Mutation Breeding Newsletter

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ANNOUNCEMENT

International Symposium on Advances in Mutation Breeding Techniques and Practical Achievements

This Symposium will be organized by FAO and IAEA in cooperation with the European Association for Research on Plant Breeding (EUCARPIA), and is planned to be held at Nicosia, Cyprus, from 21-25 April 1975. The symposium is designed as a forum for plant breeders, geneticists and scientists from other disciplines, to present and discuss advances in techniques to induce, select and utilize mutations for developing better varieties of cultivated plants.

Participants will have to be nominated to IAEA by their Governments. EUCARPIA members can be nominated through EUCARPIA.

Papers will be considered from among the following topics:

1. Advances in understanding mutation processes and nature of mutations;

2. Advances in mutation induction

   (i) mutagens
   (ii) mutagen treatment techniques
   (iii) control of repair processes
   (iv) other means;

3. Utilization of <u>in-vitro</u> culture and haploids;

4. Advances in screening techniques for mutations;

5. New approaches to use induced mutations for the improvement of vegetatively propagated plants and of trees;

6. Utilization of chromosome aberrations in plant breeding;

7. Contributions by induced mutations to improving plants

   (i) productivity
   (ii) resistance to diseases, pests and environmental stress
   (iii) nutritional value
   (iv) other characters of economic importance;

..33/30

8. Induction and selection and utilization of cytoplasmic mutations;

9. Cultivars developed via induced mutations.

Papers would have to be submitted on a special form (available upon request) to the competent official authority for transmission to the IAEA, to reach the IAEA by 2 December 1974. Working languages of the symposium will be English, French, Russian and Spanish.

Precautions in using sodium azide as mutagen

Acid solutions of sodium azide will generate HN_3, particularly when bubbled with gases. HN_3 is highly toxic and easily absorbed into the blood stream after inhalation of the vapor or spray. Consequently, all treatments involving acid solutions of sodium azide and bubbling should be done with adequate ventilation, preferably in a good fume hood. Sodium and potassium azides are not considered explosive under most laboratory conditions. The greatest hazard in the use of these azides is the inadvertent production of a shock-sensitive material, i.e. organic or heavy metal azides. Waste azide solutions can be discharged into a laboratory sink if an adequate cold-water dilution is used to prevent reactions with material in the sewer or with the sink or sewer metals. With concentrations in the 10^{-3} range no difficulties in handling sodium azide were encountered. Stock solutions of higher concentration should be stored at neutral pH in the cold.

(Contributed by A. Kleinhofs, Washington State University, Pullman, Washington 99163, U.S.A.).

Breeding of short mutant lines (wheat)

After EMS-treatment of the V 81-12 variety several mutant lines were obtained with advantageous characters, but decreasing yield. Four mutant lines were selected:

1046 : powdery mildew resistant
22-32 : large seeds
2840 : precocity and high fertility
131 : short culm.

Combinations between mutant lines produced different hybrids which were selected for the advantageous characters. Synthetic lines with short culm and mildew resistance (or tolerance) were obtained. Some combinations had a productivity equal to, or higher than, that of the initial variety. Therefore, a number of apparently unfavorable mutants can be utilized with good results in various combinations.

Interspecific hybrid VPM (*Aegilops ventricosa* x *Triticum persicum* x *T. aestivum* "Marne") contains the "Cercosporella" resistance gene contributed by the Aegilops parent. After mutagenic treatments, several short lines were obtained: a breeding process for plant height, Cercosporella resistance and size of spike, finally produced 30 short lines which have retained the favorable characters of the original VPM and can be utilized in a combination project especially aimed at Cercosporella resistance.

EMS and gamma treatments were applied on the variety "Mandon" in order to induce mutants with favorable characters as:

Winter type of growth
Cold resistance
Lodging resistance.

EMS treatments were more efficient than gamma treatments in producing short mutants. Different sowing periods were tested in M_3 in order to screen photoperiodic mutants. Three mutants with "semi-winter" behaviour were isolated but did not seem to fit into our climatic conditions (Dijon region). However, some short culm mutants could be utilized in breeding projects.

(Contributed by P. Dommergues and H. Touvin, Institut National de la Recherche Agronomique, Station d'Amélioration des Plantes, Laboratoire de Mutagenèse, Dijon, France).

Analysis of induced genetic events through the behaviour of marker genes in M_2 (Petunia)

It was previously reported that most of the induced deletions are not transmissible through the gametophytes. However, marker genes located on broken chromosomes can be transmitted into M_2 plants if a crossing-over has occurred between the deletion and the marker.

On the basis of the results above, a genetic study was carried out on about 1000 M_2 progenies: chromosomes I, V, VI and VII were marked by P_1, A-R, P_3 and W genes, respectively. M_1 plants, obtained by treatment of male gametophytes (15 and 20 kR on mature pollen grains), were observed and selfed.

Numerous genetic events on each marked chromosome were detected; the radiosensitivity was not the same for the four marked chromosomes, and the most frequent events certainly were terminal deletions. After a 20 kR treatment about 60% of the M_1 plants were carrying at least one deletion on the marked chromosomes. Since as many as four chromosomes out of seven were marked, it is likely that nearly all the M_1 plants were carrying induced genetic events. The frequency of transmissible events (as mutations, for example) is much lower: 17 among 1000 M_1 plants.

(Contributed by A. Cornu, Institut National de la Recherche Agronomique, Station d'Amélioration des Plants, Laboratoire de Mutagenèse, Dijon, France).

Induced blast resistance in rice

Since the semidwarf high-yielding varieties of rice do not possess sufficient resistance to diseases and pests, an attempt was made to induce resistance to blast in the high-yielding variety Ratna (IR8 x TKM6). Seeds obtained from M_1 of Ratna, treated with 0.1 and 0.2 % EMS were sown in nursery beds, with rows of the highly blast-susceptible variety between every second test row. A total population of 8000 plants was grown. Twenty days after transplanting, scoring of leaf blast reaction was done according to the method described by Padmanathan and Gauguly in 1959. A wide range of variability in disease reaction could be obtained by mutagenic treatments. Between 12 and 15% of M_2 plants were in resistant groups (O and A) not present in the control.

(Contributed by S.Y. Padmanathan, Central Rice Research Institute, Cuttack, Orissa, India).

The effect of irradiation on the growth of banana fruit pulp tissue in vitro

Other workers have reported rapid callus growth from fruit pulp tissue of ripening bananas. However, callus derived from such source has not differentiated in culture. The difficulty may be due to the high degree of specialization the cells have attained. It might be desirable to derive the callus from very young fruits. Preliminary experiments in our laboratory have shown that tissue inocula derived from such sources failed to proliferate in 2,4-D supplemented White's Medium.

Two types of callus growth were previously identified. These were (a) the hard and brittle slow-growing type T-1, characteristic of tissue derived from immature fruit, and (b) the cottony, fast-growing type T-2, characteristic of tissue derived from mature but unripe fruit. Irradiation at 0.1 - 1.0 kR tends to induce rapid callus growth of otherwise slow-growing inoculum. Thus, by irradiating cultures of tissue from immature fruit, growth is modified from the T-1 to the T-2 type.

(Contributed by E.V. de Guzman, College of Agriculture, University of the Philippines, Los Baños, Philippines).

Irradiation breeding of sterile triploid turf Bermuda grasses

Tifgreen, Tifway and Tifdwarf are sterile interspecific triploid hybrids that cannot be improved by conventional breeding methods. A number of techniques for inducing mutations have been studied and irradiating dormant rhizomes by gamma rays has been found to be most effective. Tifway Bermuda grass treated exactly as Tifgreen, yielded only about half as many mutants. 158 mutants are now evaluated under conditions similar to golfgreens or fairways. Several mutants appear to have greater resistance to root-knot nematode than the parent clonal material from which they arose.

(Contributed by G.W. Burton and W.W. Hanna, University of Georgia, Georgia Coastal Plain Experiment Station, Tifton, Georgia, U.S.A.).

Irradiation breeding of sterile Coastcross-1, a forage grass hybrid, to increase winter hardiness

Coastcross-1 is an outstanding sterile forage hybrid Bermuda grass, produced at the Coastal Plain Experiment Station, which has far surpassed Coastal Bermudagrass or other grasses in quality. However, it lacks winter hardiness and since it is sterile, it cannot be improved by conventional breeding methods.

In 1971, some 400,000 freshly cut green stems of Coastcross-1 were packed into bales by a standard hay baler. They were then trucked to the University of Tennessee, AEC Laboratory Oak Ridge, where they were exposed to 7000R. Afterwards they were trucked to the Mountain Experiment Station where they were broadcast and disked into the soil. Four tiny plants from irradiated material survived at -16°C, all plants from the non-irradiated stems were winter-killed. The four surviving plants are being tested in replicated plantings for their winter hardiness. To increase chances for success, another 1,300,000 freshly cut green stems of Coastcross-1 were irradiated in 1972 and another 1,000,000 in 1973. A winter-hardy mutant of Coastcross-1 would have very great economic value in the Southern U.S.A.

(Contributed by G.W. Burton and W.W. Hanna, University of Georgia, Georgia Coastal Plain Experiment Station, Tifton, Georgia, U.S.A.).

Heterosis resulting from crossing specific radiation-induced mutants with their normal inbred parent

From our pearl millet irradiation programme a number of mutants have been obtained which have specific characteristics that set them aside from the normal type on a morphological basis. In 1972, we hybridized a number of these mutants with the normal inbred line from which they came. The first yield trials were planted in 1973. The first year's data suggest that the mutants "yellow node" and "short head" gave some positive heterosis when hybridized with the parent line Tift 23. An early and a light green mutant both gave significant heterotic increases in yield when hybridized with Tift 13A.

No evidence of significant heterosis could be formed in crosses involving mutants of Tift 18.

(Contributed by G.W. Burton and W.W. Hanna, University of Georgia, Georgia Coastal Plain Experiment Station, Tifton, Georgia, U.S.A.).

Induction of die-back disease resistant bud mutations by gamma irradiation in mulberry

Mulberry is attacked by many diseases and much of mulberry breeding is concerned with breeding for resistance. In heavy snowfall regions, mulberry is always attacked by die-back disease, Diaporthe nomurai Hara. Mercury preparations have been used to control the disease but concerns about environmental pollution precludes this application in the future. These are some resistant varieties but their foliage yield and feeding value is generally very low.

25 induced mutants of cultivar Ichinosi, 18 mutants of cultivar Kokuso No.21, and 7 mutants of cultivar Kairyonezumigaeshi were tested by artificial inoculation. In addition, buds of two F_1 strains of Hakkokuwasi were irradiated and resulting shoots were inoculated after grafting. None of the 50 preselected mutant strains revealed resistance against the disease. However, two of 165 grafts showed no necrosis after artificial inoculation. Whether they are truly resistant mutants has to be ascertained in the field.

(Contributed by H. Fujita, Institute of Radiation Breeding, Ohmiya, N.I.A.S., M.A.F., Japan).

Mutagenesis in maize: Studies on seedling growth, genetic and cytogenetic effects

Dose response studies for seedling growth reduction following treatment with gamma and fission neutron radiations were completed for a series of Tennessee inbreds and hybrids. One of the inbreds (T-232) was 3 and 1.5 times more sensitive to gamma and neutron radiation, respectively, than the other three. The other three inbreds and single and double cross hybrids showed about the same sensitivity to gamma radiation but the hybrids appeared more resistant to fission neutrons. The greater radiosensitivity of T-232 appears to be due to one or more recessive genes since the hybrid utilizing this inbred either as the male or female parent did not show increased radiosensitivity.

Both seedling growth and somatic mutation (presumed cytogenetic effects) studies were conducted with the Yg_2/yg_2 heterozygote. When seeds were treated under conditions of maximum radioresistance, i.e. 12-13% water content and soaked in nitrogen-bubbled water at 22°C for two hours after irradiation, the relative biological effectiveness (RBE) of fission neutrons compared to gamma radiation for inducing yellow-green sectors was very high at low doses; >600 for 0.25 sectors per leaf 5 and almost 400 for 0.75 sectors per leaf 4. The RBE decreased with increasing dose but was still >100 for induction of 3.0 sectors per leaf 5 and 6.0 sectors per leaf 4. The RBE for seedling growth reduction decreased from 37.2 at 20% injury to 25.1 at 70% injury.

The effectiveness of both radiations increased with an increase in soaking period prior to irradiation but the increase in effectiveness of gamma radiation was relatively greater so that the RBE decreased for both seedling injury and especially for induction of yellow-green sectors. When comparing arbitrary seedling injury levels with frequencies of yellow-green sectors it was found that the mutagenic efficiency of fission neutrons decreased with increased soaking period while the efficiency of gamma radiation increased.

Seedling injury following treatment with ethylmethane sulfonate (EMS) and sodium azide (NaN_3) showed an increase with an increase in presoaking period at higher but not lower concentrations. As the concentration became higher for either mutagen (0.08 M EMS and 0.001 M NaN_3) the more dependent seedling injury was on concentration. The interaction, however, between soaking period and concentration was not statistically significant at the 5% level.

Limited data on mutation frequencies of four marker loci on the short arm of chromosome 9 following treatment with gamma and fission neutron radiation and EMS showed that the mutation frequencies were very low. Most of the mutants found were for the Yg_2 locus. Four multiple locus mutants were found. Two of these were mutant ,at the bz and sh loci and two were mutant at the wx bz and sh loci. Only one seedling of the latter two mutants was recovered. It was normal for the Yg_2 locus indicating a possible interstitial deletion.

(Contributed by B.V. Conger, UT-AEC Comparative Anomal Research Laboratory, Oak Ridge, Tennessee 37830, U.S.A.).

Mutations induced by 5-bromodeoxyuridine in presoaked seeds of barley

The highest frequencies of chlorophyll mutations and mutations for heading time and culm length were obtained with 9 and 19.5 h presoaking, respectively, followed by one hour treatment with $1x10^{-3}$ M 5-bromodeoxyuridine (BUdR). Diffuse chromatin fibers were visible in the nuclei of barley embryos during the earliest stage of germination.

When BUdR was administered for one hour immediately after diethyl sulfate (dES) treatment of 19 h soaked seeds, an increase of mutations was found, suggesting the repair error of premutational damage. These indicate that BUdR is a potent mutagen in barley and may be useful for mutation breeding.

(Contributed by H. Yamaguchi, S. Tano, and A. Tatara, Laboratory of Radiation Genetics, Faculty of Agriculture, University of Tokyo, Tokyo, Japan).

Selection for blast-resistant mutants in irradiated rice populations

In Korea, rice blast often causes considerable damage. The use of resistant varieties will be the most effective way of control. However, the blast fungus is so variable that a resistant variety can turn to be susceptible rather quickly due to new races resulting from heterocaryosis and spontaneous mutation. It will thus be necessary to establish new varieties resistant to the blast races which could become prevalent races in the future. For this purpose it was considered valuable to induce mutants of blast fungus by X-ray irradiation for production of new pathogen races which would be useful for screening resistant plants from mutagen-treated or other rice populations.

In these studies, a screening technique in the growth room was developed which was effective in selecting rice mutants resistant to specific blast races that have to be prevented from spreading in the field. Detached leaf method was also employed as an artificial inoculation technique for testing blast resistance of aged plants growing under field conditions.

The blast race N-1 which is the most prevalently distributed in Korea, could be altered in its pathogenicity into C-group or T-group races by X-ray irradiation. Particularly, one of the mutants derived from 100 kR-irradiated spores was so different from the N-1 mother race in its pathogenicity that we were unable to identify it with the Japanese differential variety set, but it was identified by the international differential variety set as a race IE-67.

This IE-67 race showed strongest infection on the leaves of variety "Tong-il" through the inoculation test as compared to the other mutants obtained. These mutants increased in pathogenicity were employed as an inoculum for screening resistant lines. The results were also useful for predictions concerning the role of spontaneous mutations in contributing to variability in nature.

From the irradiated populations of the rice varieties "Tong-il" and "Pung-kwang", some blast resistant lines were selected through the blast nursery bed test, namely 27 lines from "Tong-il" and 7 lines from "Pung-kwang".

"Tong-il" is a new rice variety which is presently highly resistant to blast disease and which was selected from the progeny of a cross between indica type and japonica type rice.

With these results, it seems possible to conduct an analysis of genes for resistance in the variety "Tong-il" and to study host-parasite interactions with mutant races obtained.

(Contributed by S.H. Kwon, Applied Genetics Laboratory, Korea Atomic Energy Research Institute, Seoul, Korea).

Compact Stella sweet cherry introduced

Agriculture Canada, Research Station at Summerland, British Columbia, introduced for commercial and home plantings a mutant of semidwarf and compact growth of the Stella cultivar. The (original) Stella cherry is self-compatible - the only sweet cherry cultivar possessing this characteristic. Compact Stella combines self-compatibility with very desirable growth type. The tree of Compact Stella is about one-half the size of a standard cherry tree. The new cultivar comes early into bearing and carries heavy crops. The fruit of Compact Stella is similar to that of the parent cultivar, in appearance, quality and season of maturity.

The mutant was induced by irradiating dormant scions of the Stella cherry with 4 kR of X-rays.

(Contributed by K.O. Lapins, Agriculture Canada, Research Station, Summerland, B.C., Canada).

A note on the influence of treatment pH on the spectrum of chlorophyll mutations in rice

Altering the spectrum of mutations in a predictable manner and thereby achieving directed mutagenesis is an important goal of current mutation research. Modifications in the treatment pH conditions is one of the varied approaches tried in the past to achieve this goal. Thus, the effect of treatment pH on the frequency and spectrum of chlorophyll mutants induced by chemical mutagens such as EMS and dES has been studied by many workers employing the normal cultivated plant species as test material. (Ramanna and Natarajan, 1965; Mohan Rao, 1972). Though many of the above workers observed marked differences in the frequency of chlorophyll mutations, no appreciable change in spectrum however, was observed. An attempt was made, therefore, to study the effect of treatment pH on the spectrum of chlorophyll mutations induced by EMS employing a different test system, viz., a viable "virescent" mutant of the popular rice variety IR-8.

The seeds presoaked in water for 20 hours were treated with buffered solutions of 0.75% EMS at five different pH levels of 5.0, 6.0. 7.0, 7.8 and 8.6. Contrary to earlier reports, the present data revealed an interesting trend in the alteration of mutation spectrum with change in the pH of the treatment solution. Only two classes of mutations, viz., albina and striata, were induced by EMS under all the five pH conditions. The proportion of striata was maximum with 89.13% at pH 5.0 which exhibited a decreasing trend as the pH of the treatment solution increased from 5.0 to 7.0 with only albina in the alkaline pH ranges of 7.8 and 8.6. The hitherto observed mutagen-specificity in different organisms has been attributed to differential recovery rather than differential induction (Auerbach, 1967). As higher pH condition is known to reduce toxicity and seedling injury (Ramanna and Natarajan, 1965; Froese-Gertzen et al, 1964), it is possible that more lethal types of mutations like albina are eliminated in the toxic conditions of low pH with increased recovery of these types at higher pH levels. Hence, the alteration in spectrum observed in the present study also may be due to the process of differential recovery as suggested by Auerbach (loc.cit.). Alternately, the observed change in spectrum can also be explained assuming differences in the number of genes governing the mutational events albina and striata and their relative survival value against diplontic selection. Thus, the results of the present study bring out the importance of suitable test systems to be employed apart from treatment conditions, in studies on directed mutagenesis.

AUERBACH, C., 1967. The chemical production of mutations. Science 158 :1141.

FROESE-GERTZEN, E.E.,NILAN, R.A. and HEINER, R.E., 1964. The effect of ethyl methane sulfonate on the growth response, chromosome structure and mutation rate in barley. Radiation Bot. 4 : 61.

MOHAN RAO, P.K., 1972. The influence of pH on damage induced by diethyl sulfate (dES) in barley. Mutation Res. 15 : 155.

RAMANNA, M. and NATARAJAN, A.T., 1965. Studies on the relative efficiency of alkylating agents under different conditions of treatment. Indian J. Genet. Pl.Breed. 25 : 24.

(Contributed by V.J. Augustine, K. Palanichamy and E.A. Siddiq, Division of Genetics, Indian Agricultural Research Institute, New Delhi, India).

Diploid-bud formations in a haploid rice plant induced by acute gamma irradiation

It has been reported that diploid rice plants were obtained from a haploid clone propagated vegetatively and irradiated by chronic gamma irradiation. These findings are interesting from the standpoint of morphogenesis.

This letter describes a preliminary result on haploid rice clones exposed to acute gamma rays of 2, 4, 8, 12 and 16 kR/20 hrs. All haploid plants were lethal at 12 kR over, and LD_{50} was estimated to be 8 kR. The developing diploid-bud, however, survived even after 16 kR irradiation, and formed diploid panicles. At such low exposure as 2 and 4 kR, fertiled seeds occurred partially in a haploid panicle. At moderate exposure, chimeric panicle with haploid-diploid spikelets were obtained. It may be explained histologically due to the cell component in the shoot apex. Therefore, it seems that a haploid panicle with partially fertiled seeds was derived from the periclinal chimera, in which the first tunica layer consists of haploid cells and the second tunica is diploid. The induced diploid panicle may consist of only diploid cells as well as the shoot apex in the original diploid rice plant. The haploid-diploid panicle would be compounded of both events. These facts will aid to make clear the developmental pattern of diploid-bud formation in a haploid plant.

(Contributed by F. Sekigichi, Faculty of Agriculture, Ibaraki University, Ibaraki, Japan).

A high protein mutant in rice

Mutant No. 398 was selected after irradiation of seeds of the variety Hokwang with X-rays. It is short-culmed, matures 20-30 days earlier and shows about 30% higher protein content under various cultivation conditions. Grain yield is equal to or slightly less than the original variety. It is resistant to leaf blast but susceptible to neck blast. Grain shape and weight, size of endosperm and embryo are almost identical to the mother variety. The increase of protein is attributable to the increment of protein in the endosperm. The mutant has been backcrossed to the mother variety (a) to introduce the high protein character to the mother variety, (b) to decide the number of genes controlling the higher protein content, (c) to clarify the linkage or pleiotropism of high protein and culm length or earliness. Histochemical investigation of the endosperm 2-3 weeks after heading seems to show that the mutant has more protein in the peripheral parts of the endosperm. However, contrary to popular belief, accumulation of protein was not abserved in the aleuron layers. To examine how the protein accumulates in the grains, developing grains were analyzed from heading to maturity. There was no difference between the mutant and the mother variety in the pattern of protein increase in the developing grain. However, the mutant showed at all stages a higher amount of protein per grain, clearly detectable already three weeks after heading.

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

COMPUTERIZED INFORMATION SYSTEM ON SCIENTISTS WORKING IN THE FIELD OF INDUCED MUTATIONS

As most of our readers know, about two years ago we implemented a survey on scientists working on induced mutations in plants. Due to the kind cooperation of our colleagues all over the world our survey includes now 217 scientists. We assume that this number comprises about two thirds of the scientists working in this field. Next year we will start to improve the survey and hope again for a good response. The primary aim of this survey is to be able to establish closer contacts with and among scientists working in the same field, having similar objectives and facing identical problems. We hope, for example, to be soon in a position to provide (upon request) a list of scientists working on induced mutations for disease resistance in wheat, or a list of scientists experimenting with a particular mutagen.

It may be of interest to our readers to learn about the number of scientists involved in mutation research or mutation breeding, and the plant genera they are concerned with (Table 1).

Table 1: Number of scientists in mutation research and breeding according to plant families and genera

Plant genera	No.of scientists		Plant genera	No.of scientists	
Forage crops	48		Forest trees	27	
Morus		5	Populus		3
Lolium		4	Pinus		5
Trifolium		4	Picea		3
Paspalum		2	Cryptumeria		3

Plant genera	No.of scientists		Plant genera	No.of scientists	
Fruit crops	28		Horticultural crops	45	
Vitis		2	Rosa		4
Arabidopsis		3	Dianthus		3
Malus		9	Gladiolus		3
Primos		2	Petunia		3
Pyrus		4	Chrysanthemum		2
Citrus		3	Hibiscus		2
			Tulipa		2
Grain and pulse crops	186		Industrial crops	27	
Hordeum		44	Brassica		6
Triticum		42	Saccharum		6
Oryzae		41	Nicotiana		5
Zea		16	Gossypium		4
Pisum		7	Linum		3
Avena		6			
Pennisetum		5	Root-, tuber- and bulb crops	11	
Phaseolus		4	Solanum		8
Secale		4	Beta		2
Triticale		4	Ipomoea		2
Sorghum		3			
Arachis		2			
			Vegetables	13	
			Lycopersicum		10

We have also made a survey of scientists working in plant mutations in different countries (Table 2) and a survey of the mutagens used (Table 3).

Table 2: Number of scientists in plant mutation research and breeding according to geographical regions

Region	No. of scientists		Region	No. of scientists	
Asia and Oceania	92		Europe	78	
Japan		50	Netherlands		14
India		15	Denmark		9
Taiwan		10	France		9
Bangladesh		4	FRG		7
Pakistan		3	Sweden		6
Philippines		3	Hungary		5
			Yugoslavia		4
North America	31				
U.S.A.		24	Middle East	5	
Canada		7	Egypt		2
South America	11				
Brazil		10			
Argentina		2			

Table 3: Number of scientists in plant mutation research and breeding working with certain mutagens

Mutagen	No. of scientists	Mutagen	No. of scientists
Gamma rays	180	Isopropyl-methane-sulfonate	12
Ethyl-methane-sulfonate	121	UV	11
X-rays	99	Ethyl-ethane-sulfonate	11
Neutrons	81	Absorbed radioisotopes	10
Ethylene-imine	43	Methyl-methane-sulfonate	10
Diethyl-sulfate	42	Nitroso-ethyl-urethane	10
Colchicine	33	Nitroso-methyl-guanidine	9
Nitroso-methyl-urea	20		

It must be stressed, however, that this is a preliminary survey based on the questionnaires returned so far. The data may not be fully representative.

FUTURE EVENTS OF INTEREST

1974

FAO/IAEA/SIDA Training Course on Plant Breeding for Disease Resistance Including the Use of Induced Mutations (Casaccia, Italy, 23 September - 31 October).

FAO/IAEA Research Coordination Meeting on Improvement of Vegetatively Propagated Crops and Tree Crops through Induced Mutations (Ohmiya, Japan, 30 September - 4 October).

FAO/IAEA Panel on Tracer Techniques in Plant Breeding (Vienna, Austria, 2-6 December).

1975

FAO/IAEA Symposium on Advances in Mutation Breeding Techniques and Practical Achievements (Nicosia, Cyprus, 21-25 April).

XIIth International Botanical Congress (Leningrad, U.S.S.R., 23-30 June).

International Barley Genetics Symposium (Munich, FRG, 8-12 July).

VIIIth International Plant Protection Congress (Moscow, U.S.S.R., 21-27 August).

NEW PUBLICATIONS

Polyploidy and Induced Mutations in Plant Breeding (Proceedings of a Meeting jointly organized by FAO, IAEA and EUCARPIA, Bari, Italy, 1972). STI/PUB/359, IAEA, Vienna, 1974.

Induced Mutations for Disease Resistance in Crop Plants (Report of an FAO/IAEA/SIDA Research Coordination Meeting, Novi Sad, Yugoslavia, 1973). STI/PUB/388, IAEA, Vienna (in press).

LIST OF MUTANT VARIETIES

Attached to this issue of the Mutation Breeding Newsletter you will find a reprint from the publication "Polyploidy and Induced Mutations in Plant Breeding" (IAEA, Vienna, 1974), which contains a list of released or approved varieties produced with induced mutations or having induced mutations in their background (based on information received by the Joint FAO/IAEA Division as of 1 October 1973).

As in previous issues, you are again kindly requested to report to us *any information about released mutant varieties that you know of.* *Of particular* interest, beside the data mentioned in the list, is information about the amount of certified seeds produced and the acreage of a particular mutant variety grown by farmers.

Below are two corrections and two new mutant varieties reported after publication of the list.

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]	Main improved attributes of variety
		CORRECTIONS (underlined)	
RICE			
PARC 1	Philippines, 1970 I.S. Santos, J.V. Elec, L.M. Verano-Brewbaker A.B. Ascensión, Philippine Atomic Res.Center Philippine At.En. Commission	40 kR ^{60}Co gamma-rays (1966) [IR-8-288-3]	Narrower and longer grains with less chalky areas
PARC 2	Philippines, 1973 I.S. Santos, J.V. Elec, L.M. Verano-Brewbaker, A.B. Ascensión, Philippine Atomic Res.Center Philippine At.En. Commission	40 kR ^{60}Co gamma-rays (1966) [IR-8-68]	5-10 days earlier maturity, slightly narrower and much longer grains with less chalky areas, good eating quality, high acceptance by farmers
		ADDITIONS	
RICE			
Hybrid Mutant 95	India, 1973 S.S. Saini, Punjab Agric. University Ludhiana (Punjab)	50 kR ^{60}Co gamma-rays (1966) [Jhona 349 x Taichung Native-1]	Short stature, short duration, high yield potential, photoperiod and thermo-insensitive; wide adaptability, high protein (12.3%) and high lysine (4.07%) content. Covers more than 20,000 ha in the Punjab. Very popular for transplanting late in the season and for multiple cropping schemes
SOYBEAN			
KEX-2	Korea, 1973 S.H. Kwon, K.H. Im, Radiation Res.Inst., Seoul M.S. Kim, Office of Rural Development, Suwon	X-rays (1963) [Kumkang-Dai-Rip]	11 days earlier maturity, ca. 16% higher yield

REQUEST FOR WHEAT MUTANTS

To identify sources of germ plasm in wheat that may be useful for breeding nutritionally improved protein wheat varieties, the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture is undertaking at the IAEA Seibersdorf Laboratory to screen via ninhydrin and DBC methods all stocks of induced wheat mutants available (except those already evaluated for protein composition).

We would like, therefore, to receive unground (whole seed) samples (approx. 10-20 grams) of genetically stable mutants of durum and/or common wheats as well as at least 30 grams whole seed of the original (mother) variety or line from which they were derived. The seeds should be packaged in "coin" envelopes, closed with sticky tape (not with staples or glue) and packed with an identifying list of the stocks.

Please mail to: Dr. R. Rabson, Joint FAO/IAEA Division, IAEA, P.O.Box 590, A-1011 Vienna, Austria.

Results of the analyses will be provided to the originator of the mutants, and summaries of test results will be presented from time to time in the Mutation Breeding Newsletter.

WANTED

Plant Breeding Expert for Nuclear Center Kinshasa, Zaïre. Assignment up to one year. Knowledge of French essential. Interested persons please contact the IAEA Experts Section, IAEA, Vienna, Austria.

EDITORIAL NOTE

Please send your contributions for inclusion in the next issue of the Mutation Breeding Newsletter to the editors by 1 November 1974.

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