf cuttings
Heirloom	1975 USA Mikkelsens Inc., Ashtabula Ohio	fast neutrons, 1973 (Schwabenland Pink)	deep bright pink coloured flowers; easier to propagate than parent; little serration on edges of leaves; more resistant to mildew
Hoblanche	1977 The Netherlands W.J. Hofstede, Huissen*	2.5 krad X-rays, 1973 (pink sport of cv. Vuurgloed)	white flower colour
<u>Chrysanthemum</u> Taruni	1979 India M.N. Gupta, S.K. Datta National Botanical Research Institute, Lucknow	gamma-ray, 2 krad, 1977 (Kingsford Smith)	azalea pink flower-heads
<u>Dahlia</u> Adagio	1970 France B. Lantin, L. Decourtye INRA** Etablissements TURC Angers	dormant tubers, 2-3 krad γ-rays, 1965 (Aztec)	orange flower
Allegro	1970 France B. Lantin, L. Decourtye INRA Etablissements TURC Angers	dormant tubers, 2-3 krad γ-rays, 1965 (Aztec)	light purple flower
Altamira	1970 France B. Lantin, L. Decourtye INRA Etablissements TURC, Angers	dormant tubers, 2-3 krad γ-rays, 1965 (Aztec)	orange and red stripes (chimera)

** INRA, Institut Nacional de Recherches Agronomique.

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
Amalfi	1970 France B. Lantin, L. Decourtye INRA Etablissements TURC, Angers	dormant tubers, 2-3 krad γ-rays, 1965 (Aztec)	light and bright red flower
Annibal	1970 France B. Lantin, L. Decourtye INRA Etablissements TURC, Angers	dormant tubers, 2-3 krad γ-rays, 1965 (Aztec)	dark purple flower
Guzmania Edith	1974 Belgium R. de Loose Rijksstation voor Sierplanten-veredeling, Melle	seeds; 3.3 krad ^{60}Co γ-rays, 1964 (Guzmania paecockii)	striped leaves
Lilium Mies Bouwman	1977 The Netherlands A.J. Bischoff-Tulleken Wieringerwerf*	X-rays, 1968 (Tabasco)	orange flower colour, excellent forcing qualities
TX 68-1	1977 The Netherlands A.J. Bischoff-Tulleken Wieringerwerf*	X-rays, 1968 (Tabasco)	orange flower colour, excellent forcing qualities
Portulaca Karna phul	1974 India B.M. Desai Bhabha Atomic Research Centre Bombay	1 kR γ-rays (P. grandiflora)	gebera-type flower

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Rosa			
Flamingo Queen	between 1966 and 1976 Canada Agriculture Canada Res. St. Ottawa, Ont.	7-8 kR X-rays, 1964 (Queen Elizabeth)	salmon pink flower colour
Streptocarpus			
Margaret	1974 United Kingdom D.R. Davies John Innes Institute, Norwich	leaves, X-rays 6krad 1970 (Constant Nymph)	very freely flowering during winter
Albatros	1973 The Netherlands C. Broertjes Association Euratom-ITAL Wageningen	leaves, colchicine, 1971 (mutant 7111 of cv. Maassen's White)	large white flowers; sturdy flower stalk; comparatively compact
Tulipa			
Faraday	1949 The Netherlands W.E. de Mol van Qud Loosdrecht	X-rays, 1936 (Fantasy)	flower colour
Estella Rijnveld	1954 The Netherlands W.E. de Mol van Oud Loosdrecht	X-rays (Red Champion)	flower colour

PUBLICATIONS

Induced Mutations for Improvement of Grain Legume Production

Report of a FAO/IAEA/SIDA Research Coordination Meeting, Bangi, Kuala Lumpur (Malaysia), 28 May - 1 June 1979.
IAEA-TEC.DOC-234 1980 (obtainable as microfiche, US$ 2.00).

Introduction to Nuclear Techniques in Agronomy and Plant Biology by P.B. Vose

Pergamon Press Oxford U.K 1980, £ 10.00.

Plant Roots

Proceedings of Seminars held at Iowa State University by J. MacKey, Uppsala (Sweden), W. Jordan, Texas A and M University (USA) and R. Zobel, Ithaca N.Y. (USA). Copies obtainable from M.J. Vivian, Agronomy Department, Iowa State University, Ames, Iowa 50011 (USA). US$ 7.00 - 10.00 depending upon postage.

The Role of Induced Mutations in Crop Improvement

Proceedings of a Symposium, Hyderabad (India), 10 - 13 September 1979, Department of Atomic Energy, Government of India, Bombay 1980, US$ 20.00.

EXPERTS AND CONSULTANTS 1980

Ashri, A. (Israel)	-	Vienna (Austria)
Black, C.C. (USA)	-	Lima (Peru)
Gaul, H. (FRG)	-	Kuala Lumpur (Malaysia)
Micke, A. (FAO/IAEA)	-	Legon (Ghana)
Mikaelsen, K. (Norway)	-	Lima (Peru)
	-	Bangkok (Thailand
Murty, B.R. (India)	-	Maracaibo (Venezuela)
Nakai, N. (Japan)	-	Mymensingh (Bangladesh)
Onozawa, Y. (Japan)	-	Seibersdorf Laboratory (Austria)
Sigurbjörnsson, B. (Iceland)	-	Jakarta (Indonesia)
Vermeulen, H. (Netherlands)	-	Mymensingh (Bangladesh)
Yamaguchi, H. (Japan)	-	Piracicaba (Brazil)

FELLOWSHIP TRAINING 1980

Bhagwat, S.C. (India)	-	Cambridge (UK)
Bhuiya, A.D. (Bangladesh)	-	Calcutta (India)
Hamid, M.A. (Bangladesh)	-	Raleigh N.C. (USA)
Klu, G.Y.P. (Ghana)	-	Casaccia (Italy)
Nimako, A. (Ghana)	-	Knoxville Tenn. (USA)
Pawlak, J.A. (Poland)	-	Wageningen (Netherlands)
Tulmann-Neto, A. (Brazil)	-	Italy, Netherland, Portugal, Sweden

FUTURE EVENTS

1981

Induced Variability in Plant Breeding. EUCARPIA Section Mutation and Polyploidy, 31 August - 4 September, Wageningen, (Netherlands). Contact: Dr. C. Broertjes, I.T.A.L., P.O. Box 48, 6700 AA Wageningen (Netherlands).

8th International Cocoa Research Conference, 18 - 24 October, Castagena, Colombia. Contact: International Cocoa Research Conference, P.O. Box 205, London WC 2N 6NB, (UK).

1982

FAO/IAEA Regional Seminar on the Utilization of Induced Mutations for Crop Improvement in Latin-America, July, Lima (Pèru).

21st International Horticultural Congress, 29 August - 4 September, Hamburg (FRG). Contact: Hamburg Messe und Kongress GmbH., P.O. Box 30 2360, D-2000 Hamburg 36 (FRG).

LAST BUT NOT LEAST

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

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

Alexander MICKE
Lhamo WAHL

Mutation Breeding Newsletter
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for Food and Agricultural Development

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