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Mutation Breeding Newsletter

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There were two highlights in 1990 worth special mentioning. One was a number of advisory and consultants' meetings attempting to set the tune for the future programme of the Section, as far as it will involve molecular genetics. Adaptation of newly emerging technologies to the needs of developing countries will be within the mandate of FAO, the use of nuclear techniques for improving these technologies should be an appropriate task within the frame of the Programme Area "Nuclear Applications" of IAEA. As a first step into realization, one or two Co-ordinated Research Programmes are going to be initiated which concern the use of "Restriction Fragment Length Polymorphism (RFLP) Techniques" as a tool to make experimental mutagenesis more useful for desired plant characteristics with complicated inheritance. In vegetatively propagated crops like bananas, where segregation by generative reproduction is impossible, RFLP-techniques should help to assess the quantity and quality of genetic alterations induced by mutagen treatments or by in-vitro culture stress as such.

The second highlight was an attempt to review mutation breeding achievements in terms of useful improvements, economic impact and unrealized expectations. 25 years after the FAO/IAEA symposium in Rome (1964) laid the foundations for sound international programmes, it appeared timely to undertake such a review. The aim obviously was too ambitious, since mutation breeding has been applied in so many countries, on so many crops, by so many researchers that it could not be expected to gather them all within one meeting room during a particular week. Of course, there were also financial limitations to this aim. Although IAEA and other donors had spent a lot of funds on research support and technical assistance during 25 years, there were no means for bringing project counterpart staff to Vienna for reporting on project results. Nevertheless, what was presented during the 5 day symposium was quite impressive. More than 1300 crop cultivars have been developed with the help of mutagenesis and 2-300 more are in the pipeline. Examples were given for a remarkable economic impact. But there were also negative reports as to objectives not reached and some critical remarks. In particular, some symposium participants called attention to difficulties to obtain "novel" genes for disease and pest resistance by experimental mutagenesis. This experience seems to be particularly relevant for crop species like wheat, which have been searched already thoroughly in many countries during decades for any kind of gene giving an improvement of resistance to pathogens. These unfortunately are the species where deliberate use of resistance genes has exhausted genetic resources so that breeders may turn to mutagenesis as the ultimate hope. It is certainly not so that genes interfering with host/pathogen relations are somehow exempted from mutational changes. But if it is believed that useful resistances require a gene activity that is dominantly inherited, probably most of those genes are known already and therefore there is little "novel" to detect. Moreover, it is well known that by mutagen application genes are more often changed to alleles with recessive inheritance in comparison to the the original one (ratio 1 dominant: ca. 200 recessive mutations). A number of effective recessive genes for better resistance were discovered in various plant species after mutagenesis using physical or chemical mutagens. Some seem to function as regulatory genes and it appears that still much is to be learned about the genetic control of host/pathogen relationships. Details may be read in the proceedings of the symposium, published in 1991 by IAEA under the title "Plant Mutation Breeding for Crop Improvement" and in the next issues of the Mutation Breeding Newsletter, where we will attempt to highlight the most relevant papers and posters.

The IAEA Technical Assistance projects taken care of in 1990 involved 34 countries. Four international and three national training courses were held, among them the 9th Seibersdorf Training Course on the Induction and Use of Mutations in Plant Breeding and the 1st Regional Training Course held at the GAEC National Nuclear Research Institute Kwabenya near Accra (Ghana).

For 1991, we will have to place much emphasis on the ongoing co-ordinated research programmes being concerned with

- improvement of disease resistance through mutagenesis and in vitro techniques
- improvement of bananas and plantains
- improvement of food crops in Africa
- improvement of root and tuber crops in Asia
- improvement of oil seed crops
- improvement of cereals in Latin-America.

5 research co-ordination meetings are to be organized probably in Costa Rica, Tanzania, Egypt, Bolivia and Germany.

As for the staff of the Plant Breeding and Genetics Section, the following changes should be mentioned: Amram Ashri (ISR), who had assisted our programme effectively during a one-year sabbatical, returned to his university at Rehovot. In 1991, Alexander Micke (FRG), who has been Head of the Section since 1969 will retire. Mirek Maluszynski (POL) has been appointed as successor. The decision who will take over his responsibilities is still pending.

NIFA-88, a high yielding mutant chickpea variety

Chickpea (or gram) is one of the important pulse crops in Pakistan grown on the rainfed area during rabi season. Most of the currently cultivated varieties are peer in yield potential and are susceptible to diseases, especially to blight [1,2]. Following irradiation of seed of the highly susceptible variety 6153 with 10 krad of gamma rays in 1980, a promising mutant line CM-1918 was selected in M_3 because of earliness, disease resistance, greater number of pods and better plant type. Preliminary yield trials indicated superiority of the mutant line over the check variety. The mutant line was named NIFA-88 (NIFA = Nuclear Institute for Food and Agriculture) after having produced a yield of up to 3270 kg/ha in the Chickpea National Uniform Yield Trial at the National Agricultural Research Centre, Islamabad, during 1989-90. It is moderately resistant to gram blight, matures two weeks earlier and has the ability to fix a greater amount of atmospheric nitrogen [3]. It exceeds in yield commercial varieties currently grown in the country by 15-20 percent.

The variety has been approved by the NWFP Provincial Seed Council on 14 February 1990 for cultivation in the rainfed areas of the southern zone of North West Frontier Province. When grown on this area, the new variety is likely to provide additional income of 50 million rupees. The characteristics of the mutant variety NIFA-88 are as follows:

Characteristics	Mutant variety NIFA-88	Parent variety 6153
Growth habit	Semi-erect	Semi-spreading
Plant height	80 cm	84 cm
Flower colour	Pink	Pink
Days to flowering	120	130
Days to maturity	178	190
Seed coat colour	Yellowish brown	Brown
Seed surface	Wrinkled	Smooth
100 grain weight	19.8 g	22.0 g
Protein content (%)	23.75	23.87
Blight resistance	MR	HS
Average yield (kg/ha)	1500	434

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(Contributed by S. Hassan and I. Khan, Nuclear Institute for Food and Agriculture, NIFA, Tarnab, Peshawar, Pakistan).

Two improved varieties of mungbean in Pakistan

Two bold-seeded, high yielding, short duration, uniformly maturing and disease resistant varieties of mungbean namely NIAB M 51 and NIAB M 54 were approved by the Punjab Seed Council as commercial varieties on 5 June 1990. The new varieties give 20-25% higher yield than those presently under cultivation, namely NIAB M 121-25, 19-19, 13-1 and 20-21. Besides there higher yield potential and bold seed size, the new varieties mature early (65-70 days) and uniformly, do not shatter at maturity, possess resistance to Mungbean Yellow Mosaic Virus (MYMV) and *Cercospora* Leaf Spot (CLS) and are amenable to mechanised harvesting and threshing. Comparing the results of three years at 91 locations, the average yield of the new varieties was 1477-1529 kg/ha against 1219 kg/ha of national standard NM121-25. Grain yields up to 2000-2400 kg/ha have been obtained by progressive farmers.

Varieties NM51 and NM54 were evolved through gamma irradiation of hybrid seeds from crossing the local small-seeded variety 6601 (resistant to MYMV but susceptible to CLS) with the bold-seeded variety VC1973A (susceptible to MYMV but resistant to CLS). Bold-seed size in mungbean gets consumer preference and provides a premium to the farmer in the market. Incidentally, all of the bold-seeded varieties happen to be exotic and fail to thrive in the summer owing to their susceptibility to MYMV. When grown in spring, these varieties suffer the drawback of pod shattering at maturity and necessitate three to four hand pickings which is not economic. Some of the exotic varieties, however, possess resistance against CLS. This is the first time in Pakistan that bold-seeded mungbean varieties have resistance to both MYMV and CLS diseases, uniform maturity and non-shattering pods.

By virtue of their higher yield, bold seed and the ability to fit in a number of crop rotations and intercropping practices, the varieties NM51 and NM54 are becoming very popular among the farmers. Seed multiplication is co-ordinated with the Punjab Seed Corporation.

(Contributed by I.A. Malik, NIAB,Faisalabad, Pakistan).

Early maturing and higher seed yielding chickpea mutants

Chickpea (*Cicer arietinum* L.) is one of the important grain legumes in Bangladesh. There are only four recommended varieties of this crop. Improvement is limited by genetic variability. To create more variability, seeds of Faridpur-1 (recommended variety) were treated with 60^{Co} gamma rays in 1979. In the M_2 generation, plants with higher seed yield, dwarf plant type, early maturity and bigger seed size were selected. Ten true breeding lines were chosen from the M_3 generation and these were grown as M_4 together with their mother variety Faridpur-1 at Jamalpur farm, Bangladesh, during 1982-83. The experiment was done in a randomized block design with three replications. Mean values and critical difference are shown in the Table.

Analysis of variance revealed significant differences among mutant strains and their mother variety. The mutant strains G-302 and G-293 seem to be particularly interesting. Earlier maturing mutants can possibly escape early monsoon shower and hailstorm.

(Contributed by K.M.Shamsuzzaman and M.A.Q. Shaikh, Bangladesh Institute of Nuclear Agriculture, P.O. Box No. 4, Mymensingh, Bangladesh).

Table Means of some agronomic characters of M_4 mutants

Mutants/variety	Days to maturity	Plant height (cm)	100 seed weight (g)	seed yield/ plant (g)
G-302	138	44	8.0	20.2
G-293	138	41	8.5	13.7
G-299	141	43	8.0	13.0
G-296	140	48	7.5	12.9
G-294	141	44	8.2	12.7
G-297	141	44	7.0	12.6
G-301	143	47	7.3	12.6
G-295	140	46	7.0	12.4
Faridpur-1 (parent)	146	48	7.5	9.6
G-300	145	43	7.0	9.0
C.D. at 5%	4.1	5.5	0.3	2.7

Cowpea-88: a new cultivar of cowpea

Cowpea (*Vigna unguiculata* (L) Walp. is an important forage and pulse crop in India. Recently a new variety Cowpea-88 has been released for cultivation in the Punjab [1]. It has been developed from the progeny obtained by irradiating the F_1 seed of a cross between the standard variety Cowpea-74 and a virus resistant strain no. H-2. It is a dual purpose variety which gives higher green fodder as well as higher grain yield than Cowpea-74. Moreover, it is highly resistant to yellow mosaic virus and anthracnose diseases. Its distinguishing features are as follows:

Character	Cowpea-88	Cowpea-74
Leaf length (cm)	13.0	9.6
Leaf breadth (cm)	8.6	7.3
No. of pods/plant	17.7	23.3
Pod length (cm)	16.4	11.9
No. of seeds per pod	16.2	14.2
100 grain weight (g)	23.4	10.8
Seed colour	chocolate brown	white with black scar
Seed testa	loose	compact
Days to 50% flowering	53	58

Table. Performance of Cowpea-88 in comparison to Cowpea-74 in Punjab

Parameter	No. of trials	Average yield (kg/ha)		increase over Cowpea-74
		Cowpea-88	Cowpea-74	
Green fodder yield	24	273.40	232.50	17.2%
Grain yield	36	10.98	6.90	59.1%

Cowpea-88 was tested at the University Research Stations as well as in farmers' fields throughout the State of Punjab. The results of these trials are summarized in the table. Apart from yield, the cooking quality of Cowpea-88 as a pulse crop is very good and the nutritive value of its green fodder is superior to that of Cowpea-74 [2].

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(Contributed by M.S. Sohoo, B.L. Bhardwaj and S.M. Beri, Forage Research Unit, Department of Animal Science, Punjab Agricultural University, Ludhiana, India).

Induced variability for grain yield and dry matter production in horsegram (Macrotyloma uniflorum Lam. Verde)

Horsegram, an important pulse crop of rabi season, is widely cultivated in India both as grain and fodder crop. Also the straw is used as feed for cattle. Genetic variability for agronomically important characters is rare. It was therefore felt desirable to induce mutations.

Table Grain yield and dry vegetative matter in M_3 progenies of horsegram

Treatment	Grain yield (g/20 plants)		Dry veg. matter (g/20 plants)	
	Range	Mean	Range	Mean
Var. Kurungkollu				
Control (n=25)	48-100	78.2	83-190	138.4
10 kR (n=93)	32-140	86.6	75-315	149.9
20 kR (n=93)	33-155	101.7	60-275	177.6
30 kR (n=100)	47-180	96.3	75-315	174.0
40 kR (n=91	20-160	90.6	65-290	161.3
50 kR (n=73)	45-205	118.9	75-395	211.5
60 kR (n=62)	60-165	107.9	95-310	190.5
70 kR (n=87)	34-190	114.1	104-300	202.6
80 kR (n=85)	55-155	111.7	105-300	206.2
Var. CO 1				
Control (n=25)	62-128	90.3	105-226	154.3
10 kR (n=37)	36-126	94.0	90-250	171.7
20 kR (n=64)	25-135	79.4	55-250	143.6
30 kR (n=100)	40-180	103.0	70-340	183.3
40 kR (n=52)	30-170	85.5	55-295	156.1
50 kR (n=60)	32-165	83.2	50-230	135.2
60 kR (n=85)	20-135	82.0	32-285	152.8
70 kR (n=90)	20-160	83.3	55-355	145.4
80 kR (n=90)	18-130	80.5	30-290	135.2

n = Number of progeny rows

Dry seeds of a locally adpated variety 'Kurungkollu' and an improved cultivar 'CO 1' were subjected to gamma irradiation at a dose range of 10-80 kR. A total of 648 M_3 progeny rows (each raised from one M_2 plant) of 'Kurungkollu' and 603 progeny rows of 'CO 1' were studied to assess the presence of mutations affecting grain yield and dry matter. Twenty five single plants selected at random from each of the untreated cultivars were also raised in progeny rows for comparison. We observed an increase in range of grain and dry matter yield of the progenies in all the irradiated populations (Table). The mean shifted positively in all the irradiated populations of 'Kurungkollu' but only in two of "CO 1". Increased variance provided scope for selection. Selected lines are already being tested in yield trials.

(Contributed by M. Suresh, A. Narayanan, P. Vaidyanathan and S.R. Sree Rangasamy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India).

Capsaicin differences in chilli mutants

The pungency in chillies (*Capsicum annuum* L.) is due to capsaicin, an alkaloid located in fruits and seeds. It is the vanillyl amide of isodecylanic acid and this is a volatile, fat-soluble, flavourless, colourless and odourless compound. This alkaloid was estimated in ripe and dried fruits of nine mutants of chilli cv Pusa Jwala selected after physical and chemical mutagenic treatments. The estimation procedures followed the method suggested by the Panel of the Joint Committee of the Pharmaceutical Society and the Society for Analytical Chemistry [1]. The capsaicin content was found to be significantly increased in four mutants. The colour of mature fruits and other characters remained unaffected. As strong pungency is a desirable character, these mutants may be utilized in breeding programmes.

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(Contributed by R.K. Raghuvanshi and Subodh Kumar, Botany Department, University of Rajasthan, Jaipur, Rajasthan 302004, India).

A radiation induced mutant of mulberry, Morus alba L., resistant to bacterial blight

Bacterial blight caused by *Pseudomonas syringae* pv. *mori* induces tissue necrosis in leaves or shoots of mulberry plants. The first symptoms of the disease are observed in April or May and the disease then spreads under the rainy environment of early summer. Infection by the bacteria can reduce the production of mulberry leaves, which are the only feed for silkworm, to zero. No method harmless to silkworm is known to be effective in alleviating the disease. The only way to avoid this disease would be resistant varieties. Unfortunately, the leading variety "Ichinose", which accounts for over 40% of mulberry tree acreage in Japan, is most sensitive to this disease, though it has excellent characteristics in all other respects.

Plants of this variety were irradiated chronically with gamma rays at up to 35 R/day for 23 years in the gamma field. In 1989, leaves were artificially inoculated with the bacteria by needle-wounding followed by spraying with the bacterial solution. This treatment resulted in typical symptoms of the disease: wilting, malformation and necrosis of leaves. The severity of disease symptoms of the leaves was classfied. Five branches of each tree were examined two weeks after bacterial inoculation. Among 57 mulberry trees observed, two branches of one tree showed significantly higher resistance to the disease. These branches, along with control branches, were grafted in a greenhouse in March, 1990. In June, leaves of the grafted trees in the greenhouse were inoculated with the bacterial solution in the same way as in 1989 and observation of severity of the disease confirmed the resistance. We now attempt to propagate this clone and to observe its resistance under a range of environmental conditions.

(Contributed by O. Yatou, T. Hiraiwa, T. Higuchi and K. Takahashi*, Institute of Radiation Breeding, NIAR, MAFF, P.O. Box 3, Omiya-machi, Naka-gun, Ibaraki-ken, 319-22 Japan; *Institute of Japan Plant Protection Association, 535, Kessoku, Ushiku-shi, Ibaraki-ken, 300-12 Japan).

Studies on the seedless character of citrus induced by irradiation

The seedless character of citrus is of high commercial value. Seedless citrus was obtained several times by irradiation, but the mutant character was often unstable or the adaptability of the varieties poor. Up to now only the mutant grape fruit variety "Star Ruby", obtained by fast neutron irradiation, is really in production. "Jin Cheng" (*Citrus sinensis* Osbeck) is a leading orange variety in China. Zhou Jiangxiang et al. [1] irradiated dry seeds of "Jin Cheng" with 10 kR ^{60}Co gamma rays in 1963. After about 15 years, two good seedless strains (Seedless Orange no. 7 and no. 8) have been bred. They retain other fine characters of the original variety. Seedless Orange no. 7 has 9 lines and Seedless Orange no. 8 has 5 lines and these have been used for the studies. "Jin Cheng" orange was used as control.

I. Seedless character and pollen fertility

During 1984-1989, the seed numbers were investigated. The seed number was 7.92 per fruit for the control, 0.06-0.51 in lines of seedless orange no. 7, and 0.71-1.91 in lines of seedless orange no. 8. The seed numbers were not significantly different (L.S.R. test) among lines of the same mutant strain nor between the years. The two mutant strains have reached the seedless standard for citrus production. Both strains are highly pollen sterile with only slight differences between them.

II. Isozyme analysis

The peroxidase and esterase isozymes of the two strains were studied using petals and leaves. The results show that the isozyme dissimilarities between the control and the seedless mutant strains exceed those observed between other cultivars of sweet orange (*C. sinensis* Osbeck). Probably gene regulation systems have been changed. The isoperoxidase zymograms were positively correlated with seed numbers. They conform with the rectilineal regression equation: $y = a + bx$. So, perhaps the number of patterns in isoperoxidase zymograms can be used as an index for pre-selecting seedless mutations.

III. Cytogenetic studies

There are no variations in chromosomal number in somatic cells of the two seedless strains or the control. The chromosomal number is 2n = 18. During pollen mother cell (PMC) meiosis, univalents and polyvalents are observed at high frequencies at diakinesis to metaphase I in the two seedless strains. The percentages of univalents and polyvalents are identical among lines of the same mutant strain. The chromosomal pairing configurations in Seedless Orange no. 7 are 3.54I + 5.81II + 0.55IV + 0.10VI and in no. 8 they are 1.06I + 5.86II + 0.01III + 1.07IV + 0.15VI, which shows a difference between the strains.

Anomalous chromosomal separation behaviour of PMCs in meiosis of the two seedless strains has been observed, which includes unequal division, polypolar division, bridges, fragments at anaphase to telophase, lagging chromosomes at anaphase, and micro-nuclei at telophase. Percentage of PMCs with lagging chromosomes is the highest, followed by unequal division and chromosome bridges. The anomalous separation behaviour is similar among the lines of the same strain. Apparently, irradiation caused translocations and inversions, resulting in anomalous meioses and as a consequence high sterility.

The seedless character of the two strains is basically stable and can be transferred to clonal progenies. The two strains are high in productivity and good in quality. They have been released to many citrus production areas in China.

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(Contributed by Chen Shanchun, Gao Feng and Zhang Jinren, Citrus Research Institute, Chinese Academy of Agricultural Sciences, Chongqing, People's Republic of China).

A new technique to enhance mutant recovery in cassava

Cassava (*Manihot esculenta* Crantz.), also known as manioc or tapioca, is a monoecious and highly heterozygous crop. Malayan 4 (M4) is a popular variety in Kerala (India) due to its excellent cooking qualities. Radiosensitivity studies on cassava were undertaken by MOH [1]. VASUDEVAN et al. [2] obtained mutations by irradiating stem cuttings with 4 kR gamma rays. However, mutation breeding has played still only a minor role in the improvement of cassava probably due to unsatisfactory methods of induction and detection of mutations.

Stem cuttings (stakes) of cassava cultivar M4, measuring 12 - 13 cm, were irradiated with 1-4 kR gamma rays. The irradiated stakes were propagated in two different ways. In the first set the irradiated stakes were planted as such in the field and mutations were screened as usual in the M_1V_1 and M_1V_2 generations. In the second set, the irradiated stakes were cut into 7-8 single node cuttings (SNC) before planting in the field. The plants surviving after 6 month were not uprooted but pruned, leaving 4-5 axillary buds. These developed secondary shoots, which are equivalent to M_1V_2 plants. The cut stems pieces were also used to raise an M_1V_2 generation as usual. Mutations were then screened in M_1V_1, M_1V_2 and the M_1V_2 shoots developing from the M_1V_1

Table: Mutation frequencies observed in cassava after gamma irradiation, using stakes vs. single node cuttings

Dose and method	No. of M_1V_1 stakes or SNC-clones planted	No. of M_1V_2 stem cuttings planted	No. of M_1V_2 shoots after pruning M_1V_1 plants	No. of mutants			Total no. of mutants detected	Mutant frequency in % of		
				M_1V_1	M_1V_2	M_1V_2 shoots		M_1V_1 stake or clone	M_1V_2 stem cuttings	M_1V_2 shoots
Stake-Method (M4 (Control)	30	150	-	0	0	-	0	0	0	-
1.5 kR	80	400	-	0	1	-	1	1.3	0.3	-
2.0 kR	65	325	-	0	3	-	3	4.6	0.9	-
3.0 kR	50	250	-	0	3	-	3	6.0	1.2	-
4.0 kR	41	205	-	0	1	-	1	2.4	0.5	-
SNC-Method (Control)	30	150	120	0	0	0	0	0	0	0
1.0 kR	80	400	326	1	3	5	9	11.3	1.0	1.5
1.5 kR	67	335	312	2	2	7	11	16.4	1.2	2.2
2.0 kR	49	245	245	2	4	9	15	30.6	2.4	3.7
2.5 kR	39	195	193	1	3	6	10	25.6	2.1	3.1
3.0 kR	31	155	136	0	4	5	9	29.0	2.6	3.7

stumps. Planting single node cuttings and pruning M_1V_1 plants lead to the recovery of more mutations than the standard method (Table). More than 50 morphological solid mutants could be isolated in the present study. The mutants differed in stem, petiole and leaf colour, size and shape, in chlorophyll content, wax coating, dry matter, HCN and tuber characters.

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(Contributed by K. Vasudevan and J.S. Jos, Central Tuber Crops Research Institute, Trivandrum 695 017, Kerala, India).

Gamma ray induced mutants in Xanthosoma

Tannia (Xanthosoma sagittifolium (L) Schott), an aroid species, native to South America, is cultivated more widely in recent decades in India, especially in subsistance farming, as the crop is more tolerant to shade and water stress than Colocasia. There appears to be no natural seed set in Xanthosoma. However, artificial induction of flowering and production of seeds were reported [2]. A germplasm collection maintained at the Institute shows little variability. A mutation breeding approach in Colocasia has been published by VASUDEVAN and JOS [1]. Adopting the same technique in Xanthosoma, i.e. propagating the gamma irradiated (0.5 to 1.5 kR) tubers as micro sets, resulted in the recovery of more than a dozen of morphologically solid mutants. The mutants differed in plant height, leaf size, shape and chalky coloration on sheath and petiole as well as in tuber shape and yield. Distinguishing characteristics of some of the mutants are given in the table.

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(Contributed by K. Vasudevan and J.S. Jos, Central Tuber Crops Research Institute, Trivandrum - 695 017, Kerala, India).

Selection for induced mutants with reduced blackspot bruise susceptibility in potato

The potato cultivar "Lemhi Russet" has excellent processing and culinary quality, but is susceptible to an internal defect called blackspot bruise. Blackspot bruise is caused by the condensation of tyrosine into melanin, and only occurs when cells in the tuber have been damaged. The result is a blackened area in the flesh of the tuber. When severe, bruised tubers are unacceptable to the consumers and processors.

Table: Characteristics of <u>Xanthosoma</u> mutants

Mutants	Plant height (cm)	Sheath		Leaf length (cm)	Leaf width (cm)	No. of tubers/plant	Wt. of tubers/ plant (g)	Dry matter %
		Length (cm)	Character					
Xam.1	82.9	34.6	Green open	29.6	25.2	14.5	640	20.0
Xam.2	109.7	50.8	Chalky open	40.4	42.5	11.4	720	22.5
Xam.3	94.0	39.5	Chalky open	34.9	36.9	8.3	620	19.0
Xam.4	55.6	19.2	Green open	22.1	21.2	4.0	450	20.5
Xam.5	72.3	31.3	Green closed	28.2	27.3	3.5	442	21.5
Xam.6	76.3	30.4	Green open	28.8	28.9	6.2	575	18.0
Xam.7	67.5	28.7	Partially green semi open	22.3	17.5	5.3	415	17.0
Xam.8	105.3	47.3	Chalky open	41.2	37.7	5.4	535	22.5
Xam.9	78.9	30.8	Green closed	30.8	31.9	8.5	635	25.5
Xam.10	78.0	29.8	Chalky closed	32.9	28.4	7.1	600	17.5
CONTROL	108.7	44.4	Chalky open	35.7	37.2	7.6	445	18.5
CD	11.3	5.6		4.3	7.8	1.3	56	

Improvement in this defect could make "Lemhi Russet" a major variety in the Northwest area of the U.S.

Disease free tubers of "Lemhi Russet" were obtained in 1987. The propagation material for the irradiation consisted of eyes excised from the tuber, along with a piece of flesh 1 cm in diameter. Two thousand eye pieces were exposed to 2.5, 3.0, 3.5 or 4.0 krad of gamma rays from a Co^{60} source. The eye pieces were planted directly to the field. After the first harvest, each tuber was considered to be a clonal unit and was evaluated separately using a method developed by PAVEK et al. [1]. Evaluation and selection on the clonal unit progeny were conducted over a four year period.

Eight clones were identified as being less susceptible to blackspot bruise than the original cultivar (Table). However, three of the clones had significantly inferior total tuber yield, and all but one of the clones had inferior yield of potato tuber grade "US No. 1". A loss of in plant vigor, resulted apparently in a reduction of tuber size. Nevertheless, the four clones LM116, LM232, LM330 and LM382, appear to have potential. Evaluation in traditional variety trials will continue for the next three to five years.

Table *Characteristics of eight "Lemhi Russet" potato mutant clones selected for resistance to blackspot:*

Clone	Gamma-ray dose krad	Total yield mt/ha	"U.S. No. 1" yield	Tuber size g	Blackspot reaction
LM332	4.0	32.9	25.5	169	2.9
LM257	3.5	31.2	23.3	165	3.5
LM330	4.0	36.0	26.1	165	3.5
LM363	4.0	31.4	24.6	150	3.5
LM232	3.5	40.4	27.0	150	3.6
LM382	4.0	37.4	25.2	129	3.7
LM295	3.5	33.8	25.1	144	3.8
LM116	3.0	40.9	33.3	184	3.9
Lemhi Check	0	41.4	33.8	191	4.6
LSD (P=.05)		6.1	5.1	27	0.7

Yield and tuber size data were collected over a three-year period, 1988-90, and blackspot data over four years, 1987-90. The LSD's were computed on the yearly average with the years serving as replications. Blackspot reaction was rated using a sample consisting of 10 abrasively peeled tubers, on a 1-5 scale with 1 = no tuber blackening to 5 = severe blackening.

REFERENCE

[1] PAVEK, J., CORSINI, D. and NISSLEY, F., A rapid method for determining blackspot susceptibility of potato clones. American Potato J. 62 (1985), 511-517.

(Contributed by Stephen L. Love, University of Idaho, Aberdeen Research and Extension Center, Aberdeen, Idaho 83210, USA).

Successful mutagenesis in sugarcane

In case of vegetatively propagated crops, mutation breeding depends not only on the rare dominant mutations, recessive mutations are also of use because the clones are usually is heterozygous [1]. In sugarcane, induced mutations have been used successfully to increase sucrose percentage, cane yield and resistance to red rot disease [2,3]. BO 91 is a commercial variety with high yield, good ratooning ability and wide adaptability in subtropical India, but unfortunately a low percentage of sucrose. Cross breeding to increase sucrose may breakdown the precious combination of the clonal variety. Improvement in the sucrose percent by mutagenesis was therefore attempted.

Single bud setts were treated during the 1987-88 crop season with 3-7 kR 60 Co gamma rays. Setts were first raised in the nursery and then transplanted to the field. The effects of the irradiation in M_1V_1 are shown in table 1.

Table 1. Effects of gamma irradiation in M_1V_1 (1987-88)

Treatments	Germination % (Nursery)	Longest root (cm)		Shoot length (cm)	
		10 days	20 day	10 days	20 days
3 kR	66.0	5.90	5.51	3.95	16.52
4 kR	64.0	7.21	6.08	2.36	11.33
5 kR	62.0	4.57	6.06	1.21	8.49
6 kR	13.0	4.87	2.70	1.23	2.76
7 kR	6.0	0.70	0.59	0.94	1.37
BO 91 (control)	80.6	11.18	12.20	2.80	11.70

Table 2. Variations observed in M_1V_2 generation (1988-89)

Dose	No. of treated buds (M_1V_1)	No. of clones studied (M_1V_2)	No. of M_1V_2 clones with			
			Higher TSS	Low TSS	Increased leaf length	Higher cane wt.
3 kR	220	49	1	-	-	1
4 kR	265	47	-	-	1	-
5 kR	215	121	8	1	-	4
6 kR	213	74	2	-	-	2
7 kR	217	92	12	-	-	-
BO 91 (Control)	176	30	-	-	-	-

TSS = Total soluble solid in juice

Every bud of the canes of the harvested M_1V_1 was planted individually, to raise the M_1V_2 in 1988-89. On the basis of number of millable canes, total soluble solids in juice, leaf length and cane weight, a number of M_1V_2 clones were selected (Table 2). The total soluble solids (TSS) in juice have a high positive correlation with sucrose percentage. Since the stalk was to be utilized for planting, juice extraction was not done for sucrose testing, only TSS was observed. The potential mutant clones shall be studied further.

REFERENCES

[1] SINGH, B.D., Plant Breeding, Principles and Methods, New Delhi, Ludhiana, Kalyani Publishers (1983).

[2] FAO/IAEA, List of cultivars, Mutation Breeding Newsletter 31 (1988), 8-38.

[3] SRIVASTAVA, B.L., BHATT, S.R., PANDEY, S., TRIPATHI, B.K. and SAXENA, V.K., Mutation breeding for red rot resistance in sugarcane, Sugarcane 5 (1986), 13-15.

(Contributed by B.L. Srivastava, S.R. Bhat and V.K. Srivastava, Indian Institutute of Sugarcane Research, Lucknow 226002, India).

Avoidance of chimerism from irradiating rice seeds (Oryza glaberrima) through vitro culture

Chimerism commonly occurs following the mutagen treatment of a multicellular meristems such as in the embryo of rice seeds. In the main panicle of M_1 plants, mutated sectors are small and the segregation ratio low while in the later formed tillers or panicles the size of mutated sectors is larger and the segregation ratio higher. The frequency of different mutations of course is higher in the main panicle than in the tillers [1]. In order to avoid problems from chimerism (cell line competition) and from small M_1 progenies often causing postponement of selection to M_3, a mutation breeding system is proposed by which mutations could be recovered from mutations from non-chimeric tillers obtained through in vitro culture of mutagenized seeds.

Mature seeds of the African rice variety 127/d (Oryza glaberrima) were irradiated with Co 60 gamma rays at doses of 100, 200, 300 Gy. Subsequently, they were cultured in MS medium supplemented with different concentrations of BAP (1, 3, 5, 10 mg/l) to induce multiple shoots. 2-4 shoots were obtained from each seed in the primary culture. They were subcultured to enhance further "tillering" and formed new clumps of shoots. The proliferation and the number of shoots increased with the concentration of BAP, reaching up to 15 shoots at 10 mg/l of BAP. No callus formation occurred, therefore the shoots probably are formed at the nodes. After two cycles of vegetative propagation (average 40 days each)

Table 1. Proliferation of rice seeds cultured with different BAP levels.

Media	No. of seed cultured	No. of primary shoot obtained	No. of secondary shoot obtained	Proliferation rate
mod. MS + 5 mg/l BAP)	28	78	286	10.22
mod. MS + 10 mg/l BAP	28	83	462	16.5

at least 15 shoots could be obtained from each seed (Tab. 1). The shoots, when separated from the clumps, formed roots without auxin containing media, but NAA favoured root formation (Tab. 2).

As shown in table 3, irradiation reduces seedling height as well as number of shoots per cultured seed. 200 Gy seems to be a suitable dose for mutation induction.

Table 2. Root formation of isolated shoots on different media

Media	No. of isolated shoots cultured	No. of shoot forming roots	Mean number of roots/shoot
MS	25	17	1.7
MS + NAA	25	25	3.6
MS + IBA	25	25	2.9

Table 3. The effect of gamma rays on M_1 seedlings and on multiple shoot formation in culture

Dose (Gy)	Mean seedling height (cm)	Primary shoots obtained/seed
0	3.94	3.33
100	3.85	2.24
200	3.55	2.47
300	2.42	1.87

Plantlets could easily be cultivated in pots to reach maturity and produce seeds. M_1 plants will be harvested separately to determine frequency and segregation ratio of mutations.

REFERENCE

[1] Chimerism in Irradiated Dicotyledonous Plants, IAEA-TECDOC 289 (1983).

(Contributed by Nguyen Tien Thinh, Nuclear Research Institute, Dalat, Vietnam and E. Santangelo, B. Donini, P.C. Remotti, ENEA, CRE Casaccia, Rome, Italy).

Mutagenesis using F_1 hybrids of pea (*Pisum sativum* L.)

Mutagen treatment of heterozygous material such as F_1 hybrid seeds has recently become rather popular, assuming that more and different genetic variation can be created than through treatment of homozygous material. However, so far, there is little experimental proof for this assumption. Therefore, we conducted experiments using 2 established varieties of pea and their hybrid to 3 different mutagens.

The varieties used were "Arkel" (vegetable pea) and "Mahndorfer" (dry grain pea). Several of 300 seeds of these varieties and their F_1 hybrids were treated with gamma rays (3, 6, 9 kR), EMS (0.1, 0.2, 0.3%) and N-nitroso-N-ethylurea (0.007, 0.014, 0.021%). The biological effects

Table 1. Biological damage in M_1

Character		Arkel		Mahndorfer		Hybrid	
		Actual	Relative %	Actual	Relative %	Actual	Relative %
Germination	C	76.0	100.0	80.0	100.0	83.0	100.0
(%)	T	54.9	72.2	50.8	63.5	54.0	66.2
Seedling	C	5.8	100.0	8.5	100.0	11.8	100.0
height (cm)	T	4.1	71.3	5.7	66.7	87.7	74.3
Plant	C	72.3	100.0	76.0	100.0	82.0	100.0
survival(%)	T	60.9	84.2	56.6	74.5	64.7	78.9
Pollen	C	98.4	100.0	92.6	100.0	97.8	100.0
fertility(%)	T	78.3	79.6	68.0	73.4	74.1	75.7
Chimeras(%)	C	-	-	-	-	-	-
	T	2.5	-	4.1	-	3.0	-

Table 2. Total mutation frequency in M_2 (% mutated progenies)

Treatment		Arkel	Mahndorfer	Hybrid
Gamma rays:	3 kR	6.80	8.66	10.63
	6 kR	8.80	11.85	13.33
	9 kR	10.00	13.00	15.20
EMS	0.1%	9.33	12.66	15.00
	0.2%	10.40	14.40	17.30
	0.3%	12.17	18.00	20.83
NEU	0.007%	12.66	17.33	17.50
	0.014%	13.90	21.00	20.80
	0.021%	16.00	21.11	21.00

in M_1 (shown in table 1) indicate a kind of intermediate reaction of the F_1 hybrid. The mutation frequencies observed (incl. chlorophyll deficiencies, and morphological changes) show clearly more genetic variation being induced in the F_1 hybrid.

(Contributed by D. Mohan and B. Sharma, Division of Genetics, IARI, New Delhi 110012, India).

LIST OF CULTIVARS

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 cultivars 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 cultivar does not imply its recommendation by FAO/IAEA.

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Alstroemeria sp. (alstroemeria)			
Audino	GDR, 1979 VEG Gartenbau Berlin	500R Gamma rays	Early flowering, improved flower colour, longer harvesting period
Chimbotina	GDR, 1981 VEG Gartenbau Berlin	500R Gamma rays	Improved flower colour, longer harvesting period, early flowering
Kolibri Blau	GDR, 1989 VEG Gartenbau Berlin	500R Gamma rays	Improved flower colour, longer harvesting period, early flowering
Kolibri Gelb	GDR, 1989 VEG Gartenbau Berlin	500R Gamma rays	Improved flower colour, longer harvesting period, early flowering
Kolibri Orange	GDR, 1989 VEG Gartenbau Berlin	500R Gamma rays	Improved flower colour, longer harvesting period, early flowering
Kolibri Rosa	GDR, 1989 VEG Gartenbau Berlin	500R Gamma rays	Improved flower colour, longer harvesting period, early flowering

Kolibri Rot	GDR, 1989 VEG Gartenbau Berlin	500R Gamma rays	Improved flower colour, longer harvesting period, early flowering
La Poza	GDR, 1981 VEG Gartenbau Berlin	500R Gamma rays	Improved flower colour, longer harvesting period, early flowering
Quitona	GDR, 1981 VEG Gartenbau Berlin	500R Gamma rays	Improved flower colour, longer harvesting period, early flowering
Tucumana	GDR, 1981 VEG Gartenbau Berlin	500R Gamma rays	Improved flower colour, longer harvesting period, early flowering
Valparaisa	GDR, 1981 VEG Gartenbau Berlin	500R Gamma rays	Improved flower colour, longer harvesting period, early flowering
Arachis hypogaea L. (groundnut)			
78961	China, 1988 Qiu Qingshu Peanut Research Institute Laixi, Shandong Province	mA 143 x RH77-4-2 both mutants derived from gamma irradiation, 24 kR dry seeds, 1971 [Baisa 1016]	10d earlier than Baisa 1016 and reduced plant height, high yield, good quality (mA 143: early, reduced plant height, thin pod shell)
Fu 22	China, 1985 South China Agric. College & Guangdong Acad. Agric. Sci. Guangzhou	Gamma irradiation	Resistant to *Aspergillus flavus* causing aflatoxin development
Lainong 10	China, ca. 1984 Agric. College Laiyang Shandong Province	Seeds, laser	Early maturity, high yield

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Arachis hypogaea L. (groundnut) (Contd.)			
MH-2 (Mungphali Haryana 2)	India, 1973 Haryana Agric. University		High yield 4060 kg/ha against 2650 for check; semi-dwarf, resistant to *Cercospora personata*
P12	China, 1986 Qiu Qingshu Peanut Research Institute Laixi, Shandong Province	(Changda 6 x mA 143) x Baisa 1016	Later and higher yielding than 78961. 7d earlier than Baisa 1016 and reduced plant height, high yield, greater peg strength
Shanyou 27	China, ca. 1985 Agric. Res. Inst. Shantou Guangdong Province	Mutant cross Yuexuan 58 x Yueyou 320-14	more uniform emergence, many branches, rust resistant, thin shell. Yield 10% higher than Yueyou 551-116
Yangxuan 1	China, ca. 1978 Agric. Crops Res. Institute Yang Jiang and Acad. Agric. Sciences Guangdong Province Guangzhou	Yueyou 1 x Yueyou 551	
Yuexuan 58	China, ca. 1978 Agric. Res. Institute Shantou Guangdong Province	Selection from Yueyou 551 (der. from Yueyou 22 x Yueyou 431	8.5% higher yield than Yueyou 551 ca. 660 000 ha
Yueyou 33	China, ca. 1971 Jiang Xienan, Zhou Yongxing Economic Crops Res. Inst. Guangdong Province Guangzhou	Selection from Yueyou 22 (derived from cross Fushi x Fuhuasheng)	Good yield, ca. 20 000 ha

Yueyou 169	China, ca. 1980 Guangdong Acad. Agr. Sci. Guangzhou	Yueyou 551-6 x 76/30	Luxurious growth, large and thick dark leaves, big pods; yield 5% higher than Yueyou 551-116
Yueyou 187	China, ca. 1981 Guangdong Acad. Agric. Sci. Guangzhou	(Yueyou 1 x Yangxuan 1) x Yueyou 551	Rel. tall, many flowers and pods; pods big and plump Yield 8.9-10.6% over Yueyou 551 ca. 33 000 ha
Yueyou 187-93	China, ca. 1982 Guangdong Acad. Agric. Sci. Guangzhou	(Yueyou 1 x Yangxuan 1) x Yueyou 551	Rel. tall, many flowers and pods; pods big and plump Yield 8.9-10.6% over Yueyou 551 ca. 33 000 ha
Yueyou 551-6	China, ca. 1975 Agric. Science College Guangdong Province Guangzhou	Selection from Yueyou 551	Higher yield
Yueyou 551-38	China, ca. 1975 Agric. Science College Guangdong Province Guangzhou	Selection from Yueyou 551	Higher yield
Yueyou 551-116	China, ca. 1975 Agric. Science College Guangdong Province Guangzhou	Selection from Yueyou 551	Yield 6.6-12.8% over Yueyou 551 Most popular in province; 2 mill. mu

Bougainvillea sp. (bougainvillea)

Los Baños variegata	India, S.K. Datta National Botanical Res. Inst. Lucknow 226 001	Gamma rays 1-5 krad stem cuttings [Los Baños Beauty]	Leaf colour changed from green to variegated

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Capsicum annuum **L.** (green pepper, chilli)			
Friari KS80	Italy, 1985 F. Restaino Istituto Speriment. per l'Orticoltura 84098 Pontecagnano	EMS 0.6%; 20^{o}C, 13 h seeds	Reduction of internode length and plant height, increased fruit production (15-20%). Tolerant to *Verticillium dahliae* Kleb.
Chrysanthemum morifolium **Ram.** (chrysanthemum)			
Agnisikha	India, 1987 S.K. Datta National Botanical Res. Inst. Lucknow	Gamma rays 1.5-2.5 krad cutting [D-5]	Flower colour changed to erythrite red from magnolia purple
Enzett Axilia Gelb	GDR, 1988 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 2x20 Gy 1983	Altered flower colour
Enzett Balina Rot	GDR, 1985 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 20 Gy 1981	Altered flower colour
Enzett Balina Weiss	GDR, 1985 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 20 Gy 1981	Altered flower colour

Enzett Dilana Gelb	GDR, 1977 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 20 Gy 1973	Altered flower colour
Enzett Dilana Rosa	GDR, 1979 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 25 Gy 1973	Altered flower colour
Enzett Heli Bronze	GDR, 1987 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 2x20 Gy 1983	Altered flower colour
Enzett Heli Gelb	GDR, 1987 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 2x20 Gy 1984	Altered flower colour
Enzett Mellit Gelb	GDR, 1989 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 2x20 Gy 1986	Altered flower colour
Enzett Minos Bronze	GDR, 1985 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 20 Gy 1982	Altered flower colour
Enzett Niva Bronze	GDR, 1984 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 20 Gy 1980	Altered flower colour
Enzett Niva Gelb	GDR, 1983 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 20 Gy 1980	Altered flower colour

Name of new cultivar	Place and date of release (or approval) and name *of principal worker* and institute	Mutagenic treatment [parent variety] *or cross* with mutant/with mutant cross derived variety	Main improved attributes *of cultivar*
Chrysanthemum morifolium Ram. (chrysanthemum) (Contd.)			
Enzett Niva Lachs	GDR, 1984 VEG Saatzucht Zierpflanzen Erfurt	Gamma rays 20 Gy 1980	Altered flower colour
Navneet	India, 1987 S.K. Datta National Botanical Res. Inst. Lucknow	Gamma rays 1.5 krad cuttings [Kalyani Mauve]	Flower colour changed to creamish white from pansy violet
Cicer arietinum L. (chickpea)			
NIFA-88 (= CM-1918)	Pakistan, 1990 Said Hassan Nucl. Inst. f. Food and Agric. Tarnab, Peshawar NWFP	Gamma rays 10 krad seeds, 1980 [6153]	Moderately resistant to *Ascochyta rabiei*; 2w earlier maturing, exceeds in yield all other commercial varieties in Pakistan by 15-20%; fixes greater amount of nitrogen
Citrus paradisi (grapefruit)			
Rio Red	USA, 1984 R.A. Hensz Texas A&I University Weslaco TX 78596	Thermal neutrons bud sticks [Ruby Red]	Fruit and juice colour deeper red. Gain ca. $ 2000 per ha, spreading worldwide

<u>Corchorus olitorius</u> (tossa jute)

IR-1 (= JRO 68-Anobika)	India, ca. 1978 D.P. Singh Jute Agric. Res. Inst. Barrackpore 743 101 West Bengal	Chronic gamma irradiation ca. 10 kR 1964-67 [JRO 632]	More vigorous, yields ca. 12% over parent. Not officially recommended but grown in 1989 on 20-20% of area under tossa jute

<u>Dianthus caryophyllus</u> L. (carnation)

Bonitas	GDR, 1985 VEG Saatzucht Zierpflanzen Barth	Gamma rays 25 Gy 1980	Miniature type, improved resistance against <u>Fusarium</u> <u>oxysporum</u>

<u>Glycine max</u> L. (soybean)

Chudo Gruzii 74	USSR, 1974 S.F. Tedoradze Gruzinskii Inst. Zemledaliya Mtskheta, Georgian SSR	Gamma rays	
Dioskuriye	USSR, 1980? S.G. Tedoradze Gruzinskii Institut Zemledeliya, Mtskheta	Gamma rays	
Kartuli 7	USSR, 1980? S.G. Tedoradze Gruzinskii Institut Zemledeliya, Mtskheta	Gamma rays	
Mutant 2	USSR, 1980? S.G. Tedoradze Gruzinskii Institut Zemledeliya Mtskheta	Gamma rays	

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Hordeum sativum L. (barley)			
Acclaim	GDR, 1984, UK D. Lau VEG Inst. f. Getreideforsch. DDR-Bernburg-Hadmersleben	Hadm 46813/68 x Trumpf	High yield, lodging resistance disease resistance, malting quality
Anker	Denmark, 1986 LK Sejet DK-8700 Horsens	Rupal x Nery	
Ariel	Sweden, 1988 G. Ewertson Weibullsholm Plant Breed. Inst. S-26124 Landskrona	Triumph x All 3109	Short and stiff straw, good malting quality
Baraka	France, 1986 Serasem F-59840 Perenchies	Midas RBR 33 x 67 Barberausse	Winter barley
Berolina	Austria, 1982; France, 1984 Saatbau Linz, A-4021 Linz	Medina x Trumpf x Diamant	High yield, good malting quality
Bacchus	UK, Spain, 1981 Plant Breeding Institute Cambridge CB2 2LF	Trumpf x Jupiter	
Camen	Denmark, 1989 Carlsberg DK-2500 Valby	Trumpf x Mirjam (1977)	High yield (malting quality)

Cargine	France, 1986 Lesgourgues F-40300 Peyrehorade Austria, 1986 Saatbau Linz A-4021 Linz	Trumpf x Medina	
Carnival	UK, FRG, 1981 Plant Breeding Institute Cambridge CB2 5PS	Trumpf x Maris Bulbeck	
Canor	Denmark, 1985 Carlsberg DK-2500 Valby	Trumpf x Nordal 1976	Good malting quality. 1990: 25 000 ha
Canut	Denmark, 1988 Carlsberg DK-2500 Valby	Trumpf x Magnum	Good yield (malting quality) 1990: 10 000 ha
Carula	Denmark, 1989 Carlsberg DK-2500 Valby	Triumph x (Rupal x (Ingrid x Proctor))	Good malting quality)
Catrin	Denmark, 1985 Carlsberg DK-2500 Valby	Trumpf x Nordal	High yield
Corgi	UK, 1985 Welsh Plant Breeding Station Aberystwyth	Triumph x 15533 CO	
Defia	GDR, 1984 E. Richter Langenstein Saatzucht GmbH Zuchtstation Derenburg	Cross with Diamant	High yield, lodging resistance, malting quality
Dinky	Belgium, 1987 SES B-3300 Tienen	Menuet x Trumpf	

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Hordeum sativum L. (barley) (Contd.)			
Dinky	France, 1987 Unisigma F-60480 Froissy		
Everest	UK, 1985 Plant Breeding Institute Ltd. Cambridge CB2 2LQ	Goldmarker x Triumph	
Frankengold	FRG, 1975 J. Breun Amselweg 1 D-8522 Herzogenaurach	Amsel x Mut. of Franken III	
Fleet	UK, 1985 New Farm Crops Ltd. Lincoln, LN3 56J	Claret x Goldmarker	High yield, erectoid type grown in Ireland and New Zealand
Fergie	UK, 1990 New Farm Crops Ltd. Lincoln LN3 5LJ	(Athos x Hood) x (Marion x Goldmarker)	
Femina	GDR, 1984 VEB	Cross with Diamant	
Formula (= W 7200)	Sweden, 1987 G. Ewertson Weibullsholm Plant Breed. Inst. S-26124 Landskrona	Triumph x All. 3109	Short, stiff straw, malting

Galant	Denmark, 1984 Carlsberg D-2500 Valby	NaN_3 seeds, 1977 [Triumph]	Proanthocyanidin free
Gavotte	France, 1986 Momont Hennete et fils F-59246 Mons-en-Peleve	P21 x Robin x Gitane	
Gorm	Denmark, 1981 LK Sejet DK-8700 Horsens	Herta 8 x Byg 191 x Ingrid x Minerva x Kristina	
Grammos (G2966-1937)	Greece, 1969 Exp. Station Prolemaida	Gamma rays seeds, 1962 [Rivale]	Cold tolerant, winter barley 1990: ca. 40 000 ha
Grisante	UK, 1984 Plant Breeding Institute Ltd. Cambridge CB2 2LQ and Serasem F-59840 Perenchies	Jupiter x HJ 69.74.272	
Helena	FRG, 1983 J. Ackermann 8444 Irlbach	(Matura x Carina) x Aramir	
Herzo	FRG, 1976 J. Breun Amselweg 1 8522 Herzogenaurach	Weib. 1947 x Volla x Matura x Ammer	
Laura	France, 1971 UNCAC F-75782 Paris Cedex 16	Pallas x Herta	
Leila	France, 1984 Rustica Bio Res. SA F-31700 Blagnac	Diamant x Berenice	

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Hordeum sativum L. (barley) (Contd.)			
Leo-INIA/CCU	Chile, 1990 INIA Estac. Exp. Carillanca Temuco, Chile and CIMMYT, Mexico	Cross involving Aramir Pitayo, Cambrinus, Arivat and Risö Mutant 1508	2 row spring barley; early maturing, 80-9- cm, yield up to 6 t/ha, HLW 69 kg, high malting quality
Lussi (= Vicky)	Sweden Swedish Seed Association Svalöf	Triumph x Akka	Malting quality similar to Triumph
Maksim	USSR V.M. Shevtsov Barley Breeding Dept. Research Institute for Agric. 350012 Krasnodar	Mutant cross	Lodging resistant
Madelon	France, 1985 Serasem F-59840 Perenchies	(MSE Aramir 202 x Athos) x Trumpf	
Matura	FRG, 1967 J. Ackermann & Co. D-8444 Irlbach	Mut.G 259 x Voldagsen 2344 x Carlsberg	
Mikkel	Denmark, 1983 L.K. Sejet DK-8700 Horsens	Visir x Sejet 678263	

Othello	UK, 1988 Plant Breeding Institute Cambridge	Triumph x Egmont	
Pacha	France, 1986 Florimond Deprez F-59242 Templeuve	Trumpf x Claudia	
Patricia	France, 1988; Unisigma F-60480 Froissy	(Triumph x Aramir) x UN 25	
Peak	UK, 1988 Plant Breeding Institute Ltd. Cambridge	Triumph x NS 756123	
Pression	France, 1986 Serasem F-59840 Perenchies	(Aramir 202 x Athos) x Trumpf	
Semal	Denmark, 1990 Landbrugets Kornforaedling Sejet DK-8700 Horsens	Sj 746570 x Triumph	Yielding up to 9t on clay soils; malting quality equal to Triumph, resistant to nematodes but susceptible to mildew
Sissy	FRG, 1990 O. Streng D-8704 Uffenheim	(Frankengold x Mona) x Trumpf	Quality of Trumpf
Valerie	France Unisigma F-60480 Froissy	[(Berenice x Atem) x Mazurka] x Trumpf	
Zazerskij 85	USSR	HE 481 (= Favorit) x 128-492	
Zgoda (= Sgoda)	USSR	Trumpf x HE 497 (= Diamant x Alsa)	

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Iris sp. (iris)			
Belyi Karlik (white dwarf)	USSR, 1978-84 I.V. Dryagina Vsesoyuznyi Institut Rastenievodstva Leningrad	Gamma rays 5,20,100 or 300 Gy seed or pollen	Good ornamental quality, easy to propagate, improved winter hardiness and disease resistance
Chistoe Pole	USSR, 1978-84 I.V. Dryagina Vsesoyuznyi Institut Rastenievodstva Leningrad	Gamma rays 5,20,100 or 300 Gy seed or pollen	Good ornamental quality, easy to propagate, improved winter hardiness and disease resistance
Marina Raskova	USSR, 1978-84 I.V. Dryagina Vsesoyuznyi Institut Rastenievodstva Leningrad	Gamma rays 5,20,100 or 300 Gy seed or pollen	Good ornamental quality, easy to propagate, improved winter hardiness and disease resistance
Marshal Pokryshkin	USSR, 1978-84 I.V. Dryagina Vsesoyuznyi Institut Rastenievodstva Leningrad	Gamma rays 5,20,100 or 300 Gy seed or pollen	Good ornamental quality, easy to propagate, improved winter hardiness and disease resistance
Podmoskownaya Osen	USSR, 1978-84 I.V. Dryagina Vsesoyuznyi Institut Rastenievodstva Leningrad	Gamma rays 5,20,100 or 300 Gy seed or pollen	Good ornamental quality, easy to propagate, improved winter hardiness and disease resistance

Lantana depressa *(wild sage)*

L. depressa bicoloured	*India, 1986* S.K. Datta National Botanical Res. Inst. Lucknow 226 001	Gamma rays 1-5 krad stem cuttings [*L. depressa*]	Leaf green; flower bicoloured yellow and white instead of yellow
Niharika	India, 1986 S.K. Datta National Botanical Res. Inst. Lucknow 226 001	Gamma rays 1-5 krad stem cuttings [L. depressa]	Leaf green; flower light yellow instead of yellow

Lilium sp. (lily)

Mies Bouwman	Netherlands, 1977 A.J. Bischoff-Tulleken Wieringerwerf (in co-operat. with the Assoc. EURATOM-ITAL, Wageningen)	X-rays 2.5 Gy bulb scales, 1968 [Tabasco]	Orange flower colour, excellent forcing qualities
TX 68-1	Netherlands, 1977 A.J. Bischoff-Tulleken Wieringerwerf (in co-operat. with the Assoc. EURATOM-ITAL, Wageningen)	X-rays 2.5 Gy bulb scales, 1968 [Tabasco]	Orange flower colour, excellent forcing qualities

Malus pumila Mill. (apple)

Senbatsu-Fuji-2-Kei	Japan, 1985 Y. Yoshida et al. Fruit Tree Research Station Morioka City, Iwate-Ken 020 01 and Nakajima-Tenkoen Co. Ltd. Higashino-City Yamagata 999-37	Gamma rays 6+3 kR dormant scions, 1963 [Fuji]	Excellent red fruit colour otherwise high quality of parent

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Oryza sativa L. (rice)			
Ailiutiaohong	China, 1989 Agric. Bureau Fengxin County Jiangxi	Gamma rays seeds [Liutiaohong]	Dwarf (88 cm), resistant to Pyricularia oryzae, insects and cold; yields much higher
Fuchuerai	China, 1978? Inst. of Biotechniques Acad. Agric. Sciences *Guangdong Province* Guangzhou	IR 20 x Zhuyin C6965 (Gamma rays 35 krad) [Zhuyin 2]	Shorter culm, improved resistance to bacterial leaf blight
Fuxian 6 (=Radiation 83-29)	China, 1989 Wang Xianyu Zhou Zhiyuan Inst. Atomic Energy Appl. Zhejiang Acad. Agric. Sci. Hangzhou, Zhejiang Province	Fu 774 x IR 26	107-110d till maturity, earlier and higher yielding than popular var. Guangluai 4, good resistance to BLB; good cooking quality 1990: ca. 3300 ha
Ikungbau 4-2	China, 1973? (Taiwan)	X-rays [Ikungbau]	
IRAT 109	Côte d'Ivoire, 1978 IRAT	Cross IRAT 13 x IRAT 10	Productive, early, high tillering *130* cm; grown in *Cameroon;* Central Africa and Guinea Bissau
IRAT 110	Côte d'Ivoire, 1978 IRAT	Cross IRAT 13 x IRAT 10	Good grain shape, productive 120 cm; grown in North Cameroon
IRAT 136	Côte d'Ivoire, 1978 IRAT	Cross IRAT 13 x Moroberekan	Better grain quality and yield than Moroberekan

IRAT 147	Côte d'Ivoire and Burkina Faso, 1979 IRAT	Cross IRAT 13 x Dourado Precoce	Good grain shape 110 cm good in AURAVT 1989
IRAT 161	Côte d'Ivoire, 1980 IRAT	Cross IRAT 13 x Moroberekan	Productive, disease resistant 140 cm
IRAT 213 = ISA 3	Côte d'Ivoire, 1982 IRAT	Cross IRAT 13 x Palawan	Good grain shape; yield higher than IRAT 170; 150 cm
IRAT 214 = ISA 4	Côte d'Ivoire, 1982 IRAT	Cross IRAT 13 x Palawan	Higher yield; good grain shape 150 cm
IRAT 268 = IDSA 16	Côte d'Ivoire, 1983 IRAT	Cross IRAT 112 x IRAT 13	Good grain quality, 120 cm early
IRAT 269 = IDSA 16	Côte d'Ivoire, 1983 IRAT	Cross IRAT 112 x IRAT 13	Good grain quality, 130 cm early
IRAT 320 = IDSA 48	Côte d'Ivoire, 1987 IRAT	Cross with IRAT 13	Good grain shape, 110 cm
M-203 (86-Y-35)	USA, 1989 H.L. Carnahan et al. California Co-op. Rice Found. Rice Exp. Station Biggs, CA	Gamma rays 25 kR seeds [M-401]	Photoperiod insensitive, heads 14-17d earlier than M-401; larger grain
Mohan (= CSR4)	India, 1983	Gamma rays [IR 8]	Salt tolerance
Padmini	India, 1988	Gamma rays [CR 1014]	Early maturity
Qinghuaai 6	China, 1980? Inst. of Biotechniques Acad. Agric. Sci. Guangdong Province Guangzhou	(Songhuaai x Fuchuerai) x F_4 line	High yield, good quality, disease resistance 1986: 240 000 ha

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Oryza sativa L. (rice) (Contd.)			
Qingwei No. 1	China, 1985 Guangdong Acad. Agric. Sci. Guangzhou	Gamma rays	High yielding disease resistant late season variety
Radiation 9-1	China, 1988 Xiong Zhenmin Wang Guoliang China National Rice Research Institute Hangzhou, Zhejiang Province	Gamma rays 3.5 krad seeds, 1981 [8004]	115-120d tillering, yield ca. 7.5t (earlier and 9% higher yielding than popular var. Guangluai 4) wide spectrum of resistance to BLB 1986-89: ca. 29 000 ha
Radiation 85-63	China, 1989 Wang Xianyu Zhou Zhiyuan Inst. Atomic Energy Appl. Zhejiang Acad. Agric. Sci. Hangzhou, Zhejiang Province	Fu 78-12^2 x IR 36	Higher tillering, higher spikelet fertility; good cooking quality; good adaptation to mountainous districts
S2-Calpearl	USA, 1987 C.H. Hu N.F. Davis Drier & Elevator Inc. Firebaugh, CA 93622	Seed irradiation [Calpearl]	Shorter culm, shorter grain class high yield
Tangernian	China, 1985 Guangdong Acad. Agric. Sci. Guangzhou	Gamma rays	High yielding, disease resistant late season variety

Valencia 87	USA, 1987 C.H. Hu N.F. Davis Drier & Elevator Inc. Firebaugh, CA 93622	Seed irradiation [Calpearl]	Lodging resistant, high yield up to 12t/ha
Wanhua	China, 1983? Inst. for Biotechniques Acad. of Agric. Sci. Guangdong Province Guangzhou	Qinghuaai 6 x Qinglian 32	Semi-dwarf, disease resistant, superior grain quality, high yield 1986: 100 000 ha
Yanzhengfu	China, 1980? Longyan Regional Inst. of Agric. Sci. Fujian Province	Gamma rays (30 kR) seeds [Longzhen No. 13]	

***Pennisetum americanum* (L) Leeke** (pearl millet)

NHB 3 (hybrid)	India, 1975 Tamil Nadu Agric. Univ. Coimbatore	MS 5071A x J104 (Gamma rays 35 kR) [Tift 23B]	Resistance to *Sclerospora graminicola*
NHB 4 (hybrid)	India, 1975 Tamil Nadu Agric. Univ. Coimbatore	(Gamma rays 35 kR) MS 5071A + K560-230 [Tift 23B]	Resistance to *Sclerospora graminicola*

Pisum sativum (pea)

Bosman	Poland, 1989 Michalczyk, M., Michalczyk, Malcherek, M. Kielpinska, T. Plant Breeding Station Prusinowo	1 34 x Allround	Afila type, improved lodging resistance

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Pisum sativum (pea) (Contd.)			
Caoyuan 10	China, 1980(?) Feng Yanqin Wang Jinming Crop Institute Qinghai Acad. of Agric. and Forestry Xining	X-rays 20 krad seeds, 1966 [Caoyuan]	Seeds yellow instead of green, taller, stem thicker, leaves and stipules larger, pod shape straight instead of sickle yield 1.2 - 1.5 t/ha
Paride	Italy, 1988 P. Vitale, ENEA, Rome F. Saccardo, Agric. Univ. Portici G. Santini, SAIS, Cesena	Gamma rays 10 krad seed [S. Cristoforo]	Determinate type, early, high yield
Priamo	Italy, 1988 P. Vitale, ENEA, Rome F. Saccardo, Agric. Univ. Protici G. Santini, SAIS, Cesena	Gamma rays 10 krad seed [Alderman]	Determinate type, high yield
Pirro	Italy, 1988 P. Vitale, ENEA, Rome F. Saccardo, Agric. Univ. Protici G. Santini, SAIS, Cesena	Gamma rays 10 krad seed [Santa Croce]	Determinate type, no need of staking, big pods, early
Shikhan	USSR, 1984 Khangil'din V.V. Priekuli Breeding Station Latvian SSR	Cross with radiation induced mutant	Resistant to seed shedding

__Portulaca grandiflora L.__ *(perennial portulaca)*

Ratnam	*India, 1974* S.K. Datta National Bot. Res. Inst. Lucknow 226 001	Gamma rays 1-5 krad terminal stem cuttings	Profusely blooming with 4.5 cm wide, single, cross-fertile flowers having 5-8 petals

__Rosa indica var. odorata__ (rose)

Light Pink Prize	India, 1989 S.K. Datta National Bot. Res. Inst. Lucknow 226 001	Gamma rays budwood [First Price]	Light pink flower colour instead of blend of light red and deep pink
Stripe Contempo	India, 1983 S.K. Datta National Bot. Res. Inst. Lucknow 226 001	Gamma rays 3 krad budwood [Contempo]	Yellow stripes on orange background instead of copper orange with yellow eye

__Spinacia oleracea L.__ (spinach)

Lavewa	Germany, 1987 S. Handke Bundesforschungsanstalt f. gartenbaul. Pflanzenz. D-2070 Ahrensburg	EMS seeds, 1971 [Frü-Remona]	Low nitrate content, high dry matter, late bolting, long vegetative growth, long harvest time

__Streptocarpus sp.__ (streptocarpus)

Aurora (= Neptun rot)	Germany, 1979 G. Fleischle Vaihingen/E. Ensingen in co-operation with the Associat. EURATOM-ITAL, Wageningen	X-rays 30 Gy 1977 Leaves [Neptun rose = Carmen)	Red flower colour

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
<u>Streptocarpus sp.</u> (streptocarpus) (Contd.)			
Dolly	Germany, 1979 G. Fleischle Vaihingen/E. Ensingen in co-operation with EURATOM-ITAL, Wageningen	X-rays 30 Gy 1977 Leaves [Neptun blau = Cupido]	Compact growth habit; blue flower colour
Freya	Germany, 1979 G. Fleischle Vaihingen/E. Ensingen in co-operation with EURATOM-ITAL, Wageningen	X-rays 30 Gy 1977 Leaves [Neptun rosa = Carmen]	Red flower colour
Helle Glocke	Germany, 1979 G. Fleischle Vaihingen/E. Ensingen in co-operation with EURATOM-ITAL, Wageningen	X-rays 30 Gy 1977 Leaves [Nadja]	Pale blue flower colour
Nanna	Germany, 1979 G. Fleischle Vaihingen/E. Ensingen in co-operation with EURATOM-ITAL, Wageningen	X-rays 30 Gy 1977 Leaves [Neptun blau = Cupido]	Compact; early; blue flower colour
Rosalie	Germany, 1979 G. Fleischle Vaihingen/E. Ensingen in co-operation with EURATOM-ITAL, Wageningen	X-rays 30 Gy 1975 Leaves [Juwel]	Pink flower colour

Streptocarpus sp. (streptocarpus) (Contd.)

Selene	Germany, 1979 G. Fleischle Vaihingen/E. Ensingen in co-operation with the Associat. EURATOM- ITAL, Wageningen	X-rays 30 Gy 1977 Leaves [Hera]	White flower colour

Triticum aestivum L. (bread wheat)

Chuanfu 2	China, 1989 Qu Shihong, Xu Zelang, Xian Qing, Guo Yuanlin Inst. of Biological and Nucl. Technology Sichuan Acad. Agric. Sciences Chengdu	Gamma rays 20 krad seeds, 1980 [Chuanfu 1 x 78-2882] F_1	High resistance to stripe rust, high yield, early maturing 1990: ca. 100 000 ha
Chuanfu 3	China, 1989 Qu Shihong, Xu Zelang, Xian Qing, Guo Yuanlin Inst. of Biological and Nucl. Technology Sichuan Acad. Agric. Sciences Chengdu	Gamma rays 20 krad seeds, 1981 [F_1(Baimai 18 x 79P-6007)]	High resistance to stripe rust, high yield 1990: ca. 20 000 ha
Fushiabo	China, 1985(?)	Gamma rays seed [Abo]	Resistant to stripe rust
Motsinave 100	USSR, 1980 S.G. Tedoradze Gruzinskii Institut Zemledeliya Mtskheta, Georgian SSR	Gamma rays seed	

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Triticum aestivum L. (bread wheat) (Contd.)			
SGT 17	USSR, 1980 S.G. Tedoradze Gruzinskii Institut Zemledeliya Mtskheta, Georgian SSR	Gamma rays seed	
Spinnaker	Italy, 1987 C. Mosconi, L. Rossi, B. Donini, F. Barlatti ENEA Agric. Laboratories CRE Casaccia Rome	Fast neutrons seeds, 1972 [Anza]	Lodgind resistant, high yielding, good quality
Xifu 4	China, 1985 Jia Linqui et al. Inst. of Agric. Sciences Xichang, Sichuan Prov.	72r-16 x Fanxiumai (72r-16 mutant from 20 krad Gamma rays, 1972 [Forlani])	Drought tolerance, wide adaptability, higher yield, good quality
Xifu 5	China, 1985 Jia Linqui et al. Inst. of Agric. Sciences Xichang, Sichuan Prov.	72r-16 x Fanxiumai (72r-16=mutant from 20 krad Gamma rays, 1972 [Forlani])	Higher yield, better quality, wide adaptability
Yuanfeng No. 5	China, 1983 W. Wand et al. Inst. Appl. Atomic Energy Shandong Acad. Agric. Sci. Jinan	Gamma rays 25 kR seeds [Lovrin 13 x Youxuan 57) x Xiayingsu]	Early maturity, high protein content, short culm; resistance to stripe and leaf rust

Triticum turgidum L. ssp. durum (durum wheat)

Febo	Italy, 1982 ENEA-CRE Casaccia Rome	(Castelporziano x Lacota) x Casteldelmonte	High yield, good quality, lodging resistance
Gergana	Bulgaria, 1984 S. Janev Inst. of Cotton and Durum Wheat Chirpan	Gamma rays 10 kR F_1 seeds [No. 788 x M5574/109]	Lodging resistance, good yield (up to 7 t/ha); good grain quality
Giano	Italy, 1982 ENEA-CRE Casaccia Rome	(Castelporziano x Lacota) x Casteldelmonte	High yield, good quality, lodging resistance
Peleo	Italy, 1988 L. Rossi, C. Mosconi, E. Gobbi, M. Vagnarelli ENEA Agric. Lab. CRE Casaccia Rome	Creso x Crane	Short culm, lodging resistance, early heading, very high yield
Ulisse	Italy, 1988 L. Rossi, C. Mosconi, F. Barlattoni, G. Pettenello, L. Pettenello ENEA, Agric. Lab. CRE Casaccia Rome	Selection from Creso	Short culm, lodging resistance, early heading 1990: ca. 10 000 ha

Tulipa sp. (tulip)

Rimo	The Netherlands, 1985 Inst. for Hort. Plant Breeding Wageningen (in co-operat. with the Associat. EURATOM-ITAL Wageningen)	X-rays 2.5-3.5 Gy Dormant bulbs, 1965 [Lustige Witwe]	Pale cherry-red flower colour with narrow white edge. Short flower stalk; suited for pot culture

Name of new cultivar	Place and date of release (or approval) and name of principal worker and institute	Mutagenic treatment [parent variety] or cross with mutant/with mutant cross derived variety	Main improved attributes of cultivar
Tulipa sp. (tulip) (Contd.)			
Santina	The Netherlands, 1985 Inst. for Hort. Plant Breeding Wageningen (in co-operat. with the Associat. EURATOM-ITAL Wageningen	X-rays 2.5-3.5 Gy Dormant bulbs, 1965 [Lustige Witwe]	Variegated leaves
Vicia faba L. (field bean)			
Bronto	Poland, 1989 S. Starzycki, M. Tkaczyk IHAR Radzikov	Gamma rays 6 kR seeds [Nadwislanski]	More stable yield
Vigna unguiculata (L) Walp (cowpea)			
Cowpea-88	India, 1990 M.S. Sohov, B.L. Bhardwaj, S.M. Beri Forage Research Unit Dept. of Animal Science Punjab Agric. Univ. Ludhiana	F_1 seed, radiation [cowpea-74 x virus resistant strain H-2]	Dual purpose variety, high grain yield and high green fodder yield resistant to yellow mosaic virus

Zea mays L. (corn)

Knezha MHP 556	Bulgaria, 1982 P. Hristova, K. Hristov Maize Research Institute Kneja	Hybrid from cross with inbred from cross with (seeds, chemical mutagen)	
De 2205 SC	Hungary, 1987 P. Pal, P. Petier Inst. Plant Production and Univ. of Agric. Sciences Debrecen 4015	Single cross of mutant lines no. 61 x no. 50 mutants selected after fast neutron irradiation (1980) of F_1 seeds	Early ripening, high yield, good humidity release

FUTURE EVENTS

1991

2-5 April	2nd International Symposium on Hybrid Rice Los Baños, Philippines Contact: S.S. Virmani IRRI, P.O. Box 933 Manila, Philippines
September	International Symposium on Tropical Crop Research and Biotechnology Trivandrum, Kerala, India Contact: N.K. Nayar Dept. of Agriculture and Botany Kerala Agricultural University Trivandrum 695 522 Kerala, India
25-27 November	First European Symposium on Industrial Crops and Products Maastricht, The Netherlands Contact: Secretariat Industrial Crops Symposium Bernhardstraat 33 NL-7491 EA Delden The Netherlands

1992

12-16 April	2nd International Food Legume Research Conference Cairo, Egypt Contact: A.E. Slinkard Crop Development Centre Univ. of Saskatchewan Saskatoon, Sask. S7N 0W0 Canada
6-11 July	13th EUCARPIA Congress "Reproductive Biology and Plant Breeding" Angers, France Contact: 13th EUCARPIA Congress Secretariat G.E.V.E.S. La Minière F-78285 Guyancourt, France
8-11 September	8th European and Mediterranean Cereal Rusts and Mildews Conference Freising-Weihenstephan, Germany Contact: F.J. Zeller Institut für Pflanzenbau und Pflanzenzüchtung Technische Universität München D-8050 Freising-Weihenstephan Germany

AWARD

Dr. Khushnood Ahmed Siddiqui, Head of the Plant Genetics Division, Atomic Energy Agricultural Research Centre, Tandojam (Pakistan) has been awarded the 1988 Gold Medal for Agricultural Sciences by the Pakistan Academy of Sciences.
Congratulations!

LAST BUT NOT LEAST

Please submit your contribution 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 ad distinguish facts from speculations. The length of contributions should not exceed 2-3 typewritten pages including tables. We regret that photographs cannot be accepted for technical reasons. References to publications containing a more detailed description of methods or evaluation of findings are welcome but should generally be limited to one or two.

Alexander MICKE

FAO/IAEA Mutation Breeding Reviews

No. 1 W.W. Hanna (1982): Mutation breeding of pearl millet and sorghum

No. 2 J. Jaranowski and A. Micke (1985): Mutation breeding in peas

No. 3 A. Micke, M. Maluszynski and B. Donini (1985): Plant cultivars derived from mutation induction or the use of induced mutants in cross breeding

No. 4 S. Daskalov (1986): Mutation breeding in pepper

No. 5 P. Spiegel-Roy (1990): Economic and agricultural impact of mutation breeding in fruit trees

No. 6 G. Röbbelen (1990): Mutation breeding for quality improvement, a case study for oil seed crops

No. 7 A. Micke, B. Donini and M. Maluszynski (1990): Induced mutations for crop improvement

No. 8 G.T. Scarascia-Mugnozza et al. (1991, in press): Mutation breeding programme for durum wheat improvement in Italy

Issues 2-7 are available upon request.