Mutation Breeding Newsletter

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Report from the FAO/IAEA Plant Breeding and Genetics Section

The Section's work during 1978 continued to focus via the IAEA Research Contract Programme upon three major areas: (1) the improvement of cereal endosperm protein (2) the improvement of disease resistance (3) mutation breeding of plants with vegetative propagation or long generation cycles. The work on the first two issues has been made possible by financial contributions from the Federal Republic of Germany (through GSF) and Sweden (through SIDA). In September 1978, an international Symposium on Seed Protein Improvement in Cereals and Grain Legumes was organized at Neuherberg (FRG), to review the achievements during 8 years of the FAO/IAEA/GSF Coordinated Research Programme and to provide an outlook upon future trends and emphasis (see report page 17). The programme will now enter a phase where consolidation of achievements and confirmation of results are expected after which practical breeding programmes will take over the task and when governmental authorities will have to be concerned with introducing nutritionally improved cereal crop cultivars into the market and promoting their cultivation by education and incentives.

The Coordinated Research Programme on Improvement of Vegetatively Propagated Crops and Tree Crops through Induced Mutations had its 3rd coordination meeting 22 - 26 May at the Pomology Research Institute Skierniewice (Poland). From 6 to 22 October, T. Hermelin guided a FAO/IAEA Study Tour on the Application on Nuclear Methods in Agriculture through the Ukrainian SSR. 19 participants from 14 Member States participated and 6 research institutes in Kiev, Odessa and Yalta were visited.

Likewise in October the FAO/IAEA Regional Seminar on the Utilization of Induced Mutations for Crop Improvement in Africa, planned since several years, was held at the International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria. In spite of a number of administrative obstacles, 25 scientists from 10 African countries participated in the Seminar. It is hoped that as a consequence of this Seminar closer cooperation will be established, leading to more efficient use of resources and to better results.

Through the IAEA Technical Assistance Programme the Plant Breeding and Genetics Section has been serving during the past year 12 projects in developing countries. In addition a number of fellowships could be provided for training. Main emphasis of Technical Assistance Projects was on genetic improvement of rice (Bangladesh, Indonesia, Malaysia, Pakistan), grain legumes (Bangladesh, Brazil, Indonesia, Malaysia, Pakistan, Venezuela), sorghum (Venezuela), wheat (Brazil, Pakistan), Barley (Iraq), cotton (Sudan). The financial support for these projects came from IAEA, UNDP and SIDA.

During 1978 the staff of the Plant Breeding Section was as follows:

Section Head:	Dr. Alexander Micke (FRG)
Section Staff:	Dr. Knut Mikaelsen (Norway)
	Dr. Richard D. Brock (Australia) left 19 January 1979
Laboratory Staff:	Dr. Thorsten Hermelin (Sweden)
	Dr. Alberto Brunori (Italy)
	Dr. Helmut Brunner (Austria)

RESEARCH NEWS

The use of the short straw mutant Cp B 132 in breeding high yielding durum wheats in Austria

The short-straw mutant Cp B 132 was produced by irradiating the Italian durum variety Cappelli with thermal neutrons [1] and has been entered in the Italian List of Varieties under the name 'Castelporziano' in 1968. The reduced straw length of Cp B 132 is controlled by a single dominant factor [2,3]. Under Austrian conditions Cp B 132 displayed a medium plant height, good standing capacity and kernel performance, high susceptibility for stem rust and mildew, and yielded 83.3% of the Austrian variety 'Adur' in the average of 11 field trials at the Probstdorfer Breeding Station near Vienna.

In 1967 the black awned Cp B 132 was crossed with 'Adur', a white-awned, long straw variety with good resistance against stem rust and mildew, and mostly lodging under conditions of high soil fertility. The intention was to breed a disease resistant, short-straw variety adapted to the climatic conditions of the Eastern plane of Austria. The first selection for short-straw, disease resistance and kernel performance was made in F_2, followed by a pedigree breeding up to F_6. Simultaneously yield tests of F_3 plant progenies were conducted. The white awned line P 20 derived from this cross and was entered in 1978 in the Austrian List of Varieties under the name 'Probstdorfer Miradur'.

In table 1 the results of the Austrian State Trials in 1976, 1977 and 1978 of 'Prob. Miradur' (= P 20) and 3 other lines (P 130, P 166, P 738) derived from the same cross (Cp B 132 x Adur), and of the higher yielding parent 'Adur', the Austrian variety 'Prob. Pandur' and the French variety 'Valdur' are given.

Table 1. Results of the Austrian Durum State Trials 1976-1978. P-lines are derived from the cross Mutant Cp B 132 x Adur (Adur = higher yielding parent)

	Average yield 1976	kg/ha 1977	1978	Yield % 1976-78	Plant height (cm)	Lodging (1-9)	Mildew (1-9)	Stem rust (1-9)	Date of heading	Weight per 1000 kernels (g)	Weight per hl (kg)	Vitreous kernels %
No. of trials	5	5	5	15	15	15	13	2	6	8	8	13
Line or Variety												
Adur	4330	4128	3996	100	131	5	3	2	8.VI	40.9	82.3	94
P 20	5322	4866	5924	129	94	2	5	2	9.VI	41.8	81.4	88
P 130	5404	4898	5896	130	98	2	5	1	9.VI	46.4	81.6	90
P 166	4956	4584	5386	120	97	2	3	1	10.VI	46.8	80.4	93
P 738	4748	4608	5250	117	92	3	4	4	10.VI	40.6	80.0	87
Pandur	4550	4496	4250	107	111	4	3	1	7.VI	39.8	78.3	94
Valdur	4802	4188	5206	114	95	3	3	1	8.VI	34.3	79.3	94
m.s.d. P 0.05				5.7								

The yield transgression of the four cross products, surpassing the better parent 'Adur' by 17 to 30%, is evident. Yield transgression was also found in other crosses with Cp B 132 [3]. In the two highest yielding lines P 20 and P 130 the short straw, the lodging resistance and in P 130 also the high kernel weight of Cp B 132 is combined with the stem rust resistance of 'Adur'. Their seedling resistance against mildew is nearly as low as in Cp B 132, whereas their adult plant resistance is improved.

When using the data of the 15 State Trials 1976-1978 for calculating the regression y = yield of the variety on x = mean yield of the trial, the b values of P 20 and P 130 are +0.92** and +0.86**, and of 'Prob. Pandur' and 'Adur' +0.49 and +0.52* respectively. The latter two b values differ, on the 0.05 probability level, from the former two. This shows the better yield response to improved growing conditions of the new lines with the short-straw factor of Cp B 132. Similar response differences were found between Cp B 132 and its mother variety 'Cappelli' in trials with increasing amounts of ammonium nitrate [1].

To make a fair comparison of the quality characters of the 30% higher yielding varieties P 20 and P 130 with 'Adur', fertilizer trials are under progress.

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[2] BOZZINI, A., SCARASCIA-MUGNOZZA, G.T., A dominant short-straw mutation induced by thermal neutrons in durum wheat. Wheat Inform. Serv. 5 (1967) 23-24.

[3] BOZZINI, A., Breeding possibilities offered by induced mutations in durum wheat. Theor. and Appl. Genetics 44 (1974) 304-310.

(Contributed by H. Hänsel, Probstdorfer Saatzucht, Probstdorf, 2301 Gross-Enzersdorf, N.O.)

Early mutants and hybrids of durum spring wheat

Five hundred mutants induced by chemical mutagenes in the variety Khar'kovakaya 46 (Kh-46) and eight hundred hybrid families from crossing of some of these mutants were studied several years. As a result of this study 258 mutants and 148 hybrid lines with valuable characteristics were selected. Among them 47 mutants and hybrid selections were notable for earlier ripening (by 3-7 days) as compared with the initial variety. Most of these earlier ripening forms were less productive than the initial variety Kh-46. Productivity of 11 mutants and hybrids approached the level of the initial variety (2800 - 3100 kg/ha). Grain yield of 7 mutants varied between 3200 and 3730 kg/ha, i.e., 282 - 812 kg/ha above the average productivity of Kh-46.

In the period from 1974 to 1978 two mutants of the latter more productive group and two less productive mutants were tested in trials with plots of 50 m^2 and four-fold repetition. Mutants 142 and 1211 ripened on the average ca 4-5 days earlier than the initial and had considerable yield reductions. The two other earlier ripening mutants, 969 and 745, proved to be significantly more productive than the initial variety (table). However, mutants 745 and 969 suffer from certain shortcomings peculiar also to the initial variety which has great height and insufficient strength of the culm. Owing to these shortcomings the mutants 745 and 969 are not resistant to lodging in humid years and at higher doses of fertilisers.

Duration of vegetation

Genotypes	1974	1975	1976	1977	1978
Kh - 46	121	110	125	119	118
Mut 142	114	106	118	114	115
Mut 745	-	-	120	116	115
Mut 969	116	107	120	116	111
Mut 1211	115	108	122	-	-

Yield in kg/ha

	1974	1975	1976	1977	1978
Kh - 46	3190	2360	3250	2680	3110
Mut 142	3110	2130	3060	-	-
Mut 745	-	-	<u>3680</u>	<u>3170</u>	<u>3680</u>
Mut 969	<u>3420</u>	<u>2890</u>	<u>3930</u>	<u>3550</u>	<u>3760</u>
Mut 1211	2640	2440	2470	-	-

Attempts were made to remove the shortcomings and to improve the productivity of earlier ripening mutants by means of single plant selection in populations of the mutants and after hybridization between themselves and with other mutant forms. Single plant selection in some cases resulted in increased productivity. At least four of these lines are of potential practical value, however, they must be tested again for productivity in larger areas. Productivity of 23 mutants and 83 hybrid lines from crossing of mutants selected for earlier (by 3-6 days) heading is also being studied. About 15% of these lines have shorter and stronger culms, and are more resistant to lodging.

One may conclude that early ripening of induced wheat mutants does not necessarily correlate with reduced productivity, and hence, early ripening of mutant forms may be combined with other valuable characters by means of hybridization.

(Contributed by P.K. Shkvarnikov, Institute of Molecular Biology and Genetics, Academy of Sciences, Ukrainian SSR, Kiev, USSR).

Italian durum wheat varieties obtained by induced mutations and their economic importance

Since 1968 eight durum wheat varieties were released and officially approved in Italy, which derived from mutation breeding. Four represent mutants induced by radiation, the others resulted from cross breeding with mutants (table).

Castelporziano, Castelfusano, Casteldelmonte and Castelnuovo showed improved lodging resistance and higher yield, particularly in Central and Southern Italy, but are now cultivated only to a small extent.

The varieties Creso, Tito, Mida and Augusto, however, represent a substantial progress for the durum wheat production in Italy due to a combination of high yield capacity, lodging resistance and disease resistance. They are recommended for fertile soils with good availability of water and under such conditions are competitive with bread wheat. Creso and Mida are semidwarf types with Norin-10 genes, while the short-straw trait of Tito and Augusto originated from the mutant Castelporziano. Tito is competitive in yielding ability and lodging resistance with the semidwarf types and represents an alternative to Norin-10 lines as a source of short culm character. After their registration in the "Catalogo Italiano dell Instituto dei Registri di Varieta dei Prodotti Sementieri", these varieties became very popular and covered already in 1977 30% (= 450 000 km) of the Italian durum wheat area. The amount of certified seeds produced rose from 69000 quintals in 1976 to 450 000 quintals in 1977.

(Contributed by B. Donini and L. Rossi, Laboratory of Agriculture, CNEN, CSN Casaccia, St. Maria di Galeria, Italy)

A short-statured mutant line of wheat with improved leaf rust resistance

Mexipak 65 was the first semidwarf, more fertilizer responsive wheat variety successfully introduced in Pakistan but after a few years it was gradually replaced by new varieties mainly due to its susceptibility to leaf rust. A programme was initiated to induce short-stature and resistance against leaf rust in Mexipak 65. The mutant line NIAB 603 was obtained which is 26.5% shorter than the parent Mexipak 65.

Variety/mutant	Height (cm)	Peduncle length (cm)	Internode length (cm)			
			I	II	III	IV
Mexipak 65	102.60	32.88	17.25	14.37	13.50	11.92
NIAB 603	75.40	27.26	13.34	9.62	7.46	4.36

The reduction of height in the mutant line is due to reduction in various internodes as well as the peduncle length. The mutation inherited as a single recessive gene.

In space planting it was observed that NIAB 603 produces less unproductive tillers than the parent. The fertile tillers emerged more

Varieties of durum wheat developed by mutation induction in Italy

Name of variety	Year of release (or approval) and name of principal workers and institute	Kind of mutagenic treatment [parent variety] or mutant crosses (mutant underlined)	References
Castelporziano	1968 Italy G.T. Scarascia-Mugnozza CNEN Casaccia	Thermal neutrons [Cappelli]	Sigurbjörnsson and Micke 1974
Castelfusano	1968 Italy G.T. Scarascia-Mugnozza CNEN Casaccia	Thermal neutrons [Cappelli]	"
Casteldelmonte	1970 Italy G.T. Scarascia-Mugnozza CNEN Casaccia	Fast neutrons [Grifoni]	"
Castelnuovo	1975 Italy G.T. Scarascia-Mugnozza A. Bozzini, D. Bagnara, C. Mosconi CNEN Casaccia	X-rays [Garigliano]	"
Creso	1974 Italy A. Bozzini, C. Mosconi CNEN Casaccia	Cp B 144 x ((Yt 54 N10-B)Cp^2-63)Tc^2)	MBNL No. 6
Mida	1975 Italy A. Bozzini, C. Mosconi CNEN Casaccia	Cp B 144 x ((Yt 54 N10-B)Cp^2-63)Tc^2)	MBNL No. 6
Tito	1975 Italy D. Bagnara, L. Rossi, G. Porreca CNEN Casaccia	Castelporziano x Lakota	MBNL No. 6
Augusto	1976 Italy D. Bagnara, G. Porreca, L. Rossi CNEN Casaccia	(Castelporziano x Lakota) x Casteldelmonte	MBNL No. 10

uniformly. The spike length and the 1000 grain weight of NIAB 603 are similar to the parent, but the yield per plant is higher which may primarily be due to higher number of grains per spike.

Variety/mutant	Spike length (cm)	Number of spikelets/ spike	Number of grains/ spike	1000 grain weight (gm)	Yield/ plant (gm)
Mexipak 65	12.75	21.60	66.60	30.40	14.20
NIAB 603	13.56	21.50	73.50	31.00	16.87

NIAB 603 showed field resistance against leaf rust during the year 1977-78, an epidemic year for leaf rust in Pakistan. Resistance against leaf rust was also confirmed through artificial inoculation under green house conditions.

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

Use of electrophoretic analysis of grain proteins in the identification of wheat radiomutant ST 7750

For a more precise comparison of the protein complexes of 7750, the methods of the electrophoresis in starch gel in various buffer systems and of disc electrophoresis in polyacrylamide gel were used for the study of anodal isoperoxidases. A determination was made of the total protein content, of the basic protein fractions, and of the quantitative proportion of amino acids. Basic qualitative correspondence of the albumin-globulin and gliadin spectrum of the examined variants was found and only in some zones of both spectra certain differences were observed in the quantitative content which may of course, indicate genotypic differentiation of the mutant SF 77 and of the starting 'Jubilar' cv. Analogous findings were confirmed also by the results of isoperoxidases. Complementary analyses of the protein fractions confirmed the correspondence of the content of albumins, globulins, and gliadins of the investigated variants. Differences were found in the content of glutelin fractions and of insoluble residue. The ascertained changes were confirmed by amino acid analysis where higher methionine, valine, leucine, and isoleucine levels were found in the ST 7750 mutant. The results obtained have shown that especially the analysis of gliadin spectra by electrophoresis in starch gel is a suitable method of differentiating and unifying wheat genotypes as it reveals the differences between the initial and the mutated genotype.

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(Contributed by A. Sasek, Ustav Genetiky a Slechteni, Prague, Czechoslovakia; J. Kubanek, M. Hanis, J. Cerny, Slechtitelska Stanice, Stupice, Czechoslovakia through INIS)

High protein wheat mutants in Chile

Seeds of six spring wheat genotypes were irradiated with gamma rays (10 and 15 krad). Seeds of ca 25,000 M-2 plants selected for agronomic and morphological traits from a population of 180,000 M-2 plants were analysed for protein content by the dye binding capacity method. Selection has been continued through the M-3 to M-8 generations. Selection was conducted on individual plants while segregation was still occurring and on plots when mutants had reached adequate homozygosis. Kjeldahl analysis was applied to check specially high or low values.

In 1976 (M-6 generation) one mutant, UC-3, was included in the National Cooperative Yield Experiment (NCYE) which contains all the registered cultivars and best lines submitted by Chilean wheat breeders. In 1977 and 1978 other mutants (UC-4, UC-5 and UC-6) were entered in the NCYE.

Yield, test-weight and protein characteristics of these four mutants over several years and locations are shown in Table 1. The highly satisfactory yield performance of mutants UC-3 and UC-4 in the NCYE in 1976 and 1977 are shown in Table 2. and the yield and protein vlaues of the best lines in the NCYE in 1976 are shown in Table 3. Registration of UC-3 under the name of "Maribel" has been requested.

Industrial quality of the four mutants is not outstanding, but neither is it extremely poor, so all four will possibly be accepted by the milling and baking industry.

(Contributed by P.C. Parodi and I.M. Nebreda, Department of Plant Science, School of Agriculture, Catholic University of Chile, Santiago, Chile)

Table 1. Yield, test-weight and protein behaviour of four mutants over several years and locations.

Mutant	Year	No. of exp.	No. of loc.	Yield kg/ha	Test-weight	Protein %
UC-3	74	1	1	5986	82.0	12.3
	75	1	1	4132	81.5	12.4
	76	18	17	5065	79.9	11.9
	77	18	14	4939	80.2	12.4
UC-4	74	1	1	5632	79.2	12.7
	75	3	3	5070	77.8	12.8
	76	8	8	5176	78.8	12.8
	77	18	14	4999	81.8	12.6
UC-5	75	1	1	4367	80.2	13.0
	76	1	1	6396	80.1	12.7
	77	5	5	6427	80.1	12.9
UC-6	74	1	1	5812	81.3	12.9
	75	1	1	5229	81.2	13.2
	76	1	1	7090	81.4	12.8
	77	5	5	6294	82.4	13.0

Table 2. Yield performance of mutants UC-3 and UC-4 in the National Cooperative Yield Experiment.

Mutant	Year	No. of loc.	Yield, kg/ha				
			Mutants mean	Mutants range Low	Mutants range High	Mean of all other genotypes	Mean of best genotype
UC-3	76	9	5422	2593	9356	4851	6287
	77	7	5090	2350	7860	4249	5090*
UC-4	77	7	4740	2860	7420	4249	5090*

*UC-3

Table 3. Protein values of the best lines in the 1976/77 National Cooperative Yield Experiments, Chile

Cultivar or line	Protein %	Yield (kg/ha)
UC-3	13.4	5422
S-60	12.5	5266
SNA-2	12.5	5037
SNA-1	12.1	6287
Marianela	12.1	6173
MEXIFEN	11.6	5216 1)
TOQUIFEN	11.5	5072 1)
L8156	10.7	6038
AURIFEN	10.5	5244 1)

1) presently leading commercial varieties.

Evaluation of wheat-rye translocation lines

Rye chromosome 1Rs carries a gene for stem rust resistance. It also carries an easily detectable marker gene for rye prolamines which is closely linked with the gene for rust resistance. Suitability of the segment ID_1-1Rs for improving rust resistance of wheat was tested by backcrosses to cultivar "Gabo". The segment had a negative effect on yield which was reduced by two backcrosses. 70 percent of control yield was reached. Further backcrosses till BC6 only slight improved yields to 76%.

Yield performance of "Pitic" mutants

While searching primarily for male sterile mutants after γ-irradiation of the wheat variety "Pitic", true breeding morphological mutants were also selected. Mutants 116R and 116W outyielded "Pitic" and the variety Kite at individual sites and in the average of a trial with 2 replications at 4 different locations in South Australia.

Physical and chemical mutagenesis in Triticale

Seeds of triticale varieties DR-IRA and Beagle were treated separately with 25 kR x-rays and 0.5% EMS. In M_2, from variety Beagle, six early and 9 dwarf plants were isolated which will be tested further. The rest of the M_2 population is being analysed for induced genetic variability of various yields components such as plant height, tillers per plant, spike length, spikelets/spike, fertility, 100 grain weight and grain yield per plant.

(Contributed by M.A. Rajput, Atomic Energy Agricultural Research Centre Tandojam (Pakistan), C.J. Driscoll and K.W. Shepherd, Waite Agricultural Research Institute, Glen Osmond, University of Adelaide, South Australia. Part of this work was carried out by M.A. Rajput while on IAEA Fellowship Training (PAK-7613) at the Waite Agricultural Research Institute)

High protein barley mutants in Cyprus

High yielding barley varieties grown in Cyprus were treated with gamma rays, fast neutrons and EMS in an effort to induce mutants with improved protein yield and satisfactory agronomic characteristics, suitable for growing in semi-arid areas. Selection in early segregating generations was based on agronomic characteristics and protein content as assessed by DBC values. In later generations the protein content of the best genotypes was assessed by DBC and Kjeldahl nitrogen measurements.

Two M-7 mutant lines selected from "Athenais" and tested in replicated trials at two locations showed superior protein yield (Table 1). Tests over three years of these mutants indicated that the superior protein production was maintained in different seasons (Table 2). Mutant M71-Ath-386-2 is more susceptible to lodging than the mother variety, Athenais.

Table 1. Performance of M-7 mutants of Athenais barley at two locations in 1977/78

Variety/mutant	Days to heading after 1.3.1978	Grain Yield		UDY Prot. %	Protein Yield	
		t/ha	% of control		kg/ha	% of control
Athenais (control)	19	3.6	100	10.9	396	100
M71-Ath-495-2	21	3.7	102	12.0	446	113
M71-Ath-386-2	15	4.1	113	12.1	501	127

M-5 mutants of "Attiki" evaluated at three locations in replicated trials also showed significant increases over the mother variety in grain yield and protein percentage. There were also differences in heading date and plant height (Table 3).

(Contributed by A. Hadjichristodoulou and A. Della, Agricultural Research Institute, Ministry of Agriculture and Natural Resources, Nicosia, Cyprus)

Table 2. Performance of M-7 mutants of Athenais barley during 1975-1978 (% of control)

Variety/mutant	Grain Yield				DBC			
	75/76 3 loc.	76/77 2 loc.	77/78 3 loc.	mean 75-78	75/76 3 loc.	76/77 2 loc.	77/78 3 loc.	mean 75-78
Athenais	100	100	100	100	100	100	100	100
M_{71}-Ath-495-2	79	103	102	94,6	109	105	111	108,3
M_{71}-Ath-386-2	85	104	113	100,6	111	109	112	110,6

Table 3. Performance of M_5 lines of Attiki barley at three locations in 1977/78

Variety/mutant	Days to heading after 1.3.78	Grain Yield		UDY Prot. %	Protein Yield	
		t/ha	% control		kg/ha	% control
Attiki (control)	19	2.8 d	100	10.9 bc	308	100
M_{73}-Att-122-2	20	2.7 d	97	12.1 a	328	106
M_{73}-Att-335-2	20	3.1 abc	111	11.1 bc	345	118
M_{73}-Att-335-3	19	3.3 a	118	11.5 b	380	123
M_{73}-Att-337-1	20	3.0 c	107	10.9 bc	329	107
M_{73}-Att-360-1	20	3.1 bc	109	10.6 c	324	105
M_{73}-Att-396-2	18	3.2 abc	112	11.1 bc	352	114
M_{73}-Att-411-2	19	3.2 abc	112	11.3 b	356	114
M_{73}-Att-415-1	19	3.3 ab	116	11.4 b	370	120

Double cropping in rice with an early maturing mutant variety

Adoption of intensive cropping is one of key solutions to bridge the widening gap of grain production and consumption in a developing country like Pakistan. Rice is an important crop both from Pakistan's food as well as economic point of view. A way to increase rice production in the country without increasing the area under cultivation, is to practice double cropping with short duration varieties.

The early maturing, photoperiod tolerant mutant variety of fine rice "Kashmir Basmati" (Awan et al. MBNL 10) was used as the experimental material. The first crop was transplanted in the first week of May and harvested in the third week of August. Subsequently, the second crop was transplanted in the same field during the fourth week of August and was harvested in the third week of November, thus leaving sufficient interval for the timely sowing of wheat crop in the same field. The grain yield of first and second crop was 2512 and 2611 kg/ha respectively. A ratoon crop was also grown for comparison. At maturity, first crop was harvested at a cutting height of 15 cm and the plots were irrigated. The grain yield of ratooned crop was 3283 kg/ha. The results of this experiment indicate that yields of Basmati rice can almost be doubled by growing two crops of a short duration variety in one season, and that the variety "Kashmir Basmati" was also a great potential for ratooning.

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(Contributed by M.A. Awan, Akbar Ali Cheema and M. Akbar, Nuclear Institute for Agriculture and Biology, Faisalabad, Pakistan)

Vicia faba mutants selected for increased protein yield

Seeds of two Egyptian field bean varieties were treated with gamma rays and EMS with the objective of selecting mutants with increased seed yield and/or protein content. In the M_2 generation selection was for high seed yield. In subsequent generations selection was for seed yield and protein content. Tests in M_4 and M_5 generation (Table) show that mutants superior in yield but still retaining the protein percentage of the parent variety have been selected. Therefore, it seems that no strong association exists between seed yield and protein content in *Vicia faba* and breeding high yielding genotypes should increase total protein yield.

Seed yield and percent crude protein of mutants and their parents in M_4 and M_5

Mutants	M_4 (1976/1977)			M_5 (1977/78)		
	Yield/ plant (g)	Protein %	Protein yield (g)	Yield/ plant (g)	Protein %	Protein yield (g)
Giza-2 (control)	45.5	27.1	12.3	32.0	26.1	8.4
G 2 - E 1	70.5**	29.6	20.9	35.2	27.3	9.6
G 2 - E 2	52.9*	25.7	13.6	43.6*	27.0	11.8
G 2 - R 1 - E 1	52.7*	29.1	15.3	40.9*	27.7	13.1
G 2 - R 2 - E 2	53.8*	31.9	17.2	35.6	29.4	10.4
Rebaya-40 (control)	43.4	32.9	14.3	33.0	27.9	9.2
R 40 - E 1	48.4*	33.6	16.3	42.6*	30.8	13.1
R 40 - E 2	44.6	32.7	14.6	44.4**	25.9	11.5
R 40 - E 3	58.3*	31.5	17.3	38.8	26.4	10.2

*, ** significantly different from controls.

The increase in protein content of some mutants was generally associated with increases in non-limiting and/or antagonistic amino acids such as arginine.

Mutants showed varying performance in different seasons hence the confirmation of the potential value of a given mutant requires several generations of experimentation.

(Contributed by H.A.S. Hussein and M.M.F. Abdalla, Department of Genetics and Department of Agronomy, Faculty of Agriculture, University of Cairo, Giza, Egypt)

Induction of short-statured, determinate type mutant lines in mungbean

Short-statured, determinate type mutant lines were identified in M_2 generation resulting from mutagenic treatment of three local cultivars of mungbean (*Vigna radiata* L.) with ^{60}Co gamma radiation (Shakoor *et al*. 1977). The mutant lines 605, 1038, 4048 and NIAB 28 were selected on the basis of their consistently superior performance as compared to the parent cultivars.

Cultivar/Mutant line		Plant height (cm)	Yield (kg/ha)	Harvest index (%)	Days taken to maturity
Pak 17		64.0	1523.3	21.0	86
	Mutant 605	55.6	1827.3	27.8	70
	NIAB 28	55.3	1914.3	29.0	68
Pak 13		60.8	1504.4	22.9	87
	Mutant 1038	52.0	1745.9	28.1	68
6601		74.8	1455.9	19.2	89
	Mutant 4048	51.4	1684.6	29.2	70

The mutant lines are early and uniformly maturing. The crop can be lifted in a single harvest instead of 2 to 3 pickings normally needed in indeterminate parent cultivars. The superiority in yield of these short-statured determinate type mutant lines may largely be due to efficient partioning of photosynthates towards grain formation as indicated by the improved harvest index. Adaptability tests of these mutant lines are being conducted before their release as commercial varieties.

REFERENCE

SHAKOOR, A., HAQ, M.A., SADIQ, M. and SARWAR, G., Induced genetic variability in M_2 and evaluation of promising mutant lines in M_4 generation of mungbean. Pak. J. Agric. Sci. 16 (1977) 3-4.

(Contributed by Abdul Shakoor, M. Ahsanul Haq, M. Sadiq and G. Sarwar, Nuclear Institute for Agriculture and Biology, Faisalabad, Pakistan)

Cytoplasmic temperature dependent chlorophyll deficient mutants in Festuca pratensis Huds.

Cytoplasmic temperature dependent chlorophyll deficient mutants have been found in a local population of meadow fescue (Festuca pratensis Huds.). Their frequency in progenies of randomly taken plants varies considerably. However, it has not exceeded 50% of the germinated seeds. Plants highest in vegetative mass production had more mutants in their progeny than low-productive ones [1]. The maximum expressivity of the character was observed at 30-35°C. A temperature of 20-25° provided a complete or partial reversal of the character within one week.

An attempt has been made to increase the frequency of temperature dependent chlorophyll deficient phenotypes using x-irradiation but with negative result. The number of mutants per M_3 progeny decreased as the irradiation dose increased from 1 to 5 kR [2].

Hybrid seedlings resulting from crosses between mutants surpassed both parents in the length of rootlets and seedlings, but not the progenies of the best selected plants. Particular hybrid progenies possessed increased radioresistance.

REFERENCES

[1] TITOV, A.F., OLIMPIENKO, G.S., Frequency of chlorophyll deficient seedlings in breeding progenies of meadow fescue (Festuca pratensis Huds.). Genetica USSR 12(2) (1976) 162-164.

[2] OLIMPIENKO, G.S., TITOV, A.F., MITROFANOV, Y.A., Depigmentation of Festuca pratensis Huds. seedlings under the effect of high temperature. Genetica USSR 12(1) (1976) 153-155.

(Contributed by G.S. Olimpienko, A.F. Titov, Institute of Biology, Academy cf Sciences of the USSR, Petrozavodsk)

Induced mutations in Sorghum

Seeds of two varieties of Sorghum bicolor (L.) Moench.'TX-414' and 'NM-31' were irradiated with 20, 35 and 50 kR of ^{60}Co gamma rays. Seeds of TZ-414 also were treated with several concentrations of hydrazine (HZ) and ethylmethane sulfonate (EMS), singly and in combinations, with and without cysteine, used as a pre- and post-treatment modifier. NM-31 was found to be more mutagen sensitive to gamma rays than TX-414, as evidenced by greater reductions in seed germination, primary root length, coleoptile length, seedling height and fertility in the M_1 generation and increases in the frequency of chlorophyll mutations in the M_2 generation. Mutations were recovered and included grain color, size and shape, grain type, glume type, panicle type, plant height and midrib color.

REFERENCE

REDDY, C.S., Physiological and genetic effects of gamma rays, ethylmethane sulphonate, hydrazine cysteine and their combinations in Sorghum bicolor (L.) Moench. Ph.D. Thesis Texas A&M University, College Station (USA) (1977) 204p.

(Contributed by C.S. Reddy through INIS)

The use of aneuploids for the improvement of grain protein in wheat

The Joint FAO/IAEA Division has been sponsoring projects aiming at improving the quantity and the nutritional value of the protein in wheat grain. In this context, in 1975 a three-years coordinated research programme was initiated to use aneuploids for elucidating the genetic control of the wheat endosperm protein. The objectives of the programme were: to establish the existence and the chromosomal localization of major genes which control the percentage of protein in the grain or its amino acid composition; to individuate high protein genes of high protein varieties by assessing the effect of individual chromosomes in different genetic backgrounds; to investigate the effect of individual chromosomes of alien species on the protein of wheat grain.

A Research Coordination Meeting was held 1977 in Vienna to evaluate and discuss the results obtained. The papers presented have been published in 1978 in "Seed Protein Improvement by Nuclear Techniques" (STI/PUB/479) IAEA, Vienna.

Investigations of the nitrogen percentage in the grain of 11 different Chinese Spring ditelocentric stocks have shown that elimination of half a wheat chromosome tends to lead to higher nitrogen percentage than the control but also lower yields [1]. Analytical data on the nitrogen percentage of grains of 71 different aneuploid types of Chinese Spring (tetrasomics, ditelocentrics and compensating nulli-tetrasomics) can be interpreted as if "promotor" gene(s) for high protein content are present on chromosomes 1B and 6A but "inhibitor" gene(s) on chromosome 7A [2]. If these are only one or very few in each chromosome, then one may envisage prospects of mutation induction focussing at these chromosomes for achieving major changes in protein content. The determination of the lysine percentage in the seed protein of 24 ditelocentric stocks of Chinese Spring did not reveal any significant difference from the control [3]. Such investigations would have to be extended to other ditelocentric stocks if one wants to draw a conclusion about the existence of major gene(s) controlling the level of lysine in the protein of the grain. A number of aneuploid stocks have been used to study the dose effect of structural genes on the endosperm proteins. The relative proportion of individual proteins was found to be gene dose dependent [4].

Data have been obtained by Morris et al [5] indicating that chromosome 5D of Atlas 66 (and to a similar extent 5A) can improve the protein percentage of Chinese Spring grain. These results could not be fully confirmed when seeds from different origin were analysed [2].

The substitution of chromosome 2M of *Aegilops comosa* for chromosome 2D of wheat resulted in a net gain of nitrogen percentage with no negative effect on yield. This result indicates that also alien species may contribute usable genes for the improvement of protein in wheat [6].

REFERENCES

[1] LAW, C.N. and BROWN, J.W.S., Seed Protein Improvement by Nuclear Techniques, IAEA, (1978) 427-442.

[2] BRUNORI, A., HERMELIN, T. and BHATIA, C.R., *ibid*. 443-454.

[3] BHATIA, C.R., PERSCHKE, H. and AXMANN, A., Cereal Res. Comm. 5 (1977) 1, 19.

[4] GARCIA-OLMEDO, F., CARBONERO, P., ARAGONCILLO, C. and SALCEDO, G., Seed Protein Improvement by Nuclear Techniques, IAEA, (1978) 555-566.

[5] MORRIS, R., MATTERN, P.J., SCHMIDT, J.W. and JOHNSON, V.A., ibid. 567-568.

[6] LAW, C.N., YOUNG, C.F., BROWN, J.W.S., SHAPE, J.W. and WORLAND, A.J., ibid. 483-502.

A. Brunori

Report on the FAO/IAEA/GSF International Symposium on Seed Protein Improvement in Cereals and Grain Legumes (Neuherberg, FRG, 4 - 8 September 1978)

The Symposium was attended by 156 scientists from 39 countries and 6 international organizations. Sixty-one scientific papers were orally presented and discussed in eight sessions. An additional 29 scientific contributions were presented as posters and were on display throughout the Symposium. One afternoon of the Symposium was devoted to examination and individual discussion of the poster displays. It was especially notable that this method of presentation and discussion of scientific results was very favourably received. Five items of scientific equipment demonstrated analytical systems in use for protein or amino acid assay in plant breeding programmes.

The Symposium clearly demonstrated the reality of nutritional deficiencies in poor countries and outlined plant breeding strategies for overcoming these. Progress was reported in improving the nutritional quality of cereals (wheat, maize, rice, barley, sorghum, millet, triticale, oats), legumes (beans, peas, soybeans, field beans, chick peas, lentils, pigeon peas, cowpeas, grams, peanuts) and some other crops (cotton, buckwheat). Notable results have been achieved, but much of the work has been in progress less than 10 years, which is too short a time for the development, testing and release of commercial varieties.

Chemical and nutritional assay methods, including some promising new methods were reviewed and assessed. Rapid developments in knowledge of the genetics, biochemistry and physiology of seed proteins are providing the basis for future plant breeding strategies. The Symposium concluded with reviews of the possible use of cell cultures and genetic transformations for seed protein improvement and a consideration of prospects for future developments of food and feed materials.

Increased scientific knowledge and the application of molecular biology and genetic engineering techniques will have an undoubted influence upon the course and speed of future progress. However, the solution of the immediate nutritional problems of the poor and the hungry is very much dependent upon the vigorous and intelligent application of existing knowledge and techniques to produce and promote the use of plant genotypes with improved nutritional value. Until there is a market value for nutritional quality such varieties will have to be at least equal in yield and all other characters to the varieties commonly grown.

The proceedings of the Symposium will be published by the IAEA Vienna in April 1979.

LIST OF MUTANT 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 themseleves 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
Hordeum vulgare			
Alf	1978 Denmark V. Haahr, Danish Atomic Energy Commission, Research Establishment Risö D. von Wettstein, Institute of Genetics, University of Copenhagen	300 rad thermal neutrons 1969 [Bomi]	short and stiff straw
Jupiter	1976 UK Plant Breeding Institute, Cambridge	cross Betina x Midas	highest yielding recommended variety in UK, 18% above "Julia" acc. to G. Jenkins and P.R. Hanson 1977
Minak	1976 UK Plant Breeding Institute, Cambridge	cross (Betina x Midas) x Maris Yak	very stiff straw, feed barley yield 12% above "Julia"
Temp	1976 USSR	NEU 1966 [Krasnodarskij 35]	feeding barley, high yield, 2-3 days earlier heading mildew resistant

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
Diabas	1977 CSSR	cross with <u>Diamant</u>	
Spartan	1977 CSSR	cross with <u>Diamant</u>	
<u>Oryza sativa</u>			
RD 15 (KDML 105' 65 G_1-U-45)	1978 Thailand Pricha Khambanonda, Asanee Sarigabutr, Malee Chombhubol, Rice Division Department of Agriculture Bangkok	15 kR gamma rays 1965 [Khao Dawk Mali 105]	10 days earlier maturity better drought resistance
M7 (CI9967)	1977 USA H.L. Carnahan, C.W. Johnson, S.T. Tseng, California Co-operative Rice Research Foundation Biggs CA 95917	cross <u>Calrose</u> 76 x CS-M3	short stature, high yield than both parents
<u>Triticum aestivum</u>			
Hankkijas Taava (Hja 12689)	1978 Finland E.I. Kivi, S. Hovinen Hankkija Plant Breeding Institute Hyrylä	20 kR gamma rays 1966 [Ruso]	slightly increased yielding ability and sprouting resistance, equally early, more resistant to lodging

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 turgidum conv. durum			
Probstdorfer Miradur	1978 Austria H. Hänsel, Probstdorfer Saatzucht Vienna	Cp B 132 x Adur	higher yield, good lodging resistance
Triticum aestivum			
Polukarlikovaya-49	1978 USSR	cross with mutant of Besostaya I induced by NEH in 1966	short culm
Lupinus albus			
Gorizont	1977 USSR	cross with alkaloid free mutant induced by EI	
Dnepr	1978 USSR	cross with mutant induced by EI	
Helianthus annuus			
Pervenets	1977 USSR	DMS 1965	high oil content, altered fatty acid composition

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
<u>Avena sativa</u>			
Belozernji	1978 USSR	NMH 1966	
Zelenji	1976 USSR	NEH 1966	high vegetative production for forage, late ripening
<u>Nicotiana tabaccum</u>			
Krupnolystnyi	1977 USSR	cross with mutant induced by NEH in 1966	
Yubileinyi	1978 USSR	" "	
American Bakhchesoraiskii	1978 USSR	" "	
<u>Solanum khasianum Clarke</u>			
RRL-20-2	1975 India B.L. Kaul, Regional Research Lab. Jammu (Tawi)	gamma rays 1969 [Dehradun local]	higher solasodine content of berries, less spines 2000 ha cultivation in 1975-76

FUTURE EVENTS

1979

6th International Congress of Radiation Research, Tokyo, 13 - 19 May with attached workshop "Crop Improvement by Induced Mutations" 21 - 22 May, Institute of Radiation Breeding, Ohmiya-machi, Ibaraki (Japan).

FAO/IAEA first Research Coordination Meeting on the Use of Induced Mutations for Improvement of Grain Legume Production, 28 May - 1 June, Kuala Lumpur (Malaysia).

FAO/IAEA Study Tour on Nuclear Techniques and Induced Mutations in Plant Genetics and Breeding, GDR, Poland, CSSR, 16 June - 7 July.

14th Pacific Science Congress, Academy of Sciences of the USSR, Novosibirsk (USSR) August. Contact: Prof. A.P. Kapitsa, President of Far East Research Centre, Academy of Sciences of USSR, 50 Leninskaya Street, Vladivostok, USSR.

Symposium on Production of Tomatoes for Processing, September, Evora, Portugal. For information contact: The Organizing Committee, Universidad de Evora, Apartado 94, Evora, Portugal.

The Fourth John Innes Symposium, "The Plant Genome" and the Second International Haploid Conference. 10 - 14 September 1979 at John Innes Institute, Norwich, England.

5th Symposium on Tropical Root Crops, Ceby City (Philippines). Contact: M.R. Villanueva, National Root Crops Research Centre, Baybay, Leyte 7127, Philippines.

International Symposium of OILB/SROP on Integrated Plant Protection in Agriculture and Forestry, 8 - 12 October Vienna (Austria). Contact: Prof. K. Russ, Bundesanstalt für Pflanzenschutz, Postfach 154, A-1021 Vienna.

1980

EUCARPIA General Congress "Genetic resources and the problem of breeding for resistance", Leningrad, USSR, May.

5th European and Mediterranean Cereal Rusts Conference, Bari, Italy 28 May - 3 June. Contact: Cereal Rusts Foundation, Wageningen, Netherlands.

2nd EUCARPIA/OILB (= IOBC) Meeting of Working Group for Resistance to Insects and Mites, Kent, UK, 9 - 11 April. Contact: Miss. J.H. Parker, East Malling Research Station, Maidstone, Kent ME 19 6BJ, UK.

1981

4th International Barley Genetics Symposium, Edinburgh Scotland, UK, 22 - 29 July. Contact: W. Campbell, University of Edinburgh, Centre for Industrial Consultancy and Liaison, 16 George Square, Edinburgh EH8 9LD.

NEW PUBLICATIONS

Evaluation of Korean Soybean Germplasm by S.H. Kwon.
Korea Atomic Energy Research Institute, Seoul, 1978.
(KAERI/TR/63/78)

Plant Breeding for Resistance to Insect Pests:
Considerations about the Use of Induced Mutations.
IAEA Technical Document No. 215, 1978.

FORUM

We would like to offer our Mutation Breeding Newsletter as a forum to raise and discuss open questions or methodological uncertainties. With the help of our readers, perhaps, we can assemble results, experiences, hypotheses and ideas, which would bring us closer to the answer or stimulate experiments towards a solution of the problem.

At present, we would like to propose two subjects for comments by our readers:

1. What is the relevance of the original genotype (parent variety) used in mutation induction experiments for the outcome (success) of such experiments?

2. Mutation induction mostly leads to mutant characters behaving as single gene recessives against the original genotype (parent). However, where, how often and under what circumstances have you made different observations (intermediate or dominant inheritance) or observed a modification of recessivity in mutant crosses?

Your comments are welcome in the form of short communications, including data and references. Furthermore, we would welcome your suggestions as to other questions we may raise in future issues.

A. Micke

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
Leila SHAWA
Lhamo WAHL

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