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RESEARCH NEWS

Induction of downy mildew resistance in pearl millet male-sterile Tift $23d_2$

The commercial production of grain hybrids was made possible in pearl millet [Pennisetum americanum (L.) Leeke] by the cytoplasmic male-sterility discovered in the USA in 1955. In India the pearl millet grain crop currently occupies an estimated 12m ha and about 25% of this area is planted to hybrids. The first pearl millet hybrid, HB-1, was released for cultivation in India in 1965. By 1972 four more hybrids were released all of which however were based on the same seed parent - Tift 23A. Pearl millet production in India declined in the early 1970's because of epidemics on these hybrids of downy mildew (DM) caused by Sclerospora graminicola. The hybrid susceptibility was due to the susceptibility of the Tift 23A seed parent. Workers in India have been able to induce DM resistance in Tift 23 (Mutation Breeding Newsletter No.2, Feb. 1973) and breed DM resistant derivatives from Tift 23 and so reconstitute the hybrids with some resistance to downy mildew. For example BJ 104 (5141A x J104), a current commercial hybrid in India, is a reconstituted version of the original most popular hybrid HB-3 (Tift 23A x J104).

A continuing major constraint to the development of new higher yielding hybrids in India is the lack of diversity among seed-parents. One line of work at ICRISAT to augment the range of seed parents, was to attempt to induce new and possibly different resistance to downy mildew into Tift $23d_2$, a male-sterile line isogenic with Tift 23 except for the d_2 dwarfing gene. A dwarf male-sterile offers particular opportunities for making hybrids of various heights, depending on the constitution of the hybrid male parent used.

Table 1. Downy mildew incidence on Tift $23d_2B$ and ICM ms 81B

Male-sterile line	Downy mildew incidence (% plants infected)
Tift $23d_2B$	100[1)]
ICM ms 81B	1.4[2)]
NHB-3 (susceptible indicator)	73.8[2)]

[1)] Observed under normal field conditions in 1978

[2)] Recorded in the downy mildew nursery, Summer 1982
n for 81B = 71, n for NHB-3 = 250

Table 2. Morphological characteristics of 3 standard male-sterile lines and ICM ms 81A[1)]

Character	Male-sterile line			
	5054A	5141A	111A	ICM ms 81A
Days to 50% bloom	50.7 ± 0.2	49.2 ± 0.1	57.7 ± 0.1	56.7 ± 0.2
Plant height (cm)	129.4 ± 0.7	130.7 ± 0.6	117.0 ± 0.7	82.7 ± 1.2
Ear length (cm)	17.4 ± 0.1	17.1 ± 0.1	28.1 ± 0.2	14.7 ± 0.2
Ear girth (cm)	5.5 ± 0.03	5.4 ± 0.03	6.3 ± 0.03	5.9 ± 0.05
No. of tillers/plant	2.7 ± 0.08	3.3 ± 0.08	1.4 ± 0.08	1.1 ± 0.02

[1)] Recorded in rainy season 1980 at ICRISAT Center. Observations represent mean ± S.E., based on 100 plants for all except ICM ms 81A based on 72.

Dry seed of Tift $23d_2B$ was therefore treated with an acute dose of 30 kR gamma-rays in a ^{60}Co gamma-cell installed at the Osmania University, Hyderabad. Three hundred treated seeds were planted at ICRISAT Centre in the rainy season (June-October) of 1975 and all plants selfed in the M_1 generation. This selfed seed was planted "head-to-row" in the M_2 generation in the summer (January-April) of 1976 in the DM screening nursery (1). Disease free plants were selfed and crossed with single plants of Tift $23d_2A$ using marked individual plant x plant crosses. Backcrossing and pedigree selection was continued in those pairs where the male-sterility was perfectly maintained and where the male-fertile B line was vigorous and DM free. This process was continued till the 6th backcross generation (corresponding to M_8 of the irradiated Tift $23d_2B$) in the rainy season of 1979 when we grew over 1100 such individual A and B pairs which exhibited a range of plant types. At this stage, based on visual assessments (height, exsertion, earlength, and number, and correspondence between A and B pairs for uniformity and synchrony in flowering), preliminary combining ability tests and previous record of DM incidence, 3 pairs were selected for multiplication in isolation plots. The best of these was named ICM ms 81A and the corresponding maintainer as ICM ms 81B which currently shows a high level of resistance to DM in contrast to the parent line (Table 1). Seed of this male-sterile and its maintainer was made available to breeders in

India in April 1981. Some of the morphological characters of this male-sterile line and three other standard male-sterile lines currently used in India are given in Table 2.

An unexpected advantage of ms 81A is the higher rate and clarity with which new male-sterile sources can be discovered using it as a tester. The discovery rate is nearly four times the previous rate (0.63%) using the standard male-steriles shown in Table 2. The reasons for this are not clear but may be due to the elimination of modifying genes which affect the full expression of male-sterility.

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(Contributed by Andrews, D.J. and Anand Kumar, International Crops Research Institute for the Semi-Arid Tropics, ICRISAT Patancheru, Andhra Pradesh 502 324, India)

New lentil mutant variety in West Bengal

Lentil occupies 20% of the total area under pulses in West Bengal, and it ranks second in respect of total area covered (112 300 ha). The area under lentil has increased from 93 600 ha in 1977-78 to 112 300 ha in 1979-80, but without a corresponding increase in production. Lentil is a cold loving crop, and its performance is greatly influenced by environment, particularly night temperature. The short span of low temperature which touches a minimum of 9-10°C for a few days every year permits only the small seeded types to grow successfully in the lentil growing tract of the state. On the other hand, the large seeded types, imported primarily from Madhya Pradesh, have more consumer acceptance, and fetch higher price in the market.

Variety B-77 was found suitable for West Bengal. It also does well under late sown conditions. Some promising lines were developed from it through physical mutagenesis (Table).

S-256 (Ranjan), a typical spreading type, and S-235 were found to be the best yielders, followed by S-238. All these varieties, developed through mutation breeding from B-77, took only 110 days to mature. S-235

Variety	Duration	1000-seed weigh, g	Yield, q/ha (1977-1980)
B-77	112	14.6	19.32
S-238 (mutant)	110	17.9	21.47
S-256 (mutant)	110	15.4	22.81
S-235 (mutant)	110	15.2	23.11

has an additional advantage of earlier flower initiation (about 5 to 7 days) than B-77, which allows the variety to attain perfect physiological maturity even with staggered maturity before the hot winds, which cause forced maturity of the other genotypes. Larger seeded varieties like Sagar from Madhya Pradesh, K-75 from Kanpur, JLS-4 from Jabalpur and Baliya Local from Uttar Pradesh gave only 50% grain yield. Based on these results and results from other trials, S-256 (Ranjan) has been recommended for cultivation in this state by the State Variety Release Committee.

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SEN, S.N., Pulses and Oilseeds Research Station, Berhampore 742101 IARI Pulse Newsletter 1981 p.28.

(Sen, S.N., Pulses and Oilseeds Research Station, Berhapore 742101 IARI Pulse Newsletter 1981 p.28).

Breeding rice for better N_2-fixation: A step forward

In MBNL No.16 (July 1980) we gave a description of the so-called "spermosphere model": in this system a young plant seedling is growing in the dark in a test tube; the tube contains a mineral medium without any combined nitrogen; the only source of carbon and energy is the endosperm. Nitrogenase activity in an associated diazotrophic bacterium is measured through acetylene reduction. This system seems to be valuable for quick, simple and cheap comparisons of genotypes for their potential of supporting nitrogen fixation by rhizosphere bacteria.

During 1981 we have improved this experimental device by adding a CO_2 trap and by using a new bacterial strain (Azospirillum 4AB1 isolated from the rhizosphere of rice), unable to grow on ethanol as a carbon source and exhibiting very high levels of nitrogenase activity. We have studied the kinetics of acetylene reduction, the effect of seed age, the effect of several rates of inoculation, and checked that exuded carbon was the only limiting factor in the conditions of the test. We have found that the main cause of variability in the final meansurement (C_2H_4 produced per plant) is the variability in initial weights of seeds.

In several experiments we have compared nitrogenase activities of mutants of the French rice cultivar Césariot with the original cultivar. Those mutants have been obtained through γ-irradiation by R. MARIE (INRA). The table presents the results obtained, expressed as percentage of Césariot activity. The seeds were of the same age but unfortunately, due to the small number of seeds available we had to use seeds differing in weight by as much as 5 mg. The relatively small experimental error could be further diminished (down to 2.2%) by using seeds of the same weight. There are large differences between genotypes: mutant no. 17 seems able to fix 50% more nitrogen than original Césariot and 150% more than mutant no. 29.

These results are encouraging and we are trying to simplify this methodology further for screening large populations and thus make it more useful for plant breeders. In the meantime we continue to compare our results with those obtained using older plants or other methods. Field and laboratory studies will be started to compare actively and poorly N_2 fixing genotypes for characteristics other than N_2-fixation: exudation, bacterial colonization, growth rate and yield.

Potential of nitrogen fixation in the rhizosphere of different induced mutants, originating from the same cultivar "Césariot", measured by regular C_2H_2 reduction on young seedlings (left) and by C_2H_2 reduction in spermosphere model (right).

Genotypes	ARA, one month seedlings in soil, in growth chamber (Dommergues, 1978) 10^{-9} C_2H_4 hr^{-1} g $root^{-1}$ ± S.D.	C_2H_4 in spermosphere model system at day 15, % of Césariot ± S.D.
Mutant no.17	3.310 ± 2.190	149 ± 12
Mutant no.11	4.890 ± 2.770	132 ± 14
Mutant no.28	2.890 ± 1.670	107 ± 13
Original Césariot cv.	2.120 ± 1.470	100 ± 5
Mutant no.29	5.320 ± 5.010	60 ± 11

(Contributed by Balandreau, J., C.N.R.S., Centre de Pédologie Biologique, B.P. 5, 54501 Vandoeuvre-les-Nancy Cédex, France).

Induction of mutation in jute by chemical and physical mutagenic agents

Genetic variability in cultivated jute is very narrow. A way to generate variability is to induce mutations by physical or chemical mutagens.

Dry seeds of Corchorus olitorius var. JRO - 632 were first soaked with water for four hours and then two lots were treated with ethyl methane sulphonate (EMS) 1.0% and nitrosomethyl guanidine (NG) 0.02% respectively for 5 hours. After washing the treated seeds and water soaked control, seeds were x-irradiated. The same doses of x-rays and the same treatments with chemical were applied in reverse order to dry seeds. Other seeds were irradiated with 40 kR and 60 kR x-rays only. The number of induced mutants is shown below:

Treatment	No. of M_2 progenies studied	No. of mutants	%
EMS 1.0%	20	1	5.0
NG 0.02%	27	1	3.7
40 kR X-rays	24	2	8.3
60 kR X-rays	22	2	9.1
EMS 1.0% + 40 kR X-rays	19	2	10.5
EMS 1.0% + 60 kR X-rays	23	3	13.0
40 kR X-rays + EMS 1.0%	56	7	12.5
60 kR X-rays + EMS 1.0%	10	3	30.0
NG 0.02% + 40 kR X-rays	28	3	10.7
NG 0.02% + 60 kR X-rays	30	4	13.3
40 kR X-rays + NG 0.02%	47	6	12.7
60 kR X-rays + NG 0.0%	15	3	20.0

Data indicate that post-irradiation treatment with chemical mutagens is more effective than pre-irradiation treatment.

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(Contributed by Chattopadhyay, S. and Basak, S.L., Jute Agricultural Research Institute, Barrackpore-743101, India).

Sucrose, raffinose and stachyose concentration in some Trombay groundnut cultures derived from mutation breeding

Several promising groundnut cultures have been developed at this Research Centre after irradiating "Spanish Improved" cultivar. Some of these cultures have large kernels which are more useful as 'table purpose' varieties (1). Sucrose concentration determines the sweet taste of the nuts while raffinose and stachyose are undesirable for table varieties since they have been implicated in causing flatulence (2). Hence the concentration of these sugars was determined. Trombay groundnut, TG-1 and TG-3, which have been approved for cultivation, are direct mutants while the other cultures are derived by crossing TG-1 with different mutants (1).

Table I. Concentration of different sugars in Trombay groundnut cultures

Culture	100 kernel wt. (g)	% Sucrose in dry kernels	In fat and moisture free meal		
			% Sucrose	% Raffinose X	% Stachyose X
Spanish Improved	45.4	3.57	7.21	0.37	0.69
TG-1	86.8	2.91	5.88	0.29	0.50
TG-3	47.8	5.01*	10.53*	0.21	0.47
TG-9	66.4	3.20	6.77	0.23	0.57
TG-17	60.8	3.79	7.88	0.13	0.37
TG-18	120.8	8.03**	14.97**	N D	N D
TG-18 A	121.5	6.16**	11.93**	0.22	0.32
TG-19 A	117.4	7.02**	13.33**	0.17	0.37
TG-19 B	91.0	5.59**	11.40**	0.17	0.26
L S D at 5%	5.9	1.17	2.40	--	--
L S D at 1%	8.2	1.62	3.30	--	--

X - Mean of two independent determinations

N. D - Not determined

Concentrations of different sugars are given in Table I. The 100 kernel weight of the samples used for analysis is representative of the kernel weights obtained under Trombay conditions. Sugars were isolated by 80% ethanol extraction. Sucrose concentration was determined using Technicon Autoanalyzer following the Technicon Method No. 142-71 A. Stachyose and raffinose concentrations were determined by densitometry using Chromoscan MK-2 (Joyes Loebel) of sugar spots separated by descending paper chromatography in a solvent system consisting of butanol: pyridine: water (10:3:3).

The sucrose concentrations in oven dry kernels were significantly higher in TC-18, 18-A, 19-A and 19-B in comparison to Spanish Improved. A similar trend was obtained in the fat and moisture free meal. Sucrose accounted for over 83% of the ethanol soluble sugars in these cultures. The concentration of raffinose and stachyose was reduced in the TG mutant cultures.

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(Contributed by Gadgil, J.D. and Mitra, R., Biology and Agriculture Division, Bhabha Atomic Research Centre, Trombay, Bombay - 400 085, India).

Cold tolerance of mutant derived rice varieties in California

Floret sterility is a problem of rice production. It is believed to be due to cold night temperatures before heading, hot temperatures at

Table: Sterility comparisons between varieties at different locations in 1979 statewide trials

	Sterility of cultivars*				
Location	M-101	S-201	M9	L-201	Mean
	%	%	%	%	%
Sacramento County	7.3 c	9.1 ef	4.5 f	9.9 d	7.7 d
San Joaquin County	9.3 c	10.0 def	7.5 def	12.3 cd	9.8 c
Yolo County (north)	10.4 c	15.2 bcd	6.4 ef	19.4 b	12.9 b
Davis (late)	12.3 bc	8.4 f	16.1 bc	15.8 bc	13.2 b
Yuba County	16.4 ab	14.0 cde	11.0 cde	14.5 bcd	14.0 b
Davis (early)	17.7 a	31.3 a	49.7 a	41.3 a	35.0 a
Kern County		8.9 +	8.0 +		
Mean	12.2 c	14.7 b	15.9 b	18.9 a	

*Means not having the same letter in common are significantly different at the .05 level according to Duncan's New Multiple Range Test. Comparisons were calculated for the same variety at different locations, different overall location means, and different overall variety means.
+Not included in the means or the statistical analysis.

flowering time and/or high levels of nitrogen fertilization. Four currently cultivated varieties were tested at 7 locations in California: M-101, S-201, M-9 and L-201. Two of these, M-101 and S-201, derived from cross breeding with the induced short culm mutant Calrose 76.

The locations differ in its climatic conditions. Yuba, northern Yolo, Sacramento and San Joaquin counties are moderate temperature areas. Davis can be classified as cold and Kern County as hot climate areas. Variety M-101 had significantly less sterility. Its cold tolerance is particularly pronounced in the early sowing trial at Davis, afflicted by cold irrigation water. S-201 also showed a somewhat better cold tolerance.

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(J.E. Board, Dept. of Agronomy, Louisiana State University, Baton Rouge LA 70803
M.L. Peterson, Dept. of Agronomy and Range Science, U.C. Davies).

Wilt resistant mutants in egg plant

Solanum melongena, the egg plant, also known as brinjal, is a widely cultivated vegetable crop in India and many other countries in the tropics and sub-tropics. Bacterial wilt caused by *Pseudomonas solanacearum* is one of the important diseases affecting this crop in India (1). A hybridization programme involving a resistant wild species *S. melongena* var. *insanum* was unsuccessful due to association between the resistance (simple dominant) and many undesirable wild characters of var. *insanum* (2). Irradiation of F_1 seeds of a cross between the cultivated variety 'Purple giant' and the var. *insanum* was undertaken to enhance recombination of resistance with commercially required fruit and yield characters. Selection for the required mutant recombinants was done from the F_2M_2 onwards under artificial wilt infection. By F_7M_7 generation, 22 resistant mutant types had been obtained, many of which were also spineless. The morphological features and yielding ability of the most promising 11 mutant types and the two parents are given below:

Mutant type no.	Morphological features	Average yield per plant in kg
SM-4	Open branching, spineless, round purple fruits of medium size	2.75
SM-5	Close branching, spineless, purple streaked oblong fruits of medium size	2.90
SM-7	Close branching, spineless, white oblong fruits with light purple shades, medium size fruits	2.75

Mutant type no.	Morphological features	Average yield per plant in kg
SM-12	Open branching, spineless, purple oblong fruits of medium size with cluster habit	2.20
SM-14	Close branching, spineless, purple oblong fruits of large size	2.75
SM-16	Close branching, spineless, purple oblong fruits of medium size	2.30
SM-17	Close branching, spineless, green long fruits of large size	3.00
SM-18	Close branching, spineless, green long fruits of medium size	2.50
SM-20	Open branching, spineless, white oblong fruits of medium size	2.20
SM-21	Open branching, spineless, green long fruits of medium size	2.30
SM-22	Close branching, spineless, round purple fruits of medium size	2.65
Purple giant (cultivated parent)	Open branching, highly spiny, round purple fruits of very large size	3.00
var. insanum (wild parent)	Spreading, highly spiny, round green mottled fruits of very small size	0.25

The fruit size of the selected types was significantly higher than of the unirradiated F_2 segregants of the same cross.

All the 22 mutant types are available as germplasm.

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(Contributed by Gopimony, R., Krishnan Nair, N. and Gopinathan Nair, V., College of Agriculture, Vellayani, Trivandrum, India)

DL-253, a barley mutant identified for cultivation in rainfed areas of Central Zone in India

One thousand dry seeds (moisture content 11%) of 'Ratna', a hulled six-rowed variety of barley, were exposed in 1972 to sequential mutagenic treatment with 20 kR gamma-rays and 0.3% EMS. The radiation treatment was given at a dose rate of 1200 R/minute. The irradiated seeds were soaked in distilled water for 12 hours and subsequently treated with 0.3% aqueous solution of EMS for 6 hours at 25 $\pm$ 2^{o}C. Treated seeds along with control were planted in the field. The first three spikes of the surviving M_1 plants were separately harvested and grown in M_2 at a plant to plant distance of 10 cm and line to line distance of 22 cm. 1350 M_2 families were raised and 500 control families. Besides recording chlorophyll and morphological mutants, data were collected on quantitative characters such as ear bearing tillers, hundred grain weight and individual plant yield of relatively normal looking plants. Families which showed no change in mean but a higher variance for total plant yield were selected. From among 145 such selected families, a total of 96 plants possessing higher hundred grain weight (4.5 g and above) and higher plant yield (18 g and above) were carried forward to M_3 and tested for their performance in a rod-row trial. 14 families were found to be superior in yield over the parent. From each of them, ten higher yielding plants were pooled and evaluated in a replicated trial in M_4. The culture DL-253 gave the highest yield in station trials. In subsequent years, trials conducted under the All India Co-ordinated Barley Project, at 6 locations in Central Zone in India, demonstrated the superiority of this mutant over the best local check. The data summarized in Table 1, show that in most years the yield of the mutant was about 3-18% higher than the local check. Besides increase in yield attributed mainly to a higher tiller number, the mutant was also found to be endowed with field resistance to covered and

Table 1. The performance of DL-253 in barley co-ordination trials in Central Zone in India

Year	Variety	Yield, kg/ha Zonal mean	Rel. yield
1976-77	DL-253	975	112.8
	*K-24	860	100.0
1977-78	DL-253	1650	110.7
	*RD-137	1490	100.0
1978-79	DL-253	1878	99.1
	*RS-6	1894	100.0
1979-80	DL-253	1329	118.0
	*RD-137	1126	100.0
1980-81	DL-253	2178	102.6
	*RD-137	2123	100.0
		Uttar Pradesh State mean	
1980-81	DL-253	1846	111.3
	*RD-137	1659	100.0

*Local check

loose smut and to yellow rust. The mutant was identified by the Barley Co-ordinated Workshop held at New Delhi, 7-9 September 1981 for pre-release seed multiplication and official release for cultivation in the Central Zone in India. The mutant is currently being grown in minikit trials on farmers fields for demonstration cum seed multiplication purposes.

(Contributed by Sharma, R.P., Division of Genetics, Indian Agricultural Research Institute, New Delhi-110012, India).

Dwarf oat mutant used in cross breeding

A dwarf mutant (OT 184D or OT 207) selected by R.I.H. McKenzie from the variety "Harmon" after fast neutron irradiation (1) is widely used by oat breeders to improve lodging resistance (see MBNL No.14 p.4, 1979). Advances were reported in Oat Newsletter No.31, 1980. Crosses with the mutant made in 1975 by Portmann and McLean (South Perth, Western Australia) led to extremely promising results. No lodging was observed in yield tests over 3 seasons at four sites. Shedding resistance has been easy to obtain and lines showing complete head emergence were readily selected. Certain lines have outyielded the commercial variety "West" by 20-40%. Grain plumpness and hectolitre weight have been more difficult characters.

At Minnesota, Stuthman and co-workers likewise use the mutant as their principle source of "dwarfness". They identified high yielding, short, lodging resistant derivatives with and without disease resistance, however have problems with late maturity and full emergence of the panicle.

Cross breeding with the mutant was initiated by Barr at Adelaide (South Australia) in 1977. F6 lines have been tested in 1980 and exhibited excellent lodging resistance, shattering resistance and useful BYDV tolerance. The plant height is about one-half to two-thirds of normal varieties. Yields were about 25-50% above variety "West".

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Mutation breeding of cotton

Cotton in Pakistan provides both lint and edible oil. Varieties grown are tall, bushy and have relatively low yield. Mutation breeding started in 1969-70.

Seeds of 21 varieties were obtained from USA, USSR, Turkey and Iran. From seed irradiation of "Stoneville", three mutants, namely St.3, M-555 and M-909, were isolated, which are short to medium statured, have good plant architecture, bear a greater number of bolls and are being used in hybridization programmes.

"St. 3" was selected in 1972 after 25 kR gamma irradiation and shows earliness, short stature and heat resistance. Trials in 1974-76 are summarized in table 1. The mutant may be suitable for higher density planting because of its compactness. It shows 90% natural defoliation, which is favourable for the fibre properties. Due to relatively uniform opening and defoliation, the mutant is interesting for mechanical harvest. Its use in cross breeding was recommended by the Punjab Agricultural Research Co-ordination Board.

Table 1. Comparison of important characteristics of mutant St-3 with parent Stonville and local variety Ac-134

	Mutant Variety		
	St-3	Stoneville (Parent)	AC-134 (Standard)
Height (cm)	75	125	170
No. of monodial	-	2-4	3-4
No. of sympodial	18	15	12
1st sympodial node number	6	8	10
No. of buds shed/plant	51	72	90
Shedding % of total fruiting points	75.0	82.2	89.4
Boll setting % of flower produced	40.1	15.2	6.1
Yield/plant (gm)	62.5	42.5	30.2
Natural defoliation (%)	90	10	4
Plant population/acre (estimated)	32,500	17,500	15,000
Maturity period (days)	140	170	190
1st pick (%)	95	40	5
Staple length (mm)	25.5	27.5	24.5

A cross of the U.S. cotton variety Deltapine-16 with the local variety AC-134 was made in 1970 and F_1 hybrid seeds were irradiated with 30 kR gamma rays. From this experiment in subsequent generations a number of mutant recombinants were selected. One of them, mutant NIAB-78, has been approved by the PARCB (Punjab Agri. Res. Co-ordination Board) as a commercial variety for general cultivation. It has determinate and medium size plants, is maturing in 140-150 days. It fits in wheat-cotton-wheat rotation and escapes the bollworm attack. it significantly outyields the commercial variety B-557 and its fibre is slightly better.

A number of other promising mutnats are in the pipeline.

(Contributed by Saeed Iqbal Khan, M., Boota Chaudhry, M., Aslam, M. and Bandesha, A.A., Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan).

Promising mutants in mungbean, *Vigna radiata* (L.) Wilczek

In India, the yield of mungbean is rather low with an average of 100-200 kg/ha, but may reach 300-500 kg/ha. Yields up to 1,000 kg/ha in Sri Lanka and 1,125 kg/ha in the United States suggest scope for improvement (Duke *et al.*, 1981). Asynchronous maturity and susceptibility to yellow mosaic virus are some reasons for the limitations of this crop. Our mutation breeding programme aims at higher yield, uniform maturity and disease resistance. Varieties ML-5 and K-851 were treated with γ-rays (20-50 kR), EMS (0.2%, 0.4%; each for 6h and 12h) and combined treatment (each dose of irradiation followed by 0.2% EMS 6h) in 1979. Desirable mutants were selected in M_2 generation. Selection was continued in advanced generations and only superior mutants were carried forward. In M_5 generation, the performance of mutants was studied in the dry and the rainy season. A small replicated trial was performed in M_6. The performance of the best mutants is shown in the table. There are three mutants with higher pod number, three with early and uniform maturity, five with higher pod number and higher yield and four with disease resistance (YMV). Further trials are underway.

Performance of mungbean mutants

	Mutant no.	M_5 Summer 1981		M_5 Rainy 1981		M_6 Rainy 1981	
		pods/ plant	yield/ plant (g)	pods/ plant	yield/ plant (g)	pods/ plant	yield/ plant (g)
Parent variety ML-5	-	66.4	6.10	32.6	7.01	-	-
Mutants with high pod no.	14	-	-	71.4	5.43	-	-
	16	-	-	46.4	5.06	-	-
	19	-	-	79.2	5.31	-	-
Parent variety K-851	-	17.0	2.64	30.6	5.55	30.6	5.55
Mutants with early and uniform maturity	3	-	-	-	-	42.5	7.23
	8	-	-	46.2	5.36	-	-
	10	-	-	37.4	4.83	-	-
Mutants with high pod no. and high yield	18	38.0	4.15	-	-	34.8	8.50
	22	109.6	16.33	36.0	5.79	41.7	5.58
	35	51.2	7.85	52.0	7.30	37.9	6.21
	37	62.2	5.68	40.8	5.80	41.1	8.48
	38	67.6	6.02	51.0	6.39	42.7	7.71

REFERENCE

DUKE, J.A., REED, C.F. and WEDER, J.K.P., *Vigna radiata* (L.) Wilczek. In "Handbook of Legumes of World Economic Importance" (Ed. J.A. Duke) (1981) 293-296, Plenum Press, New York.

(Contributed by Bahl, J.R. and Gupta, P.K., Department of Agricultural Botany, Meerut University, Meerut (U.P.), India).

Applied mutagenesis in chickpea

Chickpea, the grain legume crop of India accounting for the largest area and production, on an average yields poorly due to its evolutionary history, which made this crop adapted to stress conditions.

In view of the potential of induced mutations to regenerate genetic variability for crop improvement, a mutation induction programme was started in 1972 using gamma rays (40, 50 and 60 kR), fast neutrons (0.5, 1.0 and 1.5 kR), NMU (0.01% and 0.02%), and EMS (0.1% and 0.2%) on four varieties of chickpea (brown seeded desi varieties G-130 and H-214, culinary green seeded variety L-345, and Kabuli variety C-104). 500 seeds were used in each treatment.

Comparative mutagenesis studies were carried out in M_1 and M_2, but major emphasis was given to isolation of plant type mutations in M_2 and M_3. To assess the quantum and direction of induced variability, statistical analysis based on several parameters was done in M_2 and M_3. Selection of mutations in quantitative characters related to grain yield, like pod number, seed number per plant, seeds per pod, harvest index and grain weight was attempted. Selections were advanced to M_3 and M_4 on the basis of a new selection technique. Mutants were further studied for their yield performance and stability in M_4 - M_7, including multilocation yield trials in M_6 and M_7. The best mutants are tested in National Trials.

The major findings of the project are as follows:

(i) Growth Reduction Doses (GR50): G-130 75.5 kR, H-214 71.5 kR, L-345 67.5 kR, C-104 52.0 kR.

(ii) Differential mutagenic sensitivity: The desi types seemed more mutagen resistant. On the basis of number of mutations obtained the mutagens can be arranged in the following order:

NMU (3.8%) > EMS (2.7%) > gamma rays (2.4%) > neutrons (1.2%).

(iii) In total 1325 mutants were obtained from a M_2 plant population of 57,023. Among 901 chlorophyll mutants were 43.5% albina, 32.3% chlorina and 24.2% xantha. Among 424 viable mutants were 45 different morphological mutants of which 39 showed changes in seed shape, size and colour. A large number of mutants were affected in two or more characters.

(iv) In respect of variability in plant type the mutagen treatments have been remarkably successful and some mutant types have been reported for the first time in this species. The most interesting plant type mutants include a wide range in plant height: Miniature (7-12 cm), Fasciata (10-15 cm), Dwarf (12-20 cm), Compact (25-40 cm), Bouquet (70-90 cm), Gigas (40-60 cm), Upright (60-75 cm), Tall (70-90 cm), Spreading and Supergigas (1.20 cm diameter), etc. Some of these plant type mutants coming close to the ideotype looked for in chickpea are in yield trials and used in cross breeding.

(v) Various kinds of foliage mutations such as Tiny leaf, Narrow leaf, Close pinnae, Lobbed pinnae, Curly leaf, Simple leaf and Stalked leaf; flower and pod mutations like Open flower, Two-tier inflorescence, small pod, long pod and double podded; maturity mutants like Early and Late have been obtained.

(vi) In M_2 and M_3 there was a much greater range of variability for all the quantitative characters studied than in the controls. Our selection technique, based on coefficient of variability (CV) and mean employed from M_2 onwards resulted in sifting out of a number of "micro-mutant" strains which have given a superior performance from M_4 to M_7 in large yield trials, including multi-location trials against the best standard varieties and the best local checks. The high perfomance is based upon number of pods per plant, grains per pod, grain size, harvest index and disease resistance.

Nine high yielding "micro-mutants" (six desi and three kabuli) entered National Trials under the All-India Coordinated Pulses Improvement Programme during rabi 1979-80. The mutant strains BGM-405 and BGM-401 showed wide adaptability. On the basis of All-India performance (overall mean of all zones) they outyielded the best control. The three best mutants BGM-401, BGM-403 and BGM-405, were promoted to the Coordinated Varietal Trial during rabi 1980-81 for the 2nd year of evaluation. Results confirmed that the mutant strains BGM-401 and BGM-405 have a high potential in Northern as well as Peninsular India. Both these mutant strains undergo third year evaluation during the rabi season 1981-82.

More mutant strains showing promising performance in Institute Trials entered the Initial Evaluation Trial under the coordinated programme during rabi 1980-81 for testing in the North zone only. Two of these, BGM-408 BGM-413, occupied 2nd and 3rd rank out of 49 varieties. BGM-413 showed a wider adaptability. BGM-408 has a good tolerance to blight and is tolerant to late sowing. Both mutant strains entered the Coordinated Varietal Trial for 2nd year testing during rabi 1981-82. Five more desi mutant strains (BGM-416, 417, 418, 419, 421) have entered Coordinated Trials in 1981-82.

In case of Kabuli (white seeded) chickpea, the mutant strain BGM-415, has outyielded the best check variety in the Coordinated Trial and undergoes second year testing in Kabuli CVT during 1981-82. Three more Kabuli mutants (BGM-422, 423, 424) were included in the Kabuli CVT first year for rabi 1981-82.

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KHARKWAL, M.C., Comparative mutagenesis and cytogenetical studies in gram (Cicer arietinum L.), Ph.D. Thesis, Agra University, Agra, India, 1979.

KHARKWAL, M.C., Mutation breeding in chickpea in India. Proc. Symp. Role of Induced Mutations in Crop Improvement, Hyderabad, India, (1979) 177-183.

KHARKWAL, M.C. and JAIN, H.K., Development of new plant types in chickpea for high yields through mutation breeding. IAEA-TECDOC-234 (1980) 55-57.

SHARMA, B. and KHARKWAL, M.C., Induced mutations in grain legumes. IAEA-TECDOC-260 (1982) 59-64.

(Contributed by Kharkwal, M.C., Division of Genetics, Indian Agricultural Research Institute, New Delhi-110012, India).

LIST OF VARIETIES

The Plant Breeding and Genetics Section of the Joint FAO/IAEA Division undertakes the collection and dissemination of information on commercially used agricultural 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 attributes of variety
Arachis hypogaea			
Sin Pa detha 1	1982 Burma Tin Myint Agric. Res. Inst. Yezin Pyinmana	gamma rays 40 kR 1977 [Magwe-10, Spanish Type]	10-15 days earlier (85-95 days)
Avena sativa			
Nasta	1970 Finland Inst. of Plant Breeding Agric. Res. Centre	Cross Titus x Ryhti (=Jo 50-2395 x Blixt)	early as Titus, stiff straw, better yield, high protein and lysine content
Capsicum annuum			
Ljulin	1982 Bulgaria S. Daskalov, L. Milkova Inst. of Genetics Sofia	Zlaten medal-ms x line 100	hybrid variety based on induced male sterility, early harvest
Hordeum vulgare			
Kym	1981 UK Nickerson RPB Ltd. King's Lynn Norfolk PE343 JA	Georgie x Hanna (=cross with Diamant)	higher yield than Georgie, maturity equal, wide adaptability, good malting quality

Keti	1982 Austria, Denmark Carlsberg Plant Breeding DK 2500 Valby CA Quade & Co. DK 4930 Maribo Denmark	cross Rupal (=Pallas x Rupee) x (Ingrid x Proctor)	two row feed barley, mildew resistant, high yield
Berta	1982 Austria OÖ. Landesaatbau- genossenschaft Linz	cross Trumpf (=cross with Diamant) x Medina	high yield, lodging resistance
Debut	USSR V.M. Shevtsov P.P. Luckyanenko Res. Inst. of Agric. Krasnodar	NEM 0,05%	high yield, resistant to stress
Novator	USSR V.M. Shevtsov P.P. Luckyanenko Res. Inst. of Agric. Krasnodar	mutant cross	high yield, winter resistant, high protein
Prisiv	USSR V.M. Shevtsov P.P. Luckyanenko Res. Inst. of Agric. Krasnodar	mutant cross	high yield, winter resistant, high protein
Lens culinaris S-256 (Ranjan)	1981 India (West Bengal) S.N. Sen Pulses and Oil Res. Stat. Berhampore 742101	radiation [B 77]	spreading type, high yield
Lupinus angustifolius Chittick	1982 Western Australia D. Gladstones Div. of Plant Production Dept. of Agriculture South Perth 6151	seed treatment 1961 0,24% EI [Borre] crosses with selected early flowering mutant (efl)	early flowering

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 attributes of variety
Oryza sativa			
Shwethwetun (IR 24 M4-17)	1981 Burma M.S. Haq and Tin Myint Agric. Res. Institute Yezin, Pyinmana	gamma rays 30 kR [IR 24]	slightly taller than IR 24 higher amylose content fairly high yield
Triticum turgidum ssp. durum			
Lozen 76	1982 Bulgaria K. Filev Institute of Genetics Sofia	(788 x Castelporziano) x Castelporziano (cross with irradiated pollen)	good yield, lodging resistance and grain quality
Bougainvillea			
Jaya	1977 India V. Abraham and B.M. Desai Biology and Agric. Div. BARC, Trombay, Bombay	cuttings 2,5 kR chronic gamma rays [Jayalaxmi]	ornamental novelty
Silver Top	1978 India V. Abraham and B.M. Desai Biology and Agric. Div. BARC, Trombay, Bombay	rooted cuttings 2,5 kR gamma and 0,5% colchicine 6 hrs [Versicolour]	ornamental novely
Lady Hudson of Ceylon Variegata	1979 India B.M. Desai and V. Abraham Biology and Agric. Div. BARC, Trombay, Bombay	rooted cuttings 1 kR gamma rays and 0,5% colchicine 6 hrs [Lady Hudson of Ceylon]	ornamental novelty

Jayalaxmi Variegata	1977 India V. Abraham and B.M. Desai Biology and Agric. BARC, Trombay, Bombay	cuttings 2,5 kR chronic gamma rays [Jayalaxmi]	ornamental novelty
<u>Portulaca grandiflora</u>			
Karna Phul	1974 India B.M. Desai Biology and Agric. Div. BARC, Trombay, Bombay	1 kR gamma cuttings	Gerbera type, narrow petals, young flower buds have split petals
Five Petal	1974 India B.M. Desai Biology and Agric. Div. BARC, Trombay, Bombay	2.5 kR gamma cuttings	profusely flowering with 5 petaled flowers
Semi-double	1974 India B.M. Desai Biology and Agric. Div. BARC, Trombay, Bombay	10 kR gamma potted plants	five outer petals, petals in 4 rows
Pink colour	1974 India B.M. Desai Biology and Agric. Div. BARC, Trombay, Bombay	15 kR chronic gamma potted plants	pink colour
Rosy green	1974 India B.M. Desai Biology and Agric. Div. BARC, Trombay, Bombay	10 kR chronic gamma potted plants	non-opening flowers with rosy green periphery, light green centre

PUBLICATIONS

Induced Mutations in Vegetatively Propagated Plants II.
(Proceedings of a research co-ordination meeting, Coimbatore, India, 11 - 15 February 1980)
IAEA, Vienna STI/PUB/519, 1982 Austrian Schilling 520.-

Improvement of Oil Seed and Industrial Crops by Induced Mutations.
(Proceedings of an advisory group meeting, Vienna 17 - 21 November 1980)
IAEA, Vienna STI/PUB/608, 1982 Austrian Schilling 600.-

Semi-dwarf Cereal Mutants and their Use in Cross Breeding.
(Proceedings of a research co-ordination meeting, Vienna 2 - 6 March 1981)
IAEA-TECDOC 268, 1982

Manual on Mutation Breeding.
(translated into Chinese by S.C. Hsieh and J.S. Hsieh) US$ 5.-
Obtainable from Booking Selling Section, National Institute for Compilation and Translation, 247 Choushan road, Taipei, Taiwan

Induced variability in plant breeding.
(Proceedings of an International Symposium, Wageningen 1981)
PUDOC 1982 Dfl. 40.-

Breeding Crop Plants for Physiological Traits. US$ 5.-/8.-
Obtainable from Ms. M.J. Vivian, Agronomy Department, Iowa State University, Ames, Iowa 50011, USA

MUTATION BREEDING REVIEW

Under the above title we have started to issue a series of monographs about mutation breeding of particular crop species. Review no. 1 (by W.W. Hanna, Tifton GA, USA) deals with "Mutation Breeding of Pearl Millet and Sorghum" and is available upon request. The series will be continued at irregular intervals. The next reviews planned will be concerned with chickpea, pepper, pea, soybean, mungbean and sweet potato.

A. Micke

REQUEST

For a study on induced dwarfs from microsperma and macrosperma lentils, I would be interested in obtaining 5 - 10 g seed samples of dwarf mutants with good plant type. S.K. Sharma, Department of Basic Sciences, H.P. Agricultural University, Palampur 176062, India.

FUTURE EVENTS

1983

2nd FAO/IAEA Training Course on the Induction and Use of Mutants in Plant Breeding, IAEA Laboratory Seibersdorf, 12 April - 20 May

FAO/IAEA Training Course on Induced Mutations in Plant Breeding with Special Attention to Cross-Pollinating Crops, Sofia, Bulgaria, 15 May - 20 June in connection with FAO/IAEA Study Tour on Induced Mutations in Plant Breeding, Ukrainian SSR, 20 - 27 June; Byelorussian SSR, 27 June - 4 July

6th International Rapeseed Conference, Paris (France), 16 - 20 May. Contact: Congrès-Services, 1, rue Jules-Lefebvre, F-75009 Paris, France

10th International Congress of EUCARPIA "Efficiency in Plant Breeding", 14 - 21 June, Wageningen (The Netherlands)

7th International Congress of Radiation Research, 3 - 8 July, Amsterdam (The Netherlands)

4th International Congress of Plant Pathology, Melbourne, Australia, 17 - 24 August. Contact: Dr. Gretna Weste, School of Botany, University of Melbourne, Parkville, Vic. 3052, Australia

3rd Symposium on Seed Proteins in Plants: Genetics of Seed Proteins, Gatersleben, G.D.R., 31 August - 2 September. Contact: Prof. K. Müntz, Zentralinstitut f. Genetik und Kulturpflanzenforschung, DDR-4325 Gatersleben (German Democratic Republic)

10th International Congress of Plant Protection, Brighton, Sussex, U.K., 20 - 25 November. Contact: Ms. R.A. Bishops, 144/150 London Road, Croydon CRO 2TD (U.K)

6th International Wheat Genetics Symposium, Kyoto (Japan), 28 November - 3 December

15th International Congress of Genetics, New Delhi (India), 12 - 21 December

Message from the Editors

This issue marks a ten years anniversary of our Mutation Breeding Newsletter, no reason to celebrate but to thank our readers for their continued interest.

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
Lhamo WAHL

Mutation Breeding Newsletter
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