INDUCED CHLOROPHYLL MUTATIONS IN *PHYSALIS IXOCARPA* BROT.

S. K. MAHNA and RASHMI GUPTA
Department of Botany, Government College, Ajmer 305 001, India.

INDUCED chlorophyll mutations in solanaceous crop plants using radiations and chemicals have been reported in the past[1-3]. The present work on induced mutation in *Physalis ixocarpa* (tomatillo) is an extension of the previous studies carried out by Mahna and Singh[4], using a different mutagen (methyl methane sulfonate MMS). The data on biological damage caused in M_1 and the type of chlorophyll mutations isolated along with their frequency are reported. The isolated mutants were also genetically analysed.

Seeds soaked in distilled water were treated with different concentrations (0.025, 0.05, 0.075 and 0.1 M) of MMS for 3 hr at 28 + 2°C. Fresh solutions of MMS were prepared in phosphate buffer (pH 7.4) and used for treatment. A control was also run using phosphate buffer instead of mutagen. Treated seeds were thoroughly washed with tap water and transferred to Petri plates and pots. Three weeks old seedlings were transplanted in the field to raise M_1 population. Seeds from the individual M_1 plants were collected separately and employed for growing M_2 progenies.

Data on germination and emergence percentage and plant height were used to determine the biological damage induced by MMS in the treated population (M_1). Methyl methane sulfonate could induce a lot of biological damage to the tomatillo plants. A dose relationship was observed between the intensity of biological damage caused and the various concentrations of the mutagen. Various types of leaf abnormalities were also detected in the treated population (table 1). Chlorophyll mutations were not observed in M_1 population.

Chlorophyll mutants screened in M_2 population were classified according to Gustafsson[5] with little modifications. The frequency of chlorophyll mutations was recorded in M_2 as mutations percent M_1 plants and mutants percent M_2 seedlings (table 1). No dose relationship was seen between frequencies of chlorophyll mutations and various concentrations of MMS used (table 2). The frequency of different kinds of chlorophyll mutations was found to be in the following order maculata > alboviridis > lutescens > deep green > albina > albescens > virescens > chlorina. A brief description of the different chlorophyll mutants follows:

Albina: Seedlings possessed small cotyledonary leaves devoid of chlorophyll or carotenoid. Seedling

Table 1 *Biological damage caused by MMS in M_1 and frequencies of chlorophyll mutations in P. ixocarpa Brot.*

MMS Conc. (Molar)	% Germination.	% Abnormal seedlings	% Emergence	Average plant height (cms)	% Leaf abnormalities	Population size		Percent mutation frequency	
						M_1 plants	M_2 seedlings	M_1 plants	M_2 seedlings
00	95	—	90	25	—	30	1350	—	—
0 025	93	21	83	21	5	28	852	33.3	4 92
0 05	80	25	75	19	—	25	873	26 6	4 65
0.075	60	33	50	17	10	20	602	20.0	2 80
0 1	53	37	48	12	22	22	789	26.6	5 49

Table 2 *Frequencies of types of chlorophyll mutations in tomatillo.*

MMS Conc. (Molar)	Types of chlorophyll mutations per cent M_2 plants							
	Albina	Alboviridis	Virescens	Lutescens	Albescens	Maculata	Chlorina	Deep green
00	—	—	—	—	—	—	—	—
0 025	0.91	1 64	—	0 18	—	2.19	—	—
0 05	—	0.76	0.19	2 67	0 23	0.19	0.23	0 38
0.075	0.33	0 33	—	—	—	—	0.48	1 66
0 1	0 13	1 11	0 55	0.55	0 93	2.22	—	—

died within 5–8 days after germination. Mutation lethal.

Alboviridis: Young leaves possessed yellow colour at the tip in the beginning, turning to white within 3–4 days with the lamina base remaining green. Mutation viable. True breeding behaviour in M_3 generation.

Virescens: Mutants were characterized by uniform light green coloured leaves. Mutation viable. Bred true in the subsequent generations.

Lutescens: Green pigment of the lamina gradually got destroyed forming yellow-patches. Decolorisation of the leaves would start from margin or middle or at the base of the lamina. In some leaves complete decolourisation occurred and they turned yellow. Mutation viable, plants breeding true in M_3 generation.

Albescens: Patches of white colour appeared on the leaves of mature plants with the leaves turning completely white or yellowish white later on. Mutation viable. Bred true in M_3 generation.

Maculata: Initially the leaves were normal but later on, small dots of yellow colour appeared on the lamina. At maturity these dots were well distributed all over the surface of the leaves. Only a few of the M_2 plants bred true in M_3 and in these plants the character was poorly expressed.

Chlorina: Yellowish green leaves were formed in the young seedlings. At maturity, intercostal region became yellow white and costal part remained green. Mutation viable. Only a few of the M_2 plants bred true in M_3.

Deep green: Leaves were dark green in colour with more serrate margins. The dark green colour of the leaves persisted throughout the growing period. Mutation viable. Bred true in M_3 generation.

The inheritance of the chlorophyll mutants were also studied from the segregation of the heterozygous plants. The majority of these chlorophyll deficient types segregated in simple Mendelian 3:1 ratio (table 3).

The data on biological damage induced by MMS was quite significant and helped in determining the relative effectivity of various concentrations used.

In the present study eight different types of chlorophyll mutants were isolated. Earlier Mahna and Singh[4] have detected only five types of chlorophyll mutations in tomatillo using gamma rays and three alkylating agents namely dimethyl sulfate (DMS), diethyl sulfate (DES) and methyl ethane sulfonate (MES). The present data when compared with the previous data of Mahna and Singh[4] indicate that MMS is more effective in inducing chlorophyll mutations than DMS, DES or gamma rays.

In the M_3 generation the majority of the chlorophyll mutants (except maculata and chlorina) bred true, showing a monogenic recessive behaviour. Maculata and chlorina types either did not show any chlorophyll deficiency in M_3 or the expression was poor. Such types of "variants" have been earlier reported[6-8]. They have attributed this unpredictable behaviour of the genes to be due to environmental factors such as light and temperature. Study on the effect of various environmental factors on the isolated chlorophyll mutants is under progress.

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Table 3 *Segregation of different chlorophyll mutants in heterozygous line in M_3 generation.*

Chlorophyll mutants	Frequency of Normal	Frequency of Mutant	Total	$x^2 = (3:1)$	P
Alboviridis	40	16	56	0.380	0.70–0.50
Virescens	50	14	64	1.083	0.30–0.25
Lutescens	30	12	42	0.285	0.70–0.50
Albescens	38	12	50	0.026	0.90–0.80
Deep green	42	16	58	0.206	0.70–0.50

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INFLUENCE OF SOIL AND VARIETAL FACTORS ON DRY MATTER, QUALITY AND QUANTITY OF COTTON

V. K. KHADDAR, S. B. JADHAV and N. RAY
Project for the Management of Salt Affected Soils, J. N. Agricultural University, Indore Campus 452001, India.

COTTON plants belong to the group of tolerant crops, to sodicity[1] and its range of exchangeable sodium percentage (ESP) tolerance is 40–60. This tolerance is related with the growth and economic yield of this crop and gives no indication regarding the change (if any) in fibre properties. The present study was undertaken to study this aspect along with the yield of dry matter and seed cotton under naturally occurring heavy as well as predominently sodic and normal vertisol soils.

The experiment was conducted in pot culture in the pot house of the College of Agriculture, Indore, with 20 kg soil and two varieties of cotton (*viz.*, Khandwa-2 and Barwaha selection), replicated twelve times. Throughout the growing period, the moisture condition was maintained at field capacity and two plants were maintained per pot. After the last picking, the wt of seed cotton as well as dry wt/plant were recorded at the Cotton Technological Research Laboratory at Indore and are presented in table 2. Soil analysis before the start of the experiment has been done in respect of pH, C. E. C., E. Ce, E. S. P. and the available N, P, K as well as organic matter are presented in table 1.

The data on soil characteristics show that the cation exchange capacity of normal black cotton soil of Indore is greater than that of the salt-affected soil of Barwaha Experimental Station. The pH, E. Ce and E. S. P. of the latter soil especially the E. S. P. were much greater than in the normal soil. In fertility status also, normal black cotton soil had higher values (of available N, P, K and organic matter). In dry matter, contents and yields of seed cotton plants grown under normal soil were superior to those of the plants grown under predominantly sodic soil as reported earlier[2].

The reduction in the yield of seed cotton was however smaller in comparison with the reduction in dry matter/plant under sodic soil, which indicated that the yield of seed cotton can adjust itself better than the growth of the plants under adverse conditions. Bernstein[3] also indicated that the yield of seed or fibre in cotton might not decline even when salinity caused a decrease (as much as 50%) in plant size. It had been due to effective competition for photosynthates between the vegetative and reproductive parts. Photosynthates would preferentially flow to those sinks that had been most active at that time[4].

Fibre characteristics, like mean fibre length, fineness, maturity per cent as well as 'fibre quality index' showed no significant difference due to different soils. But bundle strength was significantly greater in sodic soil than in normal black cotton soil. Eaton[5] pointed out the genetic constitution to be the single most important consideration in determining the quality of cotton fibre, though certain other factors like water supply, locality, season, application of farm yard manure or even a particular dose of nitrogen, were also found to affect the fibre quality[6]. Recently Jadhav *et al*[7] found that fibre length also had significantly increased in sodic soil with lower dose of gypsum application (25% of gypsum requirement) than with a moderately higher dose (50% of gypsum requirement).

As far as the varietal differences were concerned, Barwaha Selection was found to have significantly higher dry wt of plants, higher yield of seed cotton, coarser fibre, higher bundle strength and better fibre quality index (Q) * (as derived by Lord[8]), in comparison to that of Khandwa-2.

The interaction effect (between soils and varieties) was significant only on maturity %. Barwaha Selection in normal soil had higher maturity % in comparison with that of Khandwa-2 and Barwaha Selection in sodic soil.

Indian *hirsutum* cotton, is poor in maturity and strength[9]. In the present study, however, both the cotton varieties, though belonged to *hirsutum* species, were better in bundle strength. In sodic soil bundle strength of Barwaha Selection belonged to 'very good' category according to the classification of Oka *et al*[10]. In Khandwa-2 also, the bundle strength in sodic soil reached 'good' category from the 'average' in normal

* $Q = (S_{1/8}\, L/HS)m$ where $S_{1/8}$ is the bundle strength at 1/8" gauge g/tex, L is the mean fibre length (mm), and HS is the intrinsic fineness which is standard fibre weight (g/inch) and m is maturity co-efficient.