Mutation Breeding Newsletter

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News from the Plant Breeding and Genetics Section

The Section presently fosters 90 research projects within the framework of the IAEA Research Contract Programme and takes care of 7 others within IAEA and UNDP Technical Assistance Programmes. Attention is being focussed to some extent upon grain quality and disease resistance improvements. In July 1976, an advisory group met in Vienna to look into problems related to the nutritional evaluation of mutants that have been selected by chemical analysis. The potential and limitations of induced mutations to contribute towards improvement of crop plant disease resistance will be reviewed at an international symposium scheduled to be held from 31 January to 4 February 1977 in Vienna, and preparations for this symposium are in full swing. The latter part of 1976 will see substantial staff changes in the Section, insofar as Robert Rabson has left to return to ERDA at Washington, D.C. (USA) and Yan Bhatia took again charge of the Plant Breeding Section at the Bhabha Atomic Research Centre in Bombay (India). As new staff members we welcome Dr. R.D. Brock from CSIRO, Canberra (Australia) and further expect Dr. A. Brunori from CNEN, Casaccia (Italy), so that the staff of the Section will be as follows:

Section Head:	Dr. Alexander Micke (FRG)
Headquarters Staff:	Dr. Knut Mikaelsen (Norway) Dr. Richard D. Brock (Australia)
Laboratory Staff:	Dr. Thorsten Hermelin (Sweden) Dr. Alberto Brunori (Italy) Dr. Helmut Brunner (Austria) Ing. Gertrude Adam (Austria)

RESEARCH NEWS

Induced mutations for high lint percentage in Egyptian cotton (Gossypium barbadense L)

The extra long staple, superior cotton G. barbadense is under cultivation in countries like Egypt, Sudan, USA, USSR and some South American countries, but it is relatively a new introduction to India. Its poor

adaptability has restricted its cultivation. Recently a superior quality strain of G. barbadense, variety "SUVIN", was released for commercial cultivation in South India and it has spread in irrigated areas. The fibre quality of this variety is comparable to that of the imported Egyptian Giza-45 and the textile industry is able to utilize this cotton in place of the imported cotton. One major drawback of the variety "Suvin" was its low lint percentage (ginning percentage) which is the weight of lint as a percentage of the weight of seed cotton.

A mutation breeding programme was started to rectify this defect in the variety "Suvin". Dry seeds were irradiated with 15 kR of gamma rays from a Co^{60} source and presoaked seeds were treated with 0.1% EMS solution for 6 hours. One hundred hand picked seeds were used for each treatment. The M_1 generation was raised in the field, the flowers were selfed and selfed seeds were used to raise the M_2 generation. The M_2 population, consisting of 1289 plants from both the treatments, was screened and after eliminating plants with reduced fertility 563 plants in EMS treatment and 244 plants in gamma ray treatment were ginned in a laboratory gin. The control population was also handled in a similar fashion. Plants from the M_2 population with higher lint percentage compared to the control were selected. The lint percentage range was 23 to 40 in the M_2 compared 27 to 29 in the parent. Selfed seeds of M_2 selections for high lint percentage were used to raise M_3 progeny. One row of the parent variety "Suvin" was grown after every 20 rows to serve as control. Seed cotton harvested from M_3 rows were ginned. The range of lint percentage was 27 to 32 in EMS treatment, 27 to 31 in gamma ray treatment and 27 to 29 in the control lines. Lines with a lint percentage of at least 31 were selected. There were 39 such M_3 lines in EMS and 4 in gamma ray treatments. These are under test for fibre qualities and other agronomic characters.

The lint percentage is a complex character influenced by seed weight and lint weight. Selection for high lint percentage may result in plants with light (small) seeds which may affect the vigour of seedlings. Hence the seed weight of the induced mutants was determined and the seed index (100 seed weight) range was 10.2 gm to 13.1 gm compared to the range of 10.8 gm to 13.3 gm of the parent variety.

(Contributed by R. Krishnaswami and R. Kothandaraman, Indian Agricultural Research Institute, Regional Station, Coimbatore 641003, India).

A daylength-insensitive mutant of cotton

MCU-5, a high yielding strain of upland cotton (Gossypium hirsutum) combining good fibre characteristics, was evolved by plant breeders in the state of Tamilnadu. It is widely cultivated at present in the southern states of India. Under the relatively long day conditions of Northern, Central and Eastern India, this variety flowers late and is not considered suitable for commercial cultivation. In order to extend its cultivation, a mutation breeding programme has been in progress at the Indian Agricultural Research Institute since 1969. Seeds of MCU-5 were treated with gamma rays and various chemical mutagens. Following treatment with gamma rays (25 and 30 kR) two mutant plants were isolated in the M_2 generation. They appeared to be relatively daylength insensitive and have bred true for this character for a number of years.

Both these cultures have been tested extensively in yield trials all over the country. At a number of locations they have yielded as well as the standard local variety. On an average the mutant strains take 60 days to flower and 160 days to mature irrespective of the location or season. The average yield recorded in small scale yield trials ranges from 10 to 25 quintals per hectare. The mutants, like the parental variety, have a fibre length of about 29 mm and spin to a count of 60.

The past three years trials have shown that the mutant strains are particularly promising for the eastern state of Orissa both for the regular kharif season and also as an off season winter crop. The State Department of Agriculture has recommended one of these strains for commercial cultivation. A large scale seed production programme has been undertaken for this purpose. It may be added that Orissa state has no significant acreage under the cotton crop. The new mutant strain holds considerable promise to introduce this crop in the state.

(Contributed by R.N. Raut and H.K. Jain, Division of Genetics, Indian Agricultural Research Institute, New Delhi, India).

Induction of short mutants in winter rye (Secale cereale)

Rye breeding needs urgently short-straw materials. Short forms already existing show undesirable pleiotropic effects or linkage causing considerable yield decrease. Therefore it seemed reasonable to induce short mutants in outstanding varieties of winter rye.

In 1971 the research program was started with the aim of elaborating methods of mutation induction in rye. It is a cross-fertilized plant showing great inbreeding depression which makes selfing impracticable. Having this in mind we decided to perform pair-crossings of phenotypically similar plants.

Fast neutrons and N-nitroso-N-ethyl-urea (NEH) were chosen as mutagens. In a series of preliminary experiments the optimum dose was determined to be 400 rads of N_f and 0,04% NEH. In the main experiment, one seed sample of 650 seeds was treated with N_f at the cyclotron of the Institute of Nuclear Physics in Cracow, immediately soaked in distilled water after the treatment and sown in the field. The other sample consisting of 3000 seeds was presoaked in water for 2 hrs, soaked in the mutagen solution for 16 hrs, and washed in running tap water for 2 hrs, and then sown in the field.

In M_2 many short mutants appeared and they proved to be stable in M_3 also. The mutagenic effect of NEH exceeded that of N_f considerably, judging from the number of short mutants isolated.

The plant height of M_3 mutants ranged from 60 to 160 cm in comparison to 100 to 160 cm for the controls.

Further research on the subject is in progress.

(Contributed by S. Muszynski, M. Darlewska and A. Dabrowska, Institute of Genetics and Plant Breeding, Warsaw Agricultural University, 02-766 Warsaw ul. Nowoursynowska 166, Poland).

A mutant rice variety in Hungarian rice production

NUCLEORYZA, an early maturing mutant rice variety, was stately patented in 1974 and officially released in 1976 in Hungary for commercial use. In three years State field trials the variety was the earliest and the highest yielding among the early maturing group. The yield of the variety was even competing with the best varieties in the late maturing category.

The variety was developed as follows: In 1966, the French variety Cesariot - which was extremely late maturing, but very good yielding and disease resistant under Hungarian conditions - was irradiated with fast neutrons in the Astra reactor of the Austrian Reactor Centre at Seibersdorf, with the help of the Plant Breeding and Genetics Section of the IAEA. The doses were approximately 1000, 1500 and 2000 rads. The irradiated seeds were planted in the rice field at the National Institute of Agrobotany, Tápiószele, Hungary, in the spring of 1966. The breeding objectives were to obtain mutants ripening 2-3 weeks earlier than the mother line, maintaining the good Piricularia and lodging-resistance, as well as the high yielding capacity.

Ca 1000 panicle-progenies were grown from each dose group in 1967 (M_2) and 1968 (M_3).

Selection for early flowering plants was started in the M_2 generation and continued in the M_3 generation.

From the 1000 rad treatment progenies a number of early flowering plants were selected and some bred true already in the M_3 generation in 1968. One of the mutants was in that year 23 days earlier than the mother variety, Cesariot.

In 1970 this early mutant line, called NUCLEORYZA, was included in local field trials at Tápiószele on the breeding station and at Szarvas on the rice experiment station of the Fishing Research Institute.

In these trials the mutant was tested against established good varieties and new breeding lines. It appeared that the mutant had a good yielding capacity and a good response to nitrogen fertilization. It maintained the high lodging and disease resistance and the good kernal shape of the French variety Cesariot. We nominated the variety candidate to the official state field trials in 1973. The results are given in Tables 1 to 4.

The official comment of the National Plant Variety Testing Institute on the NUCLEORYZA variety says: "Early maturing, high yielding, lodging resistant variety; very suitable for the mechanical combine harvesting; disease/ pathological/resistance and the husking value is appropriate. Suitable for the successful rice production in every part of Hungary."

Morphological description: Medium high, firm, thick and broad leaves. The panicles are awnless, medium long, semi-hanging and medium compact. The husk is yellow-brown, a little bit hairy. The 1000 kernel weight 32-34 g, the length of the grain 8,8 - 8,9 mm, the profile index 2,5 - 2,6. Creating a dense, closed stock.

The panicles do not rise much over the level of the leaves. For 1977 enough elite seed of NUCLEORYZA will be available for some 4000 hectares.

TABLE 1

Small plot experiments (1973-1975)
grain yield tons per hectare

	1973	%	1974	%	1975	%
NUCLEORYZA	5,40	90	5,05	116,9	5,39	132,4
SZARVAS-SLENDER	6,05	100,8	4,34	100,5	4,07	100,0
CONTROL Dubovszkij 129	6,00	100,0	4,32	100,0		
AVERAGE 7 varieties	5,40	-	4,10	-	4,36	-
LSD 5%	0,66	-	0,58	-	0,71	-

TABLE 2

Large-scale experiments (1975) grain yield
tons per hectare; average of 24 locations

NUCLEORYZA	3,40	114,9 %
CONTROL Dubovszkij 129	2,96	100,0 %
SZARVAS-SLENDER	3,30	111,5 %

TABLE 3

Phenological and morphological characters (1973-1975)

	Growing period (days)			Lodging resistance		
	1973	1974	1975	1973	1974	1975
NUCLEORYZA	135	139	124	5,0	4,6	5,0
CONTROL	138	142	132	4,8	4,8	-
SZARVAS-SLENDER	138	142	126	4,9	4,3	4,9

TABLE 4

Morphological and physiological characters (1973-1975 average)

	Stem height cm	No. of panicles m^2	Prod. tillering	Length of grain mm	Profile index	Piricularia resistance
NUCLEORYZA	79	545	1,36	8,9	2,6	3
CONTROL Dubovszkij 129	82	452	1,12	7,7	2,1	4
SZARVAS-SLENDER	85	483	1,16	9,9	3,6	3

(Contributed by Z. Sajó, National Institute of Agrobotany, Tápiószele, and J. Simon, Central Food Research Institute, Budapest, Hungary).

Graft incompatibility with induced mutants in apple

Several mutants of the apple cultivar "Fuji" [1] were obtained by chronic or acute gamma-rays irradiation showing various changes of vegetative organs. The Maruba-kaido (Malus prunifolia Borkhausen var. ringo Asami) rootstock is the most prevalently adopted rootstock in Japan, and exhibits normal compatibility and good bud union with most cultivars, especially with Fuji under practical cultivation [2].

Graft affinity between mutant shoot and Maruba-kaido rootstock was determined four years after grafting by measuring the girth of trunk at 5 cm above and below bud union. Eight mutants of dwarf-growth and 3 mutants of spur compact-growth were compared with grafts of the original cultivar "Fuji".

Most of the mutants showed weak diameter growth and low height growth when compared with their original. However, some mutants, namely, IRB 500-10, 500-14 and 500-20 produced marked overgrowth of the scion. For instance, the stock-scion ratio of IRB 500-14 was 0.89, the original being 1.29. The scions having such combination have not yet attained flowering and fruiting, and may perhaps not survive cultivation unless root inarching is conduced. The mutants, IRB 500-9, 500-17 and 500-21 also showed dwarf growth habit, but less severe overgrowth of the tops.

Maruba-kaido might not be useful as a rootstock species for mutants exhibiting weak growth habit, because of their apparent graft incompatibility. Trials to search for a new rootstock suitable for the induced mutants having weak growth habit should be started.

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(Contributed by Fukio Ikeda, Institute of Radiation Breeding, N.I.A.S., M.A.F. Ohmiya, Ibaraki-ken, Japan).

Use of radiations to induce useful mutations in fruit trees

Cherry

To obtain cultivars reduced in size as well as dwarfing rootstocks, several sweet cherry varieties and the clonal rootstock F/12/1 were treated with X-rays (Stabilipan, 250 kV, 15 mA) or gamma rays (^{60}Co source) at a total dose of 3.5 to 4.5 kR. The irradiated material consisted mainly of scions (1-2 buds), of one year old grafted plants, or of self-rooted plants for the rootstock (cut back to 2 buds). The scions were grafted on rootstocks and the treated plants were transplanted in the field. The MV_1 shoots originating from the irradiated buds were cut back in the next spring, up to the 4th bud, and the four basal buds grew into shoots (MV_2). Buds 5-12 of each primary shoot, grafted according to their position in V_1, developed into secondary shoots. At the end of the second year, measurements were made of shoot length, shoot thickness (at the 5th node) and bud number for each shoot in irradiated and control material.

A reduction of shoot length and a shortening of internodes have been noticed in the irradiated material, compared to controls. A statistically significant correlation has been found between shoot length and number of buds, and between shoot length and thickness. The points which fell outside the confidence limits (5% of the linear regression) were considered as deviants and those which had shorter internodes and increased shoot thickness were grafted again. The frequency of morphological mutations was significantly higher in the cultivars Durona di Vignola II, Bigarreau Napoleon, Mora di Cazzano than in the cultivars B. Burlat, Merton Heart and Merton Bounty. The highest frequency of deviants observed in MV_2 shoots came from bud primordia originating in the area immediately below the apical meristem of the treated bud. The more promising mutants isolated are now being evaluated in agronomic trials.

Olive

Compact growth habit mutants induced in outstanding cultivars would be of use for dense planting and for easy picking of fruit. For the experiments scions were collected from a single adult plant in each of the olive oil cultivars Morsiolo, Leccino, Frantoio, and the table cultivar Ascolana and they were rooted in a greenhouse. The plantlets, 500 for each cultivar, were irradiated, at the total dose 4 kR (dose rate 250 R/h). Histological analyses of the dormant buds were carried out to establish the number of foliage leaf and primordia already present in the shoot apex. The irradiated plantlets were transplanted in the field and during the first growth (MV_1) the primary effects on leaves and shoot were noted. The MV_1 shoots were repeatedly cut back so as to stimulate their buds to develop as the second vegetative generation (MV_2). The basal buds grew into MV_2 shoots on the original plant,

while the scions from 5 to 12 buds of each primary shoot were rooted. This method for the isolation of somatic mutations takes into consideration the apical dominance of olive trees. During the MV_2 growth, several mutations were recorded such as types with short internodes, loss of apical dominance and lateral shoot growth, change of shoot habit and leaf morphology. A different frequency of mutations was noted among the cultivars. In all the treated cultivars the highest frequency of mutations was observed in MV_2 shoots coming from primordia, already present in the buds at the time of irradiation. The morphological mutations isolated were propagated to ascertain their agronomic value.

Peach

2300 summer buds of peaches cv. Favorita and Fertilia were irradiated with 3 kR (^{60}Co) and grafted on rootstocks. The shoots developing from the treated buds were pruned normally in the successive years. Furthermore, fifty one-year-old plants for each of the two cultivars were transplanted into the Casaccia gamma field and exposed daily at 20 or 40 R. For several years the plants were pruned normally. Several morphological and chlorophyll mutations were observed both after acute and chronic irradiation. Mutations appeared mostly as sectorial chimaeras, in few cases only as periclinal chimeral. The more promising mutations were isolated under chronic irradiation in the cultivar Fertilia.

A nectarine mutant was induced twice, once as a sectorial and once as a periclinal chimera. Among the isolated mutants the nectarine type and an early ripening one (22 days earlier than the control) have been multiplied for agronomic evaluation.

Grape

Dormant buds of grape cultivars Dolcetto, Bonarda, Freisa, Delight, Regina dei Vigneti, Moscato d'Amburgo, have been acutely irradiated with gamma rays at 3 and 4 kR or with thermal neutrons. In a first experiment the main buds of the irradiated scions were grafted on rootstocks; during the MV_1 shoot growth, part of them were pruned to force the development of the axillary buds. During the winter season the shoots were cut back leaving only two buds on each shoot. In a second experiment the treated scions were rooted and at the end of MV_1 growth, the shoots were cut back. The two basal buds were left to grow on the rootstock, while the buds no. 3-8 were singly propagated. On the MV_2 and MV_3 shoots morphological and chlorophyll mutations have been observed involving leaf, shoot and fruit characters. The more interesting mutations which have been isolated concern the fruit ripening period and the self-thinning character; they have been propagated for a practical evaluation.

(Contributed by B. Donini, Laboratorio Sperimentazione e Sviluppo in Agricoltura, Divisione Applicazioni Radiazioni CNEN, Casaccia, S. Maria di Galeria, Italy).

Compact type mutants in apples and sour cherries

A project aiming originally only at the development of compact growth type mutants in commercially important apple cultivars was commenced in 1968. Results of the first four years were already published [1]. In 1973, the project was expanded to include sour cherries and vegetative apple rootstocks.

Furthermore studies were begun to learn more about the nature of the compact type mutants in order to develop less time consuming selection techniques.

The mutants selected from the buds irradiated in 1968 have been grown since 1974 in a trial orchard for comparison with standards. The mutants differ considerably among themselves, some of them being much less vigorous than the respective spontaneous compacts. More than 50 additional clones of apple are under preliminary screening. It is worth mentioning here that according to our experience at least three vegetative propagations are required to assess the stability of the new clones. Results obtained in root-stocks look very promising in the sense that a number of less vigorous mutant root stock clones have been obtained (e.g. from Alnarp 2). It will, of course, take some years to fully assess the value of those mutants.

In 1973, dormant scions of the sour cherry cultivars Schattenmorelle, Körözer and Nefris were treated with 2-4 kR gamma rays. Treated scions were grafted on P. mahaleb seedlings. Compact looking shoots were selected in 1974 and 22 were confirmed after re-propagation, 16 of them coming from Schattenmorelle. The compacts have been planted into a trial orchard.

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(Contributed by S.W. Zagaja and A. Przybyla, Research Institute of Pomology, Skierniewice, Poland).

Mutation breeding with autotetraploid Achimenes

The diploid Achimenes cultivar Tarantella and its autotetraploid form, the cultivar Tango (Broertjes 1974, 1976), both being pink-flowering, compact growing potplants were used in this experiment. Freshly detached leaves were irradiated with X-rays or fast neutrons and planted in a peaty soil to root and to produce adventitious rhizomes. The rhizomes were harvested in October-November, stored at room temperature in paraffin coated paperbags during November-December and planted early January. The irradiation with X-rays was carried out with a dose rate of 300 rad/min and doses of 2 and 4 krad. Fast neutrons of the BARN (Biological Agricultural Reactor Netherlands, Wageningen) were applied at a dose rate of 100 rad/h (γ contamination of ca. 8%) with doses between 0.75 and 2 krad.

In the diploid cultivar Tarantella, a total of only 6 morphologically recognizable mutants were observed among the 570 adventitious plantlets produced by the X-irradiated leaves. Consequently, no conclusions can be drawn about a correlation between dose and mutation frequency, nor about the mutation spectrum which can be produced by this diploid cultivar. The mutation frequency was much lower than usually found from irradiating diploid cultivars such as Paul Arnold. The reason may be that Tarantella as one of the pink-flowering cultivars, which only recently have been developed, does not have such a high degree of heterozygosity as older blue-flowering cultivars. The results obtained after irradiation of the autotetraploid cultivar Tango with X-rays or fast neutrons indicate that the radiosensitivity of this material is similar to that of the diploid cultivar. The optimal dose

range appears to be between 2 and 3 krad for X-rays and 0.75 - 1.75 krad for fast neutrons. The mutant frequency, however, is at least 20 times higher than obtained after irradiating the diploid cultivar.

Certain mutant types were more frequent than others. Smaller plants, including such characteristics as finer growth habit, compact, smaller leaves, smaller flower and variations in flower colour were very frequent. Mutants with a larger flower, on the other hand, were relatively rare. Mutants which differ in only one character from the original material were very rare and might even prove to be absent following closer observation after clonal propagation.

The pollen fertility was measured by determining the percentage of viable (dark pink stained) pollen grains in Belling glycerin. The pollen fertility of 5 arbitrarily chosen mutants of the diploid cv. Tarantella varied from approximately 0.1-0.7% whereas the fertility of 'Tarantella' itself was approximately 90%. In contrast, the pollen fertility of 7 similar mutants of the tetraploid cv. Tango was approximately the same as that of 'Tango' itself, namely 70-90%. This indicates a buffering capacity of autotetraploids against chromosome aberrations.

The number and percentage of potentially useful ("promising") mutants such as normal growing plants with improved flower colour was higher after fast neutron treatments.

Apart from the autotetraploid cv. Tango, two other newly induced and as yet unnamed autotetraploids were irradiated, namely that of the cultivar Repelsteeltje and that of Little Beauty. Here, the diploid forms were not studied so that a comparison with their respective autotetraploids is not possible. However, the results strongly support those obtained with cv. Tango as described above, such as a high mutation frequency, especially following an optimum fast neutron dose and large numbers of mutants with reduced stature, with smaller flowers and generally also with a slightly different flower colour.

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(Contributed by C. Broertjes, Association EURATOM-ITAL, Wageningen, The Netherlands).

Screening for acyanogenic somatic mutations in cassava (Manihot esculenta Crantz)

By irradiating the young stem cuttings (6-8 month old wood) of a cassava cultivar, Japonesa, (Manihot esculenta Crantz) with an acute dose of 4 kR from a ^{60}Co source, it was found that in a number of cases, the induced mutant characters appeared in the whole plants or in large chimeric sectors.

This result suggested that a cassava plant could develop from one or two initial cells in the shoot apex of a bud. This unusual biological response to radiation provides a great advantage for selection in mutation breeding.

By using the sodium picrate method, 2676 leaves from 1338 MV_1 plants irradiated with 4 kR were screened for hydrocyanic acid content (HCN). As compared with the control, some leaves had higher and some had lower HCN level, indicating that the radiation treatment broadened the variability. Whether or not those MV_1 plants producing a lower level of HCN in the leaves are truly genetic mutants has to be ascertained by further screening in subsequent vegetative propagation generations.

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

Polyploidy induction in mulberry by gamma irradiation

Tetraploidy induction by ionizing radiation has been reported by others in muscadine grapes, tea, rice, Chrysanthemum and Nicotiana [1], [2], [3], [4] and [5]. In mulberry, a chimeric tetraploid plant originated from the axillary bud of cv. Ichinose (2n=28) which was irradiated at the stage of bud primordia with 7.5 kR at 0.15kR/h of gamma rays. The plant was identified as a 2n-4n-4n chimera and had wider and thicker leaves than the original. There were, however, no significant differences between the 2-4-4 plant and the original in stomata density and size. Nuclear volumes in epidermal cells of the 2-4-4 plant and the original were approximately the same, while in the internal tissue of the 2-4-4 plant nuclear volume was more than twice that of the original. All of F_1 seedlings from crossing the 2-4-4 plant with diploid cv. Shiromekeiso were triploid plants. Four other tetraploid mutants were obtained in the same experiment (about 40%). In contrast, no tetraploid plants were detected among more than 50 mutants obtained by gamma-irradiation of dormant buds. Young and vigorously growing tissues or organs appear to be more suitable for tetraploidy-induction, both by radiation and by colchicine treatment.

Following the above results, a more extended experiment was carried out. Shoots of cv. Ichinose were exposed to 5kR (acute). Observations on mutation and tetraploidy frequency were done on secondary and tertiary shoots developed on the irradiated and non-irradiated plants. Shoots bearing darker, thicker and broader leaves were taken as tentative tetraploids, and shoot tips and young leaf tips were collected from them. A large number of tetraploid secondary and tertiary shoots developed, although almost all of them were periclinal cytochimeras having one to several tetraploid cell layers in the shoot apex. Only one solid tetraploid was detected from among 62 cytochimeral tertiary shoots. There were 8 types of cytochimeras in tetraploid shoots over all the treatments. The frequency of 2-4-4 was highest, followed by 4-2-2 and 2-4-2. In general, tetraploid cytochimeras bore broader leaves than diploid plant. Among them, 4-2-2 shoots expanded narrower leaves than the shoots of 2-4-4 and 2-4-2 plants.

Among the induced tetraploids the frequency of 2-4-2 was over 50%. The reason for this very high rate is not clear, but the direction of cell division in the second and the inner layer of the apex and the degree of radiation damage and the disorder of cell layer arrangement in the apex after irradiation may explain the phenomenon.

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(Contributed by Kouitsu Katagiri, Sericultural Experimental Station, M.A.F., Tokyo, Japan).

Bio-energetic considerations relevant in mutation breeding of cereals for improved endosperm protein

The bio-energetic implications of altering the cereal grain protein concentration or the amino-acid composition by plant breeding have been examined. Using data obtained by F.W.T. Penning de Vries (in "Photosynthesis and Productivity in Different Environments", Cambridge University Press 1975) it is concluded that increased inputs of carbon assimilates and nitrogen are necessary when the protein concentration in cereal grain is to be increased while maintaining grain yields. Also, energetic requirements for obtaining endosperm proteins with higher lysine content in maize and barley are slightly higher than in stocks with normal lysine content.

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(Contributed by C.R. Bhatia and R. Rabson, Joint FAO/IAEA Division, Vienna, Austria).

Amino acid composition of the ditelosomics of Chinese Spring wheat

The grain obtained from 25 of the possible 42 ditelosomic of bread wheat variety Chinese Spring, grown along with the control parent variety were analyzed for their amino acid composition. No major changes in grain amino acid composition were found which could be associated with the specific chromosomal arms. The results suggest that the storage proteins controlled by the gene(s) located on the chromosomal arms examined either do not differ much from the average amino acid composition of the grain or such proteins are not present in sufficient quantities to make any appreciable changes. The gene(s), if any, that can bring about major changes in the component proteins and thereby altering the amino acid composition are either absent or, more likely, present in duplicate or triplicate.

(Contributed by C.R. Bhatia, H. Perschke and H. Axmann, Joint FAO/IAEA Division and IAEA Seibersdorf Laboratory, Vienna, Austria).

Induced mutagenesis for saline resistance in rice

Soil salinity is one of the serious problems encountered in several rice growing countries and not much work has been done in evolving high yielding saline tolerant strains of rice. In India some varieties of rice have been identified as saline tolerant but almost all are poor yielders. Among them one variety from West Bengal (India) "Getu" was selected for mutagenesis by gamma irradiation with doses 10, 20, 30 and 40 kR from a ^{60}Co source. High yielding productive mutants were subjected to screening (technique described by Janardhan, 1971) for their salt tolerant capacity. The experiment was replicated three times. Some of the mutants showed better tolerance to salinity than the parent variety.

Three mutants possessing higher saline tolerance were grown in field trials in three different types of soils.

1. Saline soil (pH. 5.2)

2. Saline-alkaline soil (pH. 11.0)

3. Normal soil (pH. 6.4).

The data on yield and other ancillary characters are presented in Table 1. The mutants were superior in their yielding ability to the original parent "Getu" and the control variety Damodar in all the three field conditions. Three field experiments were conducted in kharif 1975.

In purely saline soil conditions the mutants did not give appreciably higher yields even though they maintained their higher saline tolerance. The mutants performed better in saline-alkaline conditions under proper water management.

TABLE 1

Data on the characters of mutants (kharif-1975)

Character	Soil types	Mutant No.2603	Mutant No.2723	Mutant No.2735	Getu (parent)	Damodar (control)
Height (cm)	Saline soil	87.9	87.0	86.4	106.9	92.8
	Saline-alkaline	160.0	165.0	170.0	130.0	140.0
	Normal soil	102.0	110.0	110.0	120.0	116.0
Ear bearing tillers/hill	Saline soil	9.4	10.7	10.9	10.6	12.6
	Saline-alkaline	10.0	15.0	13.0	10.0	12.0
	Normal soil	6.7	8.2	7.4	7.3	8.0
Total duration (days)	Saline soil	116	115	116	114	114
	Saline-alkaline	124	124	124	127	127
	Normal soil	115	120	120	120	118
Grain yield (kg/ha)	Saline soil	2110	2220	2110	2030	2030
	Saline-alkaline	4410	4964	5305	4410	3676
	Normal soil	3352	3831	3639	3256	3200

REFERENCE

[1] JANARDHAN, K.V., Indian J. Agric. Sci., 41 (1971) 504-507.

(Contributed by P.N. Sreedharan and R.N. Misra, Division of Genetics, Central Rice Research Institute, Cuttack-753006, Orissa, India).

Is DTT a means to improve the mutation spectrum of vegetatively propagated plants?

Freshly detached leaves of Achimenes cv. Cupido were placed, with their petioles, into a solution of DTT (dithiothreitol) for one or more hours, prior to irradiation with X-rays or fast neutrons. The radio-resistance increased considerably, requiring a doubling of the X-ray dose to obtain the same survival and production of rhizomes, as with non-pretreated leaves. The protection against fast neutrons was less. The mutation frequency decreased after pretreatment with DTT, though more drastically with X-rays than with fast neutrons. The relative number of "drastic" mutants (supposedly caused by gross chromosome abberrations) seems hardly to deviate significantly when leaves are pretreated with DTT, both after X-rays and fast neutrons, as compared to non-pretreated leaves; i.e. no improvement of the mutation spectrum has been obtained.

REFERENCE

[1] BROERTJES, C., Euphytica, 25 (1976) (in press).

(Contributed by C. Broertjes, Association EURATOM-ITAL, Wageningen, The Netherlands).

Mutant tetraploids in Solanum khasianum

The importance of Solanum khasianum as a rich source of solasodine, a basic material for synthesis of steroid hormones is well known (See Mutation Breeding Newsletter No. 7, p. 5). However, numerous spines all over the plants are impediments to harvesting. A project was undertaken in 1970 with a view to (a) eliminate or reduce the spines and (b) improve solasodine content.

Some useful results obtained through gamma ray induced mutations and colchicine induced tetraploids are reported here.

Several mutants affecting spine characters were obtained in the M_2 generation from 10 kR treatment. Two of them had blunt and thick spines which were curved and are designated as curved spine mutant. It was not possible to isolate spineless mutants, possibly due to the association of this character with sterility. Hence only the curved spine mutant was selected for further studies.

Evaluation of these curved spine mutants showed that they were easy to harvest and had a high yielding potential [1].

Success was also obtained by colchicine treatment [2]. Besides inducing tetraploidy colchicine also induced variations in the number of spines, some plants being absolutely spineless. The spineless tetraploids were sterile and hence rejected, while tetraploids with fewer spines were selected. Further selections in their progenies through eight generations have improved fertility and fruit setting.

Attempts made to induce tetraploidy in the curved spine mutant was also successful. Two such tetraploids have markedly improved fertility after four generations [3], compared to that of the spiny tetraploids. Observations summarized in the table show that the mutant tetraploids have nearly the same number and weight of the fruits as in the diploid mutant. The germination percentage of mutant tetraploids is increased to 80-90% which further provides proof of its increased seed fertility.

Another interesting feature observed in these tetraploids is the alteration in the period of fruiting. Generally, Solanum khasianum has a protracted period of fruiting extending for 100-130 days. However, the mutant tetraploids have an average fruiting period of only 44 days, although the flowering is delayed by about one month.

The analysis of tetraploid fruits has revealed that they have 1.89% solasodine as compared to 1.47% of dry weight found in diploid mutants. The purity of isolated solasodine was confirmed by TIC and IR spectra [4].

Thus it seems that treating gamma ray induced mutants with colchicine offers an effective method for obtaining tetraploids with desirable agronomic characters. Mutants with high yield, big fruits, short fruiting period and compact erect plant type have been selected for further studies.

Fruiting data on diploid and tetraploid Solanum khasianum

Material	Period of fruiting (days)	Av.No. of fruits/ plant	Av.wt. of fruits/ plant (gm)	Av.wt. of fruit (gm)	Av.No. of seeds/ fruit
2n Mutant	128 ± 9	211 ± 17	998 ± 31	4.7 ± 0.16	200
4n of mutant (C_4 generation)	44 ± 12	177 ± 29	885 ±166	5.00± 0.23	120
4n of control (C_8 generation)	70 ± 10	130 ± 12	527 ± 51	4.05± 0.7	70

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[1] BHATT, Bharati, Curved spine mutant in Solanum khasianum Clarke, induced by γ-radiation. Curr. Sci. 41, 24 (1972) 889.

[2] JANAKI AMMAL, E.K. and BHATT, Bharati, Observations on the glycoalkaloid content of diploid and tetraploid Solanum khasianum Clarke. Curr. Sci. 40 (1971) 70-71.

[3] BHATT, Bharati, Induced tetraploidy in curved spine mutant of Solanum khasianum Clarke. Curr. Sci. 44, 18 (1975) 677-678.

[4] HEBLE, M.R. and BHATT, Bharati, Solasodine from curved spine mutant of Solanum khasianum Clarke. Ind. Jr. of Exptl. Biol. (1976) (in press).

(Contributed by (Mrs.) Bharati Bhatt, Biology and Agriculture Division, Bhabha Atomic Research Centre, Trombay, Bombay 400 085 India).

FUTURE EVENTS OF INTEREST

1976

International Symposium on Experimental Mutagenesis in Plants, 14-17 October 1976, Varna (Bulgaria).

EUCARPIA/OILB Meeting on Host Plant Resistance to Insects and Mites, 7-9 December 1976, Wageningen (The Netherlands).

1977

FAO/IAEA Symposium on the Use of Induced Mutations for Improving Disease Resistance in Crop Plants, 31 January - 4 February 1977, Vienna (Austria).

ISNA Symposium on Improving Crop and Animal Productivity by Nuclear and Allied Techniques, 1-4 February 1977, New Delhi (India).

QUESTIONNAIRE

(Enclosure to Mutation Breeding Newsletter No. 8)

1. Do you want to receive further issues of the Mutation Breeding Newsletter? ☐ Yes ☐ No

   (return of this questionnaire will assure your remaining on our mailing list)

2. In case your answer is yes, please state your correct address, giving details such as department or laboratory, street, city, area code, etc.

   _____

   _____

   _____

   _____

3. Do you, or does your institution, maintain collections or assortments which include induced mutants? ☐ Yes ☐ No

   If your answer is yes, give below the Latin species name(s) and the approximate number of mutants for each species.

4. Do you, or does your institution, use any induced mutants in cross breeding? (Indicate species) ☐ Yes ☐ No

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Please return Questionnaire to:

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Head, Plant Breeding and Genetics Section
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P.O. Box 590
A-1011 Vienna
Austria

3rd Congress of the Society for the Advancement of Breeding Researchers in Asia and Oceania (SABRAO), 11-14 February 1977, Canberra (Australia).

8th Congress of the European Association for Plant Breeding Research (EUCARPIA), 23-25 May 1977, Madrid (Spain).

FAO/IAEA Regional Seminar on Improvement of Rice Production through Research using Nuclear Techniques, May/June 1977, Djakarta (Indonesia).

2nd International Conference on Environmental Mutagens, 11-15 July 1977, Edinburgh (Scotland).

1978

3rd International Congress of Plant Pathology, 16-23 August 1978, München (FRG).

14th International Congress of Genetics, 21-30 August 1978, Moscow (USSR).

RECENT PUBLICATIONS

Evaluation of Seed Protein Alterations by Mutation Breeding (Proceedings of a Research Co-ordination Meeting, Hahnenklee, FRG, 1975). STI/PUB/426, IAEA, Vienna 1976, US$14.

Induced Mutations for Disease Resistance in Crop Plants (Proceedings of a Research Co-ordination Meeting, Ames, Iowa, USA, 1975). IAEA-181, Vienna 1976. (Available as microfiche copy on prepayment of US$0.65).

Induced Mutations in Cross Breeding (Proceedings of an Advisory Group Meeting, Vienna, Austria, 1975). IAEA 1976 (in press).

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.

A. Micke
R.D. Brock
L. Shawa

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