Mutation Breeding Newsletter

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Report from the FAO/IAEA Plant Breeding and Genetics Section

The first half of 1981 has seen a number of important events in the Sections's programme, the main one being the FAO/IAEA International Symposium on Induced Mutations as a Tool for Crop Plant Improvement (9 - 13 March, Vienna). As intended, it appears to have stimulated interest in using induced mutations mutants as an analytical tool to study life processes of plants that are relevant for crop production. The proceedings, incl. 51 papers and excerpts from the discussions are in press and can be ordered soon from the IAEA Publications Division, Wagramerstr. 5, P.O. Box 100, A-1400 Vienna, Austria.

The symposium was attended by scientists from 37 countries. Some of them participated also in the First Research Co-ordination Meeting on Evaluation of Mutant Stocks for Semi-Dwarf Plant Type as Cross-Breeding Material in Cereals preceding the symposium, others participated in the Consultants Meeting on the Induction of Mutations in Extra-Nuclear Hereditary Cell Elements, which followed the symposium. The report of the latter will be part of the symposium proceedings, the proceedings of the former will be published separately.

27 April to 1 May, co-operators in the co-ordinated research programme on the Use of Induced Mutations for Improvement of Grain Legume Production in South East Asia met at Chiang Mai (Thailand) to assess progress achieved since the first meeting in Malaysia (28 May - 1 June 1979) and to agree upon future work. One special topic discussed was the probability of improving symbiotic nitrogen fixation by mutation induction in the host and/or the bacteria. 15 - 19 June 1981 a meeting concerned with induced mutations for disease resistance was

organized at the Risö National Laboratory in Denmark. It was the final meeting of the co-operators in the FAO/IAEA/SIDA Co-ordinated Research Programme on Induced Mutations for Disease Resistance in Crop Plants that has been started in 1971 and at the same time a meeting of scientists that are specially interested in improving disease resistance of grain legumes with the help of mutagen induced genetic variation. Proceedings of both meetings are to be published later this year.

An important event to take note of for 1982 would be a Regional Seminar on the Utilization of Induced Mutations for Crop Improvement in Latin America at Lima, Peru, 18 - 23 October 1982. If sufficient funds are made available, the seminar would be followed by a 2-week training course for junior scientists from Latin-America, who may wish to have an opportunity for some more in-depth discussion, laboratory exercise and field demonstration. For the planning it would be important that interested persons contact as soon as possible Dr. B. Donini, Plant Breeding and Genetics Section, Joint FAO/IAEA Division, Wagramerstr. 5, P.O. Box 100, A-1400 Vienna, Austria.

RESEARCH NEWS

Rice mutation breeding in France

Following mutagen treatment of the variety Allorio 11, short culm mutants were selected: "Allorio Lambda" short and better tillering, "Allorio Theta" even shorter. When the two mutants were crossed, the F_2 showed a continuous-type of variation of plant height with transgressions, indicating a multifactorial inheritance. From this cross exists now a line "Thetalam B" (1980 in F_{12}) which has stiff straw, plant height 80 cm against 120 cm for Allorio 11 but is maturing about 6 days later. Its grain type unfortunately does not meet market requirements in France.

"Allorio Lambda" was subjected to X-ray treatment and 4 long grain mutant lines were selected. However, they were not released as varieties since the variety "Delta", an induced mutant from the variety "Cesariot", was superior.

Following mutagen treatment of the variety "Cigalon" two mutant lines were developed which have a strong seed dormancy at harvest time, but germinate properly in spring. They mature however much later than the variety "Cigalon".

From gamma ray treatment of variety "Arlesienne" in 1970 two mutants with better threshability and other advantages were selected. They were officially approved in 1979 as varieties under the names "Calendal" and "Arlatan" (see mutant variety list in this issue of MBNL). "Arlatan" belongs to the group of short grain varieties. It gives 15% higher yield than Arlesienne and 6,6% more yield than "Balilla 28". In 1980 it was grown on 175 ha for seed propagation. "Calendal" belongs to the group of long grain varieties. It has the same productivity as the mother variety, but yields 4-5% more than the control long grain variety "Enribe".

REFERENCE

GRILLARD, M., MARIE, R. and SEGUY, J.L., Nouvelles varietes de riz pour la France. Bulletin d'information des riziculteurs de France, January - March 1979 no. 176.

(Contributed by R. Marie, Institut National de la Recherche Agronomique, Centre de Montpellier, France).

Improvement of tidal swamp rices through induced mutation

Seeds of 9 rice cultivars from the tidal swamps of South Kalimantan, Indonesia, were treated with ethyleneimine at 2 concentrations (0.2% and 0.4%) for 1 hour and 3 hours to induce earliness and short stature without affecting tolerance of tidal swamp conditions. The correlation of germination of M_1 seeds and spikelet fertility was positive and was helpful in identifying optimal treatments for further experiments. Single panicles selected from M_1 plants from the 2 effective treatments (0.2%, 3 h and 0.4%, 3 h) produced 1,844 M_2 progenies for further screening.

In the M_2, the seedling mutants segregated in a simple Mendelian ratio of 3:1. Screening of the M_2 families under natural long-day conditions in the 1979 dry season facilitated selection of photoperiod-insensitive types from Siyam Halus mutations (IR29386) and of mutants intermediate in plant height but sensitive to photoperiod from Siyam Kuning (IR30446).

The early mutants, simultaneously raised in the wet season as M_3 plant progenies, bred true for earliness; they matured about 1 month earlier than the parents, even under short-day conditions. The early and intermediate-statured mutants were also about a month shorter in growth duration and about 35 cm shorter in plant height, but were unaltered in agronomic or grain characteristics. Those intermediate in plant height, in the background of photoperiod sensitivity, also maintained most of the parent's original characteristics. Tillering was improved while spikelet number per panicle was slightly reduced.

Initial evaluation in the tidal swamps indicated that the mutant derivatives were well adapted. However, when seeded at Bandjarmasin, S. Kalimantan, Indonesia, on 25 March, most of the photoperiod-sensitive mutants were about 1 month later than Siyam Kuning. This was unexpected and will be further investigated in 1981 using several dates of planting.

If ethyleneimine is specific in altering culm length, it should be emphasized as a future tool in the improvement of specifically adapted traditional varieties.

(Quoted from article in International Rice Research Newsletter 6(1), (Feb, 1981) 4-5, by M. Mahadevappa, plant scientist, University of Agric. Sciences, Mandya, India; H. Ikehashi, plant breeder, Central Agric. Exp. Station, Konosu, Saitama, Japan; H. Noorsyamsi, plant breeder, Central Res. Institute for Agric., Bandjarmasin, Kalimantan, Indonesia and W.R. Coffman, plant breeder, International Rice Research Institute).

Effects of temperature on culm elongation in the dwarf mutant line, Fukei No. 71

The dwarf mutant line, Fukei No. 71, shows a large variation on its culm elongation under different environmental conditions. In order to elucidate the essential factors of this character expression, Fukei No. 71 was compared with the semi-dwarf mutant cultivar, Reimei, and the original cultivar of both mutants, Fujiminori, on the mode of culm elongation under different temperature conditions. In combination with three different fertilizer treatments, three different temperature treatments were performed from seedling stage to maturity as follows: 1) high temperature condition (daytime 30°C - nighttime 25°C), 2) intermediate temperature condition (23°C - 18°C), and 3) low temperature condition (16°C - 12°C). With regard to culm elongation, a remarkable difference between Fukei No. 71 and the other two cultivars was observed in the response to temperature. In two cultivars, Fujiminori and Reimei, culm elongation was accelerated approximately in proportion to an increase in temperature. On the contrary, Fukei No. 71 was depressed under high rather than moderate temperature condition. On the other hand, no particular responses to fertilizer were found in all three lines. When Fukei No. 71 was exposed to very high temperature (45°C - 30°C) from the various developing stages to maturity, the growth was so much depressed that many plants failed to emerge panicles completely from flag leaf sheath. Under such a very high temperature condition, however, Fujiminori could produce a considerable number of panicles emerged completely from flag leaf sheath, although their heading dates were slightly later than under a greenhouse condition (control). In both lines, the pattern of relative elongation of culm internodes varied considerably with different temperature conditions. In general, the upper internodes were more elongated under high temperature condition than under low temperature condition, while the lower ones were more reduced under high temperature condition than under low temperature condition. Such an expression pattern tended to be exhibited more intensely in Fukei No. 71 than in Fujiminori.

(Abstract of article by H. Kitano and Y. Futsuhara, Faculty of Agriculture, Nagoya University, Nagoya 464, Japan, published in Japan J. Breed. 31(1),(1981) 9-18).

Early maturing, short culm rice mutants in the Philippines

From the mutagen treated rice variety "Bengawan" (which is resistant to tungro virus and possesses excellent grain quality), 15 dwarf mutants have been selected which appear also less sensitive to photoperiod. While the original variety had a plant height of 149 cm and flowered in 114 days, the selected mutants had plant heights of only 41 - 61 cm and flowered in 93 to 108 days. Among these mutants two appear most interesting. Their important agronomic data are as follows:

	Yield to/ha	Days to heading	Plant ht. cm	No. of tillers	No. of grains per plant	Empty grain %
Bengawan	4.6	114	149	18	177	26
Mut. no. 1	5.4	98	41	39	66	5
Mut. no. 5	6.3	103	60	21	170	14

These two mutants should have value as cross breeding parents.

(Contributed by I.S. Santos, Agric. Res. Division, Philippine Atomic Energy Commission, Quezon City, The Philippines).

Fasciated mutant in greengram (Vigna radiata (Linn.) Wilczek)

Dry seeds of T-44 variety of greengram (Vigna radiata (Linn.) were irradiated at 10, 20, 30, 40 and 50 kR doses of gamma-rays at IARI, New Delhi. In the M_2 bulk population of the 10 kR dose a mutant with fasciation of branches, protuded stigma and increased number of floral parts was noticed in wet season of 1977. Its frequency was of 0.03% of the total M_2 population. The mutant bred true for fasciation of branches. In M_5 15 plants from the progeny of the mutant and 5 plants from the control variety were examined for number of floral parts and pollen sterility.

The flower of greengram is a typical papilionaceous consisting of 5 sepals, 5 petals, 10 stamens and one pistil. However, in the fasciated mutant, the number of floral parts, in general, had increased. The number of petals was 6 (2 standard + 2 wing + 2 keel) or 7 (1 standard + 2 or 4 wing + 4 or 2 keel). The stamens in mutant plants were 11 (1+10, 12 (1+11) or 14 (1+13). The arrangement of stamens was diadelphous both in mutant and in control plants.

The number of pistils in the mutant, in general, was 2 or 3 except two plants which had 4. The well developed pistils gave rise to pods which matured and produced seeds.

Pollen sterility, in general, was higher in the mutants, ranging from 6 to 95%.

(Contributed by D.P. Singh, Department of Plant Breeding, University of Agriculture and Technology, Pantnagar, India).

A high yielding very early mutant (MUP-1) of pea (Pisum sativum L.)

In the year 1975, seed of pea variety T-163 was subjected to three different doses of gamma irradiation (10 kR, 20 kR and 30 kR) at a rate of 1 kR/minute obtained from a ^{60}Co source at IARI, New Delhi. M_2 generation was raised as single plant progeny rows. From the 10 kR treatment, a single plant in a progeny row was 28 days earlier in flowering than the parent variety. This plant, when grown in the subsequent generations, bred true. The mutant exhibited no abnormalities, although the height of the plant was slightly reduced. It had a fairly good number of pods per plant and seeds per pod. Later the mutant was named as MUP-1.

In the year 1980-81 at Meerut, India, the mutant along with the parent variety (T-163) and another high yielding early variety L-116 was subjected to a replicated yield trial with two spacings i.e. wide (45 x 15 cm) and narrow (30 x 10 cm). The plot yields obtained were converted in kg/hectare (Table 1).

Table 1. The yield date of a replicated yield trial with two spacings in kg/hectare

Variety	Wide Spacing	Narrow Spacing
MUP-1	1,100	1,800
T-163	1,600	1,500
L-116	1,300	1,500

It is evident from the above data that in wide spacing, the mutant's yield was too low. However, in narrow spacing the mutant yield exceded both the varieties. To further test the mutant's value for its possible use as an early and high yielding variety we plan analyses of grain quality and multilocation yield trials in the next season.

(Contributed by P.K. Gupta, H.S. Balyan and Sarvesh Kumar, Department of Ag. Botany, Meerut University, Meerut, India).

Evolutation of a high yielding wheat variety through fast neutron treatment

Bread wheat (Triticum aestivum) is the most important food grain crop in Pakistan. The present average yield per hectare however is only about one-third of the estimated potential. Yield per hectare was almost doubled in the sixties with the introduction of high yielding dwarf varieties. In the Province of Sind where wheat is planted on approximately one million hectares, the varieties Mexi-Pak and Pak-70 dominated in the seventies but these varieties declined in yield due to leaf rust.

A new high yielding wheat variety called "Jauhar-78" (formerly known as Mutant-115) has been evolved by treating the mother cultivar Nayab with fast neutrons (600 rad) in 1972 through the courtesy of IAEA Vienna. The mutant was isolated on the basis of its improved grain colour (amber) and larger sink size (spike) in comparison with the red-grained mother cultivar Nayab. The mode of its isolation and details of yield trials in different wheat growing areas of Sind from 1975-1978 have been reported earlier (Siddiqui et al., 1979). The mutant produced significantly ($P > 0.05$) higher grain yield than the commercial varieties (Pak-70 and Mexi-Pak) and the mother cultivar (Nayab). In the zonal trials conducted on Government farms and farmer's fields, Mutant-115 gave 10% and 25% more yield than Pak-70 and Mexi-Pak respectively. Mutant-115 was approved as variety "Jauhar-78" by the Sind Seed Council on 10th September, 1979, for release to the farmers.

Comparative yield performance of Jauhar-78 and other wheat varieties from 1978 to 1980 is summarized in Table 1.

Jauhar-78 produced even 20% more grain yield than the newly introduced Mexican variety Pavon.

Jauhar-78 was also evaluated by agronomists, plant pathologists and plant physiologists of the Provincial Agricultural Research In-

Table 1. Comparative yield performance of Jauhar-78 and other wheat varieties in the Province of Sind

Variety	Main grain yield kg/ha	% decrease or increase compared to			
		Nayab	Pak-70	Mexi-Pak	Pavon
Jauhar-78	4176	90	56	116	20
Pak--70	2684	22	-	39	23
Mexi-Pak	1932	12	28	-	45
Nayab	2201	-	18	14	37
Pavon	3482	58	30	80	-

stitute Tandojam. In the experiment on sowing dates, Jauhar-78 gave highest grain yield when sown on 20.11.1979 and 20.12.1979 respectively. The differences in grain yield were more pronounced in the experiment sown on 20.12.1979, in which Jauhar-78 produced 46% more grain yield than Z.A-77 and 13% more yield than Pavon. In another experiment on the effects of irrigation intervals, Jauhar-78 gave highest grain yield when irrigated at 4 weeks intervals. In other trials Jauhar-78 exhibited improved salt tolerance in comparison with other varieties (Makhdoom and Hussain, 1980). The plant pathologist after surveying the crop in the Province of Sind during Rabi season 1979-80 and 1980-81 has reported that the variety is resistant to stem rust and moderately resistant to leaf rust.

The seed of Jauhar-78 was distributed to the farmers by the Sind Seed Corporation for cultivation during Rabi 1980-81. Jauhar-78 out-yielded all other existing commercial varieties during Rabi 1980-81.

The variety is characterized by its long tapering awned golden earhead. It has shattering resistance and possesses good technological properties (Siddiqui et al., 1979). Jauhar-78 is the first approved wheat variety in Pakistan evolved through mutation breeding. A vigorous mutation breeding programme is in progress at this Centre and it is expected that induced mutations in combination with other methods of manipulating genetic variability (Siddiqui et al., 1978) will further play an important role in improving the crops of Pakistan.

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MAKHDOOM, M.U. and HUSSAIN, S., Germination of wheat cultivars under artificially salanized conditions. Abstt. Regional Meeting of Plant Scientists held at Tandojam, Pakistan (1980) 39--40.

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SIDDIQUE, K.A., RAJPUT, M.A., ARAIN, M.A., GHAFOOR ARAIN, A. and JAFRI, K.A., Wheat improvement by induced mutations. Proc. 18th Gamma Field Symp. Inst. Rad. Breed., NIAS, Ohmiya, Japan (1969) 33-47.

(Contributed by K.A. Siddiqui, M.A. Arain and K.A. Jafri, Plant Genetics Division, Atomic Energy Agricultural Research Centre, Tandojam, Pakistan).

Attempts to breed a high oleic acid castor through induced mutations

Although castor (Ricinus communis) can give high oil yield under relatively dry conditions of semi-arid tropics, its oil is unsuitable for human consumption, because its fatty acids comprise 90 to 95% of ricinoleic acid. Ricinoleic acid has the property of irritating the intestinal mucosa, which is the cause of the well known purgative effect of this oil. Chemically, ricinoleic acid is 12-hydroxy-oleic acid and it is generally assumed that oleic acid acts as the precursor of ricinoleic acid in the biosynthesis of this oil. We therefore decided to induce a mutation in castor in which the conversion of oleic to ricinoleic acid is blocked. A similar mutant, albeit occuring naturally has been reported in the case of safflower (Carthamus tinctorius L.). Safflower oil normally contains about 80% linoleic acid among its total fatty acids, whereas the high oleic variety contains about 80% oleic acid.

The search for a low ricinoleic mutant was undertaken in the M_2 generation of castor (var. Aruna), grown in an area of about 3 ha during monsoon 1979. The mutagenic treatment used in this study was seed irradiation with a gamma source with dosages ranging from 10 to 50 kR. A simple alcohol solubility test was used as a means of identifying low ricinoleic castor, because glycerides containing ricinoleate radical are soluble in alcohol while other fatty glycerides are insoluble. None of the 50,000 plants in M_2 possessed oil that was clearly insoluble in alcohol. Oil of 11 plants showed a slight turbidity when shaken with alcohol. A commercial laboratory analysed these samples for us and they proved to show slightly lower values of ricinoleic percentage, ranging from 81 to 84%. Screening being continued.

(Contributed by A.D. Karve, Nimbkar Agricultural Research Institute, Phaltan 415523, Maharashtra, India (Present address: FAO Expert, Agricultural Research Institute, Yezin, Burma)).

Tifway-2 bermudagrass

Tifway-2 is a vegetatively propagated mutant of Tifway bermudagrass induced by exposing dormant rhizomes of Tifway to 9000 rads of gamma irradiation. Exposed rhizomes were planted in flats and plants developing from them were set in 2-inch clay pots. These were later set in the field on 3-foot centers in May, 1971. As they began to spread, plants or sectors of plants that appeared to be different from Tifway were transplanted to pots in the greenhouse. Tifway-2 was one of these mutants, listed in Table 1 as Tifway mutant 72-126.

Tifway-2 looks like Tifway and differs only in the characters described in Table 1. When compared with Tifway, it makes a denser, more weed-free turf, exhibits a little better quality, is more resistant to root knot, ring and sting nematodes, is more frost tolerant, and shows better spring growth. It is the combination of these traits, none of which can be used for identification, that warrant the release of Tifway-2.

Tifway-2 with 30 other turf bermudas was grown at Athens, Georgia in 1978 and 1979 where it was found to be more frost tolerant.
The ratings and various evaluations made on Tifway-2 and 11 other bermudagrasses since 1972 are summarized in Table 1.

Table 1.

The comparative performance of Tifgreen, Tifdwarf, and Tifway bermudagrass and nine of their mutants induced by exposure to gamma rays from Cobalt 60

	Maximum Height-inches	Height-inches ater 4 weeks	Turf quality May	Turf quality October	Sod webworm damage %	Nematodes 150 cc of soil after 3 years				Frost Response Athens, Ga. 1978 Ratings made		Growth and Cover 4/10/1980
						Root Knot	Ring	Stubby	Sting	11/22	12/13	
Tifgreen	8	4	2.0	1.0	0	465	127	29	69	2.5	1.7	6.5
Tifgreen mut. 72-16	12	9	1.5	1.0	0	0	90	20	290	5.5	1.7	1.0
Tifgreen mut. 72-49	6	2	1.7	1.0	8	1260	260	80	0	3.0	1.0	9.0
Tifgreen mut. 72-54	12	7	1.0	1.0	0	2360	480	60	0	4.2	1.0	2.5
Tifgreen mut. 72-59	15	8	1.0	1.0	0	0	190	0	0	4.0	2.8	2.5
Tifdwarf	2	2	2.0	2.2	63	411	153	27	16	3.5	1.5	7.0
Tifdwarf mut. 70-45	3	2	1.5	1.0	47	380	860	20	80	2.5	1.0	6.5
Tifdwarf mut. 70-47	4	3	1.2	1.0	40	140	140	0	0	1.2	1.2	5.0
Tifway	13	8	1.0	1.2	0	34	223	18	7	4.0	1.7	3.0
Tifway mut. 72-114	7	3	3.0	1.0	0	0	160	0	20	3.7	2.5	3.5
Tifway mut. 72-117	14	9	1.0	1.0	0	0	10	0	0	5.7	2.5	1.5
Tifway mut. 72.126	16	8	1.0	1.0	0	0	160	40	0	5.0	4.0	1.5

Management has been minimal to indicate those grasses able to provide good turf with reduced maintenance. Thatch has been removed each spring and 2,4-D (1 lb/A) has been applied to remove winter weeds. Fertilizer (a 4-1-2 $N-P_2O_5-K_2O$) has usually been applied to give 100 lbs. of N/A in mid March and one or two applications later in the season.

Generally herbicides, fungicides, insecticides, and nematicides have not been applied. If applied, all plots received the same treatment.

RATINGS - Grasses rating 1 have the fewest heads, the best sod density, turf quality, growth and cover and the fewest weeds. Frost response ratings made by Dr. Tim Bowyer give grasses with the least frost tolerance a rating of 1 and those with the greatest tolerance a rating of 5.0. Ratings made 12/13 following 4 days of freezing lows.

Tifway-2 will be suited for lawns, fairways, tees, and football fields throughout the South and subtropics of the world where Tifway is presently grown.

(Contributed by G. Burton, USDA, Coastal Plain Station, Tifton GA 31793, USA).

Success in mutation breeding of sesame

In 1974, 1 hour pre-soaked seeds of the sesame variety Binayak were treated with 1% EMS solution for a period of six hours at $23^o \pm 1^oC$. Later, the seeds were washed thoroughly for 1 hour and sown in the field. From among many economically useful mutants screened in M_2 generation during 1975 a particular mutant namely, BM 3-7 was found to possess several desirable traits. M_3 population was raised out of BM 3-7 seeds and segregants and off-types were harvested and kept separately. In M_4 seeds of BM 3-7 mutant lines were pooled and the performance of the mutant strain was tested in several locations for a period of 4 years. BM 3-7 has several desirable attributes. Firstly, the plant type had changed from tall, loose type to dwarf compact-branched type. The seed number per capsule has increased (Table 1). The total yield of the mutant increased

Table 1. Plant characteristics of BM 3-7 and its parent Binayak

Characters	BM 3-7	Binayak
Plant height (cm)		
Kharif-season	80	105
Rabi-season	60	70
Branch number	3.7	3.4
Branching type	Compact	Loose
Capsule size (mm)	22.3x8.1x6.7	24.0x8.2x6.6
Seed number per capsule	82	71
Seed coat colour	light brown	brown
1000 seed weight (gm)	2.18	2.78
Oil content (%)	48.7	48.5
Days to maturity	82	80

by ca. 15% and ca. 19% in Kharif and Rabi seasons respectively as compared to the parent (Table 2). In view of its high yield potential, good plant type and wide adaptability the mutant BM 3-7 was released by Orissa State Variety Release Committee in 1980 under the name "Kalika" (ref. Mutation Breeding Newsletter no. 17, p.14, 1981).

Table 2. Yield performance of Binayak and its mutant BM 3-7

	Season/Year	Yield in Kg/ha BM 3-7	Binayak
KHARIF	1976(1)*	464	462
	1977(6)	540	435
	1978(4)	371	292
	Mean	458.33	396.33
	% of parent	115.66	100
RABI	1978(4)	780	604
	1979(2)	558	514
	Mean	669	559
	% of parent	119.68	100

*The figure in parentheses denotes number of locations.

(Contributed by B.S. Panda, Potato Improvement Project Orissa University of Agriculture and Techn., Bhubaneswar 751 003, Orissa, India).

A mutant with a very long lasting vegetative phase in spinach

For field-grown spinach it would be important to have varieties that are able to grow in summer. Following treatment of 500 000 seeds of the variety "Frühremona" with 2.5% EMS a mutant no. F 73/7 with a long vegetative phase was selected. The mutant was initially female, but by artificial illumination 20 h per day it was possible to induce 5-10% male flowers so that selfed seeds could be obtained. The mutant character was found to be monogenic recessively inherited, however the recessivity is not complete. The allele's expression seems to be favoured in female segregants. Breeding experiments aim at developing a dioecious variety with the same long vegetative phase.

Monoecious F_3 lines from crosses with the mutant have been tested in yield and quality trials. They were found to have the following advantages:

1. More than double the leaf yield of standard varieties, at a three-week later harvest.

2. High dry matter values such as required by the canning industry.

3. Iron content about four times that of standard varieties, due to the later date of harvest.

4. A fourfold lower content of oxalic acid.

Even when grown in July - August, a time when even the latest spinach varieties bolt very quickly, the mutant derived lines produced a green matter yield of 282 dt/ha.

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HANDKE, S., A mutant with very long lasting vegetative phase in spinach. Proceedings of EUCARPIA Meeting on Leafy Vegetables. Littlehampton (UK) 11 - 14 March 1980.

(Contributed by S. Handke, Bundesforschungsanstalt für Gärtnerische Pflanzenzüchtung, Ahrensburg (FRG)).

Selection for higher yield in early maturing mutants of soybean

A mutation breeding programme was initiated in the Plant Breeding Department, University of Agricultural Sciences, Gödöllő, in 1971 with the objective to improve the productivity and earliness of soybean varieties.

Seeds were treated with gamma rays from ^{60}Co. Doses applied ranged from 10 kR to 30 kR. In the M_2, M_3 and M_4 generation we selected for early maturing mutants.

The seed yield of earlier maturing mutants was generally lower. In the search for higher yielding genotypes the selection for improved Harvest Index /HI/ - defined by Donald /1962/ as the ratio of the grain dry weight to the total above ground dry weight of a crop at - was tried.

Mutant lines differed significantly from control with respect to plant height, plant weight and seed weight per plant. The harvest index could not significantly exceed the control in mean performance, but some lines with better seed production efficiency than control were observed. Of all the mutant lines, 39% showed better HI values than the control. But with respect to seed weight per plant 51% of the mutant lines were inferior to the control.

The earliest mutant lines had a significantly lower HI than later maturing ones. However, control varieties with different growing periods did not differ significantly in HI values.

Strong correlations existed between plant weight and seed weight per plant, the components of HI. Some lines showed an increase in both yield per plant and HI while in others seed yield per plant increased without changing the HI.

One can conclude that for selecting high yielding genotypes in soybean, selection based on HI is insufficient and seed yield per plant must be kept in view.

(Contributed by G. Kotvics, Department of Plant Breeding, University of Agricultural Sciences, 2103 Gödöllő, Hungary).

Parameters of early mutant lines

Parameter	Mutant lines		Altona /control/	
	$\bar{x}$	$\pm s$	$\bar{x}$	$\pm s$
Plant height /cm/	76,46	10,38	46,21	5,31
Plant weight /g/	21,39	9,87	10,73	4,26
Seed weight/plant /g/	8,57	5,35	5,37	2,01
Harvest Index /HI/	0,39	0,08	0,50	0,03

Relationship between growing period and HI

Growing period till harvesting date	days	No. of Mut. lines	HI	
			$\bar{x}$	$\pm s$
	116	38	0,33	0,04
	120	22	0,41	0,08
	124	32	0,43	0,09
	142	Altona (control)	0,50	0,03
	149	Isz 10 (standard)	0,49	0,04

Relationship between seed yield of mutant lines and harvest index

Mutant lines	Seed yield/plant g	HI	Correlation coefficients	
			plant wt./ seed wt.	seed yield/ HI
A-I-13	5,49	0,35	0,99	0,17
A-II-1	8,68	0,29	0,89	0,03
C-IX-34	12,92	0,46	0,98	0,29
C-XIV--128	10,41	0,52	0,86	0,21
C-XIV-133	18,42	0,52	0,92	0,25
C-X̄-36	23,96	0,51	0,93	0,16
Altona (Control)	5,37	0,50	0,95	0,18

(Based upon paper "The effect of gamma irradiation in soybean" presented by G. Kotvics, Department of Plant Breeding, Agricultural University Gödöllő, Hungary at the ESNA Conference 1980, Debrecen, Hungary).

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
Triticum aestivum			
Jauhar-78	1979 Pakistan K.A. Siddiqui Atomic Energy Agric. Res. Centre, Tandojam Sind	600 rad N_f 1972 [Nayab]	high yield, improved grain colour (amber)
Yuang Nong No. 53	1970 P.R. of China The Lab. of Mutation Genet. and Breeding, Inst. for Application of Atomic Energy, CAAS, Beijing	^{60}Co γ-ray (15 kR) 1967 [(Yuang Nong No. 39 x Orefen)]	spring wheat, higher yield, resistant to three kinds of rust, growth period about 90 days, 110 cm height, suitable for northern China spring wheat region
Yuang Nong No. 61	1971 P.R. of China The Lab. of Mutation Genet. and Breeding, Inst. for Application of Atomic Energy, CAAS, Beijing	^{60}Co γ-ray (20 kR) 1967 [(Yuang Nong No. 39 x Orefen)]	spring wheat, higher yield, resistant to three kinds of rust, 90 cm height, suitable for northern China spring wheat region

Yuan Chun No. 7112	1974 P.R. of China The Lab. of Mutation Genet. and Breeding, Inst. for Application of Atomic Energy, CAAS, Beijing	[Mo Pa No. 66 x Yuan Nong No. 60]	spring wheat, high yield, short and strong, straw (about 70 cm), good tillering, resistant to three kinds of rust
Yuan Dong No. 772	1977 P.R. of China The Lab. of Mutation Genet. and Breeding, Inst. for Application of Atomic Energy, CAAS, Beijing	^{60}Co γ-ray (25 kR) 1972 [(11141 x 12040)]	winter wheat, higher yield, good tillering and winter hardiness, early maturity, resistant to stripe rust, white grain colour
Yuan Dong No. 7848	1978 P.R. of China The Lab. of Mutation Genet. and Breeding, Inst. for Application of Atomic Energy, CAAS, Beijing	^{60}Co γ-ray (25 kR) 1973 [(12040 x Aurora)]	winter wheat, higher yield, resistant to stripe and leaf rust, early maturity, strong straw, good plant type, white grain colour
<u>Triticum turgidum</u> G 0367	1970 Greece E.A. Skorda Cereal Institute Thessaloniki	12.5 x 10^{12} N_{th} cm^{2} 1963 [YG 3688]	short culm, resistant to lodging excellent quality
<u>Oryza sativa</u> Arlatan	1979 France R.A. Marie, M. Grillard J.L. Seguy Station d'Amelior. des Plantes, INRA Montpellier	γ-rays 1970 [Arlesienne]	improved threshability higher yield (15%)

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
Oryza sativa (continuation)			
Calendal	1979 France R.A. Marie, M. Grillard, J.L. Seguy Station d'Amelior. des Plantes, INRA Montpellier	γ-rays 1970 [Arlesienne]	longer grain, improved threshability, better tolerance to Sclerotium oryzae same yield
M 301	1980 USA C.W. Johnson, H.L. Carnahan, S.T. Tseng, D.M. Brandon Coop. Rice Res. Foundation Inc. Biggs and Dept. Agron. Univ. of California Davis	cross (Calrose 76 x CS-M3) x M5 1974	medium grain shape, intermediate maturity, short stature, daylength tolerant, lodging resistant
S 201	1980 USA H.L. Carnahan, C.W. Johnson, S.T. Tseng, D.M. Brandon Coop. Rice Res. Foundation Inc. Biggs and Dept. Agron. Univ. of California Davis	cross (Calrose 76 x CS-M3) x S6 1974	short stature, resistant to lodging short grain, early maturing, daylength tolerant
RD 10	1981 Thailand P. Khambanonda Rice Div. Dept. Agriculture Bangkok	1 krad N_f 1969 [RD 1]	glutinous endosperm otherwise like RD 1; daylength tolerant, 130 days to maturity, high yield, slender grain, moderate resistance to blast and BLB

CNM 6	1980 Calcutta State, India A.R. Debnath, S. Sen Rice Res. Station Chinsurah West Bengal	dry seed 30 kR X-ray 1971 /IR 8/	earlier maturing 15-23 days, increased effective tillering, long grain; 10% higher yield per day, drought tolerant
CNM 20	1980 Calcutta State, India A.R. Debnath, S. Sen Rice Res. Station Chinsurah West Bengal	pre-soaked seed 30 kR X-ray 1971 /IR 8/	earlier maturing 10-12 days, increased effective tillering, long grain, resistant to BLB, BLS, BPH
CNM 25	1979 Calcutta State, India A.R. Debnath, S. Sen Rice Res. Station Chinsurah West Bengal	pre-soaked seed 30 kR X-ray 1971 /IR 8/	earlier maturing 14-25 days, increased effective tillering, long grain; 15% higher yield per day, resistant to thrips
CNM 31	1979 Calcutta State, India A.R. Debnath, S. Sen Rice Res. Station Chinsurah West Bengal	pre-soaked seed 30 kR X-ray 1971 /IR 8/	earlier maturing 10 days, increased effective tillering, long grain; 9% higher yield per day, resistant to BLB, BLS, BPH, brown spot
Linum usitatissimum			
Dufferin	1979 Canada E.O. Kenaschuk Agric. Canada Res. St. Morden Manitoba	Cross Redwood 65 x (4013 x Raja)	similar to Redwood 65, but higher oil content and better resistance to Melampsora lini (Ehrenb.) Lev.
Pisum sativum			
Hamil	1981 Poland J. Jaranowski Inst. of Genetics Acad. of Agric. Poznan J. Mikolajczyk, H. Strykala Plant Breed. Stat. Przcbedowo	Cross (Wasata x 1.6L/78) x Porta	change of leaflets to tendrils, early maturity, high yield, lodging resistant; suitable for combine harvest

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
Zea mays			
Yuan 74-751 (inbred)	1974 P.R. of China The Lab. of Mutation Genet. and Breeding, Inst. for Application of Atomic Energy, CAAS, Beijing	^{60}Co γ-ray (25 kR) x micro-wave (8 mm, 60'), 1971 [(Tang Szu Pin Tou x Ye No. 2)]	good plant type, erect leaf, resistant to leaf spot, good combining ability, "Yuan Lien No. 5" is a single cross hybrid, with this inbred, suitable for Hobei, Honan and Sandong provinces
Yuan 79-171 (inbred)	1979 P.R. of China The Lab. of Mutation Genet. and Breeding, Inst. for Application of Atomic Energy CAAS, Beijing	^{60}Co γ-ray (3 kR), 1976 [Pollen grains of inbred "Kung No. 70"]	short culm (about 140 cm), growth period around 90 days, resistant to leaf spot, good combining ability, the growth period of single-hybrid (79-171 x 79-418) is about 80 days, suitable for Beijing region
Yuan 79-418 (inbred)	1979 P.R. of China The Lab. of Mutation Genet. and Breeding, Inst. for Application of Atomic Energy CAAS, Beijing	fast neutrons (1.2x10"/cm) 1976 [(A96 x Da Qiu36 x B64)]	growth period around 95 days, resistant to leaf spot, tolerant to water log, good combining ability, suitable for Beijing region
Prunus cerasus L.			
Polukarlik Orlovskoi Rannei (Orel early semi-dwarf)	1979? USSR Zonal Istnaya Plodovo=Yagodnaya Opytnaya Stantsiya Orel	buds, gamma-rays [Orel Early]	semi-dwarf type
Polukarlik Turgenevki (Turgenevka semi-dwarf)	1979? USSR Zonal Istnaya Plodovo=Yagodnaya Opytnaya Stantsiya, Orel	buds, gamma-rays [Turgenevka?]	semi-dwarf type
Karlik Samorodka (Dwarf Nugget)	1979? USSR Zonal Istnaya Plodovo=Yagodnaya Opytnaya Stantsiya, Orel	buds, gamma-rays [Samorodka?]	dwarf type

Prunus persicae			
Plovdiv 6	1981 Bulgaria A. Angelov, K. Filev, T. Arnaudova Inst. of Fruit Growing Plovdiv and Inst. of Genetics Sofia	pollen of Dupnishka γ-rays 1966 [Halle x Dupnishka]	higher yield, large fruit, good quality; middle early flowering
Corchorus capsularis			
JRC-7447	1980? India S. Sen, J. Joseph Jute Agric. Res. Inst. Barrackpore, W. Bengal	25 kR X-rays [JRC 212]	10% more yield with 60 kg N/ha recommended for capsularis jute belt except low lying areas
Ficus carica L.			
Bol (Abundant)	1979? USSR Institut Genetiki i Selektsii Baku, Azerbaijan SSR	seeds; 5-7 krad gamma-rays [?]	
Punica granatum L.			
Karabakh	1979? USSR Institut Genetiki i Selektsii Baku, Azerbaijan SSR	seeds; 5-7 krad gamma-rays [?]	
Khyrda	1979? USSR Institut Genetiki i Selektsii Baku, Azerbaijan SSR	seeds; 5-7 krad gamma rays [?]	dwarf type

PUBLICATIONS

The Catalogue of Pisum Lines (Collection of Wiatrowo Pea Gene Bank), Poznan 1981. Available from W.K. Swiecicki, Plant Experiment Station Wiatrowo, 62 - 100 Wagrowiec (Poland).

Improvement and Production of Maize, Sorghum and Millet, 2 volumes. FAO Plant Production and Protection Paper 24. FAO Rome 1980.

The Role of Induced Mutations in Crop Improvement. Proceedings of a symposium, Hyderabad (India), 10 - 13 September 1979. Published by Food and Agric. Committee, Department of Atomic Energy, Government of India, Bombay 1980.

The papers are concerned with the following subjects:

I. Rice

V.V.S. Murty	mutation breeding for high yield
R.N. Misra	induced mutation in rice breeding
G.M. Reddy	induced mutations in rice improvement
P. Narahari	induction of mutations and their use
A.R. Debnath, S. Sen	high yielding mutants for West Bengal
R.C. Chaudhary et al.	productive mutants in scented rice
H.K. Mohanty, S.R. Das	plant height mutations
S.C. Prasad, S.K. Sinha	promising mutant variety
J.P. Lal, A.K. Richharia	plant type for nitrogen responsiveness
T. Venkat Reddy et al.	amylase activity in induced dwarfs

II. Wheat

V.L. Chopra, R.A. Pai	mutation research in wheat in India
J. Singh et al.	yield contributing traits and protein
R.M. Desai	protein quantity and quality (durum)

III. Sorghum, Maize, Barley

C.S. Reddy, N.G.P. Rao	induced mutations in sorghum improvement
Joginder Singh	induced mutations in maize improvement
R.P. Sharma	mutation breeding in barley
H.C. Bansal	improving nutritional quality

VI. Pulses

B.H. Matai et al.	improvement of pulse crops
B. Sharma	mutation breeding of grain legumes
M.C. Kharkwal	mutation breeding in chickpea
C.P. Batnagar et al.	early, high yielding mutant in gram
S.E. Pawar et al.	seed size in early pigeon pea
J.L. Tickoo	high yielding mung

V. Oil seeds

T.P. Yadav, P. Kumar	major oil seed crops
K.S. Labana et al.	Brassica juncea
S.H. Patil, Ch. Mouli	groundnut
P.K. Sinha, H. Rahman	mutant varieties of groundnut
Ch. Mouli et al.	sequential flowering in groundnuts
G.G. Nayar	improvement of mustard

VI. Fibre crops

R.M. Raut	induced mutations for cotton breeding
D.P. Singh, S.L. Basak	problems of breeding in jute
D.C. Joshua	mutation breeding in jute
S.P. Sinha et al.	plant height in jute

VII. Vegetatively propagated crop plants

M.D. Upadhya, S.P. Tiwari	induced mutations in potato
D. Jagathesan	genetic variability in sugar cane
H.K. Sh. Rao	mutation breeding in sugar cane
V. Gapinathan Nair	productive mutants in lemon grass
S.N. Kak, B.L. Kaul	improvement of Mentha species

VIII. Stimulant and medicinal plant

K.T. Ramavarma et al.	low nicotine mutants
K.K. Krishnamurty et al.	mutants in tobacco cross breeding
V.R. Dnyansagar, A.R. Pingle	S.viarum with high solasodine content

IX. Induced mutations for disease resistance

R.G. Saini, A.K. Gupta	mutations for disease resistance
S.C. Mathur	disease resistance in rice
M.V. Reddy, Y.L. Nene	Ascochyta blight resistance in chickpea

X. Induced mutations for quantitative characters

J.V. Goud	improvement of quantitative characters
Ravi et al.	quantitative traits in lentil
I.A. Khan, N. Hashim	quantitative parameters in green gram

XI. Ornamental plants

M.N. Gupta	improvement of ornamental plants
S.G. Kashikar, A.S. Khalatkar	Petunia hybrida
B.M. Desai, V. Abraham	somatic mutations in ornam. plants

Improvement of Native Rices Through Induced Mutation.
M. Mahadevappa, H. Ikehashi, H. Noorsyamsi and W.R. Coffman.
IRRI Research Paper Series no. 57, Feb. 1981.

FUTURE EVENTS

1981

New Genetical Approaches to Crop Improvement, 7 - 11 November, Karachi (Pakistan). Contact: K.A. Siddiqui, Atomic Energy Agric. Research Centre, Tandojam, Pakistan

1982

FAO/IAEA Regional Seminar on the Utilization of Induced Mutations for Crop Improvement in Latin-America, Lima (Peru), 18 - 23 October.

5th International Congress of Plant Tissue and Cell Culture, 11 - 16 July, Tokyo (Japan). Contact: Japan Convention Services Inc. Nippon Press Centre, Bldg. 2-1, Uchisaiwai-cho, 2-chome, Chiyoda-ku, Tokyo.

21st International Horticultural Congress, 29 August - 4 September, Hamburg (FRG). Contact: Hamburg Messe und Congress GmbH. Postfach 30 23 60, D-2000 Hamburg 36, FRG.

1983

6th International Wheat Genetics Symposium, 28 November - 3 December, Kyoto, Japan. Contact: S. Sakamoto, Faculty of Agriculture, Kyoto Univ., Mozume Muko, Kyoto 617, Japan.

10th International Congress of Plant Protection, 20 - 25 November, Brighton, UK. Contact: Franck Bishop (Conference Planners) Ltd., 144 - 150 London Road, Croydon CRO 2TD (UK).

ANNOUNCEMENT

In 1982/83 we plan to have consultations on

(a) the importance of selection methods for success in mutation breeding.

(b) the potential role of induced mutations for "domestication" of "wild" plant species.

Please write to us if you have something substantial to contribute to one of these topics.

Mutagen treated material for training and demonstration

The IAEA Laboratory has available M_1 single plant/spike progenies of barley (cv. Aramir) and pea (cv. Rheinländerin) from treatments with gamma rays, fast neutrons and EMS. Anyone interested in using the material (e.g., for demonstrating M_1 spike sterility and M_2 segregation of seedling mutations) may write to Dr. T. Hermelin, Agriculture Section, IAEA Seibersdorf Laboratory, P.O. Box 100, A-1400 Vienna, Austria.

If you want to have your own seed material treated with gamma rays or fast neutrons, you may send them to Dr. H. Brunner, (address as Dr. Hermelin) in good time before you need the material.

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 generally be limited to one or two.

Alexander MICKE
Lhamo WAHL

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

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