4.2 Use of physical/chemical mutagens in plant breeding program in Vietnam

Tran duy quy, nguyen huu dong, bui huy thuy, le van nha, nguyen van bich et al.

Agricultural Genetics Institute, Hanoi, Vietnam.

I. Introduction.

History of induced mutation was initiated nearly one hundred years ago when Hugo de Vries proposed the theory of mutation and the ability to obtain artificial mutation.

So far, the process of induced mutation research spread onto 5 main periods, marked by many famous works of scientist all over the world (such as of Sweden, Germany, Poland, Russia, India, United States, Japan, France, China, Asia countries) on theory as well as on practice (Muller 1927; Delone 1928; Sapeghin 1936; Rapoport 1948-1989; Gustafson et al 1940-1953; Kawai 1954; Matsuo et al 1987; Mackey 1953; Marie et al 1969; Meinhold, Smith, Sparrow 1971; Mikaelsen; Maluzynski et al 1988-2000; M. E. Swaminathan et al 1991, Amano et al 1968-1990, Tran Duy Quy, Nguyen Huu Dong 1985-2000; Leu Leexiang 2000; Ismachin et al 1998-2000; Kang et al 1998-2000; Padolina 1998-2000; Ibrahim et al 2000; Phadvibulya 2000; ect).

According to IAEA, in the world, up to now, more than 1870 new plant varieties were formed by mutation breeding. In plus, more a thousand of promising mutant lines are being studied and selected in many laboratories of 46 countries. Among them, 44 varieties of different plants were formed by Vietnamese scientists. In Vietnam, the first research on induced mutation was carried out in 1966 in Department of Genetics, Hanoi University in rice, bean, soybean, mulberry (Trinh Ba Huu, Phan Phai, Tran Minh Nam, Le Duy Thanh et al 1966-1969). The research was promoted from 1970 up to now in AGI, Cuu Long Delta Rice Research Institute, Institute of Food Crop Research, Agriculture University No. 1, 2, 3 or 4 ect.

Recently, Vietnam has formed 44 varieties of rice maize, soybean, peanut, tomato, jujuba, green bean... after treatment with physical/chemical mutagens such as Gamma ray, neutron, DMS, DES, EI, NMU, NEU, NaN_3.

In this paper, some results obtained in different institutions in Vietnam on the field of induced mutation were reported.

II. Material and method

2.1. Material.

- Rice: 17 local and introduced varieties: aromatic rice Tam thom Me tri, aromatic rice Tam Thai binh, glutinuous rice Nep cai hoa vang, glutinuous rice Nep Hai hau, Chiem bau, C4-63, IR-22, Moc tuyen, IR-8423, IR-8, IR-5, TB-1, IR-2070, 84-1, OM -80, Cuom, Baothai.

- Maize: VM1, local Ngo da, local glutinuous corn.
- Soybean: Cuc, V74, Dh4, Coc chum, AK-04, V70.
- Peanut: Bach sa, Hoa 17, Sen lai.
- Tomato: V-224, Ba lan, local variety.
- *Mentha arvensis*.
- Jujuba (*Ziziplus jujuba*).

2.2. Mutagens:

- Gamma ray: ^{60}Co, ^{137}Ce.
- Chemical mutagens:
  - ethylenimine (EI)
  - dimethylsulfate (DMS)
  - diethylsulfate (DES)
  - N-Nitrosomethylurea (NMU)
  - N-Nitrosoethylurea (NEU)
  - NaN_3 Sodium azide
- Dose of Gamma ray: 0.2, 0, 1, 2, 5, 10, 15, 20, 25, 30, 40 krad; depending on treated particular objective and materials: dried seed, sprouting seed, but or tuber.
- The samples were treated by chemical mutagens with concentration of 0.005, 0.02, 0.025, 0.03, 0.1, 0.2, 0.3, 0.4, 0.6 %; in 12-24 hours, in 27-30°C, pH 7.

2.3. Research purposes.

2.3.1. Study on somatic effect in M1 plants:

- delayed germination
- delayed and reduced emergence
- reduction of growth
- chlorophyll defects
- reduction of fertility
- reduction of survival

2.3.2. Study on genetic effect in M2 plants:

- morphological and chlorophyll mutation.
- mutation rate and their spectrum.

2.3.3. Study on cytological effect in anaphase of meiose

- chromosomal aberration
- disturbance of the cell cycle.

2.3.4. Study on genetic nature of mutant in M2, M3, and M4.

2.3.5. Direct and indirect use of mutants in plant improvement.

2.4. Method:

- Using methods of classification, measuring the frequency and spectrum of mutation as discribed by IAEA (1973-1979).
- Data treated by Biological Statistic Method.

III. Results and discussions

In this report, the results of the cytological, genetic effects in M1 plants, the frequency and the spectrum of chlorophyll and morphological mutants, mutant obtained and genetic nature of the next generations were detailed in rice only.

3.1 **Rice mutation.**

3.1.1. Chromosomal aberration.

Table 1. Frequency chromosomal aberration after treament by physical and chemical mutagens in rice variety IR8.

Mutagen concentration (%), dose (krad)	Frequency (%)	
	Dried seed	Sprouting seed
EI 0.01	17.2	19.9
0.03	22.3	28.1
0.05	27.9	31.3
DMS 0.01	10.2	18.2
0.03	19.6	24.8
0.05	21.2	28.9
DES 0.01	9.7	14.4
0.03	13.5	17.9
0.05	19.4	23.7
Gamma rays 25	29.3	
35	29.4	
Control	2.86	2.67

The data of table 1 showed that the aberration effects caused by mutagenic treatment were very diverse, depending on the nature, the dose, the concentration of mutagens as well as the physiological situation of treated samples. The effect of physical and chemical mutagens in the field of chromosomal aberration could be ranged as follows:

Gamma rays > EI > DMS > DES

Among two treatment methods, the chromosomal aberration frequency of sprouting treatment is higher than that of dried seed treatment.

In treatment of other 5 rice varieties, the similar results were reported following: (Table 2).

Table 2. Frequency and spectrum of chromosomal aberration after treatment by physical and chemical mutagens in some rice varieties.

Varieties Mutagens	Frequency and spectrum of chromosomal aberration		
	Concentrations of treatment (%)		
	0.01	0.02	0.03
IR22			
NMU	26.37 ±1.77 5 types of variation	28.59 ±1.79 5 types	35.73 ±1.96 5 types
NEU	21.79 ±1.66 5 types	27.82 ±1.71 5 types	30.08 ±1.82 5 types
Control	1.66; 1 type		
C4-63 Gamma ray			
10 krad	18.64 ± 2.78 8 types		
20 krad	26.5 ± 3.31 8 types		
NMU	25.90 ±1.73 5 types	30.08 ±1.85 5 types	38.59 ±1.9 5 types
NEU	23.19 ± 1.62 5 types	26.28 ± 1.69 5 types	33.04 ±1.78 5 types
Control	1.73; 1 type		
Moc tuyen Gamma ray 10			
krad	16.94 ± 2.35 8 types		
20 krad	26.91 ± 1.97 8 types		
NMU	20.71 ± 1.63 5 types	26.35 ± 1.81 5 types	30.65 ± 1.89 5 types
NEU	17.78 ± 1.54 5 types	21.04 ± 1.62 5 types	27.15 ± 1.81 5 types
Control	0.84 %		
TB - 1 Gamma ray 10			
krad	14.1 ± 1.86 8 types		
20 krad	21.9 ± 1.93 8 types		
NMU	19.68 ± 1.52	23.38 ± 1.60	29.65 ± 1.76
NEU	15.73 ± 1.46	20.09 ± 1.59	24.83 ± 1.82
Control	2.1%		
TTB Gamma ray 10			
krad	13.84 ± 2.61 8 types		
20 krad	16.93 ± 2.10 8 types		
NMU	10.72 ± 2.21 5 types	16.57 ± 2.35 5 types	20.21 ± 3.03 5 types
Control	1.44 ± 0.71; 1 types		

3.1.2. Chlorophyll mutation

Table 3: Frequency and spectum of chlorophyll mutation in IR8 variety after treatment by physical and chemical mutagens in some rice varieties.

Mutagen concentration (%) and dose (kr)	Number of M_2 plants	Frequency of chlorophyll mutation (%)	Type of chlorophyll mutation			
			albina	xantha	viridis	others
Sprouting seed						
Control	8650	0.081 ± 0.03	100	0	0	0
EI 0.01	8348	2.75 ± 0.18	26.61	51.74	5.65	20.00
0.03	9155	3.51 ± 0.19	27.73	55.45	3.11	13.71
0.05	8428	4.33 ± 0.22	33.70	45.75	4.38	16.16
DMS 0.01	9415	2.10 ± 0.14	25.24	56.06	3.03	15.66
0.03	9620	2.35 ± 0.15	21.24	50.88	6.64	21.24
0.05	8730	3.13 ± 0.18	31.13	47.62	7.33	13.93
DES 0.01	8744	1.38 ± 0.12	29.75	46.28	6.61	17.35
0.03	8656	2.41 ± 0.16	31.58	52.15	4.31	11.96
0.05	9637	2.67 ± 0.16	24.90	53.70	7.00	14.40
Gamma ray 5	10141	1.69 ± 0.13	49.12	26.90	21.01	2.92
10	11245	3.44 ± 0.17	50.39	25.51	22.22	3.88
Dried seed						
Control	8500	0.07 ± 0.03	100	0	0	0
EI 0.01	9321	1.86 ± 0.14	26.59	41.62	7.51	24.28
0.03	9642	1.98 ± 0.14	30.89	49.21	6.28	13.61
0.05	9146	2.63 ± 0.16	34.85	43.57	8.71	12.86
DMS 0.01	9326	1.36 ± 0.12	20.47	51.18	6.30	22.05
0.03	9560	1.84 ± 0.13	27.27	48.86	7.39	16.48
0.05	8766	2.21 ± 0.15	30.41	50.52	8.25	10.82
DES 0.01	8783	1.12 ± 0.11	18.37	50.0	8.16	23.42
0.03	9610	1.09 ± 0.10	28.57	47.62	10.48	13.33
0.05	8891	1.92 ± 0.14	23.39	52.63	8.19	15.71
Gamma ray 25	12383	1.25 ± 0.10	58.71	18.06	23.23	0
35	11647	2.69 ± 0.15	62.62	13.42	18.21	5.7

3.1.3 Morpho- physiological variation

Table 4: Frequency and spectrum of morpho- physiological variation in M_2 plant of IR8 variety after treating with various mutagen concentrations.

Mutagen (concentration (%)) (Dose kr)	No. of M_2 plants	Variation frequency		Type of variation
		Number of plants	%	
Sprouting seed				
Control	3680	0	0	0
0.01	4560	263	5.77 ± 0.34	14
0.03	3987	283	7.28 ± 0.41	17
0.05	4015	348	8.67 ± 0.44	21
Total	12562	994	7.24 ± 0.24	17
0.01	4350	138	3.17 ± 0.26	16
0.03	4210	223	5.30 ± 0.34	18
0.05	4185	264	6.31 ± 0.27	15
Total	12745	625	4.93 ± 0.20	16
0.01	4225	137	3.24 ± 0.32	13
0.03	4381	212	4.84 ± 0.36	12
0.05	4237	244	5.76 ± 0.37	16
Total	12843	593	4.61 ± 0.18	14
5	6650	403	6.10 ± 0.29	9
10	6148	482	7.84 ± 0.34	12
Total	12798	888	6.97 ± 0.22	11
Dried seed				
Control	3880	0	0	0
0.01	4391	195	4.44 ± 0.31	12
0.03	4582	241	5.26 ± 0.33	13
0.05	4174	298	7.14 ± 0.40	13
Total	13087	134	5.61 ± 0.20	13
0.01	4630	121	2.61 ± 0.23	10
0.03	4510	164	3.64 ± 0.28	11
0.05	4248	187	4.40 ± 0.31	9
Total	13388	472	3.55 ± 0.16	10
0.01	4160	89	2.14 ± 0.22	12
0.03	4280	132	3.08 ± 0.26	10
0.05	3987	183	4.59 ± 0.38	11
Total	12427	404	3.27 ± 0.16	11
25	6250	397	6.35 ± 0.31	7
35	5415	481	7.50 ± 0.33	9
Total	12665	878	6.93 ± 0.22	8

Table 5: Frequency and spectrum of morpho - physiological variation in M_2 plant of some rice varieties after treating with various mutagen concentrations

Variety	Mutagen	Number of plants	Frequency of variation	Type of variation
IR-22	Control	5356	0	0
	NMU 0.010	5099	3.41± 0.25	21
	NEU 0.010	4896	2.72 ± 0.23	17
	0.015	4200	3.78 ± 0.24	17
	0.020	4158	3.05 ± 0.27	18
	0.025	3841	3.25 ± 0.28	18
	0.030	2600	4.46 ± 0.40	20
MT	Control	5236	0	0
	NEU 0.010	5786	2.11 ± 0.19	17
	0.015	5682	2.78 ± 0.22	18
	0.020	5697	3.00 ± 0.23	18
	0.025	5676	2.85 ± 0.22	20
C_4 - 63	Control	4900	0	0
	Gamma rays 10	4720	1.06 ± 0.15	7
	15	4368	1.85 ± 0.20	10
	20	4583	1.92 ± 0.20	11
	NMU 0.010	4190	2.39 ± 0.23	18
	0.015	3895	3.03 ± 0.27	18
	NEU 0.010	4654	2.17 ± 0.21	13
	0.015	4632	2.33 ± 0.22	11
	0.020	4010	2.47 ± 0.24	18
	0.025	3981	3.14 ± 0.27	18
	0.030	3883	2.94 ± 0.27	18
TB - 1	Control	5600	0	0
	Gamma rays 10	5345	1.46 ± 0.16	10
	15	5428	1.95 ± 0.19	11
	20	5234	2.90 ± 0.23	11
	NMU 0.010	5216	2.97 ± 0.23	17
	0.015	4891	3.43 ± 0.26	17
	NEU 0.010	4810	2.51 ± 0.22	14
	0.015	4802	2.87 ± 0.24	15
	0.020	3898	3.05 ± 0.27	17
	0.025	3895	3.16 ± 0.28	17
	0.030	3813	3.07 ± 0.28	18
TTB	Control	5600	0	0
	Gamma rays 10	5915	0.95 ± 0.12	7
	20	5889	1.39 ± 0.15	11
	NMU 0.010	5632	1.95 ± 0.18	16
	0.015	5515	2.32 ± 0.20	17
	0.020	5112	3.19 ± 0.44	18
	NEU 0.010	5638	1.86 ± 0.18	14
	0.015	5454	1.89 ± 0.18	13
	0.020	5627	2.42 ± 0.20	15
	0.025	5449	2.92 ± 0.22	15
	0.030	5321	3.29 ± 0.24	14

3.2 Highlight Results on Mutation Breeding in Vietnam

3.2.1. Rice

3.2.1.1. Mutant rice variety - DT10:

The dry seeds of C_4-63 variety were treated with irradiation of gamma rays. The effective dosage of ^{60}Co gamma rays is 20 krad. M2 individuals were selected, then were treated with NEU, using dose 0.025% during germination phase. DT10 has been released to farmers after many years of testing in North Vietnam. It was recognized as a National Rice Variety in 1990. In contrast with its parents, DT10 is tolerant to coldness and drought and resistant to disease, and yields within 5.5 to 7 tons/ha/crop, particularly 7.0-7.5 tons/ha/crop; maturity: 180-185 days, 100 - 115 grains/panicle: 32-34 gr/1.000 grains. It has been spread in the North Vietnam about 1 million hectares (covered 30-35% of rice area). It is suitable for early Spring crop.

3.2.1.2. Mutant rice variety - DT11.

To develop DT11, C_4-63 was irradiated with ^{60}Co gamma ray, dosage 20 krad, M1 was selected after the continuous treatment with NEU dosage 0.025% in germination phase. The resistance to pests and diseases was improved and the yield about 5.5 to 7.5 tons/ha/crop. The cooking quality and aromatic characteristics are better than that of DT10. It was cultivated largely in North Vietnam.

3.2.1.3. Mutant rice variety - A20.

It was derived from the variety A8 by treatment with NMU, dosage 0.015%. After selecting, the mutants H_{30} and H_{20} were newly treated with NMU, dosage 0.015%. By crossing between the above two mutant lines, A20 was obtained. It was adopted as a National Rice Variety in 1993. It is tolerant to drought, salt alumniferous soil and resistant to disease, yields about 5 to 7 tons/ha/crop,; good grain quality and grain rate: 70%.

3.2.1.4. Chiem bau mutant rice variety - CM_1.

Chiem Bau is a local, rice variety grown in North Vietnam, tolerant to salt and alumniferous soil. But, it was tall and had late maturity and low-yielding capacity. AGI has undertaken several mutation breeding steps to improve the agronomic traits by gamma rays of ^{60}Co, at dosages 15, 20 and 25 krad. At first, a short maturity mutant was selected (CM_1), and then several promising hight yielded mutants were obtained (line 1, 5). These lines are now being propagated in coastal northern parts of Vietnam. CM_1 was certified as national rice variety in 1999.

3.2.1.5. Mutant rice variety - DT33.

CR203 was irradiated with gamma rays, dosage 20 krad, and selected over many generations. DT33 was released widely in the North Vietnam since 1994. It was blast resistant and about 20 percent higher yielding than the CR203.

3.2.2. Maize

3.2.2.1. DT6

Its origin was from Mexico and had a white colour of grain. 12 valuable mutants were obtained from treatment with NEU and NMU. By crossing between them to form the synthetic

DT_6 variety. DT6 was recognized as a National Variety in 1990. It has short and strong stem, it is about 20% higher yielding than other conventional varieties, good grain quality. The grains occupy 82% of ear weight, 1% higher grain protein content than the origin variety. It has been grown on over 1.000 hectares on alluvium soil.

3.2.2.2. DT8. This variety was developed by crossing between DT6 and local red corn variety. The hybrid has a light red colour of grain and high yield. It is in national trial cultivation.

3.2.3. Oil plants

3.2.3.1. Legumes.

The induced mutation method has been applied to have diverse starting materials for peanut and soybean breeding, in order to improve genetic traits with the desired purposes for agricultural production:

- Starting materials for mutagenic treatment: pure varieties, hybrid varieties mutant.
- Mutagen: ^{60}Co γ-rays, Ethylenimin EI, Nitrosomethylurea NMU, Dimethylsulfat DMS, Sodium azide NaN_3 with the concentration of 0.005%-0.05%.
- Procedures: combining physical with chemical treatment method. Treatment with dry seeds, wet seeds or treatment at flowering phase.
- Number of seeds used in treatment: from 500 and more. The mutated generation have been in continuous survey from M2 to M4: selection, isolation after pedigree method, the good lines have been selected through succeeding generations to obtain good, stable agromic traits.

The research results

- The effect of induced mutation is highest at flowering period with high mutant frequency and wide mutant spectrum. The total of variation and mutants amounted to 80% in M1 and M2 generation (Tran Tu Nga, Tran Van Lai 1995).
- The effect of physical and chemical treatment with dry seeds is higher than that wet seeds.
- The effect of combining chemical with physical treatment is higher than that with separated chemical or physical agent.
- The different lines have got the different sensitivity with mutagens.

3.2.3.2. Peanut

The mutant varieties released to production were mainly used since 1990 with the average yield from 2.2 to 3.4 tons/ha. They are the following varieties: B5000, V74, 4329, D332, D329, DPC 9102... The fundamental characters of mutant varieties are suitable for export requirements (high yield, white seed color).

Table 6: Result of peanut mutation breeding in Vietnam

Varieties	Year	Original materials	Treating methods	Yield (T/ha)	Characters
B5000	1989	Bachsa	γ ray	2.2	High yield, big grain
V79	1992	Bachsa	γ ray	2.4	High yield, thin skin seed,
4329	1993	Hoa 17	γ ray	3.1	early maturity.
4321	1994	Hoa 17	γ ray	2.8	High yield, big grain
D322	1992	Sen lai	NUM	3.4	High yield, big grain
D332	1992	Sen lai	NUM	3.3	High yield, big grain
OPC-9102	1995	Ly	NUM + ^{60}Co γ	3.0	High yield, big grain High yield, thin skin seed
		promising	**mutant**	**varieties**	
V79-3-26	1995	V79	^{60}Co γ	3.2	High yield, maturity
TM4-2-79	1995	V79	^{60}Co γ	2.9	High yield, maturity
Ly-2-12	1995	Ly	^{60}Co γ	3.1	High yield, thin skin seed

Owing to the scientific and technologic advances, many peanut varieties have been formed, in which the mutation breeding has contributed a worthy part. The new varieties with high yield, good grain quality are highly evaluated by farmers (Tran Van Lai, 1993). Therefore, in 20 years ago, the cultivated area of the whole country have increased to 165%, the yield more 48% and the produce more 292%. Today, Vietnam ranges an export country among 10 peanut production countries in the world.

3.2.3.3. Soybean

In parallel with hybrid breeding, the Vietnamese scientists have carried out mutation breeding in soybean and have got many satisfactory results.

The national certified varieties being cultivated as follows: DT84, DT90, DT95, M103, V48, A5... with high yield, big grain, and they can be planted 2-3 crops/year (Mai Quang Vinh, Tran Van Lai 1995).

Besides, there are many promising lines and varieties in verification trials before releasing to farmers.

Among the varieties used in production now, the mutant varieties occupy 45%. Thus, in the last two decades, the cultivated area was increased to 228%, the yield to 98% and the output was increased to 552%. The production can satisfy the need of people for daily food, processing and animal feed.

However, the demand of soybean products is continuously increasing in Vietnam, so the new introduction of high yielding varieties is in serious need to promote soybean production.

Table7: Result on soybean mutation breeding in Vietnam

Varieties	year	Original materials	Treating methods	Yield (T/ha)	Characters
DT83	1987	Coc chum	^{60}Co γ ray	2.36	High yield,
DT84	1994	DT80 x DH4	^{60}Co γ ray	2.86	High yield, big grain.
DT90	1993	G7002 x Coc chum	^{60}Co γ ray	2.75	High yield, early maturity
DT95	1995	AK04	^{60}Co γ ray	3.25	High yield, large adaptation
M103	1993	V70	EI 0.01%	2.56	High yield, big grain
V48	1996	DT74	NaN_3 0.05%	2.4	High yield, early maturity
A5	1994	DH4	^{60}Co γ ray -5-10kr	2.1	Early maturity, high protein content.
		Promising	mutant	varieties	
V54	1995	V74	NaN_3 0.05%	2.45	High yield, early maturity
V06	1995	V74	$NaN_3$0.05%	2.35	High yield, early maturity
V52-2	1995	V74	$NaN_3$0.05%	2.22	High yield, early maturity
S25	1994	V74	$NaN_3$0.05%	2.34	High yield, early maturity
S31	1994	V74	$NaN_3$0.05%	2.56	High yield, early maturity
S52	1994	V74	$NaN_3$0.05%	2.65	High yield, yellow seed
B206	1993	AK04	γ ray	2.86	High yield, yellow seed
B326	1993	AK04	γ ray	3.20	High yield, yellow seed
B180	1993	AK04	γ ray	3.10	High yield, yellow seed
B148	1993	AK04	γ ray	2.96	High yield, yellow seed
B118	1993	AK04	γ ray	3.30	High yield, yellow seed
B22	1993	AK04	γ ray	3.20	High yield, yellow seed

3.2.4. Horticultural crops.

3.2.4.1. Mint variety.

Mint is a herbaceous plant widely cultivated in the Vietnamese farmers' garden. This plant is used as aromatic crop and also for economic aim. Mint essential oil is a precious material for a lot of industrial branches (food, chemical, cosmetic products). The demand of this material keeps increasing in the recent years in world wide. The world production of mint essential oil amounted to keep 8-10,000 T/ha, of which 40% was obtained from the varieties of Mentha arvensis L.species. The oil distilled from this species is specified by the high menthol content and has essentially met the local needs. Since 1975, the Vietnam Institute for Science Research and the Ministry of the Foreign Trade have cooperated to introduce and popularize the mint variety NV-74 (*M. arvensis* L.) that can be grown and suitable developed in the climatic condition of Vietnam. So for many years, the local needs has been satisfied and considerable quantity of product was for export. However, the quality of mint oil produced in Vietnam could not match with the best ones in the world. The essence content reached about 60% (some cases even 54-56%) while some mint oil producing countries (Argentina, Brazil, Korea) offer their product with 70% mint essential oil. Especially, in the recent time, India has widely cultivated new mint varieties (CIMAP/MASI Hybrid 77) producing the oil with 80% mint essential oil. This fact harmly influences the price and the export capacity of the produced mint oil in Vietnam.

To maintain and to develop mint cultivation and mint essential oil processing in Vietnam, the research task focuses on creating new variety with good quality, high oil content, as the best one planted in the world today.

According to the research data (1990-1995), the mutant variety TN-8 was selected after Vietnamese standard of the National Program for Science and Biotechnology Research (KY-02). In addition, the variety TN-8 was resistant to pest and disease and environmental stress.

3.2.4.2. Tomato variety 224.

Almost tomato varieties cultivated in Vietnam are local cultivars. They have low yielding capacity, low fruit quality, high acidity degree, low nutrition content... Some introduced varieties have high yield, high fruit quality, but are not good resistant to pest, disease and environmental stress, so they were quickly deteriorated.

To overcome these constraints, Food Crop Research Institute has formed and selected some good varieties that were certified by the Goverment. Among which, the mutant variety 214 had stable position in the tomato variety structure.

3.2.4.3. New mutant jujuba variety "Ma hong"

"Ma hong" is a name of new jujuba mutant variety, obtained by chemical mutagenic treatment. Jujuba (*Ziziphus jujuba*) is a fruit tree very popular in Vietnam. The local variety gives small fruits, thin and sour pulp. Some years ago, a new variety was introduced from Thailand, but this one has low yield, mucous, sweeter pulp. The experiment was conducted at Food Crop Research Institute. After mutagenic treatment with colchicine, the dosage 0.2%, the shoots were observed separately, some mosaic shoots were removed and multiplied. The selected line has pinkish pericarp, non mucous and sweet pulp. After testing this mutant variety is higher yielded than many local varieties. It is a variety widely used in horticulture now.

3.3. Some remarks taken through mutation breeding study

Through many years study on induced mutation caused by chemical/physiological mutagens onto some agricultural crops (mainly rice, maize, soybean) it could be concluded:

1. When treating with mutagen, the mutation frequency and the chromosome mutation spectrum, appearing at anaphase, depended on kinds of mutagen, dose and concentration of agents treated, and genetic traits of the variety.

Normally, gamma irradiation caused the highest mutation frequency (39.39%) and the chromosome mutation spectrum was wider than that treated with chemical mutagens.

Gamma irradiation mainly caused chromosome aberrations and fragments, meanwhile the others chemical/physical agents caused chromatid aberrations and single fragments.

Considering the effects causing chromosome mutants the mutagens can be ranged after the following order.

Gamma ray > NMU > NEU > EI > DMS > DES

2. Considering the index of chromosome mutation frequency and spectrum, germination rate, survival rate, the influence of treatment on growth and development, the yield component

fastors, it was showed that the varieties newly developed by crossing or selecting had the sensibility higher than that of the local cultivars.

Among some rice varieties planted in Vietnam, the sensibility with chemical/physical mutagens could be ranged after this order.

IR8 > IR 24 > C_4 63 > TB_1 > MT > TTB

3. The morphological/chlorophyll mutation frequency and spectrum at M_1, M_2 generation depended on kinds of mutagen, dosage/concentration used in treatment, genetic nature of variety and physiological status of seed in treatment.

For the first time, this appraisal on mutation effect was reported: the treatment of sprouting seeds caused more effects (1,5-2 times) than of dry seeds (13% moisture)

Chemical mutagens caused effects more than gamma ray on morphological/chlorophyll mutation. It could be ranged: NEU > NMU > EI > Gamma ray > DMS

The expressions of mutant traits appeared were high in $C_4$63, IR22, IR8 variety, and fewer in MT_1, TTB variety.

4. The mutation frequency of modified plants in M_1 was higher than that of unmodified ones. The mutation spectrum difference between M_2, M_3 was insignificant. However in M_3, there were some types of mutants distinctly different with of M_2, it could be observed on some rice varieties.

5. In studying the morphological/chlorophyll mutation spectrum, it was showed that:

- The chemical mutagens caused chlorophyll mutation, mainly xantha, viridis, while ray effected albina.
- Some dominant mutants were seen only after treating with NEU, NMU, EI onto some varieties such as IR8, TB1, C_4 63.

  Among 11 obtained mutants related to some particularities: shape and colour of palea and seed, shape of ear.

  There were 4 types newly acquired:
- Brown black colour bran (gene Rc)
- Hard stem, resistance to lodging (Gene Bc)
- Round seeds (Lk)
- The seeds easily fallen (Sh_1, Sh_2)

IV. Conclusions

From 1995 up to now, Vietnam became official member of Mutation Breeding Cooperation in Asian Region (including 8 neighboring Asian countries). Institute of Agricultural Genetics (AGI) was considered as the representational Institute of Vietnam on mutation breeding field.

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In the future certainly further results using nuclear techniques and biotechnology will be obtained, and will contribute to agricultural development of Vietnam.

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