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Mutation Breeding Newsletter

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Report from the Plant Breeding and Genetics Section of the Joint FAO/IAEA Division

The programme of the Section continues to take interest in all aspects of plant mutagenesis and the use of induced mutants for plant breeding, although financial incentives can be provided only to a few selected topics. In the IAEA Research Contract Programme, we focus mainly on semi-dwarf cereal mutants, induced somatic mutations in tropical root and tuber crops and on mutations in grain legumes for the improvement of symbiotic nitrogen fixation. Of course we also pay attention to in-vitro culture technology as far as it has advanced to a stage of practical usefulness. At an international symposium and a connected research co-ordination meeting (19 - 28 August 1985) we reviewed the role of in-vitro cultures in mutation breeding, looking at the valuable uses of "micropropagation", the limits of in-vitro selection, the multiple potential of haploids, the staggering enthusiasm about somaclonal variation, the uncertainty about in-vitro mutagen applications and the fantastic expectations from gene engineering. Details can be found in the proceedings to be published soon.

The prospects of avoiding genetic vulnerability of wheat and rice by making available induced mutant sources for semi-dwarfness (alternative to the few genes commonly used) were discussed at research co-ordination meetings in Japan and Italy. The fourth FAO/IAEA Interregional Training Course on the Induction and Use of Mutations in Plant Breeding was held at the Seibersdorf Laboratory (17 September - 25 October 1985) and a regional course mainly on cereal mutation breeding was conducted at Piracicaba, Brazil (18 November - 13 December 1985).

Through the IAEA Technical Co-operation Programme, assistance was provided to plant breeding institutes in 34 developing countries. The scope of these projects is very wide. It includes improvement of lentils and peanuts, barley and sorghum, jute and sesame, cocoa and cassava and many other species. It might be mentioned that disease problems of banana and plantain receive particular attention in terms of in-vitro mutation breeding projects.

An important event in 1985 was certainly the first travel of the Head of the Plant Breeding and Genetics Section to China. A symposium in Beijing and subsequent visits to institutes at Harbin, Nanjing, Hangzhou and Guangzhou permitted direct contact with scientists who have been very active in plant mutagenesis research and successful in mutation breeding during the past decades. This Newsletter reports some of the information received.

RESEARCH NEWS

"Plant breeding by inducing mutations and in-vitro biotechniques"

Under this title, an international symposium was held at Beijing (China) 16 - 20 October 1985. From presented papers and posters, the following news have been extracted:

Achievements in mutation breeding in China

Mutation breeding of plants in China has made remarkable advances during the past twenty years. The first Laboratory for Application of Atomic Energy in Agriculture was established in Beijing in 1957. Later on research laboratories for the same purpose were set up in many provinces and autonomous regions. In 1960, the First National Working Conference for Applications of Atomic Energy in Agriculture was held in Beijing. Till 1975, 81 improved crop varieties belonging to 8 different species were developed and released for commercial use.

In 1981, a National Working Conference on Radiation Genetics and Breeding was held and a nationwide Co-ordination Association for Mutation Breeding of Plants was set up by the Institute for Agricultural Applications of Atomic Energy (IAAE), Chinese Academy of Agricultural Sciences (CAAS).

Up to 1985, at least 194 improved varieties were developed and released, belonging to 19 species as follows: rice 79, wheat 55, soybean 14, maize 11, millet 6, peanut 4, rape 4, cotton 3, sorghum 3, mulberry 2, citrus 2, barley 1, sesame 1, flax 1, chinese cabbage 1, cucumber 1, forage crops 1, ornamentals 5. 162 varieties were developed by the direct use of induced mutants, 32 by cross breeding with mutants. 85% of the mutant varieties obtained after gamma irradiation.

Mutant varieties are grown in China on ca. 9 million ha, which is an 8.7 times increase since 1975. 21 mutant varieties were cultivated on more than 200 000 ha each thus having a substantial economic impact. The most famous varieties are Yuan Fengzao (rice), Lumian No.1 (cotton) and Tiefeng No.18 (soybean). They won the National First Class Invention Price. Another rice mutant variety Zhe Fu 802 is becoming popular with its area increasing from 20 000 ha in 1982 to 670 000 ha in 1985.

Examples of other valuable mutant cultivars are:
- 8013 (rice) maturing 24 days earlier
- Ha75-622 (soybean) matures in 64 days
- Shuiyaai (rice) culm 40 cm shorter
- Yuandong 96 (wheat) good rust resistance, culm 20 cm shorter

- 7201 (rice) resistant to leaf blight
- T131 (rice) resistant to blast
- M112 (rice) resistant to sogatella
- Yuandong No.3 (wheat) resistant to several rusts and powdery mildew
- Longfu 78-5009 (wheat) tolerant to Cochliobolus
- Yuanfu 17 (maize inbred) resistant to Helminthosporium
- Wenyou No. 1 (rice) resistant to cold in the fall
- 72-Fu-1 (pear) tolerant to - 35°C
- T151 (rice) high protein content (15.6%)

A number of male sterile and fertility restoring mutants of rice, maize and cotton are used in hybrid seed production.

REFERENCE

WANG, Linqing., Improved varieties of crops obtained through mutation breeding in China. Journal for Application of Atomic Energy in Agriculture No. 1 (1985).

(Contributed by WANG Linqing, Institute for Application of Atomic Energy, CAAS, Beijing, China).

Mutation breeding of rice in China

Since 1980, rice mutation breeding is co-ordinated on the national level. The organization includes 123 researchers from 23 institutions in 12 provinces. The work comprises mutation induction, improvement of mutagenesis technology, genetic analysis of mutants, preservation and utilization of mutants in cross breeding, and development of new varieties.

In 1966, a mutant variety "Ai Fu 9" was developed in Zhejiang Province. It was a short straw, high yielding variety which reached a cultivation area of 100 000 ha. Another famous rice mutant variety is "Yuan Feng Zao". It matures 45 days earlier than the original variety "Ke Zi 6", produces more seeds per panicle, is adapted to high fertilizer levels and yields up to 10 t/ha. Released in 1976, it is still one of the three leading varieties. It played an outstanding role in replacing single cropping of rice by double cropping in the Yangtse River basin.

Increasingly mutants are used in cross breeding. For example, crossing a mutant of "Yuan Feng Zao" with IR29 resulted in the early variety "Er Jiu Feng". Using a mutant of "Fu Nong 709" as parent produced another new variety "Ce 48". These two are now the leading varieties in Zhejiang Province and won the first class price.

A lot of mutant germ plasm is available for cross breeding such as:
W404 (Zhejiang Agric. Academy) matures in 97 days.
R813 " " 62 cm culm length
Fu8238 " " high yield and high protein content
Hong Tu31 (Zhoushan Agric. Station, Zhejiang Province) high quality
Boo 37 (Jiangxi Agric. Acad.) high quality
Nong Shi 4 (Fujian Agric. College) high quality
Xiang Jing Nuo (South China Agric. College) sweet smell
Dan Fu Hei Nuo (Rongxian Agric. Station, Guangdong Province) good for medical purpose and for Hei Nuo champagne. Up to now a collection of 867 mutants has been established.

(Contributed by WANG Xianyu, CHENG Jinqing, SHEN Shoujiang and ZHANG Mingxian, Institute for Application of Atomic Energy in Agriculture, Zhejiang Agricultural Academy, Hangzhou, China).

A new rice variety "Zhongtie 31" obtained by inducing mutation with fast neutrons

Dry seeds of the rice variety "Tieqiu 15" were irradiated with 14 MeV fast neutrons. A high yield, long grain variety "Zhongtie 31" was obtained through mutation breeding. Its yield is 11.4% over the hybrid rice "Shanyou No. 6"; its good quality, stress tolerance and adaptability is comparable to hybrid rice varieties.

(Contributed by CHEN Zhengba and YOU Risheng, Guangdong Test and Analysis Institute, Guangzhou, China).

Mutant rice variety "M112"

"M112" is a late-season *indica* rice. It was developed within six generations after irradiation with 30 krad ^{60}Co gamma-rays. It is suitable as a main season single crop or second season crop, and usually can yield 4500-6300 kg/ha, even up to 7500 kg/ha, 10% over other released varieties. The total area planted with this variety from 1980 to 1984 amounted to more than 160 000 ha, bringing a production increase of 75 million kg and on economic profit of 18,600,000 yuan (ca. 6 million US$). The valuable characteristics of "M112" are as follows: (1) cold-tolerance, (2) not apt to shattering, (3) resistant to whitebacked planthopper (*Sogatella furcifera* Horv.) and (4) good grain quality.

(Contributed by YANG Sufen, YANG Shongsheng and YANG Shuilian, Rice Institute, Jiangxi Academy of Agricultural Sciences, Nanchang, China).

Xiang-Fu 81-10 - A new glutinous rice variety with good quality

"Xiang-Fu 81-10" is a glutinous rice variety with good quality, high yields and multiple resistance developed by irradiating dry F2 seeds of IR29 X "Wen-Xuan-Qing" with ^{60}Co gamma-rays. It was selected through 4 generations during 3 years. "Xiang-Fu 81-10" has good plant type, desirable yielding components and wide adaptability. It matures in 117 days or 107 days when grown as an early or late season crop, respectively. Generally, it can yield 6.75 t/ha in the early season or 6 t/ha in late season. It is highly resistant to bacterial blight and blast, and is very good in grain quality and glutinosity.

(Contributed by WAN Xianguo, PANG Bailing, ZHU Xiaoji, Hunan Institute for Atomic Energy Application in Agriculture, Changsha, China).

Mutant variety "Zhe Fu 802" in rice

Dry seeds of the rice variety "Si Mei 2" were irradiated with 30 krad ^{60}Co gamma rays in 1978. From this experiment the mutant variety "Zhe Fu 802" was developed and released in 1982-1983. It is characterized by early ripening (maturing in 112 days, 4 days earlier than "Si Mei 2"), better disease resistance, higher yield potential (6375 kg/ha in average, 6-18% higher than the check) with 14.05% crude grain protein content, and wide adaptability. It also has large panicles and higher filled spikelet percentage. The height of the plant is about 78 cm, and the panicle is 19 cm in length. It has about 90 grains per panicle, the 1000-grain-weight is 24 g. It is classified as a medium long bold variety type. "Zhe Fu 802" could be grown in various areas and early or late season because of its good adaptability.

(Contributed by XIA Yinwu, Zhejiang Agricultural University, Hangzhou, China).

The utilization of mutant "Zhu-yin C6965" in rice breeding

A promising mutant "Zhu-yin C6965" (resistant to blast and Xanthomonas oryzae), induced in Zhu-yin No.2, by 35 krad ^{60}Co gamma rays treatment, was crossed with IR20, and a new donor line "Fu-Zhu-Er-Ai" was developed. This donor line was crossed with other varieties and a series of new varieties has been obtained in 1983, such as "Qing-Hua-Ai No. 6" and "Zhu-Bao 384". The cultivation area of "Qing-Hua-Ai No.6" is about 130 000 ha, two other varieties are semi-dwarf and disease resistant, possess good grain quality and give high yields.

(Contributed by YE Zhorong, WANG Houcuong, ZHONG Qichen and CAI Jianxi, Guangdong Academy of Agricultural Sciences, Guangzhou, China).

Induced mutants for resistance to blast (Pyricularia oryzae) in rice breeding

Eleven rice varieties were treated with ^{60}Co gamma rays, neutrons, lasers and other mutagens. 154 mutants with different characters and their parents have been inoculated with blast (Pyricularia oryzae). 7 mutants were classified as resistant, 10 as medium resistant. It was found that mutants with different levels of disease resistance can be selected. There is a different frequency of mutations for disease resistance with different parental varieties. After inoculation with 13 blast races, it was found that the spectrum of resistance to blast of the mutants differed from the spectrum of the original varieties. "R 8113" is a promising short culm blast resistant mutant from irradiated "Aijing No.23", yielding 6% more than the parent. It is being tested in various locations.

(Contributed by ZHANG Mingxian, LUO Rongting, XU Baocai and XU Gang, Institute for Utilization of Atomic Energy, Zhejiang Academy of Agric. Sci., Hangzhou, China).

"Fu Gui No. 1" - A new blast resistant mutant rice variety

"Fu Gui No. 1" is an improved variety bred by Guangdong Academy of Agricultural Sciences. It was obtained by selection from irradiated "Gui Chao No. 2". According to preliminary statistics in Guangdong and other provinces, "Fu Gui No. 1" has already been cultivated on more than 6600 ha. It is one of the more widely cultivated new varieties derived from radiation induced mutation.

(Contributed by CAI Jianxi, Guangdong Academy of Agricultural Sciences, Guangzhou, China).

R462 - A new rice strain obtained from irradiated anther in vitro culture

Application of gamma ray to rice anthers cultured in-vitro can increase the frequency of callus induction and promote callus differentiation and plantlet regeneration. It is possible to get a considerable number of haploid plants for selecting valuable mutants. R462 - a new strain was selected from japonica rice "501 Xuan" anthers cultured in-vitro and irradiated with 2000 rad gamma ray. It is a spontaneously doubled haploid. It has short stature, early ripening and high yield. The zymogram of peroxides and esterase isozymes revealed that there were significant differences between R462 and it's parent "501 Xuan". The new strain yielded more than 6700 kg/ha. It may be cultivated in 1985 on more than 8000 ha and eventually replace indica varieties in the Yangtse river area.

(Contributed by YIN Daochuan and YU Qiucheng, Academy of Agricultural Sciences of Jiangsu Province, Nanjing, China).

Induction of useful mutations by gamma irradiation of anther cultures of rice

Anthers of rice at mid-late uninucleate pollen stage were treated with ^{60}Co gamma rays and then cultured. Results indicated that the progenies of irradiated anther cultures have a greater range of variation in main characters than those of anther culture alone; especially the frequency of beneficial variation is higher. A new variety of rice "2205" has been developed from irradiated anther culture. This new variety possesses good quality and taste, higher yield, mid-early maturity and better disease resistance. The combination of gamma radiation and mirospore culture in rice will be an effective means for rice breeding. It can increase the frequency of induction of mutation but it also will speed up the stability of new lines and shorten the period of breeding.

(Contributed by KUO Dahwa, Institute for Application of Atomic Energy, Hubei Academy of Agricultural Sciences, Wuhan, China).

Early mutant "Fu-06" used for hybrid rice

Dry seeds of the late maturing rice variety "Taiyin No. 1" were irradiated with ^{60}Co gamma rays. The early mutant strain "Fu-06" was selected within 4 generations. It is 20 days earlier in heading than the original variety. When the mutant strain was crossed with male sterile lines, the average fertility of the F_1 came to 95.5% and heterosis was more significant than with the original variety, particularly for the no. of seeds per main panicle and the seed weight per plant. In 1984, the area planted with the rice hybrid "G-aiA X Fu-06" was about 6600 ha. Commonly, the yield reached 8000 kg/ha and the maximum yield obtained was 11000 kg/ha.

To study the inheritance of early maturity, in 1981-1983 "Fu-06" was crossed with the original variety "Taiyin No.1" and the late variety "IR24". Late heading showed incomplete dominance in F_1 and the date of heading in F_2 exhibits a bimodal distribution, with a ratio of 3 late to 1 early. Some transgressive segregation occurred. It appears that the early maturity of "Fu-06" is controlled by a recessive major gene, and affected by some modifying genes.

(Contributed by DENG Da-shing and WU Wanyi, Sichuan Provincial Institute of Application of Nuclear Technology, Chengdu, China).

Use of induced reciprocal translocations in rice breeding

Dry seeds of the hybrid "Ai Tang Zhu" x "IR24" were irradiated with 30 krad ^{60}Co gamma rays. Mean M_1 fertility was only 26%. 40 plants in M_2 segregated in a ratio of 1 normal fertile : 1 semi-sterile. A plant with 63.5% fertility was selected and selection for normal fertility was continued for several generations. By this procedure, "Tang Er Nian" was developed as a late season, high yield fine grain rice variety. In 1984 variety trials it yielded 6400 kg/ha. It is medium resistant to bacterial blight, has a 1000-grain-weight of ca. 18 g and translucent grains free from "white belly". In 1985, the variety is propagated on a large scale. "Tang Er Nian" may actually not be a translocation homozygous but a corresponding homozygous substitution line.

The new variety "Qing Wei No.1" on the other hand is a confirmed translocation homozygote. In 1980, F_1 plants of a cross "Qing Er Ai" x hybrid (V20 x Gui 630) were irradiated at meiosis. 18 M_1 plants were grown, two were semi-sterile and recognized as translocation heterozygotes. M_2

segregates with normal fertility were test-crossed with the standard variety "Qing Er Ai". F_1 examination led to the detection of translocation homozygote "83-E26". From offspring segregating for blast resistance and agronomic characteristics, "Qin Wei No.1" was selected. It yields more than 6000 kg/ha, exceeding "Qing Er Ai" by 16% and was included in 1985 variety trials.

(Contributed by K. Asai, WU Jin Yi, CHEN Pu Hua, LI Xi and ZHENG Shi Huo, Guangdong Academy of Agricultural Science, Guangzhou, China).

Breeding and utilization of high-yield and early-maturity variety "Chuanfu 1" of wheat

In 1977 dry seed of "Chuan Yu 5" were soaked in $KH_2{}^{32}PO_4$ solution. In 1980, "79p-17", a promising strain was selected which was named "Chuanfu 1" by the Sichuan Seed Bureau in 1984. It is an early maturing spring wheat. The plant height is about 85 cm. It has more productive tillers with late senescing leaves. It is highly resistant to stripe rust, medium resistant to scab and tolerant to wet, barren soils. "Chuanfu 1" has good grain quality, stable yield ranging from 4.5-6.0 t/ha and is easy to be threshed. More than 70,000 ha were covered by "Chuanfu 1" in Sichuan and other provinces in 1985.

(Contributed by QU Sihong, YU Zeliang, XIA Qun and ZHANG Zhixiong, Institute of Agricultural Application of Atomic Energy, Sichuan Academy of Agricultural Sciences, Chengdu, China).

Inducing mutations by irradiation of wheat hybrids

The genotype of the initial material plays an important role in mutation breeding. Irradiating hybrids can increase mutation frequency, foster recombination and widen the mutation spectrum. In China, 23 out of 48 wheat mutant varieties derived from irradiated hybrids.

In our experiment, 4 varieties were used and the following hybrids: Yuandong 767 x Lovrin, Yuandong 767 x Aurora, Yuandong 771 x Naixue, Yuandong 771 x 80076 early, Yuandong 777 x Gaodabei, Changnoun 17 x Norin 77, Youbobei x San Pastore, Youbobei x Aurora and Yuandong No. 1 x St. 2422/464. Dry seeds (13% moisture) were irradiated with 30 krad ^{60}Co gamma rays. The radiation sensitivity observed in the M_1 was higher for hybrids (F_1M_1) than for varieties (M_1). Variation of plant height, no. of spikelets per spike, no. of grain per spike and 1000-grain-weight was higher in F_2M_2 than in F_2 progenies. The variation was different among hybrid progenies, confirming the expected influence of parent genotypes. There were in total 3,3% variants for earliness, dwarfness and spike characters in F_2M_2 against 1,5% in F_2. New characters appeared which could not be found in the parent material, e.g mutant "Yuandong 96" is 20% shorter than parent stocks and possesses good rust resistance. Most lines were still segregating in F_3M_3 and F_4M_4, but stabilization appeared to be more rapid than in F_3 and F_4 material.

"Yuandong 94" and "Yuandong 96" are mutant wheat varieties from hybrid irradiation. "Yuandong No. 3" is a new variety with complex resistance to rust, to powdery mildew and tolerance to dry hot winds. It derived from irradiated F_3 of the cross 12040 x Aurora.

(Contributed by WANG Linqing, FAN Qingxia, SHI Jinguo and WANG Zitian, Institute for Application of Atomic Energy, CAAS, Beijing, China).

Super early maturing wheat variety Longfumei No. 1

The new wheat variety "Longfumei No.1" had been selected in F_4M_3 generation after treating F_1 seeds from the cross "Xin No.3" x "Lio No." with thermal neutrons. Its characteristics are: a) super early maturity; the duration is 70-75 days from emergence to maturity (Chinese cabbage and chinese radish can still be planted after harvest); b) good quality; the protein content is 15-18.2% lysine content is 0.38-0.40% and wet gluten content is 31.9-46.1%; c) high yield above 3 t/ha, up to 4.5 t/ha on fertile soils. It has been cultivated on 13,000 ha in 1985.

(Contributed by SUN Guangzu, CHEN Yichen, WAN Ziwin, ZHANG Yuexue and SHANG Zhimin, Institute for Application of Atomic Energy, Heilongjiang Academy of Agricultural Sciences, Harbin, China).

Induced mutation from irradiated anther cultures of wheat

Anther donors were winter wheat "Jingzuo 348", spring wheat "Alondra's" and allo-octoploid triticale "h739". Florets were gamma irradiated with 50-600 rad and anthers of mid-uninucleate microspore stage were cultured. Phenotypic variation among anther culture derived plants was found fourfold higher for irradiated anthers than in a parallel experiment without irradiation. Variation among plants of triticale without irradiation was much higher than in wheat. Irradiation doubled the frequency of variants. 100 rad appeared to be the most appropriate dose. It also promoted callus induction. Most of the variants bred true, but in one case the offspring of a dwarf wheat "pollen plant" was taller than the original variety.

(Contributed by ZHENG Qicheng, ZHU Yaolan and CHEN Wenhua, Institute for Application of Atomic Energy, CAAS, Beijing, China).

Increasing segregation range in spring wheat by irradiation

Dry seed irradiation of parents before crossing increased ranges of segregation in F_2 for plant height, ears per plant, length of main ear, number of seed-setting spikelets per ear, number of grain per ear, grain number per plant, grain weight per plant, plumpness of grain and 1000-grain-weight. These results obtained earlier were confirmed for three other hybrid combinations of spring wheat. The variation coefficients for plant height, ears per plant, spikelet number of main ear, grain number per plant and grain weight per plant were greater in F_2 from irradiated parents than in the normal F_2. There was a significant decrease of correlation coefficients, which would indicate breaks of gene linkages and more gene recombination through irradiation. From such combination of irradiation with hybridization a new wheat variety "Xin Cun 2" was developed which is lodging resistant, drought resistant and yields over 7,5 t/ha.

(Contributed by WU Zhenlu, The Institute of Atomic Energy Application, Xinjiang Academy of Agricultural Sciences, Wulumuqi, China).

Induction of short culm mutants for wheat improvement

149 short culm mutants of wheat were induced by gamma-rays, thermal neutrons and ethylene imine in three local cultivars. Thermal neutron treatment appeared to be the most effective for this type of mutation. Morphological examination indicated that the shortening of the culm is due to

shorter internodes rather than a decreased number of internodes. Two mutant lines No. 1309 and No. 7412 appear promising for direct utilization because of lodging resistance, early maturity and high yield.

Genetic studies revealed mutant lines with dwarfing genes different from the "Norin-10" genes Rht_1 and Rht_2. Mutant line No. 633-1 carries a recessive semi-dwarfing gene, mutant lines No. 650 and No. 1300 carry two recessive semi-dwarfing genes. The semi-dwarfing gene of mutant No. 527 shows partial dominance. In constrast to "Norin-10" genes, these induced mutant genes do not show a pleiotropic effect upon coleoptile length: The coleoptile of mutant No. 527, 1300 and 633-1 is just as long as in their respective mother varieties. Thus the mutants have a good potential for developing short culm wheat varieties with better emergence than those carrying "Norin-10" genes.

Promising results have been obtained from crossing mutant No. 7412 with mutant L30-3-2 (derived from the Romanian variety "Lovlin 10"). Selected lines combine short culm, early maturity and long spike with high resistance to stripe and stem rust.

(Contributed by LING Tinan and LI Chunlan, Department of Agrophysics, Beijing Agricultural University, Beijing, China).

Breeding new disease resistant strains of wheat by using radiation and distant hybridization

Distant hybridization has often been used to transfer genes from related species and to develop disease resistant substitution or addition lines. Translocation lines would generally be more appropriate and these can be obtained by irradiating hybrids.

In crossing triticale x common wheat a seed set of 16,4% was obtained. The F_1 plants, however, showed a higher level of sterility with only 4,1% seed set. When F_1 seeds were irradiated with 11 krad gamma ray before planting, fertility of F_1 plants increased to 23,9% and variation in F_2 increased as well. Good lines were selected from F_3 onwards. An early maturing line "Longfu 82-92072" yielded 14,8% above the control Shen 68-71. A medium maturity line "82 Nan 389" yielded 18,1% above the control "Kefu No.1". Both lines possess some typical characters of rye. "Longfu 82-92072" was found to be a substitution line (6R/6D) and "82 Nan 389" a translocation line. Both lines have entered regional trials of Heilongjiang Province in 1985.

(Contributed by ZHEN Yichun, SUN Guongzu, ZHANG Yuexue and SHANg Zhimin, Institute for Application of Atomic Energy, Heilongjiang Academy of Agricultural Sciences, Harbin, China).

Induced chromosome translocations by ionizing radiation in triticale x wheat hybrids

Since 1978, seeds of hybrids between octoploid triticales and common wheat or their offspring have been treated with ^{60}Co gamma rays or neutrons. The aim was to induce chromosome translocations to transfer chromosomal fragments or genes from rye to A, B and D genomes of wheats Among 11 selected translocation lines, 3 have really valuable agronomic characteristics:

- "Har Shi 82-14": 85 cm culm length, TGW 33 g resistant to loose smut, leaf rust, powdery mildew, root rot and scab. Yield 20% more than standard variety "Kefeng 1".
- "Har Shi 82-1-4": 70 cm culm length, drought tolerant, resistant to rust, powdery mildew, loose smut and scab, TGW 30 g. Yield 25% more than standard variety "Kefeng 1".
- "Har Shi 84-18": 89 cm culm length, 18 cm spike length, TGW 36 g. Yield 27% more than "Kefeng 1".

Two others are of interest as germ plasm:
- "Har Shi 83-449" carrying a 6RL/6AL translocation
- "Har Shi 83-1294" carrying 5RL/4AL translocation.

(Contributed by LI Jilin, XU Xiangling, XUE Xi and WANG Tongchang, Department of Biology, Harbin Normal University, Harbin, China).

A new soybean cultivar Liaodou No. 3

F_1 seeds of the cross "45-15 x 5621" were irradiated with 12 krad gamma rays. A good mutant No. 6405 was selected, later named as variety "Tiefeng No.18". "Tiefeng No.18" was crossed with "Amsoy" (US) as male parent. Lines of medium maturity, compact plant shape, more nodes, good disease resistance and better seed characters were selected. One of them, showing also good yield was released as variety "Liaodou No. 3" in 1983.

The average yield over 3 years was more than 3400 kg/ha, 12.9% above "Tiefeng No.18". In 1984, the variety reached already 10 000 ha of cultivation. Highest yields reported by farmers in 1983-1984 were between 4,7 and 6.0 t/ha. Average growing period was 122 days.

The plant habit is semi-determinate, about 1 m high, pagoda shape. Light penetration is good. It possesses more effective nodes, has less pod shedding and pod blight. TGW 180-200 g. Protein content ca. 42%, oil content ca. 20.6% optimal planting density is 165-195000 plants/ha.

(Contributed by WANG Yijiang, YUAN Hongwei and YANG Shufan, Institute for Application of Atomic Energy, Liaoning Academy of Agriculture, Shenyang, China).

Soybean variety Heinong No. 26

The soybean variety "Heinong No. 26" has been developed by crossing a mutant Ha 63-2294 of good quality and early maturity (derived from "Dongnong No.4" irradiated with ^{60}Co gamma rays) in 1965 with "Xiao Jinhuang No.1" a variety well adapted in Jilin Province. In Heilongjiang Province, the conditions for soybean cultivation are characterized by a short frost-free period, variable climate, sometimes harmful low temperature and early frost.

"Heinong No. 26" has several superior characters: (1) It requires 125 days from emergence to maturity, (2) The yield per ha was 4380 kg under good condition and 1900-2600 kg under common condition. The yield average was 11.8% over the standard variety "Heinong No. 10" in regional experiments. The variety has stable yield, is tolerant to drought and to low temperature during the seedling stage. The germination was 86% at 6-7^{o}C, 42-64% higher than the standard. The seeds are nearly round, the seed coat is thick, yellow with yellow hilum. TGW is about 180 g, protein content 40.83%, fat content 21.8%.

Since its release in 1975 the planting area "Heinong No. 26" has steadily increased. In 1980 "Heinong No. 26" became the main cultivar in mid-south of Heilongjiang Province. In 1982 the planting area was more than 265 000 ha in

Heilongjiang Province spreading also to Jilin, Hebei, Xinjiang and Shanxi Provinces.

Soybean variety "Heinong No. 26" gained the second prize by the Invention and Evaluation Commission of the State Scientific Commission on June 21, 1984 because of large area, long time cultivation and significant economic benefit.

(Contributed by WANG Binru, WANG Lianzheng, WENG Xiuying, CHEN Yi, WU Heli, XU Xingchang and WANG peiying, Soybean Research Institute, Heilongjiang Academy of Agricultural Sciences, Harbin, Heilongjiang Province, China).

Study of mutants with opposite trifoliate leaves and multi-leaflet leaves in soybeans

Soybean varieties with normal trifoliate leaves were treated with 15 krad of ^{60}Co gamma rays. Two special mutation types have been obtained. One of them had two opposite trifoliate leaves per node ("SF 7910-3") and the other had 4-7 leaflets instead of 3 per leaf ("SF7919-61"). These mutations were observed besides greater variations in plant height, node number and fertility already in M_1 generation and they appeared again in M_2. Four plants with opposite trifoliate leaves and six multi-leaflet types were selected. Selection continued in M_3 and M_4. The plants in M_4 were uniform, strain comparison test was done in M_5 generation.

Under field conditions, the mutant lines had dark green and horizontally expanding leaves, and were virus and downy mildew resistant. They matured 3 to 5 days earlier than "Tiefeng No.18". The 1000-grain-weight was 224 and 212 g respectively. There were no purple stain seed spots. The line "SF7910-3" has oval leaflets and white flowers, the line "SF7919-61" narrow leaflets and white flowers. Crosses between the mutants and the variety "Tiefeng No.18" which has purple flowers, oval leaflets and normal trifoliate leaves were done in 1982. All F_1 plants of the cross "Tiefeng No. 18" x "SF7910-3" had opposite trifoliate leaves, oval leaflets and purple flowers, while all the F_1 plants of the cross "Tiefeng No.18" x "SF7919-61" had normal trifoliate leaves, oval leaflets and purple flower. F_2 from the cross "Tiefeng No.18" x SF7910-3" segregated: 3084 plants with opposite trifoliate leaves and 1039 plants with alternated trifoliate leaves. In the F_2 from "Tiefeng No.18" x SF7910-61", there were 4382 plants with normal trifoliate leaves and 1480 plants with multi-leaflet leaves. So, it is concluded that the opposite trifoliate leaf character is controlled by a single dominant gene and the multi-leaflet leaf character by a single recessive gene.

Results of trials showed the yields of the two lines being significantly higher than those of "Tiefeng No.18". Because the lines have a faster growth rate, a higher leaf are an index, stronger stem and lodging resistance, good disease resistance, high yield, they are valuable soybean germ plasms.

(Contributed by FU Laiqing, Sheyang Agricultural College, Shenyang, China).

"Multi-leaflet" mutants in soybean

Dry seeds of variety "Tie 6817" were irradiated with 16 krad ^{60}Co gamma rays. The multi-leaflet character was first observed in M_3 in 1978. Through directional selection from 1979 to 1981 two lines (M_6) were obtained in which the multi-leaflet frequencies were 100% and 95.5% respectively. Genetic studies showed that "multi-leaflet" was a recessive character controlled by a single gene. The multi-leaflet line was identified as gene mutation by isoenzyme analysis.

The "Mufu 81-6009" multi-leaflet mutant has white flowers, indeterminate growth habit, grey pubescence, yellow and round seeds, 4-7 leaflets per leaf and later maturity; the plant has vigorous growth and more branches. 1000-seed-weight is 150-170 g. The content of protein is about 42.15%. The leaf area of "Mufu 81-6009" in full blooming stage is greater than that of "Mufeng No.5". The rate of photosynthesis measured by infra-red CO_2 analyzer is the same as for "Mufeng No.5". The peroxidase isoenzyme of "Mufu 81-6009" is different. There are several multi-leaflet lines in China and abroad, e.g. PI 86024 from USA, Jinte No.1 and Bei 7771-31 from China. All of these show 3-7 leaflets at each petiole in different mixture.

(Contributed by GUO Mingxue, Mudanjiang Institute of Heilongjing Academy of Agricultural Sciences, Mudanjiang, China).

Investigation on mutation induction in maize

Mutant inbred lines of maize have been reported by many people to increase hybrid yields when used in cross pollination instead of the original line. In our institute we have developed the mutant inbred line "Yuan-Wu No.2", which gave early maturing high yield hybrids like "Lu Yuan S.C. No.4" or "Lau Yu No.5". These hybrids were planted in 1983 on 860 000 ha.

Inbred line "Huang-Zao No.4", a common parent line for maize hybrids cultivated in Northern China, was used for mutation experiments. Dry seeds (13,8% moisture) were irradiated with 20 krad ^{60}Co gamma rays. M_1 plants were pollinated with mixed pollen of normal plants. M_2 in 1983 was selfpollinated. There were no visible mutations in M_2, however, there was a measurable increase in variability for maturity, plant height, cob length and TGW. In M_3, there was segregation for visible mutations as expected.

(Contributed by ZHU Doubei, WANG Zonggui, XU Fangzuo, CHEN Xiao and YAO Chuanfang, Institute for Application of Atomic Energy, Shandong Province, Academy of Agricultural Sciences, Jinan, China).

Salt resistant plants from callus of tobacco

Segments of tobacco leaves were directly cultured on modified MS medium containing 0.5% NaCl. The concentration of NaCl in the medium was increased stepwise to 1.0, 1.5 and 2.0% NaCl. Eventually cell line 04-9 resistant to 2.0% NaCl was obtained and 12 plants with long and thick leaves and more pedicel branches were regenerated. Through artificial pollination, a few seeds were obtained. The cell size, chlorophyll and proline contents, osmotic potential, and peroxidase isozymes of NaCl resistant callus and the leaves of its regenerated plants were different from the original type.

(Contributed by ZHOU Rongren and YANG Shirong, Institute of Plant Physiology, Academia Sinica, Shanghai, China).

A new male sterile line in cotton

Seeds of five Sea Island cotton cultivars were treated with ^{60}Co gamma rays at doses of 15 - 50 krad. All the M_1 plants were damaged to a certain degree. About 9.6% showed male sterility and leaf shrinkage. The male sterility of these plants was not inherited except for one plant 72-563-3 derived from 15 krad gamma ray treatment at 119.5 rad/min. From the progeny of crossing this mutant with Sea Island cultivars, the "Xinhai" male sterile line with a constant sterility rate of about 50%, was developed.

The "Xinhai" male sterile line when crossed with other Sea Island varieties gave F_1 populations with a 50% segregation of male sterile and fertile plants. The male sterile plants from F_1 when sib-crossed with fertile plants or backcrossed with the F_1 hybrid, again segregated. The constant segregation ratio of 1:1 was consistant with the assumption of male sterility being controlled by a dominant nuclear gene. The fertile plants from the F_1 generation, when selfed or crossed, gave progenies of normal fertility. The "Xinhai" male sterile line when crossed with upland cotton, gave F_1 plants with full restoration of fertility.

The pollen abortion in the "Xinhai" male sterile line generally occurs between the single and the double nuclear stage, which is different from MS4, MS7, MS10 and Ton A3. Therefore, it might be considered that the "Xinhai" male sterile line is controlled by a new gene. The gene symbol tentatively assigned is MSc5.

The development of the "Xinhai" male sterile line may offer a new approach for producing hybrid cotton by the "one line and dual purpose" method using an upland cotton variety as restorer.

(Contributed by ZHANG Yunshen, ZHANG Zhennan, Industrial Crops Institute, Xinjiang Academy of Agricultural Sciences, Wulumuqi, China).

Mutation breeding in sweet potato (Ipomoea batatas Lam.)

6543 hybrid seeds from 23 cross combinations were irradiated between 1978 and 1984 with a fairly high dose of fast neutrons. The irradiation promotes the development of adventitious buds from single epidermal cells of the hypocotyl, as the apical buds are severely inhibited. The adventitious buds sprout ca. 2-3 cm below the cotyledonary node. Between 40 and 70% of the adventitious bud lines were mutated. Mutated characters include pigments, leaf shape, vine type, flower colour, glucoside content, yield and resistance to black spot disease. Five promising lines with strong disease resistance, high percentage of starch and high yield are under further test.

(Contributed by CUI Guangqin, YANG Zhongcui, LIN Shujuan, WANG Qingxu and LIN Zujun, Yantai Agricultural Research Institute, Yantai, Shangdong Province, China).

Mutation breeding of Hevea by using irradiated pollen

Good pollen of a good Hevea clone was treated with gamma rays or X-rays in the Spring 1973 and then hand pollinations were made on a female parent of another good clone. Some hybrid seeds were obtained, and some variant seedlings were found in the nursery. All the hybrids were planted in the field in 1975. The two parents as well as other recommended clones were used as controls in the same field. Hybrids were tapped since 1982 and 8 high-yielding mutants have been identified. According to 3 years consecutive tapping the yield of mutants surpassed that of the controls by a big margin. In 1984 the yield of 2 most outstanding high yielding mutants was twice that of the controls.

(Contributed by ZHENG Xueqin, ZENG Xiansong, HU Dongqion, CHEN Xianming and YANG Guangling, South China Academy of Tropical Crops, Dain County, Hainan Island, China).

Mutation breeding of Chinese chestnut

Fast neutrons were used in treating branches of Chinese chestnut from Yangshan District, Guangdong Province. The treated branches were grafted on four year old seedling stocks and then further propagated for the second and the third generation. Results of observations taken during nine years are as follows: 1. Trunks are dwarfed by 47% and the crown extent decreased by 45%. The plants are therefore suitable for dense planting and convenient in management. 2. Male flowers decreased while the female flowers increased in number. Several seeds are produced in one bract. Nut yield of individual trees increased by 86.8%. If converted to unit area, yield would be raised by 123.8%.

(Contributed by HONG Peiying, XIE Zhifang, HE Zhaoheng, CHEN Bingquan and ZHU Ganbo, Forestry Department, South-China Agricultural University, Guangzhou, China).

Using gamma rays to induce mutations for seedlessness in citrus

Since 1978 shoots of seedy citrus varieties cultivated in South China have been irradiated with different doses of gamma rays of ^{60}Co to induce chromosomal translocations. These would result in the abortion of pollen grains, and failure to form seeds. 8 krad appeared to be an appropriate dose. Through screening, 15 seedless mutant clones from 5 varieties have been obtained.

(Contributed by WU Shouyi, LIANG Jun, LIN Runcai, LI Zhiqiang, TANG Xiaolang and ZENG Sairong, The Fruit Tree Research Institute of Guangdong, Academy of Agricultural Science, Guangzhou, China).

Mutation breeding in rose

Mutation induction studies in rose started in 1982 with gamma irradiation (3 krad) of green branches of "Crimson Glory", "Super Star", "Condesa de Sastago", "Peace", "Pink Peace", "South Seas" and others. During M_1V_1, M_1V_2 and M_1V_3, mutants were selected for leaf and flower characteristics. Between 3.8 and 15% of plants carried mutant branches, almost half of which were chimeric flower colours. From stable clones the following new cultivars were developed: "Ji Guang", "Xia Guang Wan Dao", "Zhen Jie" and "Nan Hai Lang Hua".

(Contributed by HUANG Shanwu and CHEN Yanfang, Flower Breeding Group, Vegetable Institute, Chinese Academy of Agricultural Sciences, Beijing, China).

Early ripening mutant lines of Sorghum bicolor

Dormant seeds of variety "Xinliang No.7" of kaoliang (Sorghum bicolor L.) were irradiated with thermal neutrons, gamma rays, microwaves and laser in order to obtain early ripening lines capable of escaping cold damage in Heilongjiang Province. In M_2, maturity varied by more than 30 days. 18 mutants with good characteristics were selected. One of them which ripens 15 days earlier, is adapted to close planting and mechanical harvest. It was introduced in 1979 into commercial production under the name "Longfuliang 1". Other mutants will be used as parents of hybrids.

By using the range of climatic conditions available in China, the variety was released after 4 generations in only 2 years. "Longfuliang 1" is 90-100 cm tall, yields 5-7 t/ha and is currently cultivated on more than 20 000 ha.

(Contributed by HU Je, YANG Jinlan, LIU Xinchun and ZHAO Yenggiao, Radiation Genetics and Breeding Laboratory, Institute of Agricultural Utilization of Atomic Energy, Heilongjiang Academy of Agricultural Sciences, Harbin, China).

Cell selection of tobacco mutants resistant to *Phytophthora parasitica* var. *nicotiana*

A highly virulent isolate of the pathogen was grown on Huang's medium or potato dextrose decoction medium and produced toxins in two weeks. A synthetic medium was used to extract the toxin. Tobacco Medium No.1 mixed with different quantities of crude toxin was used as selection medium. Anthers of late uninucleate stage were put on the selection media. After about 1 1/2 months the induction frequency was calculated. Anthers of varieties "Small Golden Leaf", "Quiaochung", "Black Plantlet", "Xiangyin No.1" and one hybrid were irradiated. A dose between 500 and 1000 rad appeared appropriate. 50-60% of toxin was sufficient for differentiating resistant and susceptible varieties and was used for anther culture selection, but 66-80% concentration was used for cell selection. 6 tolerant plants were selected from anther cultures, about 300 derived from cell selection. For retesting with the fungus the detached leaf test was used. A reasonable confirmation was obtained. Inheritance studies are still under way. F_1 results indicate incomplete dominance of resistance.

(Contributed by ZHOU Jiaping and HUANG He, Institute of Genetics and Institute of Microbiology, Academica Sinica, Beijing, China).

Mutation induction in apple

Mutation induction is increasingly being used for the improvement of fruit tree cultivars. Thus, variety "Hongju No.418" has been improved by the Orange Research Institute, Chinese Academy of Agricultural Sciences and a seedless clone 9-12-1 of variety "Xuegan" has been obtained on Guongxi Xingguong Farm.

Since 1974, we are using gamma rays, microwave and fast neutrons for irradiating dormant annual shoots of apple cultivars "Xoushuei" and "Fuji". 850 irradiated shoots were grafted. There was a high tendency for bifurcation among shoots treated with neutrons, but the number of blind shoots was higher with gamma rays. M_1V_1 and M_1V_2 shoots of "Fuji" were irradiated again. Red colored mutants of "Fuji" were selected. Similar colored mutants were already found in Japan after irradiation of "Fuji". An oblong fruit shape was found not to be heritable.

(Contributed by LI Yazhi, XU Abing, LI Xiaojian, WANG Cunxi and CUI Decai, Shandong Agricultural University, Tainan, China).

LIST OF TRAINEES AND FELLOWSHIP HOLDERS IN 1985

Achutegui Betulu, A.M. (Venezuela)	Seibersdorf (Austria)
Baktash, Y. (Iraq)	scientific visit to Yugoslavia, Italy
Bazur Rashid, A.Q.M. (Bangladesh)	Pullman, WA (USA)
Füredi, J. (Hungary)	scientific visit to Austria, FRG, Switzerland
Ghafoor, A. (Pakistan)	scientific visit to USA
Harahap, Z. (Indonesia)	scientific visit to UK., Netherlands, IAEA
Ismachin, M.K. (Indonesia)	scientific visit to Denmark, France, USA
Kim, J.W. (Rep. of Korea)	Baton Rouge, LA (USA)
Klu, G.Y.P. (Ghana)	FAO/IAEA Seibersdorf (Austria)
Lee, J.Y. (Rep. of Korea)	U.K
Loekman, J. (Indonesia)	Tokyo (Japan)
Lethi, D. (Vietnam)	Bombay (India)
Moacir, P. (Brazil)	Rehovot (Israel)
Quaynor-Addy, M. (Ghana)	Casaccia (Italy)
Roy, M.K. (India)	Liverpool (UK)
Santha, I.M. (Indonesia)	Durham (UK)
Shamguzzaman, K.M. (Bangladesh)	Canberra (Australia)
Siddiqui, Sh. (Pakistan)	scientific visit to Australia, Japan, USA
Smutkupt, S. (Thailand)	scientific visit to Sweden, FRG, Poland, IAEA
Tulmann-Neto, A. (Brazil)	FAO/IAEA Seibersdorf Lab. (Austria)
Wanyera, N.W.M. (Uganda)	FAO/IAEA Lab. Seibersdorf (Austria)
Zia Uddin Ahmed (Bangladesh)	Brisbane (Australia)

FAO/IAEA Regional Training Course on Application of Mutation Techniques for Improvement of Local Cultivars of Cereals, Piracicaba (Brazil), 18 November - 13 December.

Acevedo, A. (Argentina)
Alvarez, A.L. (Colombia)
Arhana, V. (Ecuador)
Castellano, G. (Venezuela)
Felicio, J.C. (Brazil)
Fuentes Perez, J. (Chile)
Ishiy, T. (Brazil)
Januzzi Mendes, B.M. (Brazil)
Kazuyuki Kamikoga, M. (Brazil)
Montepeque Roldan, R. (Guatemala)
Pereira de Araujo, J.P. (Brazil)
Riede, C.R. (Brazil)
Silveira Mairesse, L.A. (Brazil)
Torres Aranda, M. (Peru)
Tisselli Filho, O. (Brazil)

4th FAO/IAEA Interregional Training Course on the Induction and Use of Mutations in Plant Breeding, Seibersdorf, (Austria), 17 September - 25 October.

Achutegui Betelu, A. (Venezuela)
Al-Saqaff, M.M. (P.D. Rep. of Yemen)
Afzal Arain, M. (Pakistan)
Al-Baiz, A. (Saudi Arabia)
Cedeño Vargas, J.C. (Panama)
Dhwoj Shahi, R. (Nepal)
Gençer, O. (Turkey)
Jan-orn, J. (Thailand)
Kang, Chul-Whan (Rep. of Korea)
Kari, A. (Cyprus)
Klu, G.Y.P. (Ghana)
Maleka Lungu, D. (Zambia)
Nwasike, C. (Nigeria)
Ratkos, J. (Hungary)
Ronson Ayiseni, D.A. (Uganda)
Santana Buzzy, N. (Cuba)
Scurtu, I. (Romania)
Tarfirio Ortega Urrutia, A. (Ecuador)
Xu Bujin (People's Rep. of China)
Zabaneh Colocho, R. (El Salvador)

LIST OF EXPERTS AND CONSULTANTS IN 1985

Ahnström, G. (Sweden)	FAO/IAEA Lab. Seibersdorf (Austria)
Baenzinger, P.S. (USA)	FAO/IAEA Meeting Rome (Italy)
Brown, D.A. (USA)	Suweon (Rep. of Korea)
Brunner, H. (IAEA)	Irapuato (Mexico)
Daskalov, S. (IAEA)	Hanoi, Ho Chi Minh City (Vietnam)
Donini, B. (Italy)	Piracicaba (Brazil)
Fossati (Switzerland)	Bamako (Mali)
Gao, M. (People's Rep. of China)	FAO/IAEA Meeting Rome (Italy)
Göbel, E. (Fed. Rep. of Germany)	FAO/IAEA Vienna (Austria)
Gustafsson, J.P. (USA)	Lima (Peru)
Hamissa, M.R.A. (Egypt)	Jakarta (Indonesia)
Kao, K.N. (Canada)	FAO/IAEA Meeting Rome (Italy)
Kawai, T. (Japan)	FAO/IAEA Vienna (Austria)
Lepoivre, P. (Belgium)	FAO/IAEA Vienna (Austria)
Maluszynski, M. (FAO/IAEA)	Bogota (Colombia), Quito (Ecuador), La Paz (Bolivia), Santiago (Chile), Asuncion (Paraguay), Montevideo (Uruguay)
Micke, A. (FAO/IAEA)	Warsaw (Poland)
Mikaelsen, K. (Norway)	Seoul (Rep. of Korea), Rangoon (Burma)
Min, S.K. (People's Rep. of China)	FAO/IAEA Meeting Matsuka (Italy)
Murty, B.R. (India)	Maracaibo (Venezuela)
Novak, F. (FAO/IAEA)	Caracas, Maracaibo (Venezuela), Quito (Ecuador), Panama City (Panama), Turrialba (Costa Rica)
Rowe, P.R. (Honduras)	FAO/IAEA Vienna (Austria)
Szarejko, I. (Poland)	FAO/IAEA Vienna (Austria)
Ullrich, S.E. (USA)	FAO/IAEA Meeting Rome (Italy)

LIST OF VARIETIES

The Plant Breeding and Genetics Section of the Joint FAO/IAEA Division undertakes the selection and dissemination of information on commercially used agricultural and horticultural varieties developed through the utilization of induced mutations. This list does not claim to be comprehensive. Its content is strictly based on information transmitted by the breeders themselves and/or other institutions involved. Listing of a variety does not imply its recommendation by FAO/IAEA.

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment [parent variety] or mutant crosses (mutant underlined)	Main improved attribute of variety
Arachis hypogaea L. (groundnut)			
Changhua No.4	China, 1972 Changwei Regional Institute of Agric. Science Shandong Province	seed, 1,5 krad gamma rays (recurrent irradiation) [Fuhuasheng]	early flowering, cold and drought tolerant, dense pods
Brassica napus L. (rape)			
Huyou No.4	China, 1970 Shanghai Acad. Agricultural Science	seeds, 60 krad gamma rays [Shengliqinggeng]	cold tolerant, disease resistant, high and stable yield
Xinyou No.1	China, 1979 Inst. of Economic Crop Res. Xinjiang Acad. Agric. Sci. and Tulufan Regional Inst. of Agric. Sci. Xinjiang	seeds, 70 krad gamma rays [Baichenghuangyoucai]	good seedling growth, tight stature; tolerant to cold, drought, salinity and alkaline soils; good quality, cultivated on 30 000 ha in 1985
Citrus sp. (orange)			
Hongju 418	China, 1983 Inst. of Citrus Research Chinese Acad. Agric. Sci. Beijing	buds, 10 krad gamma rays [Dakongpao]	almost seedless, high yield, sweet taste

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment [parent variety] or mutant crosses (mutant underlined)	Main improved attribute of variety
<u>Glycine max. L.</u> (soybean)			
Heinong No.6	China, 1967 Heilongjiang Acad. Agric. Sciences Harbin	seeds, X-rays [Mancangjin]	tall plants, drought tolerant
Feng shou No.11	China, 1970 Keshan Inst. of Agric. Sci. Heilongjiang Province	seeds, 14 krad gamma rays [Ke 56-4285]	30 days earlier than parent, strong stem, lodging resistant, high number of branches
Liaodou No.3	China, 1983 Institute for Appl. of Atomic Energy Liaoning Acad. Agric. Sci.	seeds, gamma rays <u>6405</u> x Asom	early maturing, strong stem, resistant to lodging, resistant to virus and <u>Sclerophotora macrospora</u>, tolerant to water logging
<u>Gossypium sp.</u> (cotton)			
Yunfu 885	China, 1977 Institute of Cotton Res. Shanxi Acad. of Agric. Sci.	seeds, 15 krad gamma rays [Daizimian No.15 x Xiaoyiemian]	early maturity, large number of bolls, good quality, suitable for wheat-cotton multiple cropping
Xinhai No.2	China, 1979 Inst. of Economic Crop Res. Xinjiang Acad. of Agric. Sci. and Tulufan Regional Inst. of Agric. Science Xinjiang Autanomous Region	seeds, 30 krad X-rays [66-170]	long branch type, good fibre quality, more resistant to <u>Fusarium oxysporum</u>

Linum usitatissimum L. (flax)			
Heiya No.4	China, 1978 Institute of Beet Research Heilongjiang Acad. of Agric. Science Harbin	2-67-1-681 (gamma ray induced mutant) x 6409-640	early maturing, resistant to lodging, tolerant to moisture, salinity and alkalinity
Morus sp. (mulberry)			
Fusang No.10	China, 1980 Institute of Silkworm Mulberry and Tea Research Jiangxi Acad. of Agric. Sci.	gamma rays	short internodes, thick leaf blades, dark colour
Oryza sativa (rice)			
Fubao 201	China, 1978 Pingnan County Inst. of Agric. Sci. Guangxi	seeds, 30 krad gamma rays [Baoxuan No.2]	early maturity, short culm, resistant to lodging, disease resistant
Fugui No.1	China, 1980 Guangdong Acad. of Agric. Science	1,5 krad gamma rays at zygote stage [Guichao No.2]	early maturity, short culm, disease resistance
Fulianzao No.3	China, 1968 Zhejiang Acad. Agric. Sci. Hangzhou	seeds, 30 krad gamma rays [Liantangzao]	very early maturity, disease resistance, short culm
Fuluzao No.1	China, 1976 Guangdong Acad. Agric. Science	gamma rays [Guangluai No.4 x IR8]	large leaf blades, good tillering, more effective tillers
Fushe 410	China, 1974 Sichuan Acad. Agric. Science	seeds, 30 krad gamma rays [Chenyai No.8]	intermediate resistance to blast

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment [parent variety] or mutant crosses (mutant underlined)	Main improved attribute of variety
Oryza sativa L. (rice)	contd.		
Fuxiang No.1	China, 1978 Shandong Acad. of Agric. Science and Qianjing Brigade Zhangqiu County Shangdong Province	50 krad gamma rays 1971 30 krad gamma rays and microwaves 1972 [Mingshuixiangdao]	15 days earlier maturing, 30 cm shorter culm, cold tolerant, good taste, higher yield than original variety
Fuxuan No.1	China, 1968 Sichuan Institute of Nuclear Techniques	seeds, 30 krad gamma rays [Zhongnong No.4]	early maturity, salinity tolerant, good adaptability
Fu 769	China, 1976 Inst. for Appl. of Atomic Energy, Zhejiang Acad. of Agric. Sciences Hangzhou	seeds, 30 krad gamma rays [Jiangerai]	disease resistant, high yield, suitable for mountain areas, 1985: 34000 ha
Fu 756	China, 1975 Inst. for Appl. of Atomic Energy, Zhejiang Acad. of Agric. Sciences Hangzhou	seeds, 30 krad gamma rays [Jiangerai]	disease resistance, good appearance at maturity stage, good taste
Gongshe No.13	China, 1969 Jiangsu Acad. of Agric. Science	seeds, 20-30 krad gamma rays [Laolaiqing]	disease resistance, high 1000 grain-weight
Guangfen No.1	China, 1977 Zhejiang Acad. of Agric. Sciences Hangzhou	63J laser [Guangluai No.4]	early maturity, good tillering, short culm, lodging resistant

Hongfuzao No.7	China, 1980 Inst. of Rice and Wheat Research Fujian Acad. Agric. Sci.	seeds, 30 krad gamma rays [Hong 410]	short culm, large panicle
Jiguang No.2	China, 1977 Hebei University	He-Ne laser [Guangluai No.4]	short culm, intermediate maturity
Liaofeng No.5	China, 1969 Liaoning Acad. of Agric. Sci.	seeds, 25 krad gamma rays [Liaogeng 125]	early maturity, short culm, resistant to blast
M 112	China, 1981 Jiangxi Acad. of Agric. Sci.	seeds, 30 krad gamma rays [5450 x Yinnishuitiangu]	cold tolerant, resistant to *Sogatella furcifera*, high yield, 1985: 65000 ha
Nangeng 23	China, 1967 Jiangsu Academy of Agric. Science	seeds, 20-30 krad gamma rays [20025]	short culm, more tillers, more resistant to *Xanthomonas oryzae*
Nanzao No.1	China, 1980 Fujian Acad. of Agric. Science	seeds, 20 krad gamma rays [Nanjing No.11]	early maturity, large panicle with multiple grains, good adaptability, high uniformity
Nongshi No.4	China, 1975 Fujian Agric. College	seeds, 5×10^{11} fast neutrons [IR20]	early maturity, cold tolerant, resistant to blast and *Xanthomonas oryzae*
Suiwan No.3	China, 1974 Suiwan County Institute of Agric. Sci. Hubei	seeds, 30 krad gamma rays [Huxuan 19]	good tillering, lodging resistant
Wanhongfu	China, 1980 Jingxi County Inst. of Agric. Sciences Guangxi	seeds, 35 krad gamma rays [25-1 x Hongmiyouzhan]	cold tolerant, disease resistant, suitable for mountain areas

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment [parent variety] or mutant crosses (mutant underlined)	Main improved attribute of variety
Oryza sativa L. (rice) contd.			
Youfu No.5	China, 1980 Fujian Academy of Agric. Science	seeds, 20 krad gamma rays Siyou No.2	early maturity, large panicle with more grains
Zaoyeqing	China, 1980 Fujian Acad. of Agric. Sci.	seeds, 20 krad gamma rays [Zaoyeqing No.8]	large panicle, tolerant to high temperature
Zhongmounuodao	China, 1982 Agric. Tech. Station of Zhongmou County Agricultural Burea Henan Province	seeds, 20 krad gamma rays [Tianbian No.10]	glutinous, good quality and taste tolerant against stress
Zhuqin 40	China, 1978 Huizhou Inst. of Agric. Science Anhui Province	seeds, 30 krad gamma rays F_2[Zhulianai x Qiuzhen]	resistant to blast, suitable for mountain areas
202	China, 1973 Yueyang Regional Institute of Agric. Sci. Hunan Province	seeds, 20 krad gamma rays [IR8]	small leaves, big panicle, drought tolerant
240	China, 1980 Lixiahe Inst. of Agric. Jiangsu Province	seeds, 30 krad gamma rays [Guangbeiguang]	early maturity, disease resistance
69-280	China, 1969 Hunan Acad.of Agric. Sci.	seeds, 30 krad gamma rays [Ainanzhan x Qingxiaojingzao]	short culm, good stature, more effective tillers

Sesamum indicum L. (sesame)			
Ningya No.10	China, 1982 Guyuan Regional Inst. of Agric. Science Ningxia	10 krad gamma rays [Yanza No.10]	early flowering, branchy, resistant to lodging, good quality
Setaria sp. (millet)			
Angu 221	China, 1978 Anyan Regional Inst. of Agric. Science Henan Province	seeds, 40 krad gamma rays [Ange No.4]	strong seedlings, early heading, high seed setting, large grains
Zhangnong No.10	China, 1966 Changjiako Baxia Regional Inst. of Agric. Sci. Hebei Province	seeds, 20-30 krad gamma rays [Hongshizhu]	purple seedlings, yellow, glossy grains, intermediate early maturity, 110-130 cm plant height
Zhangnong No.11	China, 1966 Changjiako Baxia Institute of Agric. Sci. Hebei Province	seeds, 20-30 krad gamma [Hongshizhu]	tolerant to waterlogging, large head
Zhufu No.1	China, 1974 Inst. for Appl. of Atomic Energy, CAAS and Jingqiuwucun of Zhucheng County Shandong Province	gamma rays [Moligu]	good appearance at maturity, suitable for summer sowing, good quality
Sorghum bicolor L. (sorghum)			
Jinfu No.1	China, 1970 Inst. of Economic Crop Research Shangxi Acad. of Agric. Sci.	seeds, 24 krad gamma rays [Jingza No.5]	better quality than original variety for machine harvest 1985: 470 000 ha

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment [parent variety] or mutant crosses (mutant underlined)	Main improved attribute of variety
Triticum aestivum L. (wheat)			
Changwei 51503	China, 1983 Changwei Regional Inst. of Agric. Sci. Shandong Province	seeds, 35 krad gamma rays [Xiangyang No.1 x Heimangmai]	good tillering, tolerant to cold, drought, salt and alkaline
Chuanfu No.1	China, 1982 Inst. for Appl. Atomic Energy, Sichuan Acad. of Agric. Science	10 μc beta rays [Chuanyu No.5]	early maturing, tolerant to moisture and drought, resistant to stripe rust, good appearance at maturity stage 1985: 70 000 ha
Emai No.9	China, 1980 Hubei Acad. of Agric. Sci.	gamma rays [Selected strain of Emai No.6]	tolerant to Gibberella zeae, powdery mildew, salt, alkaline, high temperature at late stage. High and stable yield 1985: 200 000 ha
Fuer	China, 1977 Zhangyie Regional Inst. of Agric. Science Gansu Province	16 krad gamma rays [Keshibaipi x 774 strain]	resistant to rust, tolerant to powdery mildew, tolerant to stress
Heichun No.2	China, 1979 Heibe Regional Inst. of Agric. Sci. Heilongjiang Province	Nongken 149 x Xinshuguang No.1 (gamma ray induced mutant)	early maturity, strong culm, more resistant to leaf rust, tolerant to drought at seedling stage and to moisture at late stage

Humai No.3	China, 1978 Shanghai Academy of Agric. Science	seeds, 25 krad gamma rays [Yangmai No.1]	early maturity, high 1000 grain-weight, high protein and lysine content
Jiaxuan No.1	China, 1974 Qianjia Brigade of Jiaxiang County Shandong Province	seeds, gamma rays [Maoyingafu]	tolerant to salt, alkaline and cold, resistant to stripe rust and powdery mildew
Kexing No.15	China, 1972 Guizhou Acad. of Agric. Science	seeds, gamma rays [local variety]	resistant to rust and powdery mildew. high 1000 grain-weight
Neimai No.5	China, 1979 Inner Mongolian Agric. and Animal Husbandry College	seeds, gamma rays [(Orofen x Liachun No.1) x Ruluo]	intermediate early maturity, escapes *Meromyza saltatrix*, tight stature, high resistance to rust, tolerant to hot dry wind
Qichun No.1	China, 1971 Qitai Agric. Expt. Station Xinjiang Autonomous Region	Xinjing No.1 x Yuannong No.1 (gamma ray induced mutant)	strong seedling, tolerant to drought, high 1000-grain-weight, good quality
Taifu No.10	China, 1968 Shanxi Academy of Agric. Sci.	seeds, 10 krad gamma rays [F_2 (Nongda 183 x Neixiang No.5)]	drought tolerant, resistant to stripe rust, wide adaptability
Taifu No.15	China, 1968 Shanxi Academy of Agric. Sci.	20 krad gamma rays (two years successive irradiation) Nongda 183]	early maturity, resistant to stripe rust, tolerant to drought
Taifu No.22	China, 1968 Shanxi Academy of Agric. Sci.	seeds, 20 krad gamma rays [F_2 (Nongda 183 x Neixiang No.5)]	good tillering, tolerance to drought

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment [parent variety] or mutant crosses (mutant underlined)	Main improved attribute of variety
Triticum aestivum L. (wheat)			
Wanyuan 75-6	China, 1979 Nanyang Regional Institute of Agric. Science Henan Province	seeds, 30 krad gamma rays + DES [F_2 (St. 2422/464 x Neixiang No.5)]	early maturity, semi-dwarf, resistant to lodging and rust, tolerant to hot dry wind 1985: 100 000 ha
Wuchun No.3	China, 1973 Wumeng Inst. of Agric. Sci. Inner Mongolia	(Pakistan x Kechun No.5) x Yuannong 53 (gamma ray induced mutant)	tolerant to drought, resistant to Meromyza saltatrix, large grains
Xiaoyan No.6	China, 1979 Northwest Inst. of Botany Chinese Academy of Sciences	laser [St. 2422/464 x Xiaoyan 96]	resistant to stripe rust, tolerant to Gibberella zeae, good appearance at maturity 1985: 400 000 ha
Xifu No.3	China, 1977 Xichang County Institute of Agric. Science Sichuan Province	seeds, 30 krad gamma rays [NP 824]	growing well, disease resistant, tolerant to stress
Yuandon No.2	China, 1982 Inst. for Applic. of Atomic Energy Chinese Acad. Agric. Sci.	seeds, 25 krad gamma rays [12040 x Aurora]	early maturing, good stature, resistant to stripe rust, good adaptability, good appearance at maturity stage
Yunfu No.2	China, 1982 Inst. of Cotton Research Shanxi Acad. of Agric. Sci.	M4 70 A2 (gamma ray induced mutant) x 68 G44-2	early maturity, tolerant to drought, high yield

Zhonga No.1	China, 1969 Inst. for Applic. of Atomic Energy, Shandong Acad. of Agric. Science	seeds, 20 krad gamma rays [Afu]	more resistant to cold than original variety, red grain mutated to white
77 L15	China, 1983 Inst. of Food crop Research Shanxi Acad. of Agric. Sci.	laser [F_1 (Zhengyin No.1 x Shangian)]	strong culm, resistant to lodging, resistant to stripe, leaf and stem rust, tolerant to *Gibberella zeae*, large spike, good appearance at maturity stage
352	China, 1983 Inst. for Applic. of Atomic Energy Zhejiang Academy of Agric. Science Hangzhou	50J laser [470]	early maturity, tolerance to *Gibberella zeae*, high yield
503	China, 1975 Inst. for Applic. of Atomic Energy Zhejiang Acad. of Agric. Sci.	seeds, 30 krad gamma rays [Jiulan]	good tillering, resistance to cold and rusts, suitable for mountain areas
Zea mays L. (maize)			
Jidan No.1	China, 1967 Jilin Acad. of Agric. Sci.	Ji 63 (gamma ray induced mutant) x M14	high resistance to leaf blight *Sphacelotheca reliana* 1985: more than 50 000 ha
Luyuandan No.3	China, 1976 Inst. for Applic. of Atomic Energy Shandong Academy of agric. Sci.	Yuanwu 02 (gamma ray induced mutant) x Zifeng 154	disease resistant, good stature

Name of new variety	Place and date of release (or approval) and name of principal worker and institute	Kind and date of mutagenic treatment [parent variety] or mutant crosses (mutant underlined)	Main improved attribute of variety
Zea mays L. (maize)			
Luyuandan No.4	China, 1976 Inst. for Applic. of Atomic Energy Shandong Acad. of Agric. Sci.	Yuanwu 02 (gamma ray induced mutant) x Weifeng 322	early maturity, good stature, high yield, wide adaptability 1985: more than 600 000 ha
Xiangsan No.1	China, 1980 Zhangqiu County Agric. Bureau Shandong Province	(Yuanwu 02 (gamma ray indcued mutant) x Weifeng 322) x 330	disease resistant high yield

FUTURE EVENTS

1986

2-6 June	2nd FAO/IAEA Research Co-ordination Meeting on the Improvement of Root and Tuber Crops and Similar Vegetatively Propagated Crop Plants in Tropical Countries by Induced Mutations, Vienna (Austria).
1-5 July	FAO/IAEA Workshop on Improvement of Grain Legume Production Using Induced Mutations, Pullman, WA (USA). (Final joint research co-ordination meeting of four FAO/IAEA Co-ordinated Research Programmes).
29-31 July	Conference on Molecular and Cellular Biology of the Soybean, Ames, Iowa (USA). Contact: Walther R. Fehr, Biotechnology Co-ordinator, College of Agriculture, Iowa State University, Ames, Iowa 50011 (USA).
14-19 September	17th ESNA Meeting, Hannover (FRG). Contact: (Prof. E.G. Niemann), Institute of Biophysics D-3000 Hannover 21, Herrenhauser Str. 2.
15 September - 26 October	FAO/IAEA Regional Training Course on Plant Breeding by Using Radiation Induced Mutations, Hangzhou, China

PUBLICATIONS

FAO/IAEA Mutation Breeding Reviews

The following issues are available upon request:

No.1 Mutation Breeding of Pearl Millet and Sorghum
by W.W. Hanna

No.2 Mutation Breeding in Peas
by J. Jaranowski and A. Micke

No.3 Plant Cultivars from Mutation Induction or the Use of Induced Mutants in Cross Breeding
by A. Micke, M. Maluszynski and B. Donini

No.4 Mutation Breeding in Pepper
by S. Daskalov

LAST BUT NOT LEAST

Please submit your contributions to the Newsletter by 1 June and 1 December of each year.

Authors are kindly requested to take into account that the readers want to learn about new findings and new methods but would also like to see the most relevant data on which statements and conclusions are based. Conclusions should be precise and distinguish facts from speculation. The length of contributions should not exceed 2-3 typewritten pages including tables. We regret that photographs cannot be accepted for technical reasons. References to publications containing a more detailed description of methods or evaluation of findings are welcome but should generally be limited to one or two.

Alexander MICKE

Mutation Breeding Newsletter

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