Mutation Breeding Newsletter
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Report from the Plant Breeding and Genetics Section

The Section continued its efforts to support and assist in research concerned with the production of genetic variability in crop plants and its utilization for the development of better cultivars.

During the first half of 1975 a main event was the Third Co-ordination Meeting of the FAO/IAEA/GSF Co-ordinated Research Programme on the Use of Nuclear Techniques for Seed Protein Improvement. The meeting was held at Hahnenklee/FRG and was attended by 48 scientists, including 8 from institutions not directly associated with the programme but interested in its objectives and results. The meeting included an excursion to the Institut für Strahlenbotanik at Hannover and the Institut für Pflanzenbau und Pflanzenzüchtung at Göttingen. Proceedings of the meeting will be published by IAEA.

The FAO/IAEA/EUCARPIA Symposium on Advances in Mutation Breeding Techniques and Practical Achievements, which was planned to be held in 1975, had to be postponed and later on cancelled, due to uncertainty about the proposed conference site (Cyprus) and resulting complications in planning and preparation. Whether or not a similar symposium can be organized in 1976 or 1977 has not yet been decided.

The Co-ordinated Research Programme on Induced Mutations for Disease Resistance was reviewed after three years' duration and a two-year extension was approved. The Third Co-ordination Meeting will be held 15-19 September at Ames/Iowa (USA).

For a long time we have considered to pay more attention to the genetic improvement of leguminous crops which contribute so much valuable food and many feed products. We now hope to obtain the necessary financial resources and are developing a Regional Programme for Improvement of Grain Legume Production in South East Asia. This programme will essentially be a co-operative activity of breeders, agronomists, plant pathologists and mutation breeders working on grain legumes in countries of South East Asia. As a first step, we plan to invite those scientists to a seminar in December 1975 for discussing the problems encountered in legume improvement and designing bilateral as well as multilateral co-operative projects for various legume species of importance in the region. Anyone interested in this field of work may contact Dr. R. Rabson of the Plant Breeding and Genetics Section, FAO/IAEA, Vienna.

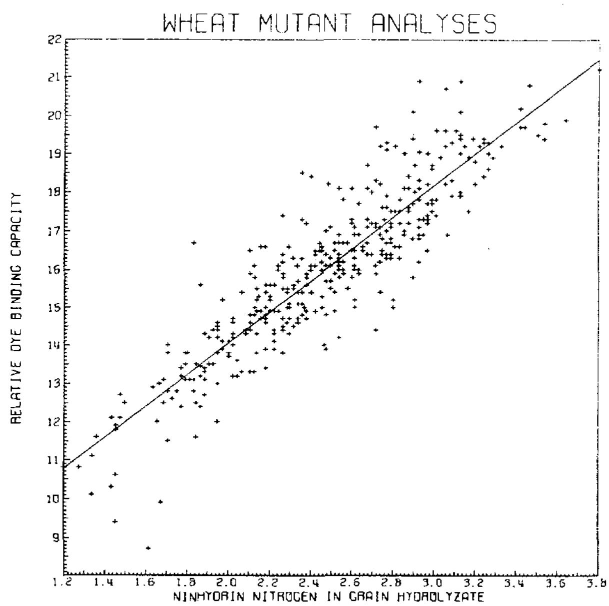
Our initiative to mobilize aneuploid techniques for the genetic improvement of wheat protein which was mentioned in Mutation Breeding Newsletter No. 5 is beginning to materialize now in the form of a Co-ordinated Research Programme on the Use of Aneuploids for Wheat Protein Improvement.

Scientists in 12 different countries have been invited to join this programme and our plans are to convene a research planning meeting with them in October 1975 in Vienna.

RESEARCH NEWS

Wheat mutants with improved protein?

Readers of this Newsletter will recall that in No. 4 a request was made for samples of confirmed bread and durum wheat mutants for morphological and other characters to be sent to IAEA for protein analysis. Approximately 400 of these samples have been received from investigators in some 8 countries. Analyses of these samples have been made and a scatter diagram of the results is presented below. On the vertical axis the dye binding capacity analysis (which is specific for the basic amino acids lysine, arginine, histidine) is plotted in terms of relative levels, and on the horizontal axis the amino nitrogen of hydrolyzed grains as determined by ninhydrin is plotted. Those samples which appear interesting by virtue of having proportionally higher basic amino acid content are being further investigated. It should be stressed that these are preliminary results and it is too early to ascertain whether any of these mutants will have utility in breeding programmes. We would greatly appreciate receiving additional wheat mutant material for evaluation.



(Contributed by R. Rabson, Joint FAO/IAEA Division, Vienna).

Induced mutations for protein improvement in wheat

A large part of the WSU collection of induced common wheat mutants (1500 mutants from "Marfed", 40 mutants from "Idaed 59" and 50 mutants from "Luke") were analyzed at the IAEA Laboratory Seibersdorf (Austria) for protein content and composition. Micro-Kjeldahl or ninhydrin analyses were used for total N and Udy for basic amino acid determinations. Some promising variants were also analyzed for their total amino acids. The mutants included a wide range of phenotypes. The greatest variability for protein content was found in the recent mutant populations, which had been subjected to less severe screening. Sphaerococcoids generally, but not always, had higher protein contents than other mutants.

A semidwarf mutant, MJD720175, induced in "Marfed" was analyzed for baking and other quality characters. Parallel analysis at WSU and IAEA on 1972 and 1973 crop seeds confirmed that the Udy/Kjeldahl protein ratio is higher for the mutant than for the parent variety. The 1974 crop recently analyzed provided further confirmation of the higher Udy/Kjeldahl protein ratio of the mutant. Amino acid analyses at the IAEA Laboratory indicate that the mutant has a slightly higher lysine and arginine content than "Marfed". Baking quality tests showed that flour from the mutant produced a slightly lower loaf volume, and the sedimentation value for the mutant was about half that of its parent. Pastry quality and other characteristics were similar to "Marfed".

(Contributed by C.F. Konzak, Department of Agronomy and Soils, Washington State University, Pullman, Washington 99164, U.S.A.).

Selection of new mutants for polyenoic fatty acids in rapeseed*

In order to improve the polyenoic fatty acids pattern in rapeseed oil (increase of linoleic and decrease of linolenic acid content) seeds were mutagenically treated with EMS. By selection, particularly within M_3-seeds, and following check in M_4 as well, and comparison under various conditions of cultivation (greenhouse, field), mutants were obtained with less than 3.5% of linolenic and more than 27% or even 30% of linoleic acid in their seed oil. Since the mutants with high linoleic acid had already been selected, the selection this time was specially directed to genotypes low in linolenic acid. The results suggest that it is more promising in such mutation experiments not to select for linoleic and linolenic acid contents simultaneously. For it was possible by a second mutagenic treatment of one of the obtained mutants to further improve the pattern of polyenoic fatty acids. Likewise the desired combination could also be recovered by crossing of two complementary mutants. Plants with 39% linoleic and 4.3% linolenic or with 30% linoleic and 3.2% linolenic acid in their seed oil were fully viable. This clearly indicates that there is no reason why such values could not be realized in adapted and high yielding varieties of rapeseed as well, or that they have already reached the physiological limits of this plant species. The present mutants, however, still require extensive work of plant breeders until these genes are efficiently used in practicable varieties.

*Manuscript accepted by Zeitschrift für Pflanzenzüchtung

(Contributed by G. Röbbelen, A. Nitsch, Institute of Agronomy and Plant Breeding, 34 Göttingen, F.R.G.).

Performance of rice mutant in Thailand

Glutinous mutant selection (KMDL 105'65 - G_2U-68-254) obtained from a non-glutinous recommended variety KMDL-105 (Khao Dawk Mali-105) gave an average yield of 3645 kg/ha against 2892 kg/ha of the parent in inter-station yield trials during the wet season of 1974. These trials were conducted at eight locations in the north and north-east region. Yield of other check varieties included in the trials were 3216, 2991 kg/ha for Muey Nawng 62 M and Khitom Yai 98 respectively. During the same season average yield of the mutant selection was 1940 kg/ha against 1674, 1799 kg/ha of KMDL-105 and check variety Niaw Sanpahtawng (NSPT) in 24 trials conducted at farmers fields in the north-eastern region. In the northern region average yield at 14 locations on farmers field were 3272, 3227 and 3022 kg/ha for the mutant the check varieties NSPT and Dawk Mali-3.

(Contributed by P. Khambanonda, A. Serigabutr and S. Awakul, Rice Division, Department of Agriculture, Ministry of Agriculture and Co-operatives, Bangkok, Thailand).

Studies on cross progenies (F_2) of two drastic morphological high protein mutants in durum wheat

In continuation of crossing experiments using two drastic morphological mutants (sphaerococcoid and compactoid dwarfs) which revealed higher protein levels of about 20-30% over the parent line during 3 years investigations and positive changes in amino acid pattern, more investigations were carried out with the parent lines and F_2-populations.

Mutants were tested under different environments to establish the nature of protein differences indicating a more stable expression of protein content compared with the motherline but with changes in amino acids independent of protein levels. Two years data of criteria for technological quality such as wet gluten content and fractionation of milling products showed less wet gluten increase in the sphaerococcoid mutant in spite of higher protein enhancement compared with the compactoid mutant. The coarsest semolina fraction was also increased by about 25% over the motherline which indicate a harder endosperm in the mutant.

In ultra structure and electrophoresis studies of grains from mutants, motherline and different F_1 and F_2 crossing products the ultrastructural differences are verified by the electrophoretic banding pattern of water-soluble proteins. In the F_1 grains of a reciprocal cross the hybrids get the same ultrastructural appearance as the father variety, a remarkable phenomenon as the father variety contributes only one genome in comparison with the two genomes from the mother variety.

To evaluate the nutritive value of mutant grains for feeding purpose and human consumption whole grain meal and milling products without bran were used in feeding trials with rats in which NPU and urea content in blood were taken as parameters to characterize the protein quality.

To exploit the genetic potential these mutants were used in wide crosses with Tr. dicoccum and Tr. aestivum beside back crosses with the motherline. A wide array of recombinants confirm the absence of pleiotropic inheritance in the sphaerococcoid cross progenies and suggest that this mutant carries a duplication. The compactoid dwarfs were used in similar crosses and in a double mutant cross with the sphaerococcoid genotype to analyze the genetic constitution of protein traits.

Heritability and simple correlations between different traits were calculated for F_2. High heterosis effects for grain weight and protein per grain were obtained in crosses with Tr. dicoccum. Promising recombinants of the different cross progenies were isolated as parents for further back crosses and analyses.

(Contributed by K. Nagl, Bundesanstalt für Pflanzenbau und Samenprüfung, Vienna, Austria).

Structure and composition of protein bodies from the endosperms of Bomi barley and its mutant 1508

The increased lysine content of the endosperm proteins from high lysine cereals is a result of alterations in storage protein composition. Primarily the deposition of the lysine poor prolamines is reduced and compensated for by an increased synthesis of lysine rich proteins. In the barley mutant 1508 this change in protein composition is reflected by an altered development and structure of the protein bodies, which are the principal protein stores of the cereal endosperm. In this study protein bodies were isolated from developing endosperms of Bomi barley and its mutant 1508. Sections through pellets of isolated protein bodies from both the mutant and the wild type revealed protein body structures identical with those observed in sections through the intact endosperms. The majority of the wild type protein bodies were homogeneous spheres accompanied with a granular component. Particles with the same structure were present in the protein body preparation from the mutant where, however, the granular component was the most prominent. Amino acid composition and SDS-polyacrylamidegel electrophoresis of the proteins from the protein body preparation revealed that the wild type protein bodies contained large amounts of prolamines and some glutelins, whereas the mutant protein bodies have glutelin as the major component and little prolamines. It is suggested that the homogeneous protein body component represents a storage organelle with a high concentration of prolamines, and the granular component a storage organelle with a high concentration of glutelins.

(Contributed by J. Ingversen, Danish Atomic Energy Commission, Research Establishment Risø, Roskilde, Denmark).

Genetic studies of high lysine barley mutants

The effect on grain and protein yield of the high lysine gene in mutant 1508 was studied preliminary in the offspring from a cross with a normal lysine variety. The segregated high lysine lines had, on the average, the same protein yield and seed number as the segregated lines which were homozygous for the normal lysine gene. However, the seed size and the grain yield of the high lysine lines were reduced about 15% as compared with the normal lines.

Nitrogen and DBC analyses of F_2-plant offspring showed that six mutants, Nos. 7, 8, 13, 16, 17 and 527, each have a single recessive gene, which causes the increased lysine content of the protein. All but the first of these mutants have clearly shrivelled seeds. This character was completely related to increased relative DBC in all the offspring studied. Only mutant 7, which has a 15% lysine increase in the protein, seems to have normal, well-filled seeds.

A haploid technique has been used to produce homozygous lines derived from F_1-plants of crosses between a normal variety and the high lysine mutants Nos. 29, 56 and 1508. The lines are now propagated and tested in order to have a detailed evaluation of the three high lysine genes with respect to their effects on productivity.

(Contributed by H. Doll, Danish Atomic Energy Commission, Research Establishment Risø, Roskilde, Denmark).

Protein composition and nutritional value of barley mutants

Hordein, the alcohol soluble storage protein of barley, may be characterized as three groups - A, B and C hordeins - with decreasing lysine content. A considerable amount of hordein polypeptides are also found in other solubility fractions which means that in genetic context hordein comprises about half of the total N in barley seed.

All the Risø high-lysine mutants show decreased amounts of B hordein and often also of C hordein. Mutant 1508 has only traces of B and C hordeins, whereas mutant 56 has traces of B but increased amounts of C hordein. The low-lysine mutant 10 has increased C and decreased A hordeins.

When increasing amount of N-fertilizer is given the seed of normal barley will increase the relative content of especially C hordein but also of B hordein much faster than total N and thus decrease the lysine concentration of the seed protein. Since mutant 1508 has no B and C hordeins, it maintains a nearly constant concentration of lysine in the protein when the amount of N-fertilizer is increased.

A rat experiment (by B.O. Eggum) covering both normal and high-lysine barley lines with different concentrations of protein in the seeds showed that the mutants have a highly increased biological value. The average B.V. for Bomi was 76 and for mutant 1508 90. A significant negative correlation between B.V. and percent N in the seed was found for both Bomi and mutant 1508. In the case of Bomi this may be explained by the diminishing concentration of lysine and other essential amino acids when percent N in the seed increases. No explanation for the variation in B.V. in mutant 1508 was found.

(Contributed by B. Køie, Danish Atomic Energy Commission, Research Establishment Risø, Roskilde, Denmark).

Evolution of rice varieties with improved quality through induced mutations

Rice is the most important cereal crop of Bangladesh constituting over two thirds of a typical diet. Rice varieties with improved protein content may reduce protein deficiency to some extent. In this study some advanced generation (M_{10}) mutants (Haq, 1973), hybrids (F6), recommended varieties and local collections were screened for protein content. The mutants, IRATOM-24 and IRATOM-38, were also grown along with the parent variety (IR8) and IR20 (another recommended Aman variety) under uniform fertilizer conditions but in different locations for studying their environmental adaptability in respect of some agronomical and physiochemical parameters.

The variety IR8 had 7.9% (K.P) and 8.1% (DBC) protein in comparison to 8.0% and 9.0% respectively in IRATOM-24 and 9.5% and 10.7% respectively in IRATOM-38. There was not much difference in amylose percent among these varieties/strains. Three of the recommended Aman varieties showed higher protein content compared to others and 11 out of 16 hybrid lines were in the range of 10-12% protein content. Amylose content of the recommended varieties and hybrid lines ranged from 15-29%. The maximum amylose content (29%) was in the hybrid line INA-7-19-2. Wide variation in protein content was observed in the 34 local strains (6.6-12.9%). Ten strains were in the range of 6-8%, 19 were in the range of 8-10% and four were in the range of 10-12% protein.

Protein contents and other physiochemical properties of the same variety/strain varied when grown in different locations. Thus protein contents ranged from 6.4-8.0% in IR8, 7.5-8.7% in IR20, 6.2-10.7% in IRATOM-24 and 7.0-11.9% in IRATOM-38 depending on locality. Similarly, wide range of variation was observed in amylose content, starch-iodine-blue value and water absorption by grains. In general however, the two mutants have shown stability in respect of length and breadth of grain, 100-grain weight, seed yield and number of days to maturity. Moreover, in spite of variations, IRATOM-38 showed higher contents of protein in all except four localities. IRATOM-24 had also slightly higher content of protein than in the mother variety IR8.

(Contributed by M.A.Q. Shaikh, Institute of Nuclear Agriculture, Bangladesh Agricultural University Campus, Mymensingh, Bangladesh).

Induction of mutations for protein variability in rice and wheat

In India, at present, no high protein cultivars of wheat or rice would be acceptable for cultivation by the farmers unless their grain yield is equal or superior to the existing high yielding cultivars. High protein or high lysine wheat strains even though slightly lower in yield would be cultivated if sponsored by the industry manufacturing bread or processed nutritive foods. The demand of wheat for this purpose is, of course, rather small. Our mutation experiments were initiated in 1970 with the object to explore the possibilities of improving the nutritive value of the then best cultivars of wheat and rice, either by increasing the protein content or altering the protein composition. Both macro- and micro-mutant populations have been screened. The results obtained so far indicate:

1. No high protein mutants have been obtained without depression of grain yield after screening a few thousand lines.

2. Many induced macro-mutants show increase in protein percent as well as protein/grain in non-shrunken grains but grain yields are always lower.

3. Micro-mutants selected for increased protein/grain do not show yield depression but increases in protein content are also not significant.

The results raise the question whether it would be possible to obtain high protein mutants without reduction in grain yield if larger populations, say 50,000 or more, are analyzed. We do not have the possibilities of doing this. However, some conclusions in this regard can be drawn if the results from different laboratories are pooled for each crop. On the other hand, we are investigating whether the 'high protein' mutants obtained can be used as genetic source for this character in hybridization programmes.

(Contributed by P. Narahari, R. Mitra, T. Gopalakrishna and C.R. Bhatia, Biology and Agriculture Division, Bhabha Atomic Research Centre, Bombay, India).

Induction of mutants with high protein content in soybean

In 1969, seeds of Mutsumejiro, Raiden and Miyagishirome, leading varieties in Tohoku district, were acutely irradiated by gamma rays of ^{60}Co with the doses of 8 kR and 16 kR. M_1 and control plants were planted individually and two seeds were randomly harvested from each plant. M_2 seeds were planted individually and 5 seeds were taken from each plant as materials for M_3 lines. M_3 seeds were planted in plant progeny rows.

Selections were made for maturing, plant type and yield. Then seeds of each selected plant were analyzed for their protein contents by Biuret method and selections for protein content were made to have about 2 percent higher protein content than each control population mean.

In M_4 generation, control populations, selected populations and unselected populations were planted to determine the effectiveness of selections for protein content in M_3 generation. Mean protein contents of selected populations of Mutsumejiro and Raiden treated by dose of 16 kR and Miyagishirome treated by dose of 8 kR were significantly higher than that of each control population and the selections were effective among these populations. Mean protein contents of all selected populations except Raiden treated by dose of 8 kR were also significantly higher than that of each unselected population.

In M_5 generation, mean protein contents of selected populations of Mutsumejiro and Raiden were significantly higher than that of each control population.

From the results of this study, radiation had possibility in the improvement of protein content in soybean. Although small increase of protein content was obtained in this study, the chance of obtaining large increase of protein content of soybean could be greatly increased by observations on larger populations derived from irradiated seeds.

(Contributed by Susumu Hiraiwa, Shigeki Nakamura* and Sachihiko Tanaka, Institute of Radiation Breeding, Ohmiya, Ibaraki-Ken, Japan.
* Tohoku National Agricultural Experiment Station, Kariwano, Akita-Ken, Japan).

Induction of mutations in protein content of rice

Since 1969, high protein rice mutants have been isolated from progenies of seeds irradiated by gamma rays in order to increase the protein productivity in a unit area. A lowland rice variety Nihonbare having the largest cultivating share in Japan and rather high protein content (8.0%) among Japanese lowland varieties (7.5%) was used as material for this experiment. Breeding procedures and results obtained in each generation were as follows:

M_1: One thousand air dried seeds were irradiated with 20 + 30 kR of ^{60}Co gamma rays. Radio-sensitivity of Nihonbare was nearly the same as that of Japanese lowland varieties tested previously.

M_2: Panicle progenies from 220 M_1 plants with high seed fertility in each treatment were raised by pedigree method. M_3 seeds on 3300 M_2 plants in each treatment were analyzed for their protein content by Kjeldhal method and 201 high protein variants were isolated regardless to their visible changes on adult plants. Most of them were malformed ones.

M_3: Thirty seven lines which did not segregate for visible mutations and had similar phenotypes to original ones were screened among progenies from the 201 high protein variants. Out of the 37 lines, 11 lines had significantly increased protein content in comparison with the original ones.

M_4: The 11 line progenies were raised as individual families. As M_3 lines consisted of 15 plants, each M_4 family had 15 lines, therefore, yield trial of 165 lines in 11 families was made with duplication. Out of the 11 families, one had considerably low grain yield resulting from partial sterility and two other lines segregated for visible mutations, though the grain yield of these two lines were nearly the same as that of the original one. Finally, 12 lines from the other seven families were isolated as high protein mutant lines.

After M_4 generation, protein productivity of these 12 lines were successively examined at several national experiment stations under various environmental conditions. As a result obtained by 1974, a few lines having increased protein productivity under various conditions were isolated, though the protein yield varied considerably with environmental conditions.

It was concluded that (a) screening of high protein variants in earlier generations must be made on normal looking plants, because most of the high protein variants were resulted from decreased starch synthesis ability due to malformed plant types and/or sterility, (b) although some of the isolated lines as high protein mutants had minor changes in visible characters, they maintained superior agronomic traits of the mother variety, that is, an increase of protein content was not always accompanied with inferior changes of other characters, (c) high protein lines having 10-20 percent increase of protein productivity in a unit area could be isolated from Japanese varieties through mutation breeding, however, mutant lines with extremely increased protein content and grain yield can be hardly obtained by a single mutagen treatment, because both the characters are not fully controlled by major genes.

(Contributed by Sachihiko Tanaka, Institute of Radiation Breeding, Ohmiya, Ibaraki-Ken, Japan).

Studies on the high protein mutants of rice

Several high protein mutant lines (M_4 plant generation, 1974) obtained from X-ray irradiated Jinheung variety were examined at three different locations for their agronomic characters, protein and grain yields.

Although variation of protein percent of mutant lines from Jinheung was comparatively large depending on year and location, most of the high protein mutant lines had higher protein yield per unit area than the mother variety and their grain yields were equal to or better than the mother, being resistant to both leaf and neck blast. They were several days earlier-maturing and had shorter-culm except one mutant line.

(Contributed by Ch. Harn, Korea Atomic Energy Research Institute, Seoul, Korea).

White bean mutant, NEP-2, for distribution

Many common bean varieties with black seed-coat color are superior in production and disease resistance. Because of their seed color, they are not acceptable to consumers in many parts of the world. It is known that there are three categories of genetic factors affecting the bean seed-coat colors: (1) pigmentation factor, _P_, (2) complementary color factors, and (3) modifying factors. The _P_ factor produces no color by itself but other complementary color factors must depend upon the presence of the dominant _P_ factor in order to express their color in the seed-coat. If the pigmentation factor is in its recessive form, _p_, the complementary color factors cannot express their colors and thus the bean seed-coat is white.

The pigmentation factor, _P_, is mutable. By using mutagenic agents, EMS or gamma rays, the dominant _P_ can readily be changed into its recessive form, _p_. Therefore, many good black bean varieties can be altered into white to suit consumers' inclination. We had used induced mutation methods to obtain 12 white mutants from 5 black bean varieties.

One of the white bean mutants, NEP-2, has been studied in more detail. The field trial in 1972 at Turrialba, Costa Rica, showed that the yield of NEP-2 was slightly but not significantly lower than its black parent (2268 kg/ha _vs._ 2452 kg/ha). In addition, the results sent back from different laboratories showed that this white mutant has other good agronomic characteristics.

1. Nutritional study of this mutant carried out by the nutrition center of Central America (INCAP) showed that the NEP-2 beans had a higher PER value in rat feed tests (1.72 for NEP-2 and 1.16 for its black parent). However, the difference in protein quantity was insignificant. The reason for higher PER value of the mutant is not understood at present.

2. According to the test by Purdue University, the NEP-2 mutant has no detectable tannin content.

3. Analyses carried out at Michigan State University showed that the NEP-2 beans were low in stachyose, raffinose, and sucrose. These sugars are believed to be implicated in the flatulence problem in beans.

4. NEP-2 had a good canning quality according to the H.J. Heinz Co. of England.

Any laboratory or experiment station that would like to have the NEP-2 bean for field studies or for breeding purposes, may request seeds from the

Tropical Crops and Soils Department, Tropical Agricultural Research and Training Center, Turrialba, Costa Rica.

(Contributed by C.C. Moh, Nuclear Energy Program, Tropical Agricultural Research and Training Center, Turrialba, Costa Rica).

Improved pearl millet hybrids

Pearl millet is grown in India in an area of 12 million hectares. The total grain production, which had risen to 8 million tons during 1970, came down to 3.6 million tons during 1974, due to severe attack of downy mildew disease, especially on the hybrids. The hybrids, all of which had a common (susceptible) female parent, were on their way out of cultivation. The percentage of disease varied from 30 to 100% in different areas.

The main reason for this failure was that Tift.23A, the male sterile line of the pearl millet hybrids, became so susceptible to disease that it was no longer possible to raise it. Efforts to induce disease resistance in this, otherwise, ideally suited male sterile line through irradiation resulted in the development of male sterile line 5071A (reported in the IAEA Mutation Breeding Newsletter, 1974), which showed a high degree of field resistance to downy mildew. The line has now replaced all the present stocks of Tift.23A, and is the only male sterile line under large scale multiplication in the country.

With the development of male sterile line 5071A, it became possible to introduce disease resistance in the present commercial hybrids. Amongst these, HB.5, which had earlier shown high degree of susceptibility to downy mildew became resistant and has been released for large areas of country by the All-India Varietal Release Committee under the name New Hybrid Bajra 5 (NHB.5). About 600 tons of seed (seed rate 4 kg/hectare) of this hybrid was produced during 1974 and large scale multiplication has been taken up during 1975, to replace some of the existing hybrids.

About 2245 minikrit demonstrations were organised with this new hybrid in the farmers' field during 1974. However, the data presented below represents the results of 235 received at the time of compilation, along with the yield of checks, which represented the recommended (but susceptible) hybrid for that area. In most of the cases NHB.5 has yielded better than the existing hybrids mainly due to its resistance to disease, except at Delhi and in some trials in Madya Pradesh, where disease infection was not so severe. The disease in terms of percentage of affected plants varied from 20 to 60% in HB.5 compared to 0-13% in case NHB.5.

Summary results of all-India Minikit trials of bajra (pearl millet) conducted during 1974-75

State	No. of trials	Mean grains NHB.5	Yield (kgs/ha) recommended (old hybrids)
Bihar	1	1160	-
	1	1013	925
Gujarat	2	780	530
	8	1434	1013

State	No. of trials	Mean grains NHB.5	Yield (kgs/ha) recommended (old hybrids)
Haryana	10	1067	965
	6	968	531
Jammu & Kashmir	3	1755	1060
	1	-	932
	5	1434	846
Karnatka	3	926	973
	2	730	810
Maharashtra	31	1455	1124
	11	522	409
	4	1677	1075
Madhya Pradesh	7	984	969
	5	1000	1077
Rajasthan	26	1513	1119
	32	1282	1095
	6	1281	777
	2	1320	1150
	5	920	753
	3	1387	763
Tamil Nadu	1	900	-
	1	2800	2500
	3	309	217
Uttar Pradesh	11	1894	1670
	6	1387	871
Delhi	12	2607	3425
	5	1292	-
Universities			
UPAP, Hyderabad	3	283	308
HAU, Haryana	3	2280	1866
APKV, Rahuri	6	2838	1318
GB Pant Univ. Pantnagar	6	2771	1679
AU Varanasi	4	755	568

Delhi data on disease and yield

Name of hybrid	% plants affected with downy mildew	Yield in kgs/ha
HB-5	20-25% (Max. 45/60)	21/34
NHB.5	3-8% (Max. 13%)	23/90

(Contributed by H.K. Jain and S.C. Pokhiryal, Indian Agricultural Research Institute, New Delhi, India).

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 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/cross (parent variety)	Main improved attributes of variety
BARLEY			
Denar	CSSR 1969	X-ray mutant of the hybrid Celechovicky x Bavaria	
Ametyst	CSSR 1972	Cross with "Diamant" (mutant) obtained 1956 by X-ray treatment 10 Krad [Valticky]	Superior to "Diamant" in yield
Favorit	CSSR 1973		"
Hana	CSSR 1973		"
Minsk	USSR 1974	^{60}Co Gamma rays [Viner]	Improved lodging resistance and yield, good milling and brewing qualities
Boyer	USA 1975, R.A. Nilan, W.S.U., Pullman	Cross with mutant variety [Luther]	High yield, lodging resistance, short straw, winter hardiness
Blazer	USA 1974, R.A. Nilan, W.S.U., Pullman	Cross "Traill" x 1038 - 6704 (induced recombinant)	High yield, high alpha amylase, white lemma, good quality
CLOVER (Trifolium incarnatum)			
Cardinal	CSSR		

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment/cross (parent variety)	Main improved attributes of variety
MUSTARD			
Seco	Sweden 1961	Primex x Rumanian white mustard	Superior to Primex in seed yield, content of crude fat, early maturity and stalk stiffness. Also resistant to shattering.
Trico	Sweden 1967	Selection from Primex	Increased seed yield and oil content over Primex.
DURUM WHEAT			
Cresco	Italy 1974 A. Bozzini, C. Mosconi, CNEN, Casaccia	CpB144 (mutant) x [(Yt54-N10B) x Cp^2-63)] x Tc3	Improved lodging resistance, yielding ability, leaf rust resistance, kernel quality and test weight.
Mida	Italy 1974 A. Bozzini, C. Mosconi, CNEN, Casaccia	CpB144 (mutant) x [(Yt54-N10B) x Cp^2-63)] x Tc3	Improved lodging resistance, yielding ability, leaf rust resistance, kernel quality and test weight.
Tito	Italy 1975 D. Bagnara, L. Rossi, G. Porreca, CNEN, Casaccia	Castelporziano (mutant) x Lakota	Improved lodging resistance, yielding ability, stem rust resistance.
AZALEA			
Mrs. R. de Loose	Belgium 1972 R. de Loose Rijksstation voor Sierplantenteelt, Melle	Recurrent irradiation with ^{60}Co Gamma- and X-rays, 1965-69 [de Waele's Favorite]	Flower colour change from blue-red with white edge towards yellow-red (synthesis of flavonols is completely stopped, anthocyanins are unchanged).

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment/cross (parent variety)	Main improved attributes of variety
AZALEA (continued)			
Adinda	Belgium 1972 R. de Loose Rijksstation voor Sierplantenteelt, Melle	Recurrent irradiation with X-rays, 1968 [Karl Glaser]	Flower colour change from blue-red towards yellow-red.
Mira	Belgium 1972 R. de Loose Rijksstation voor Sierplantenteelt, Melle	Recurrent irradiation ^{60}Co Gamma- and X-rays, 1965-69 [Euratom]	Flower colour change from blue-red towards intense red.
Saidjah	Belgium 1972 R. de Loose Rijksstation voor Sierplantenteelt, Melle	Recurrent irradiation ^{60}Co Gamma rays, 1965-66 [Euratom]	Flower colour change from blue-red towards yellow-red.
Pastorale	Belgium 1973 R. de Loose Rijksstation voor Sierplantenteelt, Melle	Recurrent irradiation with ^{60}Co Gamma- and X-rays, 1965-70 [de Waele's Favorite]	Flower colour change from blue-red with white edge towards blue-red with very small white edge.
Sierra Nevada	Belgium 1974 R. de Loose Rijksstation voor Sierplantenteelt, Melle	Recurrent irradiation with ^{60}Co Gamma- and X-rays, 1965-66 [de Waele's Favorite]	Flower colour change from blue-red with white edge towards yellow-red with very small white edge (synthesis of flavonols completely stopped, anthocyanins unchanged)
Eroica	Belgium 1974 R. de Loose Rijksstation voor Sierplantenteelt, Melle	Recurrent irradiation ^{60}Co Gamma- and X-rays, 1965-70 [Knut Erwen]	Flower colour change from blue-red towards intense red (synthesis of flavonols is partially stopped, anthocyanins unchanged)

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment/cross (parent variety)	Main improved attributes of variety

CORRECTION

BREAD WHEAT

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment/cross (parent variety)	Main improved attributes of variety
Sharbati Sonora	India, 1967 G. Verughese and M.S. Swaminathan, IARI, New Delhi (A. Austin for quality)	Dry seeds (12%) 1 h 2600 Å UV + 20 krad ^{60}Co Gamma rays (1963) [Sonora 64]	Amber grain colour (preferred in India); good nutritive and chapati (unleavened bread) making quality.

NOTE: Readers are kindly requested to report to us any information about commercial mutant varieties including varieties which have induced mutants in their pedigree. Of particular interest is information about the commercial value of such varieties (acreage covered, amount of certified seeds produced, date of withdrawal from commercial production).

FUTURE EVENTS OF INTEREST

1975

Third FAO/IAEA/SIDA Research Co-ordination Meeting on Induced Mutations for Disease Resistance in Crop Plants, 15-19 September 1975, Ames/Iowa (USA).

First FAO/IAEA Research Co-ordination Meeting on the Use of Aneuploids for Wheat Protein Improvement, 6-10 October 1975, Vienna.

FAO/IAEA Advisory Group Meeting on Induced Mutations in Cross-Breeding, 13-17 October 1975, Vienna.

International Conference on Crop Productivity, 20-25 October 1975 at Harbor Springs/Michigan (USA).

FAO/IAEA Regional Seminar for South East Asia on Grain Legume Improvement, tentatively 8-12 December 1975 at Peradeniya (Sri Lanka).

1976

Second FAO/IAEA/SIDA Training Course on Plant Breeding for Disease Resistance including the Use of Induced Mutation Techniques. First half 1976. Location undetermined.

International Symposium on Coconut Research and Development, 28-30 December 1976 at Kasaragod/Kerala (India).

Second FAO/IAEA Research Co-ordination Meeting on Improvement of Vegetatively Propagated Crops and Woody Perennials through Induced Mutations. Date and location not yet determined.

Second FAO/IAEA Research Co-ordination Meeting on the Use of Induced Mutants in Rice Breeding and Production. Date and location not yet determined.

Third FAO/IAEA Research Co-ordination Meeting on the Improvement of Mutation Breeding Techniques. Date and location not yet determined.

RECENT PUBLICATIONS

Induced Mutations for Disease Resistance in Crop Plants (report of an FAO/IAEA/SIDA Research Co-ordination Meeting, Novi Sad, Yugoslavia 1973). STI/PUB/388, IAEA, Vienna 1974, US$10.

Improvement of Vegetatively Propagated Plants through Induced Mutations (Proceedings of a Research Co-ordination Meeting, Tokyo, Japan 1974). IAEA-173, Vienna 1975.

(Available as microfiche copy on prepayment of US$0.65).

Nuclear Techniques for Seed Protein Improvement II (Proceedings of a Research Co-ordination Meeting, Ibadan, Nigeria 1973). IAEA 1975 (in press).

REQUESTS

1. For a study of the relationship between leaf size and ear formation in wheat we are looking for material with deviating leaf forms. We would be especially interested in types with extremely short leaf blades, but otherwise not too much deviating from normal types. We would appreciate if anyone who has such types available could send us some seeds.

Ir. N.M. de Vos, Instituut voor Biologisch en Scheikundig Onderzoek van Landbouwgewassen, Wageningen, P.O. Box 14, Netherlands.

2. For a study on induced dwarfs from indica rice we would be interested in obtaining 5-10 g seed samples of induced dwarf mutants with good plant type, irrespective of yield potential (phytosanitary certificate required).

Dr. E.A. Siddiq, Division of Genetics, Indian Agricultural Research Institute, New Delhi 110012, India.

REMINDER

The Plant Breeding and Genetics Section of the Joint FAO/IAEA Division, Vienna, is interested in research projects in the following subject areas:

- Induced mutations for disease resistance of plants
- Induced mutations for nutritional improvement of plant products
- Induced mutations for genetic improvement of legumes, vegetables, vegetatively propagated plants and woody perennials
- Induced mutations in cross-pollinated plant species
- Induced mutations in cytoplasmic traits
- Tracer techniques for plant selection.

Scientists working in any one of these fields should be reminded about the possibility to submit proposals for research contracts or research agreements to IAEA. For further information, please contact Dr. A. Micke, Head of the Plant Breeding and Genetics Section.

WANTED

IAEA frequently receives requests from member states for expert advice in the use of induced mutations for plant improvement. Assignments would be for periods between 3 months and 1 year. Such posts are being advertised by IAEA and respective national authorities. However, frequently the notification does not reach the interested persons in time. Therefore, we suggest that anyone having substantial experience in plant breeding and/or induced mutations with a particular crop plant (such as cereals, grain legumes, vegetables, fruits, etc.), who is interested in such a temporary assignment, might contact the IAEA Expert Section or the Plant Breeding and Genetics Section of the Joint FAO/IAEA Division in Vienna. Candidates with French or Spanish language ability are particularly sought for.

EDITORIAL NOTE

Please send your contributions for inclusion in the next issue of the Mutation Breeding Newsletter to the editors by 1 November 1975.

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