V. RESULTS AND DISCUSSION

This study was carried out at the experimental station of Faculty of Agriculture, Moshtohor, Zagazig University during the four successive winter seasons; 1997/1998, 1998/1999, 1999/2000 and 2000/2001. The main goal of breeding faba bean (*Vicia faba L.*) is to produce new genotypes improved in one or more necessary features such as protein quality and quantity beside some other characters such as plant height, number of branches per plant, height of first pod from soil surface, number of pods per plant, number of seeds per pod, number of leaflets per leaf, 100 seed weight per plant and yield weight per plant.

This aim could be achieved by carefully planned mutation breeding program. Mutation is one of the necessary breeding methods to induce variations in plants. In such experiment, chemical mutation program was used for induction of variability in six local and exotic varieties through using EMS chemical agent. Data were collected on yield components such as number of pods per plant, number of seeds per pod, 100 seed weight and the yield weight per plant and beside some important economical characters.

I. Effect of ethylmethane sulphonate (EMS) on some economical characters of faba bean (Vicia faba L.): -

Six varieties of faba bean (Giza 402, Giza 2, Giza 3, FAB-337/78, FAB-89/74 and FAB-114/80) were exposed to four concentrations of the chemical mutagen EMS 0.1 %, 0.2 %, 0.3

% and 0.4 % after soaking in distilled water for 2 hours. Table (1) indicated the data on the effect of EMS on germinated seeds of the studied varieties of faba bean. The data showed marked effect of the EMS on germination, especially at the concentrations, 0.2 and 0.3 %.

In case of Giza 402 treated seeds with EMS, it was found that 62 % germination at 0.1 % concentration, 60 % germination at 0.2 % concentration and 62 % at 0.3 % and 0.4 % concentration compared with 88 % in seeds of control.

In case of Giza 2 treated seeds with EMS, it was found that 62 % germination at 0.1 % concentration, 51 % germination at 0.2 % concentration and 47 % at 0.3 % and 48 % at 0.4 % concentration compared with 85 % in seeds of control. In case of Giza 3 treated seeds with EMS, it was found that 70 % had germinated at 0.1 % concentration, 49 % germination at 0.2 % concentration and 45 % at 0.3 % and 58 % at 0.4 % concentration compared with 87 % in seeds of control.

In case of FAB 337/78 treated seeds with EMS, it was found that 64 % had germinated at 0.1 % concentration, 52 % germinated at 0.2 % concentration and 54 % at 0.3 % and 60 % at 0.4 % concentration compared with 81 % in seeds of control.

In case of FAB 89/74 treated seeds with EMS, it was found that 60 % had germinated at 0.1 % concentration, 55 % germination was obtained at 0.2 % concentration and 55 % at 0.3

Table (1): Percentages of seeds germination in faba bean genotypes treated with Ethylmethane Sulphonate (EMS).

EMS Concentration	*Genotypes*					
	Giza402	**Giza-2**	**Giza-3**	**FAB337/78**	**FAB 89/74**	**FAB 114/80**
0.1%	62%	62%	70%	64%	60%	70%
0.2%	60%	51%	49%	52%	55%	53%
0.3%	62%	47%	45%	54%	55%	66%
0.4%	62%	48%	58%	60%	54%	59%
Control	88%	85%	87%	81%	89%	88%

% and 54 % at 0.4 % concentration compared with 89 % in seeds of control.

In case of FAB 114/80 treated seeds with EMS, it was found that 70 % had germinated at 0.1 % concentration, 53 % germination at 0.2 % concentration and 66 % at 0.3 % and 59 % at 0.4 % concentration compared with 88 % in case of control. These results agreed the finding of **Kumari (1996)** who found that germination of seeds was decreased with the increase of EMS concentration.

Therefore, control of these varieties was used under the same conditions to detect weather the effect is returned to the mutagenesity or environmental conditions in M_2 and M_3 generations.

Data in Tables (2, 3 and 4) had that all the studied characters had highly significant differences at 5 % and 1 %.

The nature and amount of variability induced after EMS treatments for faba bean (Giza 402, Giza 2, Giza 3, FAB-337/78, FAB-89/74 and FAB-114/80) in different morphological, yield characters and seed characters were analyzed quantitatively to assess the extent of induced variations, Tables (5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 and 17). The data on the effect of various concentrations of EMS on the mean values and variances of the different economic characters in M_2 and M_3 generations would be discussed as the following

Table (2): Mean squares for some economical characters of faba bean (*GIZA-402 And GIZA-2)* treated with EMS in M_1, M_2, and M_3 generation.

Source of Variation		d.f	GIZA-402								GIZA-2							
			PH	NB/P	HFP	NP/P	NS/P	NL/L	100SW	YW/P	PH	NB/P	HFP	NP/P	NS/P	NL/L	100SW	YW/P
M1	Rep.	24	50.75	2.430	4.250	0.171	98.470	0.175	2.070	1.303	82.158	4.322	1.732	0.117	60.718	0.350	2.666	0.165
	EMS Treatment	4	128.63*	13.67*	206.92*	4.47*	3256.7*	1.47	159.29*	762.44*	2486.5*	13.792*	97.812*	3.860*	686.71*	0.620	298.34*	329.84*
	Error	96	51.94	2.55	5.40	0.139	64.50	0.218	2.67	1.280	45.920	2.775	2.858	0.156	36.125	0.366	0.338	0.550
M2	Rep.	24	81.150	0.717	0.544	0.173	5.566	0.286	62.329	118.838	71.590	0.866	0.173	0.263	29.786	0.272	150.134	106.913
	EMS Treatment	4	334.46**	11.713**	269.1**	0.306	929.39**	1.450	1914.15**	5554.06**	1057.47**	9.781**	3.284**	0.756**	239.44**	0.906	445.57**	610.23**
	Error	96	27.989	0.546	0.179	0.066	3.414	0.057	18.485	30.319	22.600	0.068	0.030	0.030	4.150	0.200	22.947	26.986
M3	Rep.	8	9.537	1.856	0.450	0.106	5.139	0.106	91.313	105.700	83.961	0.539	2.254	0.100	6.00	0.256	72.003	100.360
	EMS Treatment	4	398.58**	2.189**	7.589**	0.693	125.19**	1.122	1490.42**	954.08**	378.58**	5.878**	34.018**	0.900**	89.24**	0.800	332.15**	516.28**
	Error	32	4.585	0.301	0.083	0.011	0.819	0.010	15.504	40.400	15.109	0.028	0.099	0.010	0.382	0.100	17.910	25.850

* *Significant at 5% Level*

** *Significant at 1% Level*

***PH**= Plant Height (CM.), **NB/P**=Number OF Branch/Plant, **HFP**=Height OF First Pod (cm.), **NP/P**=Number OF Pods/Plant, **NS/P**=NumberOF Seeds /Pod, **NL/L**=Number OF Leaflets/leaf, **100SW**=100 Seed Weight (gm.), **YW/P**= Yield Weight /Plant (gm.).*

Table (3): Mean squares for some economical characters of faba bean (*GIZA-3 And FAB 337/78)* Treated with EMS in M_1, M_2, and M_3 generation.

Source of Variation		d.f	GIZA-3								FAB337/78							
			PH	NB/P	HF/P	NP/P	NS/P	NL/L	100SW	YW/P	PH	NB/P	HF/P	NP/P	NS/P	NL/L	100SW	YW/P
M1	Rep.	24	29.301	1.799	2.633	0.111	4.947	0.208	0.885	0.492	71.850	1.223	1.530	0.083	28.175	0.269	1.713	2.640
	EMS Treatment	4	433.88*	5.552*	46.040*	9.628*	484.852*	0.548	2329.58*	3874.85*	729.46*	23.370*	24.780*	0.320	1153.2*	0.312	1037.81*	2491.82*
	Error	96	34.113	2.073	1.819	0.132	36.750	0.248	0.244	0.041	53.850	1.139	1.451	0.130	33.640	0.258	0.513	0.995
M2	Rep.	24	115.67	0.846	0.090	0.227	272.63	0.533	13.965	31.260	29.302	0.993	0.153	0.280	9.052	0.280	79.129	25.570
	EMS Treatment	4	419.335**	8.594**	3.996**	0.991**	413.641**	0.231	817.371**	3581.59**	369.87**	0.981	2.324**	5.019**	758.075**	1.888	194.101**	1606.83**
	Error	96	15.154	0.027	0.040	0.080	1.864	0.031	27.650	21.230	28.206	0.561	0.049	0.032	3.348	0.067	25.721	14.138
M3	Rep.	8	10.559	2.256	0.828	10.150	2.872	0.222	18.544	25.800	47.163	0.389	0.606	0.089	0.589	0.056	133.935	22.560
	EMS Treatment	4	287.217**	3.467**	14.420**	1.589	171.639**	0.500	1160.23**	4710.2**	299.828**	9.889	14.994**	4.056**	298.356**	1.533	357.00**	2585.75**
	Error	32	18.649	0.017	0.231	0.101	1.087	0.015	20.113	25.700	22.236	0.126	0.908	0.068	1.818	0.083	33.088	20.480

** Significant at 5% Level*
*** Significant at 1% Level*

***PH**= Plant Height (CM.), **NB/P**=Number OF Branch/Plant, **HFP**=Height OF First Pod (cm.), **NP/P**=Number OF Pods/Plant, **NS/P**=Number OF Seeds /Pod, **NL/L**=Number OF Leaflets/leaf, **100SW**=100 Seed Weight (gm.), **YW/P**= Yield Weight /Plant (gm.).*

Table (4): Mean squares for some economical characters of faba bean (FAB 89/74 *And FAB 114/80)* treated with EMS in M_1, M_2, and M_3 generation.

Source of Variation		d.f	FAB 89/74								FAB114/80							
			PH	NB/P	HF/P	NP/P	NS/P	NL/L	100S W	YW/P	PH	NB/P	HF/P	NP/P	NS/P	NL/L	100S W	YW/P
M1	Rep.	24	42.911	2.845	1.055	0.022	26.778	0.315	2.809	2.472	38.979	2.399	2.302	0.038	17.509	0.495	58.510	19.591
	EMS Treatment	4	1147.60*	127.648*	115.952*	0.032	108.67	0.212	201.304*	221.13*	305.92*	12.792*	123.45*	19.038*	49.792	0.688	2356.48*	1413.09*
	Error	96	34.018	3.373	1.894	0.024	49.710	0.308	0.396	2.010	34.592	2.471	2.344	0.038	23.488	0.556	45.494	21.663
M2	Rep.	24	32.953	1.006	0.254	0.267	6.823	0.226	70.924	13.186	39.865	1.890	22.772	0.107	11.170	0.133	53.890	40.661
	EMS Treatment	4	452.340**	2.250	6.856**	0.869*	589.206**	0.500	348.898**	350.685**	296.654**	3.669	46.075**	2.150**	184.531**	0.519	1581.519**	2961.79**
	Error	96	11.538	0.343	0.043	0.035	3.380	0.113	39.082	3.787	15.945	0.175	3.077	0.090	3.618	0.185	31.737	18.075
M3	Rep.	8	25.618	2.900	1.025	0.022	2.272	0.150	20.453	15.800	7.765	0.922	0.200	0.089	1.600	0.256	133.435	38.750
	EMS Treatment	4	280.474**	5.651*	12.186**	0.032	38.586**	0.444	119.082**	325.080**	163.251**	2.378**	87.892**	2.089**	18.611	0.856	250.591**	388.180**
	Error	32	4.381	0.469	0.070	0.012	1.508	0.019	18.718	2.750	2.826	0.078	0.178	0.089	0.211	0.031	38.530	25.500

Significant at 5% Level, *
** *Significant at 1% Level*

***PH**= Plant Height (CM.), **NB/P**=Number OF Branch/Plant, **HF?**=Height OF First Pod (cm.), **NP/P**=Number OF Pods/Plant, **NS/P**=Number OF Seeds /Pod, **NL/L**=Number OF Leaflets/leaf, **100SW**=100 Seed Weight (gm.), **YW/P**= Yield Weight /Plant (gm.).*

GIZA 402 :

a. M_2 generation:

Data on the effect of EMS in Giza- 402 are found in Table (5) and figures (1 and 2). The mean of plant height was reduced significantly at all the concentration levels (78.91, 77.55, 72.59 and 70.98 cm as compared to control, 82.23 cm). The mean of number of branches per plant was also reduced significantly at concentrations of 0.1 % and 0.2 % five branches per plant, 0.3 % four branches per plant and 0.4 % three branches per plant, respectively. In case of the height of the first pod, it was found that it had decreased significantly as compared with the control (15.93 cm) as the height of first pod at 0.1 % concentration was 13.80, at 0.2 % concentration was 13.20, at 0.3 % concentration was 13.12 and at 0.4 % concentration was 12.10, respectively. Means of number of pods per plant showed highly significant reduction at the concentrations 0.1 % and 0.2 % (17.00 pod per plant), 0.3 % (16.00 pod per plant) and 0.4 % (15.00 pod per plant), respectively as compared with the control (33.00 pod per plant).

The mean number of seeds per pod was not affected by the used concentrations as compared with the control (3.00 seeds per pod). The mean number of leaflets per leaf has not affected also at all the used concentrations as compared with the control (6.00 leaflets per leaf). Data on the 100 seed weight revealed that significant reduction as compared to the control (92.13 gm) since the 100 seed weight at 0.1 % concentration was 65.26, at 0.2 % concentration was 56.39, at 0.3 % concentration was 51.69 and at 0.4 % concentration was 47.20. Concerning yield weight per

Table (5): Mean performance (X), Phenotypic Variance (V_{ph}), Genotypic Variance (Vg), and Heretability ($H^2\%$) for some economical characters in M2 generation of faba bean (*GIZA-402*) treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	82.230	27.989			7.00	0.546			15.930	0.179			33.00	0.066		
EMS 0.1%	78.910	71.740	43.751	60.985	5.00	1.650	1.104	66.910	13.800	0.397	0.218	54.910	17.00	0.517	0.451	87.340
EMS 0.2%	77.550	81.165	53.176	53.176	5.00	1.296	0.750	57.870	13.200	0.359	0.180	50.140	17.00	0.196	0.130	66.330
EMS 0.3%	72.590	50.260	22.271	44.311	4.00	1.529	0.983	64.290	13.120	0.315	0.136	43.180	16.00	0.233	0.167	71.670
EMS 0.4%	70.980	55.940	27.951	49.966	3.00	1.096	0.550	50.180	12.100	2.110	1.931	91.510	15.00	0.196	0.130	66.330
L.S.D 0.05	4.899				0.688				0.538				0.365			
Treatment	Number Of Seed /Pod				Number Of Leaflets/leaf				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	3.00	3.414			6.00	0.057			92.130	18.485			110.600	30.319		
EMS 0.1%	3.00	7.396	3.982	53.840	6.00	0.250	0.193	77.200	65.260	61.427	42.942	69.910	33.410	178.966	148.650	83.100
EMS 0.2%	3.00	12.396	8.982	72.460	6.00	0.250	0.193	77.200	56.390	64.470	45.991	71.330	27.120	195.173	164.490	84.280
EMS 0.3%	3.00	9.933	6.519	65.630	6.00	0.250	0.193	77.200	51.690	70.491	52.006	73.78	25.860	100.956	70.640	69.780
EMS 0.4%	3.00	8.400	4.986	59.360	6.00	0.296	0.293	80.740	47.200	59.784	41.389	69.130	21.550	153.945	123.630	80.310
L.S.D 0.05	2.492				0.359				8.386				12.480			

plant, it was also found that it has been decreased significantly as compared to the control (110.60 gm) as the yield weight per plant at 0.1 % concentration was 33.41, at 0.2 % concentration was 27.12 gm, at 0.3 % concentration was 25.86 gm and at 0.4 % concentration was 21.55 gm. This reduction in length of first pod, number of pods and 100 seed weight reflected the high effect of EMS as a chemical mutagen on yield and yield components in M_2 generation.

Data in Table (5) revealed a high significant increase in the heretability percentages in case of number of pods per plant at 0.1 concentration, h^2 was 87.34 %, number of seeds per pod at 0.2 % concentration, 72.46 %, number of leaflets per leaf at all concentrations especially at 0.4%, 80.74 %, 100 seed weight per plant at 0.2 and 0.3% concentrations, 71.33 % and 73.78 %, respectively and the yield weight per plant at all concentrations especially at 0.2 % concentration, 84.28 % in the M_2 generation in comparison to control.

b. M_3 generation:

Data on the effect of EMS in Giza - 402 are found in Table (6) and figures (1 and 2). The mean of plant height was reduced significantly at all the concentration levels 81.23, 79.46, 48.42 and 44.69 cm as compared to control, 82.23cm.

The mean of number of branches per plant was also reduced significantly at concentrations of 0.2 %, 0.3 % and 0.4 % six and four branches per plant, respectively as compared to control seven branches per plant. In case of the height of the

Table (6): Mean performance (X), Phenotypic Variance (V_{ph}), Genotypic Variance (Vg), and Heretability ($H^2\%$) for some economical characters in M_3 generation of faba bean (*GIZA-402*) treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	82.230	4.585			7.000	0.301			15.930	0.083			44.000	0.011		
EMS 0.1%	81.610	25.553	20.968	82.056	7.000	1.788	1.487	83.170	15.000	1.351	1.268	93.860	19.000	0.160	0.149	93.130
EMS 0.2%	79.460	25.072	20.487	81.713	6.000	2.263	1.962	86.690	14.290	0.469	0.386	82.300	18.000	0.260	0.249	95.770
EMS 0.3%	48.420	15.652	11.067	70.710	6.000	1.263	0.962	76.170	14.280	0.702	0.619	88.180	17.000	0.270	0.259	95.930
EMS 0.4%	44.690	35.946	31.361	87.245	4.000	1.273	0.972	76.360	12.260	0.763	0.680	89.120	16.000	0.281	0.270	96.100
L.S.D 0.05	2.813				0.961				0.733				0.256			
Treatment	Number Of Seed /Pod				Number Of Leaflets/leaf				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	3.000	0.819			6.000	0.010			92.130	15.504			110.600	40.400		
EMS 0.1%	4.000	3.389	2.570	75.830	6.000	0.281	0.271	96.440	85.490	119.714	104.210	87.100	35.880	165.500	125.100	75.590
EMS 0.2%	4.000	10.020	9.201	91.830	6.000	0.260	0.250	96.150	75.630	114.955	99.451	86.510	30.500	175.180	134.780	76.940
EMS 0.3%	4.000	2.699	1.880	69.660	6.000	0.137	0.127	92.700	74.260	48.147	32.643	67.800	24.800	80.885	40.490	50.100
EMS 0.4%	4.000	5.439	4.620	84.940	6.000	0.130	0.120	92.310	72.000	42.259	26.755	63.310	23.100	143.200	102.800	71.790
L.S.D 0.05	1.876				0.440				7.154				1.806			

first pod, it was found that it has been decreased significantly as compared with the control (15.93 cm) as the height of first pod at 0.1 % concentration was 15.00, at 0.2 % concentration was 14.29, at 0.3 % concentration was 14.28 and at 0.4 % concentration was 12.26, respectively. Means of number of pods per plant showed highly significant reduction at the concentrations 0.1 %, 0.2 %, 0.3 % and 0.4 % 19.00, 18.00, 17.00 and 16.00 pod per plant, respectively as compared with the control 33.00 pods per plant.

The mean of number of seeds per pod were significantly affected as it showed increase in number of seeds per pod (4 seeds per pod) in all the used concentrations as compared with the control (3.00 seeds per pod). The mean numbers of leaflets per leaf were also not affected in all the used concentrations as compared with the control (6.00 leaflets per leaf). Data on the 100 seed weight revealed that significant reduction as compared with the control 92.13 gm since the 100 seed weight at 0.1 % concentration was 85.49, at 0.2 % concentration was 75.63, at 0.3 % concentration was 74.26 and at 0.4 % concentration was 72.00, respectively. Concerning yield weight per plant, it was also found that it has been decreased significantly as compared to the control 110.60 gm as the yield weight per plant at 0.1 % concentration was 35.88, at 0.2 % concentration was 30.50, at 0.3 % concentration was 24.80and at 0.4 % concentration was 23.100, respectively.

Table (7): Mean performance (X), Phenotypic Variance (V_{ph}), Genotypic Variance (Vg), and Heretability ($H^2\%$) for some economical characters in M2 generation of faba bean *(GIZA-2)* treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	91.420	22.600			7.00	0.068			17.160	0.030			28.00	0.030		
EMS 0.1%	77.100	122.751	100.151	81.590	4.00	0.967	0.899	92.970	15.860	0.404	0.374	92.574	22.00	0.250	0.220	88.000
EMS 0.2%	75.190	58.232	35.632	61.190	4.00	1.429	1.361	95.240	13.630	0.229	0.199	86.899	21.00	0.263	0.233	88.590
EMS 0.3%	74.630	76.993	54.393	70.650	3.00	0.929	0.861	92.680	13.300	0.904	0.874	96.681	21.00	0.267	0.237	88.760
EMS 0.4%	70.450	31.778	31.778	58.440	3.00	4.663	4.595	98.540	12.770	0.240	0.210	87.500	16.00	0.303	0.303	91.000
L.S.D 0.05	5.505				0.940				0.464				0.389			
Treatment	Number Of Seed /Pod				Number Of Leaflets/leaf				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	3.00	4.150			6.00	0.100			104.947	22.947			96.900	26.986		
EMS 0.1%	3.00	59.400	55.250	93.010	6.00	0.229	0.129	56.330	52.360	350.385	327.438	93.450	35.310	178.719	151.173	84.590
EMS 0.2%	3.00	25.363	21.213	83.640	6.00	0.783	0.683	87.230	51.780	472.751	449.804	95.150	25.110	70.299	43.313	61.610
EMS 0.3%	3.00	28.067	23.917	85.210	6.00	0.200	0.100	50.000	45.580	133.045	110.098	82.750	24.600	86.408	59.422	68.770
EMS 0.4%	3.00	25.163	21.013	83.510	6.00	0.263	0.163	61.980	40.680	332.075	309.128	93.100	22.940	823.470	796.480	96.720
L.S.D 0.05	3.475				0.447								9.091			

This reduction in height of first pod, number of pods and 100 seed weight reflected the high effect of EMS as a chemical mutagen on yield and yield components in M_3 generation.

Data in Table (6) revealed highly significant increase in the heretability percentages in case of number of pods per plant, number of seeds per pod, number of leaflets per leaf, 100 seed weight per plant and the weight yield per plant at all concentrations except at 0.3 % concentration, 50.10 % in the M_3 generation in comparison to control.

GIZA 2:

a. M_2 generation:

The data on the effect of various concentrations of EMS on the mean values and variances of the different economic characters, in case of Giza 2 were found in Table (7) and figures (1 and 2). The mean of plant height was reduced at all concentration level (77.10, 75.19, 74.63 and 70.45 cm as compared to control, 91.42 cm).

The mean of number of branches per plant was also reduced at the concentrations of 0.1 % and 0.2 % five branches per plant, 0.3 % four branches per plant and at 0.4 % three branches per plant, respectively. Concerning the height of the first pod, it was found that it has been decreased significantly as compared to the control 17.16 cm as the height of first pod at 0.1 % concentration was 15.86, 0.2 % concentration was 13.63, 0.3 % concentration was 13.30 and 0.4 % concentration was 12.77, respectively.

The mean of number of pods per plant was highly reduced at concentrations of 0.1 % (22.00 pod per plant); 0.2 % and 0.3 % (21.00 pod per plant) and 0.3 % (16.00 pod per plant), respectively as compared to the control 28.00 pod per plant.

The means of number of seeds per pod were not significant at all concentrations as compared with the control (3.00 seeds per pod). The mean numbers of leaflets per leaf were also not affected at all the used concentrations as compared with the control 6.00 leaflets per leaf. Meanwhile, the 100 seed weight character revealed highly significant reduction as compared with the control (104.947 gm) as the 100 seed weight at 0.1 % concentration was 52.36 gm , 0.2 % concentration was 51.78 gm , 0.3 % concentration was 45.58 gm and 0.4 % concentration was 40.68 gm , respectively. Concerning weight yield per plant, it was also showed highly significant reduction as compared with the control (96.90 gm) as the yield weight per plant at 0.1 % concentration was 35.31 gm , 0.2 % concentration was 25.11 gm , 0.3 % concentration was 24.60 gm and 0.4 % concentration was 22.94 gm , respectively.

Data in Table (7) showed highly significant increase in the heretability percentages in case of plant height (81.59 % at 0.1 concentration), number of branches per plant (92.97 %, 95.24 %, 92.68 % and 98.54 %, respectively), height of first pod (92.57 % at 0.1 % concentration and 96.68 % at 0.3 % concentration), number of pods per plant (at all concentrations especially at 0.4 % concentration, 91.00 %), number of seeds per pod (at all concentrations especially at 0.1 % concentration, 93.01 %), 100

seed weight per plant (at all concentrations) and the yield weight per plant (at all concentrations especially at 0.4 % concentration, 96.72 %) in the M_2 generation in comparison to control.

b. M_3 generation:

The data on the effect of various concentrations of EMS on the mean values and variances of the different economic characters, in case of Giza 2 were found in Table (8) and figures (1 and 2). The mean of plant height was reduced at every concentration level (81.40, 80.40, 68.47 and 42.46 cm as compared to control, 91.42 cm). The mean of number of branches per plant was also reduced at the concentrations of 0.1 % and 0.2 % (6 branches per plant), 0.3 % and 0.4 % (5 branches per plant), respectively.

Concerning the height of the first pod, it was found that it has been decreased significantly as compared with the control (17.16 cm) as the height of first pod at 0.1 % concentration was 15.381, 0.2 % concentration was 14.154, 0.3 % concentration was 14.967 and 0.4 % concentration was 13.60, respectively. The mean of number of pods per plant were highly reduced at concentrations of 0.1 % and 0.2 % (18.00 pod per plant); 0.3 % (17.00 pod per plant) and 0.4 % (16.00 pod per plant), respectively as compared with the control (28.00 pod per plant).

The mean of number of seeds per pod were significantly increased (4.00 seeds per pod) at all concentrations as compared with the control (3.00 seeds per pod). The mean numbers of leaflets per leaf were also not affected at all concentrations as

Table (8): Mean performance (X), Phenotypic Variance (V_{ph}), Genotypic Variance (Vg), and Heretability ($H^2\%$) for some economical characters in M_3 generation of faba bean *(GIZA-2)* treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	91.420	15.109			7.000	0.0280			17.160	0.099			28.000	0.010		
EMS 0.1%	81.400	52.320	37.211	71.120	6.000	2.600	2.572	98.920	15.381	3.621	3.522	97.266	18.000	0.240	0.230	95.830
EMS 0.2%	80.400	45.384	30.275	66.710	6.000	1.256	1.228	97.770	14.154	1.119	1.020	91.153	18.000	0.260	0.250	96.150
EMS 0.3%	68.470	69.291	54.182	78.190	5.000	0.824	0.796	96.600	14.967	1.631	1.532	93.930	17.000	0.270	0.260	96.300
EMS 0.4%	42.460	38.978	23.869	61.240	5.000	0.667	0.639	95.800	13.600	0.960	0.861	89.688	16.000	0.303	0.293	96.700
L.S.D 0.05	7.567				0.920				1.288				0.304			
Treatment	Number Of Seed /Pod				Number Of Leaflets/leaf				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	3.000	0.382			6.000	0.100			107.300				96.900	25.850		
EMS 0.1%	4.000	3.497	3.115	89.100	6.000	0.270	0.170	62.960	73.530	83.962	66.052	78.670	36.600	165.300	139.450	84.360
EMS 0.2%	4.000	4.494	4.112	91.500	6.000	0.303	0.203	66.990	73.250	119.673	101.763	85.030	28.400	65.480	39.630	60.520
EMS 0.3%	4.000	4.494	4.112	91.500	6.000	0.203	0.103	50.740	70.530	53.799	35.889	66.710	27.300	74.400	48.550	65.260
EMS 0.4%	4.000	3.880	3.498	90.150	6.000	0.275	0.175	63.640	67.820	102.170	84.260	82.470	21.210	55.170	524.320	95.300
L.S.D 0.05	1.482				0.429				8.476				7.500			

compared with the control (6.00 leaflets per leaf). Meanwhile, the 100 seed weight character revealed highly significant reduction as compared with the control (104.947 gm) as the 100 seed weight at 0.1 % concentration was 73.53 gm , 0.2 % concentration was 73.25 gm , 0.3 % concentration was 70.53 gm and 0.4 % concentration was 67.82 gm , respectively. Concerning weight yield per plant, it was also showed to be highly significant reduced as compared with the control (96.90gm) as then yield weight per plant at 0.1 % concentration was 36.60 gm , 0.2 % concentration was 28.40 gm, 0.3 % concentration was 27.30 gm and 0.4 % concentration was 21.21 gm, respectively.

Data in Table (8) showed highly significant increase in the heretability percentages in case of plant height (78.19 % at 0.3 concentration), number of branches per plant (98.92 %, 97.77 %, 96.60 % and 95.80 %, respectively), height of first pod (97.266 % at 0.1 % concentration, 91.153 % at 0.2 %, 93.930 % at 0.3 % and 89.688 % at 0.4 % concentration), number of pods per plant (at all concentrations; 95.83 %, 96.15 %, 96.30 % and 96.70 %,respectively), number of seeds per pod (at all concentrations; 89.10 %, 91.50 %, 91.50 % and 90.15 %, respectively), number of leaflets per leaf showed significant reduction in heretability as compared to other characters; 100 seed weight per plant (at all concentrations especially at 0.2 % concentration, 85.03 %) and the weight yield per plant (at all concentrations especially at 0.4 % concentration, 95.30 %) in the M_3 generation in comparison to control; this means that it is

possible to make selection for the economical characters which had values more than 50.0 %

GIZA 3:

a. M_2 generation:

The data on the effect of various concentrations of EMS on the mean values and variances of the different economic characters, in case of (Giza 3), were found in Table (9) and figures (1 and 2). The mean plant height was reduced at every concentration level (81.35, 80.44, 70.46 and 48.80 cm as compared with the control, 85.32 cm). The mean of number of branches per plant reduced also at concentrations of 0.1 %, 0.2 % (8 branches per plant), 0.3 % (6 branches per plant) and 0.4 % (5 branches per plant).

Concerning the height of the first pod, it was found that it has been decreased significantly as compared with the control (16.20 cm) as the height of first pod at 0.1 % concentration was 15.30 cm, 0.2 % concentration was 14.155 cm, 0.3 % concentration was 14.489 cm and 0.4 % concentration was 12.194 cm, respectively. The mean of number of pods per plant was highly reduced at concentrations of 0.1 % (18.00 pod per plant), 0.2 % (16.00 pod per plant), at 0.3 % (16.00 pod per plant) and 0.4 % (14.00 pod per plant), respectively as compared with the control (26.00 pod per plant). The mean of number of seeds per pod were significantly increased (4.00 seeds per pod) at all the used concentrations as compared with the control (3.00 seeds per pod).

Table (9) : Mean performance (X), Phenotypic Variance (V_{ph}), Genotypic Variance (Vg), and Heretability (H^2%) for some economical characters in M_2 generation of faba bean *(GIZA-3)* treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	H^2%	X	V_{ph}	V_g	H^2%	X	V_{ph}	V_g	H^2%	X	V_{ph}	V_g	H^2%
Control	85.320	18.649			6.000	0.017			16.200	0.231			26.000	0.101		
EMS 0.1%	81.350	367.541	348.892	92.930	8.000	1.708	1.691	99.000	15.300	2.542	2.536	99.760	18.000	0.260	0.159	61.150
EMS 0.2%	80.440	51.397	35.748	69.550	7.000	4.404	4.387	99.610	14.155	1.001	0.770	76.920	16.000	0.270	0.169	62.590
EMS 0.3%	70.460	50.291	31.642	62.920	6.000	1.400	1.383	98.790	14.489	0.704	0.473	67.190	16.000	0.270	0.169	62.590
EMS 0.4%	48.800	58.962	40.313	68.370	5.000	4.018	4.001	99.580	12.194	0.912	0.681	74.670	14.000	0.260	0.159	61.150
L.S.D 0.05	6.940				0.548				1.326				0.250			
Treatment	Number Of Seed /Pod				Number Of Leaflets/leaf				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	H^2%	X	V_{ph}	V_g	H^2%	X	V_{ph}	V_g	H^2%	X	V_{ph}	V_g	H^2%
Control	3.000	1.087			7.000	0.015			153.160	20.113			80.500	25.700		
EMS 0.1%	4.000	5.199	4.111	79.100	6.000	0.110	0.095	86.360	77.718	46.278	26.165	56.540	44.250	164.300	138.600	84.360
EMS 0.2%	4.000	7.617	6.530	85.730	6.000	0.160	0.145	90.630	74.300	48.698	28.585	58.690	38.800	85.820	60.120	70.100
EMS 0.3%	4.000	2.856	1.769	61.940	6.000	0.221	0.206	93.210	70.194	104.634	84.521	80.780	35.400	100.210	74.510	74.350
EMS 0.4%	4.000	2.992	1.905	63.670	6.000	0.112	0.097	86.610	62.420	114.645	94.532	82.460	31.820	90.150	64.450	71.490
L.S.D 0.05	1.295				0.277				8.650				8.995			

The mean number of leaflets per leaf were also highly significantly reduced (6.00 per leave) at all the used concentrations as compared with the control (7.00 leaflets per leaf). In case of 100 seed weight, it was decreased significantly as compared with the control (153.16 gm) as the 100 seed weight at 0.1 % concentration was 77.718 gm , 0.2 % concentration was 74.30 gm , 0.3 % concentration was 70.194 gm and 0.4 % concentration was 62.42 gm., respectively. Concerning yield weight per plant, it was also revealed that it decreased significantly as compared with the control (80.50 gm) as the weight yield per plant at 0.1 % concentration was 44.250, 0.2 % concentration was 38.80 gm , 0.3 % concentration was 35.40 gm and 0.4 % concentration was 31.82 gm, respectively.

Data in Table (9) showed highly significant increase in the heretability percentages in case of plant height (92.93 % at 0.1 concentration), number of branches per plant (99.00 %, 99.61 %, 98.79 % and 99.58 %, respectively), height of first pod (99.76 % at 0.1 % concentration, 76.92 % at 0.2 % and 74.67 % at 0.4 % concentration), number of pods per plant (at 0.1 % and 0.4 % concentration, 61.15 % and at 0.2 % and 0.3 % concentration, 62.59 %), number of seeds per pod (at concentrations 0.1 % and 0.2 % were 79.10 % and 85.73 %, respectively), number of leaflets per leaf (at all the concentrations),100 seed weight per plant (at 0.3 % and 0.4 % concentrations were 80.78 % and 76.92 %, respectively) and the weight yield per plant (at all concentrations especially at 0.1 concentration, 84.36 %) in the M_2 generation in comparison to control. Also, high values of h^2 to make selection among the treated plants.

b. M_3 generation:

The data on the effect of various concentrations of EMS on the mean values and variances of the different economic characters, in case of (Giza 3), were found in Table (10) and figures (1 and 2). The mean plant height was reduced at all concentration level (72.59, 71.89, 68.69 and 68.14 cm as compared to control, 85.32cm). The mean of number of branches per plant was reduced also at concentrations of 0.1 %, 0.2 % and 0.3 % (5 branches per plant) and 0.4 % (4 branches per plant).

Concerning the height of the first pod, it was decreased significantly as compared with the control (16.20 cm) as the length of first pod at 0.1 % concentration was 13.957 cm, 0.2 % concentration was 13.424 cm, 0.3 % concentration was 12.93 cm and 0.4 % concentration was 12.678, respectively. The mean of number of pods per plant were highly reduced at concentrations of 0.1 % (25.00 pod per plant), 0.2 % (20.00 pod per plant), 0.3 % (17.00 pod per plant) and 0.4 % (15.00 pod per plant), respectively as compared with the control (26.00 pod per plant).

The mean of number of seeds per pod was significantly increased (4.00 seeds per pod) at all the used concentrations as compared with the control (3.00 seeds per pod). The mean number of leaflets per leaf were also significantly highly reduced (6.00 leaflets per leaf) at all the used concentrations as compared with the control (7.00 leaflets per leaf). In case of 100 seed weight, it was revealed that it has significantly decreased as compared with the control (153.16 gm) as the 100 seed weight at

Table (10): Mean performance (X), Phenotypic Variance (V_{ph}), Genotypic Variance (Vg), and Heretability ($H^2\%$) for some economical characters in M_3 generation of faba bean *(GIZA-3)* treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	85.320	15.154			6.00	0.027			16.200	0.040			26.00	0.080		
EMS 0.1%	72.590	75.062	59.908	79.810	5.00	1.050	1.023	97.430	13.957	0.220	0.180	81.820	25.00	0.263	0.183	69.580
EMS 0.2%	71.890	42.959	27.805	64.720	5.00	0.729	0.702	96.300	13.424	0.113	0.073	64.600	20.00	0.250	0.170	68.000
EMS 0.3%	68.690	68.624	53.470	77.920	5.00	0.563	0.563	95.200	12.930	0.161	0.121	75.160	17.00	0.229	0.149	65.100
EMS 0.4%	68.140	47.063	31.909	67.800	4.00	1.429	1.402	98.110	12.678	0.181	0.141	77.900	15.00	0.157	0.077	49.040
L.S.D 0.05	7.589				0.643				0.265				0.323			
Treatment	Number Of Seed /Pod				Number Of Leaflets/leaf				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	3.00	1.864			7.00	0.031			153.160	27.650			80.500	21.230		
EMS 0.1%	4.00	3.529	1.665	47.180	6.00	0.400	0.369	92.250	57.860	48.668	21.018	43.190	46.110	184.338	163.108	88.480
EMS 0.2%	4.00	10.896	9.032	82.890	6.00	0.400	0.369	92.250	54.600	64.508	36.858	57.100	36.100	89.530	68.300	76.290
EMS 0.3%	4.00	17.467	15.603	89.330	6.00	0.329	0.298	90.580	53.910	84.859	57.209	67.420	34.970	63.189	41.959	66.400
EMS 0.4%	4.00	36.533	34.669	94.890	6.00	0.163	0.132	80.980	48.570	86.532	58.882	68.100	34.380	59.124	37.890	64.100
L.S.D 0.05	11.220				0.339											

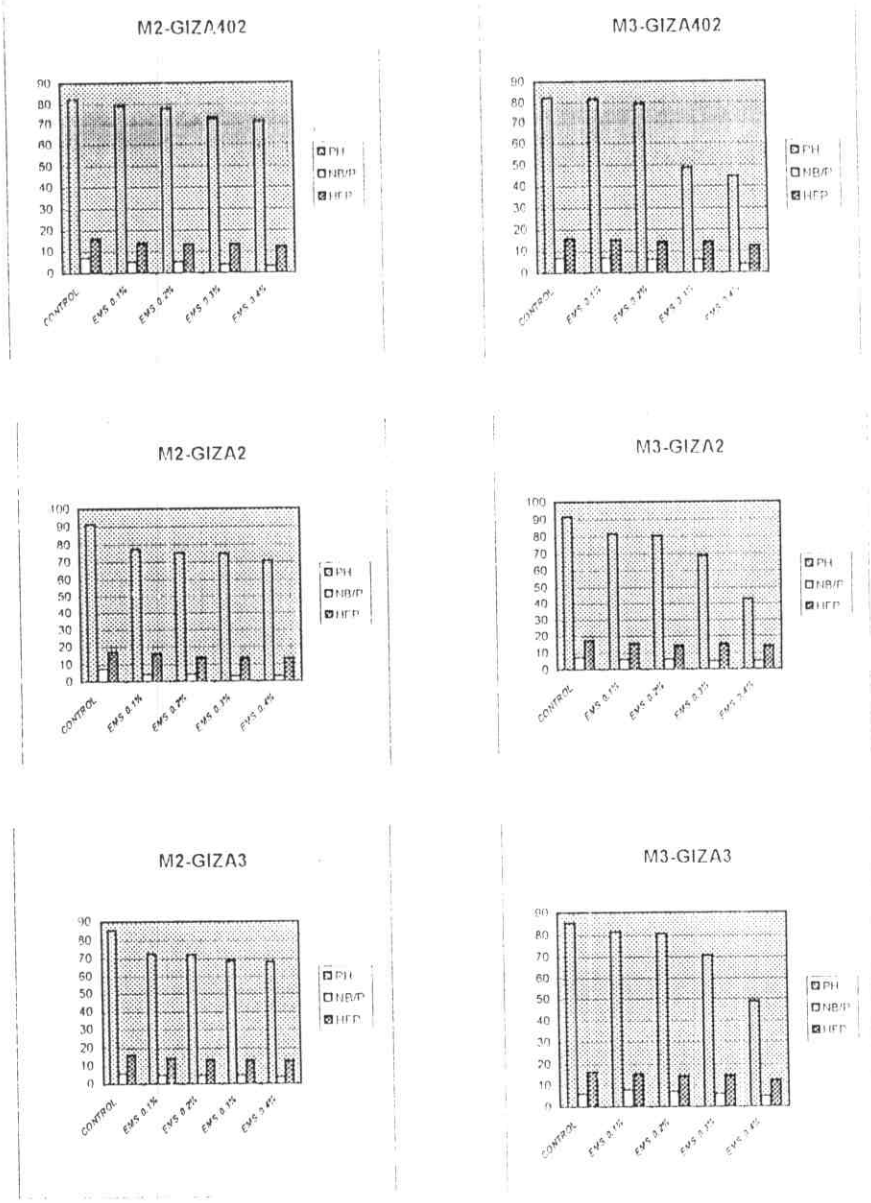


Figure (1): Effect of EMS concentration in both of M_2 and M_3 generations in Giza402, Giza2 and Giza3 for plant height, number of branches and height of first pod

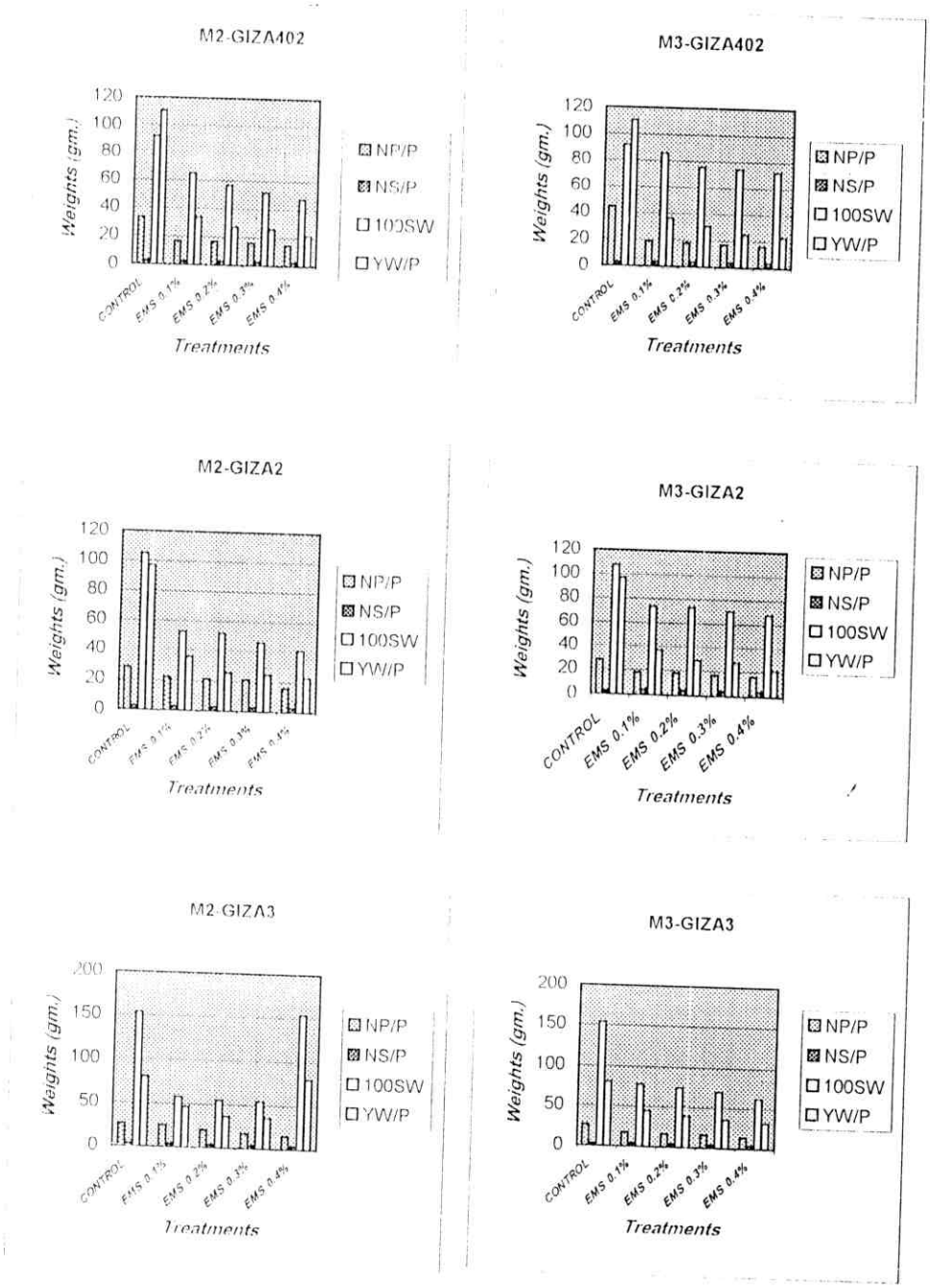


Figure (2): Effect EMS concentration in both of M_2 and M_3 generations in Giza402, Giza2 and Giza3 for Number of pod/ plant, Number of seed/pod, 100 seed weight and Yield weight /plant

Table (11): Mean performance (X), Phenotypic Variance (V_{ph}), Genotypic Variance (Vg), and Heretability ($H^2\%$) for some economical characters in M_2 generation of faba bean *(FAB 337/78)* treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	65.520	28.206			5.00	0.561			16.480	0.049			31.00	0.032		
EMS 0.1%	63.540	56.585	28.379	50.150	4.00	1.463	0.902	61.650	13.560	0.259	0.210	81.100	16.00	0.296	0.264	89.190
EMS 0.2%	56.550	45.082	16.876	37.430	5.00	1.463	0.902	61.650	13.480	0.087	0.038	43.680	16.00	0.117	0.085	72.650
EMS 0.3%	55.180	94.160	65.954	70.040	5.00	1.129	0.568	50.310	13.260	0.168	0.119	70.830	15.00	0.263	0.231	87.830
EMS 0.4%	53.550	42.908	14.702	34.260	5.00	0.700	0.139	19.860	12.520	0.077	0.028	36.360	14.00	0.133	0.101	75.940
L.S.D 0.05	4.190				0.617											
Treatment	Number Of Seed /Pod				Number Of Leaflets/leaf				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	3.00	3.348			5.00	0.067			73.00	25.721			58.180	14.138		
EMS 0.1%	3.00	5.067	1.719	33.930	5.00	0.333	0.266	79.880	57.490	72.539	46.818	64.540	25.920	28.163	14.025	49.800
EMS 0.2%	4.00	4.596	1.248	27.150	5.00	0.163	0.096	58.900	52.790	49.043	23.322	47.550	22.670	23.255	9.117	39.200
EMS 0.3%	4.00	6.733	3.385	50.270	5.00	0.196	0.129	65.820	52.470	82.763	57.042	68.920	21.140	44.171	30.033	67.990
EMS 0.4%	3.00	4.867	1.519	31.210	5.00	0.196	0.129	65.820	44.810	77.507	51.786	66.810	18.890	36.014	21.876	60.740
L.S.D 0.05	1.782				0.365											

FAB 337/78:

a. M_2 generation:

The data on the effect of various concentrations of EMS on the mean values and variances of the different economic characters, in case of (FAB 337/78) were found in Table (11) and figures (3 and 4). The mean of plant height was significantly reduced at 0.2 %, 0.3 % and 0.4 % concentration level (56.55, 55.18 and 53.55 cm, respectively as compared to control, 65.52 cm). The mean of number of branches per plant reduced also at 0.1 % concentration (4 branches per plant) as compared to 5.00 branch per plant.

Concerning the height of the first pod, it was decreased significantly as compared with the control (16.20 cm) as the length of first pod at 0.1 % concentration was 13.56 cm , 0.2 % concentration was 13.48 cm , 0.3 % concentration was 13.26 cm and 0.4 % concentration was 12.52 cm, respectively. The mean of number of pods per plant was highly reduced at concentrations of 0.1 % and 0.2 % (16.00 pod per plant), 0.3 % (15.00 pod per plant) and 0.4 % (14.00 pod per plant), respectively as compared with the control (31.00 pod per plant).

The mean of number of seeds per pod were significantly increased (4.00 seeds per pod) at 0.2 and 0.3 concentrations as compared with the control (3.00 seeds per pod). The mean number of leaflets per leaf were not affected (5.00 per leave) at all the used concentrations as compared with the control (5.00 leaflets per leaf). In case of 100 seed weight, it was revealed that it decreased significantly as compared with the control (73.00

Table (12): Mean performance (X), Phenotypic Variance (V_{ph}), Genotypic Variance (Vg), and Heretability ($H^2\%$) for some economical characters in M_3 generation of faba bean *(FAB 337/78)* treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	65.520	22.236			5.000	0.126			16.480	0.908			31.000	0.068		
EMS 0.1%	61.950	160.197	137.961	86.120	6.000	1.667	1.541	92.440	16.130	5.982	5.074	84.820	20.000	0.290	0.222	76.550
EMS 0.2%	61.340	289.440	267.204	92.320	7.000	0.500	0.374	74.800	14.520	1.772	0.864	48.760	17.000	0.240	0.172	71.670
EMS 0.3%	60.500	80.102	57.866	72.240	6.000	0.868	0.742	85.480	14.320	3.112	2.204	70.820	16.000	0.303	0.235	75.910
EMS 0.4%	58.500	37.400	15.164	40.550	6.000	0.730	0.604	82.740	13.850	3.037	2.129	70.100	16.000	0.300	0.232	77.330
L.S.D 0.05	5.140				1.221				1.065				0.305			
Treatment	Number Of Seed /Pod				Number Of Leaflets/leaf				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	3.000	1.818			5.000	0.083			73.000	33.088			58.180	20.480		
EMS 0.1%	3.000	3.143	1.325	42.160	5.000	0.144	0.061	42.360	71.740	133.523	100.435	75.220	27.950	145.900	125.120	85.760
EMS 0.2%	4.000	3.203	1.385	43.240	6.000	0.203	0.120	59.110	69.100	295.390	262.302	88.800	23.400	155.850	133.370	85.580
EMS 0.3%	4.000	9.181	7.363	80.200	6.000	0.100	0.017	17.000	66.740	289.060	255.971	88.550	21.500	75.300	54.820	72.800
EMS 0.4%	3.000	4.336	2.518	58.100	6.000	0.105	0.022	20.950	66.510	89.807	56.719	63.160	20.950	53.500	33.020	61.720
L.S.D 0.05	1.687				0.445				5.269				3.850			

gm) as the 100 seed weight at 0.1 % concentration was 57.49 gm , 0.2 % concentration was 52.79 gm, 0.3 % concentration was 52.47 gm and 0.4 % concentration was 44.81 gm, respectively. Concerning weight yield per plant, it was also revealed that it decreased significantly as compared with the control (58.18 gm) as the yield weight per plant at 0.1 % concentration was 25.92 gm, 0.2 % concentration was 22.67 gm, 0.3 % concentration was 21.14 gm and 0.4 % concentration was 18.89 gm, respectively.

Data in Table (11) showed highly significant increase in the heretability percentages in case of plant height (70.04 % at 0.3 concentration), number of branches per plant (61.65 % at 0.1 % and 0.2 % concentrations, respectively), height of first pod (81.10 % at 0.1 % concentration and 70.83 % at 0.3 % concentration), number of pods per plant (at all concentrations especially at 0.1 % concentration, 89.19 %), number of seeds per pod (at only one concentration, at 0.3 % concentration, 50.27 %), number of leaflets per leaf (at all concentrations especially at 0.1 % concentration, 79.88 %) 100 seed weight per plant (at all concentrations especially at 0.3 %, 68.81 %) and the yield weight per plant (at 0.3 % and at 0.4 % concentration, 67.99 % and 60.74 %) in the M_2 generation in comparison to control.

b. M_3 generation:

The data on the effect of various concentrations of EMS on the mean values and variances of the different economic characters, in case of (FAB 337/78), were found in Table (12) and figures (3 and 4). The mean of plant height was significantly reduced at all concentrations (61.95, 61.34, 60.50

and 58.50 cm, respectively as compared to control, 65.52 cm). The mean of number of branches per plant has increased at 0.1 %, 0.3 % and 0.4 % concentrations (6 branches per plant) while it highly increased at 0.2 % (7 branches per plant) as compared to 5.00 branch per plant. Concerning the height of the first pod, it was found that it decreased significantly as compared with the control (16.48 cm) as the height of first pod at 0.1 % concentration was 16.13 cm, 0.2 % concentration was 14.52 cm, 0.3 % concentration was 14.32 cm and 0.4 % concentration was 13.85 cm, respectively.

The mean of number of pods per plant were highly reduced at concentrations of 0.1 %, 0.2 %, 0.3 % and 0.4 % (20.00, 17.00, 16.00 and 16.00 pod per plant, respectively) as compared with the control (31.00 pod per plant). The mean of number of seeds per pod were significantly increased (4.00 seeds per pod) at 0.2 % and 0.3 % concentrations as compared with the control (3.00 seeds per pod).

The mean number of leaflets per leaf were increased at 0.2 %, 0.3 % and 0.4 % concentrations (6.00 per leave) as compared with the control (5.00 leaflets per leaf). In case of 100 seed weight, it was revealed that it decreased significantly as compared with the control (73.00 gm) as the 100 seed weight at 0.1 % concentration was 71.740, 0.2 % concentration was 69.10 gm , 0.3 % concentration was 66.74 gm and 0.4 % concentration was 66.51 gm, respectively.

Concerning yield weight per plant, it was also revealed that it has been decreased significantly as compared with the control (58.18 gm) as the yield weight per plant at 0.1 % concentration was 27.950gm, 0.2 % concentration was 23.40 gm, 0.3 % concentration was 21.50 gm and 0.4 % concentration was 20.95 gm, respectively.

Data in Table (12) showed highly significant increase in the heretability percentages in case of plant height at 0.1 and 0.2% concentration (86.12 and 92.32%), number of branches per plant 92.44 % at 0.1 %, 0.3 and 0.4 % concentrations 85.48 and 82.74%, respectively), height of first pod was highly and improvement, number of pods per plant at all concentrations about (71.67 and 77.33%) and especially at 0.3 % concentration, 80.20 %), 100 seed weight per plant and the yield weight per plant were better than local variety (Giza 402 , Giza2 and Giza3) at all concentrations especially at 0.1 , 0.2 and 0.3 % (75.22 88.80 and 88.55%) and (85.76,85.58 and 72.80% respectively) in the M_3 generation in comparison to control. The elevation of h^2 values was enough to make selection among the plants of the M_2 and M_3.

FAB 89/74 :

a. M_2 generation:

The data on the effect of various concentrations of EMS on the mean values and variances of the different economic characters, in case of (FAB 89/74), were found in Table (13) and figures (3 and 4). The mean plant height was reduced significantly at 0.4% concentration level (74.15 cm as compared

Table (13): Mean performance (X),Phenotypic Variance (V_{ph}),Genotypic Variance (Vg), and Heretability ($H^2\%$) for some economical characters in M_2 generation of faba bean *(FAB 89 74)* treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	88.110	11.538			5.00	0.343			16.800	0.043			29.00	0.035		
EMS 0.1%	80.660	25.961	14.423	55.560	5.00	0.896	0.553	61.720	13.975	0.223	0.180	80.720	18.00	0.133	0.098	73.680
EMS 0.2%	79.290	54.855	43.317	78.970	5.00	1.196	0.853	71.320	13.686	0.150	0.107	71.330	17.00	0.250	0.215	86.000
EMS 0.3%	77.320	41.237	29.699	72.020	5.00	1.163	0.820	70.510	12.564	0.184	0.141	76.630	16.00	0.396	0.361	91.160
EMS 0.4%	74.150	25.303	13.765	54.400	5.00	2.329	1.986	85.270	12.716	0.187	0.144	77.010	16.00	0.232	0.232	86.890
L.S.D 0.05	3.998				0.819				0.267				0.343			
Treatment	Number Of Seed /Pod				Number Of Leaflets/leaf				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	3.00	3.380			6.00	0.113			106.700	39.082			80.250	3.787		
EMS 0.1%	3.00	5.650	2.270	40.180	6.00	0.467	0.354	75.800	61.610	184.471	145.389	78.810	29.100	42.419	38.632	91.100
EMS 0.2%	3.00	7.696	4.316	56.100	6.00	0.467	0.354	75.800	56.680	184.345	145.263	78.800	26.940	75.085	71.298	94.950
EMS 0.3%	3.00	5.400	2.020	37.410	6.00	0.467	0.354	75.800	50.590	153.926	114.844	74.610	25.840	9.573	5.786	60.440
EMS 0.4%	3.00	10.463	7.083	67.700	6.00	0.517	0.404	78.140	48.140	144.510	105.430	72.960	23.520	9.259	5.472	59.100
L.S.D 0.05	2.166				0.507				10.010				6.682			

to control, 88.11 cm). The mean of number of branches per plant was not significant at all the concentrations of EMS as compared to the control (5 branches per plant). In case of the height of the first pod, it was found that it decreased significantly as compared with the control (16.80 cm) as the Height of first pod at 0.1 % concentration was 13.975 cm , 0.2 % concentration was 13.686 cm , 0.3 % concentration was 12.564 cm and 0.4 % concentration was 12.716 cm, respectively. The mean of number of pods per plant were highly reduced at concentrations of 0.1 % (18.00 pod per plant), 0.2 % (17.00 pod per plant), 0.3 % and 0.4 (16.00 pod per plant), respectively as compared with the control (29.00 pod per plant).

The means of number of seeds per pod were also not significant (3.00 seeds per pod) at all the used concentrations as compared with the control (3.00 seeds per pod). The mean number of leaflets per leaf were also highly significantly reduced (6.00 leaflets per leaf) at all the used concentrations as compared with the control (6.00 leaflets per leaf). In case of 100 seed weight, it was revealed that it has decreased significantly as compared with the control (106.70 gm) as the 100 seed weight at 0.1 % concentration was 61.61 gm , 0.2 % concentration was 56.68 gm , 0.3 % concentration was 50.59 gm and 0.4 % concentration was 48.14 gm, respectively. Concerning weight yield per plant, it was also revealed that it decreased significantly as compared with the control (80.25 gm) as the yield weight per plant at 0.1 % concentration was 29.10, 0.2 % concentration was 26.94 gm , 0.3 % concentration was 25.84 gm and 0.4 % concentration was 23.52 gm , respectively.

Data in Table (13) showed highly significant increase in the heretability percentages in case of plant height (78.97 % at 0.2 and 72.02% at 0.3% concentration), height of first pod (80.72 % at 0.1 %, 76.63 % at 0.3 % and 77.01% at 0.4% concentration), number of pods per plant (91.16 % at 0.3 %, 86.89 % at 0.4 and 86.00 at 0.2%), 100 seed weight per plant was found that the heretability % was nearly together at all concentrations comparison to control (72.96 - 78.81%) and the yield weight per plant at 0.1 % and 0.2 % concentration (91.10 % and 94.97 %) in the M_2 generation in comparison to control.

b. M_3 generation:

The data on the effect of various concentrations of EMS on the mean values and variances of the different economic characters, in case of (FAB 89/74), were found in Table (14) and figures (3 and 4). The mean plant height was reduced significantly at 0.4% concentration level (51.380 cm as compared to control, 88.11 cm). The mean of number of branches per plant was affected at all the concentrations of EMS (6 and 7 branches per plant) as compared to the control. In case of the length of the first pod, it was found that it decreased significantly as compared with the control (16.80 cm) as the height of first pod at 0.1 % concentration was 14.225 cm , 0.2 % concentration was 14.25 cm , 0.3 % concentration was 13.964 cm and 0.4 % concentration was 13.775 cm , respectively.

The mean of number of pods per plant were highly reduced at concentrations of 0.1 % (18.00 pod per plant), 0.2 % and 0.3% (17.00 pod per plant) and 0.4% (16.00 pod per plant),

Table (14): Mean performance (X),Phenotypic Variance (V_{ph}),Genotypic Variance (Vg), and Heretability ($H^2\%$) for some economical characters in M_3 generation of faba bean *(FAB 89/74)* treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	91.800	4.381			5.000	0.469			16.800	0.070			21.000	0.012		
EMS 0.1%	87.570	10.506	6.125	58.300	6.000	2.932	2.463	84.000	14.225	0.451	0.381	84.480	18.000	0.260	0.248	95.380
EMS 0.2%	84.770	19.633	15.252	77.690	6.000	1.929	1.460	75.690	14.250	0.865	0.795	91.910	17.000	0.240	0.228	95.000
EMS 0.3%	70.870	17.103	12.722	74.380	6.000	1.952	1.483	75.970	13.964	0.337	0.267	79.230	17.000	0.281	0.269	95.730
EMS 0.4%	51.380	29.670	25.289	85.230	7.000	2.970	2.501	84.210	13.775	0.961	0.891	92.720	16.000	0.240	0.228	95.000
L.S.D 0.05	1.766				1.164				0.584				0.142			
Treatment	Number Of Seed /Pod				Number Of Leaflets/leave				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	3.000	1.508			6.000	0.019			106.700	18.718			80.250	2.750		
EMS 0.1%	3.000	2.993	1.485	49.620	6.000	0.125	0.106	84.800	84.310	60.373	41.655	68.996	35.800	25.100	22.350	89.040
EMS 0.2%	3.000	3.168	1.660	52.400	6.000	0.184	0.165	89.670	72.790	58.523	39.805	68.016	28.500	33.400	30.650	91.770
EMS 0.3%	3.000	6.150	4.642	75.480	6.000	0.135	0.116	69.480	69.480	63.361	44.643	70.458	26.400	53.820	51.100	94.890
EMS 0.4%	3.000	3.880	2.372	61.130	6.000	0.139	0.120	67.120	67.120	81.360	62.642	76.994	23.300	33.030	30.280	91.670
L.S.D 0.05	1.798				0.449				7.843				4.665			

respectively as compared with the control (29.00 pod per plant). The means of number of seeds per pod were not affected (3.00 seeds per pod) at all the used concentrations as compared with the control (3.00 seeds per pod).

The mean number of leaflets per leaf were also highly significantly reduced (6.00 leaflets per leaf) at all the used concentrations as compared with the control (6.00 leaflets per leaf). In case of 100 seed weight, it was revealed that it decreased significantly as compared with the control (106.70 gm) as the 100 seed weight at 0.1 % concentration was 84.31 gm , 0.2 % concentration was 72.79 gm, 0.3 % concentration was 69.48 gm and 0.4 % concentration was 67.79 gm, respectively. Concerning yield weight per plant, it was also revealed that it decreased significantly as compared with the control (80.250 gm) as the yield weight per plant at 0.1 % concentration was 35.80 gm , 0.2 % concentration was 28.50 gm , 0.3 % concentration was 26.40 gm and 0.4 % concentration was 23.30 gm, respectively.

Data in Table (14) showed highly significant increase in the heretability percentages in case of plant height were medium and high in (77.69 % at 0.2, 74.38% at 0.3 and 85.23% at 0.4% concentration respectively.), number of branches per plant was highly heretability percentages in all concentrations, height of first pod (84.48 % at 0.1, 91.91 % at 0.3 and 92.72 % at 0.4% concentration), number of pods per plant in all concentrations was highly and nearly (95.0-95.73%), 100 seed weight per plant (at all concentrations especially at 0.3 %, 70.46 % and 0.4%

76.99%) and the yield weight per plant had high heretability% in all concentration which ranged between 91.67-89.04% in the M_3 generation in comparison to control.

FAB 114/80 :

a. M_2 generation:

The data on the effect of various concentrations of EMS on the mean values and variances of the different economic characters, in case of (FAB 114/80), are showed in Table (15) and figures (3 and 4). The mean plant height was reduced significantly at 0.3 and 0.4 % concentration levels (68.97 and 68.89 cm as compared to control, 78.00 cm).

The mean of number of branches per plant was reduced also at concentrations of 0.2 % and 0.4 % (5 branches per plant) as compared with the control (6 branches per plant). Concerning the Height of the first pod, it was found that it has decreased non-significantly as compared with the control (13.140 cm) as the height of first pod at 0.4 % concentration was 12.723. It has increased also non-significantly at 0.3 % concentration (16.059 cm).

The mean of number of pods per plant were highly decreased at concentrations of 0.1 and 0.2% (18.00 pod per plant) and at 0.3 and at 0.4% (17.00 pod per plant), respectively as compared with the control (25.00 pod per plant). The mean of number of seeds per pod were not affected (3.00 seeds per pod) at all the used concentrations as compared with the control (3.00 seeds per pod). The mean number of leaflets per leaf were also

Table (15): Mean performance (X), Phenotypic Variance (V_{ph}), Genotypic Variance (Vg), and Heretability ($H^2\%$) for some economical characters in M_2 generation of faba bean (*FAB 114/89*) treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	78.000	15.945			6.00	0.175			13.140	3.077			25.000	0.090		
EMS 0.1%	73.336	129.325	113.380	87.670	6.00	1.129	0.954	84.500	13.959	15.536	12.459	80.190	18.000	0.250	0.160	64.000
EMS 0.2%	72.930	48.335	32.390	67.010	5.00	1.096	0.921	84.030	13.520	19.182	16.105	83.960	18.000	0.217	0.127	58.530
EMS 0.3%	68.970	46.961	31.016	66.050	6.00	1.983	1.808	91.170	16.059	11.031	7.954	72.110	17.000	0.250	0.160	64.000
EMS 0.4%	68.890	38.934	22.989	59.050	5.00	1.317	1.142	86.710	12.723	13.157	10.080	76.610	17.000	0.250	0.160	64.000
L.S.D 0.05	5.290				0.767				3.323				0.308			
Treatment	Number Of Seed /Pod				Number Of Leaflets/leave				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	3.000	3.618			6.000	0.185			97.170	31.737			77.740	18.075		
EMS 0.1%	3.000	12.463	8.845	70.970	6.000	0.333	0.148	44.440	65.726	83.015	53.278	64.180	38.828	80.942	62.867	77.670
EMS 0.2%	3.000	9.400	5.782	61.510	5.000	0.483	0.198	40.990	64.552	119.553	87.816	73.450	36.152	95.242	77.167	81.020
EMS 0.3%	3.000	13.600	9.982	73.400	5.000	0.303	0.118	38.940	63.100	128.019	96.282	75.210	31.192	82.506	64.431	78.100
EMS 0.4%	3.000	13.583	9.965	73.360	6.000	0.296	0.111	37.500	61.485	60.252	28.515	47.330	31.963	102.168	84.093	82.310
L.S.D 0.05	2.193				0.378				9.463				10.080			

highly significantly reduced (5.00 leaflets per leaf) at the concentrations 0.2 and 0.3% as compared with the control (6.00 leaflets per leaf).

In case of 100 seed weight, it was revealed that it was significantly decreased as compared with the control (97.17 gm) as the 100 seed weight at 0.1 % concentration was 65.726 gm , 0.2 % concentration was 64.552 gm , 0.3 % concentration was 63.10 gm and 0.4 % concentration was 61.485 gm, respectively. Concerning yield weight per plant, it was also revealed that it decreased significantly as compared with the control (77.74 gm) as the yield weight per plant at 0.1 % concentration was 38.828 gm , 0.2 % concentration was 36.152 gm, 0.3 % concentration was 31.192 gm, and 0.4 % concentration was 31.963 gm, respectively.

Data in Table (15) showed highly significant increase in the heretability percentages in case of plant height (87.67 % at 0.1% concentration), number of branches per plant (84.03 % at 0.2 and 86.71% at 0.4 % concentrations, respectively), height of first pod (72.11 % at 0.3 and 76.61% at 0.4 % concentration), number of pods per plant the heretability percentages was nearly the same in all concentrations, but the heretability percentages was highly 73.45% at 0.2 and 75.21% at 0.3% concentrations) in case 100 seed weight per plant. The weight yield per plant at 0.2 % and 0.4 % concentrations were 81.02 and 82.31% in the M_2 generation in comparison to control.

b. M_3 generation:

The data on the effect of various concentrations of EMS on the mean values and variances of the different economic characters, in case of (FAB 114/80), were found in Table (16) and figures (3 and 4). The mean plant height was reduced significantly at only 0.4% concentration levels (68.35 cm as compared to control, 78.00cm). The mean of number of branches per plant were affected also at concentrations of 0.2 % and 0.4 % (7 branches per plant) as compared to the control (6 branches per plant).

Concerning the height of the first pod, it was found that it has decreased significantly as compared with the control (13.14 cm) as the height of first pod at 0.1 and 0.2% concentration was 14.60 cm and 14.35 cm. It has increased also but non-significantly at 0.3 % concentration (16.059 cm). The mean of number of pods per plant were highly decreased at concentrations of 0.1 and 0.2 (18.00 pod per plant) and at 0.3 and 0.4% (17.00 and 16.00 pod per plant), respectively as compared with the control (25.00 pod per plant).

The mean of number of seeds per pod were not affected (3.00 seeds per pod) at 0.1 and 0.4% concentrations as compared with the control (3.00 seeds per pod). The mean number of leaflets per leaf were also highly significantly reduced (5.00 leaflets per leaf) at the concentrations 0.2 and 0.3% as compared with the control (6.00 leaflets per leaf). In case of 100 seed weight, it was revealed that it decreased significantly as compared with the control (97.17 gm) as the 100 seed weight at

Table (16): Mean performance (X), Phenotypic Variance (V_{ph}), Genotypic Variance (Vg), and Heretability ($H^2\%$) for some economical characters in M_3 generation of faba bean (*FAB 114/89*) treated with EMS.

Treatments	Plant Height (cm.)				Number of Branch /Plant				Height of First Pod (cm.)				Number Of Pods /Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	78.000	2.826			6.000	0.078			13.140	0.178			25.000	0.089		
EMS 0.1%	75.120	18.308	15.482	84.560	6.000	1.528	1.450	94.900	14.600	0.357	0.179	50.140	18.000	0.260	0.171	65.800
EMS 0.2%	72.230	13.615	10.789	79.240	7.000	0.386	0.308	79.790	14.350	0.554	0.376	67.870	18.000	0.270	0.181	67.040
EMS 0.3%	71.780	13.835	11.009	79.570	6.000	0.593	0.515	86.850	13.457	0.349	0.171	48.997	17.000	0.280	0.191	68.210
EMS 0.4%	68.350	11.390	8.564	75.190	7.000	0.487	0.409	83.980	13.733	0.809	0.631	77.998	16.000	0.250	0.161	64.400
L.S.D 0.05	2.109				0.664				0.664				0.287			
Treatment	Number Of Seed /Pod				Number Of Leaflets/leaf				100 Seed Weight (gm.)				Yield Weight/Plant			
	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$	X	V_{ph}	V_g	$H^2\%$
Control	3.000	0.211			6.000	0.031			97.170	38.530			77.740	25.500		
EMS 0.1%	3.000	1.533	1.322	86.240	6.000	0.194	0.163	84.020	85.811	255.001	216.471	84.890	36.750	70.650	45.150	63.907
EMS 0.2%	4.000	4.080	3.869	94.830	6.00	0.260	0.229	88.100	84.220	114.371	75.841	66.310	35.400	85.665	60.165	70.233
EMS 0.3%	4.000	4.666	4.455	95.480	6.000	0.100	0.069	69.000	83.540	113.249	74.719	65.980	32.500	75.250	49.750	66.113
EMS 0.4%	3.000	2.689	2.478	92.150	6.000	0.100	0.069	69.000	71.820	78.167	39.637	50.710	30.150	65.889	40.389	61.299
L.S.D 0.05	1.428				0.478				8.509				7.669			

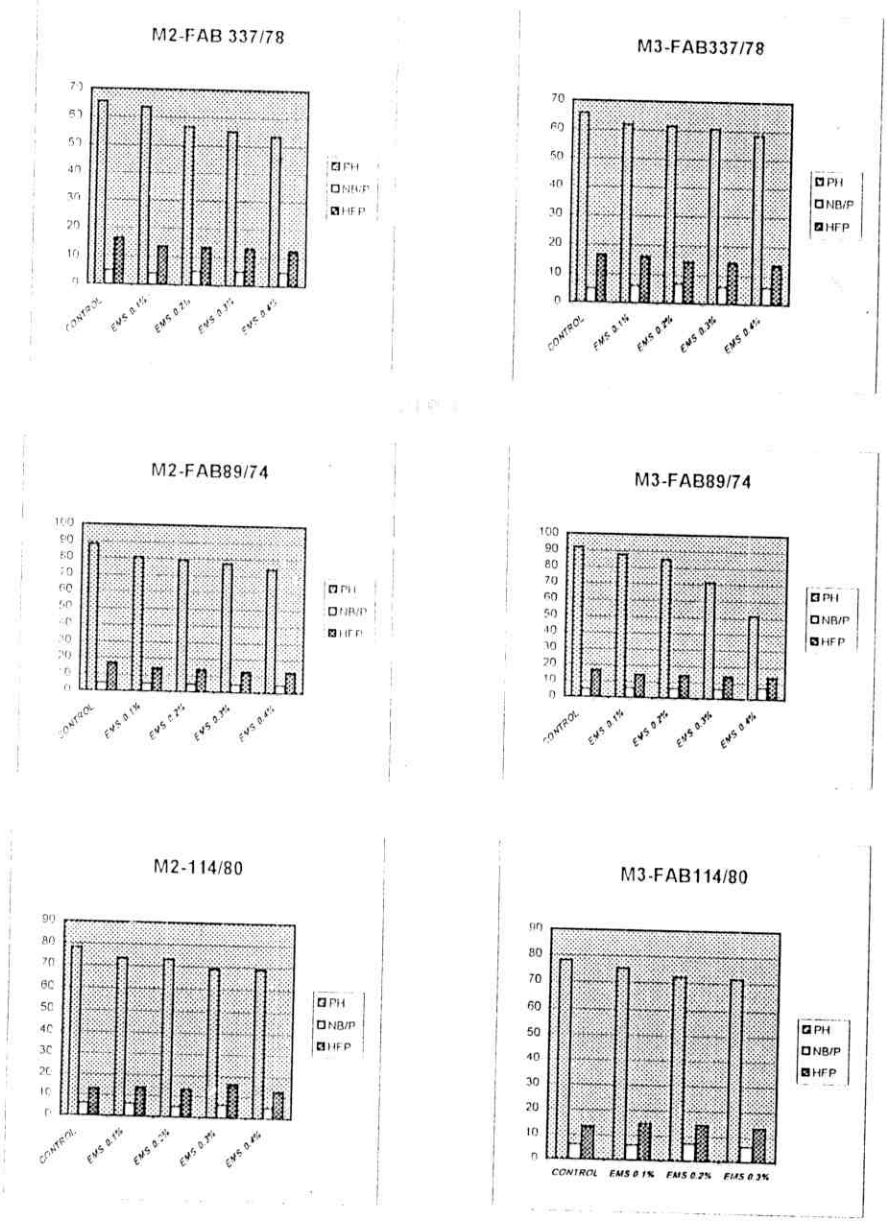


Figure (3):Effect of EMS concentration in both of M_2 and M_3 generations in FAB337/78,FAB89/74 and FAB114/80 for plant height, number of branches and height of first pod.

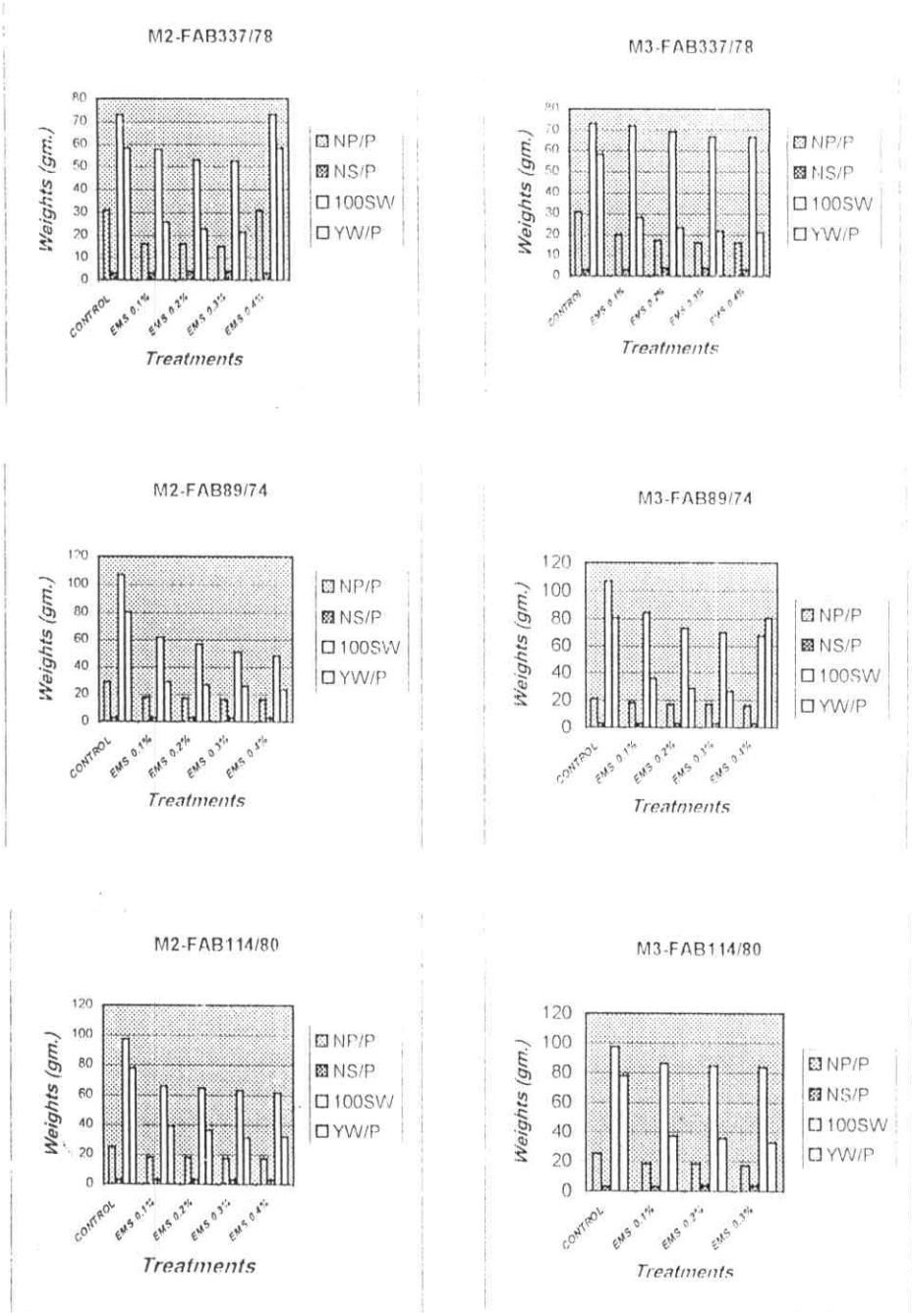


Figure (4): Effect of EMS concentration in both of M_2 and M_3 generations in FAB337/78,FAB89/74 and FAB114/80 for Number of pod/ plant, Number of seed/pod, 100 seed weight and Yield weight /plant

0.1 % concentration was 85.810, 0.2 % concentration was 84.22 gm , 0.3 % concentration was 83.54 gm and 0.4 % concentration was 74.82 gm, respectively. Concerning yield weight per plant, it was also revealed that it decreased significantly as compared with the control (77.74 gm) as the yield weight per plant at 0.1, 0.2 and 0.3% concentrations were 36.75, 35.40 and 32.50 gm and at 0.4 % concentration was 30.15 gm, respectively.

Data in Table (16) showed highly significant increase in the heretability percentages was nearly in case of plant height in all concentrations, number of branches per plant (94.50 % at 0.1 % and 86.85% at 0.3 % concentrations, respectively), height of first pod (81.10 % at 0.1 % concentration and 70.83 % at 0.3 % concentrations), number of pods per plant the heretability percentages was nearly medium in all concentrations was ranged from (64.40-68.21%), 100 seed weight per plant (at all concentrations especially at 0.1 %, 84.89 %) and in cases the yield weight per plant the heretability percentages was nearly with (at 0.1 %, 0.3 % and at 0.4 % concentrations, but especially at 0.1%, 70.23% in the M_3 generation in comparison to control.

Concerning the seed size characters of faba bean genotypes showed in table (17) and figure (5a ,b), it was found that highly significant differences between the six varieties under study in seed length, width, thickness and indices of seeds (Length / Width) and (Width / Length).

Table (17): Mean values of some physical seeds size characters of faba bean genotypes treated with EMS in M_3 generation.

GENOTYPES	Treatments	Seed Length (mm.)	Seed Width (mm.)	Seed Thickness (mm.)	L/W INDEX	W/T INDEX
GIZA-402	Control	16.00	11.00	6.00	1.454	1.833
	EMS 0.1%	10.00	7.80	5.20	1.282	1.500
	EMS 0.2%	12.33	9.00	4.56	1.370	1.974
	EMS 0.3%	12.92	6.77	5.31	1.908	1.275
	EMS 0.4%	13.63	6.88	5.13	1.981	1.341
GIZA-2	Control	17.00	12.00	5.00	1.417	2.400
	EMS 0.1%	11.90	7.50	4.60	1.587	1.630
	EMS 0.2%	11.56	8.00	5.67	1.445	1.411
	EMS 0.3%	12.67	6.56	5.11	1.931	1.284
	EMS 0.4%	13.25	7.00	5.25	1.893	1.333
GIZA-3	Control	14.00	10.00	6.00	1.400	1.667
	EMS 0.1%	11.50	8.33	4.66	1.381	1.788
	EMS 0.2%	11.29	9.00	5.86	1.254	1.536
	EMS 0.3%	12.25	6.42	5.33	1.908	1.205
	EMS 0.4%	15.30	7.70	6.40	1.987	1.203
FAB 337/78	Control	13.00	11.00	6.00	1.182	1.833
	EMS 0.1%	11.00	8.80	6.00	1.250	1.466
	EMS 0.2%	11.67	8.33	6.00	1.401	1.388
	EMS 0.3%	14.33	7.00	5.00	2.047	1.400
	EMS 0.4%	12.67	7.33	6.00	1.728	1.222
FAB 89/74	Control	15.00	10.00	6.00	1.500	1.667
	EMS 0.1%	11.00	8.13	5.25	1.353	1.549
	EMS 0.2%	12.00	7.25	5.63	1.655	1.288
	EMS 0.3%	13.40	7.00	6.00	1.914	1.167
	EMS 0.4%	13.71	6.43	5.00	2.132	1.286
FAB 114/80	Control	15.00	11.00	4.00	1.364	2.750
	EMS 0.1%	13.00	9.17	4.83	1.418	1.899
	EMS 0.2%	13.88	6.50	5.50	2.135	1.182
	EMS 0.3%	13.78	6.89	5.44	2.00	1.267
	EMS 0.4%	13.33	6.56	5.22	2.032	1.206

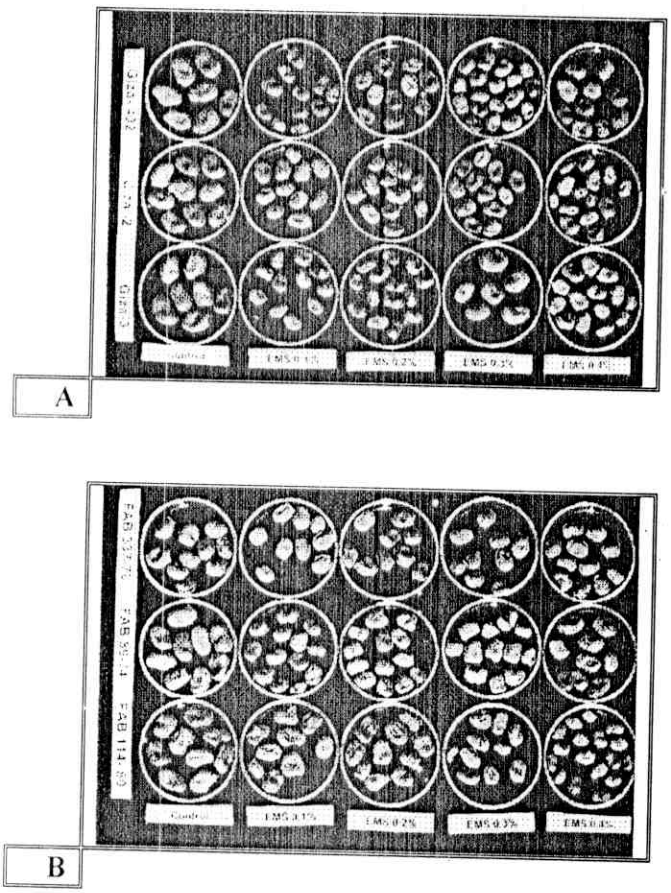


Fig (5 a, b): Variation between M_3 generation seed size of different genotypes faba bean *(Vicia faba L.)* treated with EMS.

Giza 402:

The measurements of seed characters (seed length, width, thickness and indices of seeds (Length / Width) and (Width / Length) in Giza 402 revealed significant reduction in index of seed length / width in M_3 population after treatment with EMS especially 0.1% treatment (1.282) and 0.2% treatment (1.370) while it significantly increased at 0.3 % treatment (1.908) and 0.4% treatment (1.981), respectively comparing to the control (1.454). Also, significant reduction in index of seed (Width / Length) in M_3 population after treatment with EMS especially 0.1% treatment (1.500), 0.3% treatment (1.275) and 0.4% treatment (1.341). Meanwhile it significantly increased at 0.2 % treatment (1.974) comparing to the control (1.833).

Giza 2:

The seed characters (seed length, width, thickness and indices of seeds (Length / Width) and (Width / Length) in Giza 2 showed significant increase in index of seed (Length / Width) in M_3 population after treatment with EMS (in all treatments, 1.587, 1.445, 1.931 and 1.893, respectively) as compared to the (1.417). Also, highly significant reduction in index of seed (Width / Length in M_3 population after treatment with EMS (in all treatments, 1.630, 1.411, 1.284 and 1.333, respectively) as comparing to the control (2.400).

Giza 3:

Concerning the seed characters (seed length, width, thickness and indices of seeds (Length / Width) and (Width / Length) in Giza 3, it was found significant reduction in index of

seed (Length / Width) in M_3 population after treatment with EMS especially 0.1% treatment (1.381) and 0.2% treatment (1.254) while it significantly increased at 0.3% treatment (1.908) and 0.4% treatment (1.987), respectively as comparing to the control (1.400). Also, significant reduction in index of seed (Width / Length) in M_3 population after treatment with EMS especially 0.2% treatment (1.536), 0.3% treatment (1.205) and 0.4% treatment (1.203). Meanwhile it significantly increased at 0.1% treatment (1.788) comparing to the control (1.667).

FAB 337/78:

In studying the seed characters, seed length, width, thickness and indices of seeds (Length / Width) and (Width / Length) of FAB 337/78, significant increase in index of seed (Length / Width) in M_3 population after treatment with EMS (in all treatments; 1.250, 1.401, 2.047 and 1.728, respectively) comparing to the control (1.1.182) were recorded. Also, significant reduction in index of seed (Width / Length) in M_3 population after treatment with EMS (in all treatments; 1.466, 1.388, 1.400 and 1.222 respectively) as compared to the control (1.833).

FAB 89/74:

In case of studying the seed characters, seed length, width, thickness and indices of seeds (Length / Width) and (Width / Length) in FAB 89/74, it was detected significant reduction in index of seed (Length / Width) in M_3 population after treatment with EMS treatment, 0.1% (1.353) while it significantly increased at 0.2% treatment (1.655), 0.3% treatment

(1.914) and 0.4% treatment (2.132), respectively comparing to the control (1.500). Also, significant reduction in index of seed (Width / Length) in M_3 population after treatment with EMS (in all treatments (1.549, 1.288, 1.167 and 1.286, respectively) as compared to the control (1.667).

FAB 114/80:

In case of studying the seed characters, seed length, width, thickness and indices of seeds (Length / Width) and (Width / Length) in FAB 89/74, it was detected significant reduction in index of seed (Length / Width) in M_3 population after treatment with EMS treatment, 0.1% (1.018), while it significantly increased at 0.2% treatment (2.135) , 0.3% treatment (2.000) and 0.4% treatment (2.032), respectively comparing to the control (1.364). Also, significant reduction in index of seed (Width / Length) in M_3 population after treatment with EMS (in all treatments; 1.899, 1.182, 1.267 and 1.206, respectively) as compared to the control (2.750).

The polygenic characters Viz. high grain yield, plant type quality, grain quality and protein quality have been improved by mutagensis (**Jain, 1975;Virupakshappa, *et al.*, 1980;Sarkar and Sharma, 1987 and 1988;Verma and Singh, 1984**).

These findings are enough evidence that chemical mutagensis EMS is potential tool to be employed in the crop improvement.

The response to different concentration (0.1, 0.2, 0.3 and 0.4%) of mutagens agent EMS as measured by magnitude and the nature of the induce variability varied from character to other and between the six varieties of faba bean. The estimates between difference concentration of EMS and genotypes showed significant increases in all six characters in both M_2 and M_3 plants and observed above results in table (2, 3 and 4); after two cycle of selection in M_2 and M_3 population showed non-significant increases in two characters number of seed/pod and number of leaflets/leaf. Also observed significant mutagenically induce inter-treatment and between different genotypes of faba bean for all the studied characters, associated with negative shift of some treatment means in the treated population against the control means **(Ismail, *et al*, 1976 a ,b; Virupakshappa, *et al.*, 1980; Khan, *et al*, 1984 and Vandana, 1992a)**.

The analysis of genetics variance and heretability % and observations on variety and treatment interaction suggests that individual treatments differed more in M_3 than in M_2 in generating variability and for overall means increased significantly in the mutagenically derived populations and were still associated with a high overall and inter-mutant lines variance values. Using both chemical mutagens and gamma rays, many other workers have also found mean values decreasing significantly for most of the characters in M_2 generation, suggesting occurrence of more polygenic mutations in negative direction **(Virk, *et al.*, 1978;Brock, 1965;Khalil and Nassib, 1986 and Danish, *et al.*, 1981)**.

They attributed the decline to either physiological damage caused chiefly by chemical mutagens or chromosomal aberrations caused mainly by irradiation. These physiological disturbances get eliminated progressively in subsequent generations.

Seed yield is a complex characters; decrease in yield components get adversely affect by mutagenic treatments, most of the induced mutations are of deleterious nature and recessive and this explains the reduction in the mean values. **Brock, 1965** observed that random mutations in characters with definite selection history shift the treatment means away from the control mean in the direction, opposite to the previous selection history.

Contrarily, it is proposed that random mutations bring about unidirectional changes in the mean values of almost all the quantitative characters of interest to the plant breeder **(Gaul and Aastveit, 1966; Filippetti and Pace, 1981 and Naik, *et al.*, 2000)** that vitality of the genotype is the probable factor governing the mean behavior, though partly explains the irregular behavior of the mean, still is not satisfactory.

In the present investigation in six of the eight characters studied, the M_2 and M_3 population mean were got significantly reduced, The eight character registering increase in M_2 and M_3 mean values, also confirms Brock's theory, because the previous selection for the character up till now has been for bigger leafy plant types and consequently for low harvest values.

It is generally expected that most of the induced mutations are recessive nature and if a parental character is determined by wild type genes, the induced variation will largely be in the reverse direction.

On the other hand, recessive genes if involved in determining a character in the parent, only a very small fraction of the induced variation in the opposite direction is to be expected. Most quantitative characters however, have a complex genetic determination involving a large number of genes interacting with one another, consequently variation in both the direction is to be expected, although the two components will not be uniformly generated. It is implied that study, for number of seed/pod and number of leaflets/leaf between different genotypes the number of plus and minus effects in the studied quantitative characters were essentially equal.

It was selected some mutant lines in M_3 population that was highly in quality characters. It was found that the high degree of genetic stability in all local varieties (Giza-402, Giza-2 and Giza-3) and introduced varieties (FAB 337/78 , FAB 89/74 and FAB 114/80), also the mutant lines were entered in screening and selection programs by corresponding between economical characters and Biochemical characters i.e. percentage of protein content, percentage of soluble protein and percentage of available protein % and trypsin inhibitor content .

II. Effect of Ethylmethane Sulphonate on Some Biochemical Quality in Faba Bean *(Vicia faba L.)* : -

Faba bean ***(Vicia faba L.)*** seeds are used directly or indirectly (after processing) for human nutrition and animal feeding; consequently, the nutritional quality of the seeds is an important breeding objective. Increased seed protein content and percentage of sulfur containing amino acids along with a decrease in the amount of antinutritional factors (ANF) are the main traits to be used as selection criteria during breeding for seed quality.

A large genetic variability **(Filippetti, 1979; Filippetti, *et al.* 1985),** high heretability **(Sjodin, 1981),** and negative correlation with seed yield has been detected for seed protein content. and its improvement is feasible through recombinant DNA technology and genetic transformation **(Muntz, *et al.* 1993).**

II.1 The improvement of Protein contents and Trypsin Inhibitor content:

Little information is available on the extent of variation in concentrations of ANF. The presence of ANF impairs the nutritional value of the protein in faba beans compared with that of adequately heated soybean protein ***(Huisman, 1991).*** The main components of ANF in faba beans are: protease Trypsin inhibitor content 0.7-1.6 mg/g dry seeds, according to **Huisman** 1991; 2.24 - 4.1 mg/g dry seeds. According to **(Bond, *et al.* 1991),** lectins **(Liener 1989)**, and vic-ine/convicine **(Marquardt, 1989).**

Trypsin inhibitors and lectins increase the secretion of endogenous proteins (salivary proteins, digestive enzymes, mucus and epithelial cell proteins) in animals fed a diet containing faba bean seeds. The primary effect of trypsin inhibitor activity (TIA) is related to the inactivation of chymotrypsin produced by the pancreas. Because of this inactivation, a negative feedback mechanism makes the pancreas enhance enzyme secretion **(Huisman, 1991).**

The true digestibility of crude protein of Faba bean seed is about 93% but this value was reduced to 76% in pigs, as measured by the difference between intake of Faba bean protein and amino acids and the amount of protein and amino acids in the ileal chyme **(Jansman, 1995).** In the pig and other non-ruminant farm anti-mals T.I.A decreased growth rate and feed conversion efficiency (**Marquardt 1989 and Huisman 1991**).

No sources of zero TIA are yet available, germplasm sources with low TIA are known **(Azadegan, 1993**). It is, however, known that TIA responds to selection **(Sjodin *et al.* 1981a, b),** even though TIA is subject to modification by environment (year and location), and genotype environment interaction has been observed **(Bond, *et al.*1991**).

The possibility of breeding varieties with low TIA in otherwise good genetic backgrounds for nutritional quality (i.e. high protein content) and grain yield requires the availability of adequate germplasm, and knowledge of combining ability of contrasting lines for TIA and protein content. The proposal of a

breeding strategy to produce varieties with low concentrations of trypsin inhibitors, good seed protein concentrations and high seed yield ability.

Concerning the biochemical characters of faba bean genotypes showed in table (18 and 19) and figures (6, 7, 8 and 8), it was found highly significant differences between quality of total protein %, soluble protein %, available protein %and trypsin inhibitor content.

1-Giza 402:

In M_2 population high percentage of total protein 31.59% at 0.1% concentration of EMS was revealed , while the soluble protein % was 17.20, at the same time the available protein % was 25.90 at the same concentration of EMS as compared to control. Also, in M_3 population high total protein % was 31.34, soluble protein % 16.68 and available protein % 25.62 at 0.1% concentration of EMS as compared to control. In addition to, l was observed different content of trypsin inhibitor between higher or low levels 3099.26 and 3062.20 U/1g dry seed weight at 0.1% concentration of EMS as compared to control in M_2 and M_3 generation.

Table (18): Percentages of some biochemical characters of faba bean genotypes treated with EMS in $M_{2,}$ generation

Genotypes	*Treatments*	Total Protein Content %	Soluble Protein Content %	Available Protein Content %	Trypsin Inhibitor Content *TIU/gm.DW*	*Genotypes*	*Treatments*	Total Protein Content %	Soluble Protein Content %	Available Protein Content %	Trypsin Inhibitor Content *TIU/gm.DW*
GIZA-402	***Control***	28.16	13.77	23.09	3829.00	*FAB 337/78*	***Control***	31.46	12.64	25.79	1875.00
	EMS 0.1%	31.59	17.20	25.90	3599.26		***EMS 0.1%***	30.46	15.64	24.98	1762.50
	EMS 0.2%	30.14	15.75	24.71	3637.55		***EMS 0.2%***	34.61	15.79	28.38	1781.25
	EMS 0.3%	29.24	14.85	23.98	3675.84		***EMS 0.3%***	33.24	14.42	27.26	1800.00
	EMS 0.4%	29.48	15.09	24.17	3714.13		***EMS 0.4%***	34.12	16.30	27.98	1818.75
GIZA-2	***Control***	28.78	14.11	23.59	3614.00	*FAB 89/74*	***Control***	28.70	13.69	23.53	1674.00
	EMS 0.1%	27.50	12.35	22.55	3397.16		***EMS 0.1%***	32.31	17.30	26.49	1573.56
	EMS 0.2%	31.50	16.83	25.83	3433.30		***EMS 0.2%***	27.39	12.38	22.46	1590.30
	EMS 0.3%	30.18	15.51	24.75	3469.44		***EMS 0.3%***	29.06	14.05	23.82	1607.04
	EMS 0.4%	30.56	15.89	25.06	3505.58		***EMS 0.4%***	28.59	13.58	23.44	1623.78
GIZA-3	***Control***	22.90	13.37	18.78	2530.00	*FAB 114/80*	***Control***	30.91	12.94	25.35	1613.00
	EMS 0.1%	26.03	16.50	21.34	2378.20		***EMS 0.1%***	31.26	13.26	25.63	1516.22
	EMS 0.2%	23.77	14.24	19.49	2403.50		***EMS 0.2%***	33.79	15.79	27.71	1532.35
	EMS 0.3%	22.65	13.12	18.57	2428.80		***EMS 0.3%***	33.10	16.78	27.14	1548.48
	EMS 0.4%	26.19	16.66	21.48	2454.10		***EMS 0.4%***	31.50	17.36	25.83	1564.61

Table (19): Percentages of some biochemical characters of faba bean genotypes treated with EMS in M_3, generation.

Genotypes	*Treatments*	Total Protein Content %	Soluble Protein Content %	Available Protein Content %	Trypsin Inhibitor Content *TIU/gm.DW*	*Genotypes*	*Treatments*	Total Protein Content %	Soluble Protein Content %	Available Protein Content %	Trypsin Inhibitor Content *TIU/gm.DW*
GIZA-402	*Control*	28.16	13.77	23.09	3829.00	*FAB 337/78*	*Control*	31.46	12.64	25.79	1875.00
	EMS 0.1%	31.24	16.68	25.62	3063.20		*EMS 0.1%*	31.27	21.45	25.64	1500.00
	EMS 0.2%	29.50	24.52	24.19	3178.07		*EMS 0.2%*	33.33	23.51	27.33	1556.25
	EMS 0.3%	29.72	15.33	24.37	3254.65		*EMS 0.3%*	31.03	12.21	25.44	1593.75
	EMS 0.4%	27.78	13.39	22.78	3446.10		*EMS 0.4%*	32.55	13.73	26.69	1687.50
GIZA-2	*Control*	28.78	14.11	23.59	3614.00	*FAB 89/74*	*Control*	28.70	13.69	23.53	1674.00
	EMS 0.1%	28.81	21.05	23.62	2891.20		*EMS 0.1%*	30.17	22.16	24.74	1339.20
	EMS 0.2%	32.20	18.53	26.40	2999.62		*EMS 0.2%*	27.17	19.17	22.28	1389.42
	EMS 0.3%	27.39	12.72	22.46	3071.90		*EMS 0.3%*	29.56	14.56	24.24	1422.90
	EMS 0.4%	29.58	14.91	24.26	3252.60		*EMS 0.4%*	29.33	14.33	24.05	1506.60
GIZA-3	*Control*	22.90	13.37	18.78	2530.00	*FAB 114/80*	*Control*	30.91	12.94	25.35	1613.00
	EMS 0.1%	27.46	20.56	22.52	2024.00		*EMS 0.1%*	33.46	24.46	27.44	1290.40
	EMS 0.2%	24.20	14.67	19.84	2099.90		*EMS 0.2%*	28.25	19.25	23.17	1338.79
	EMS 0.3%	23.46	13.93	19.24	2150.50		*EMS 0.3%*	32.17	17.71	26.38	1371.05
	EMS 0.4%	26.50	22.46	21.73	2277.00		*EMS 0.4%*	32.29	14.29	26.48	1451.70

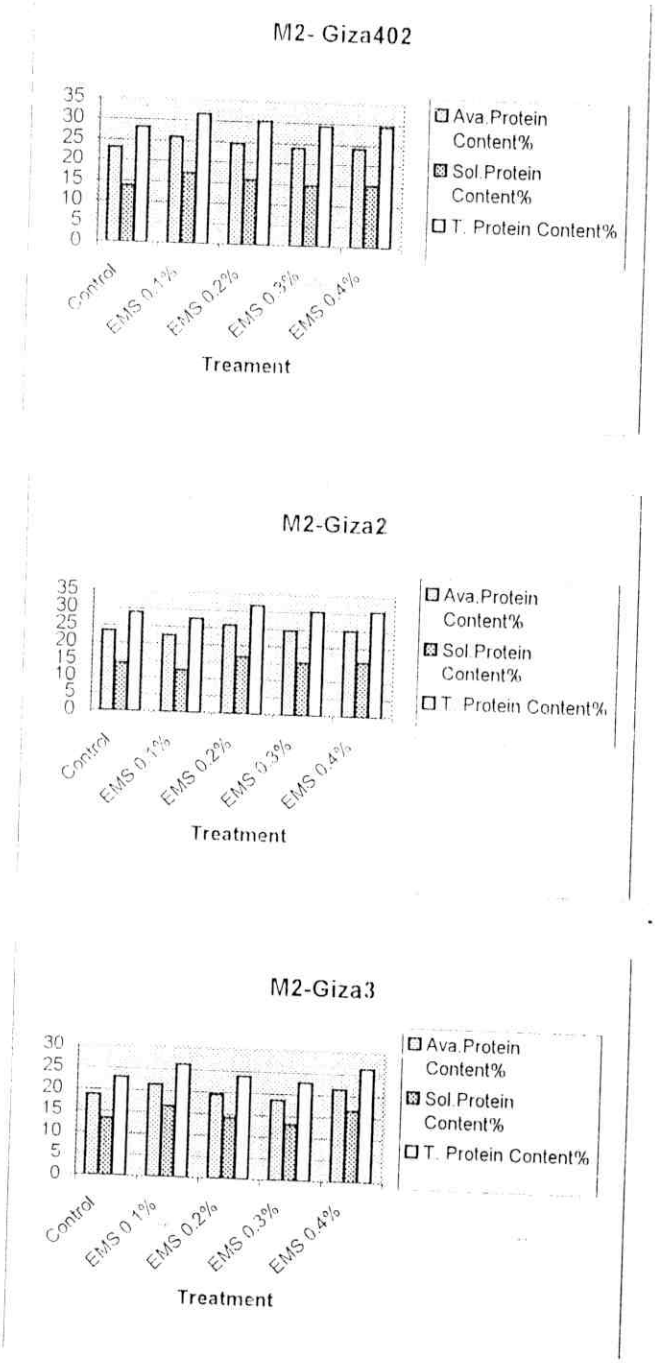
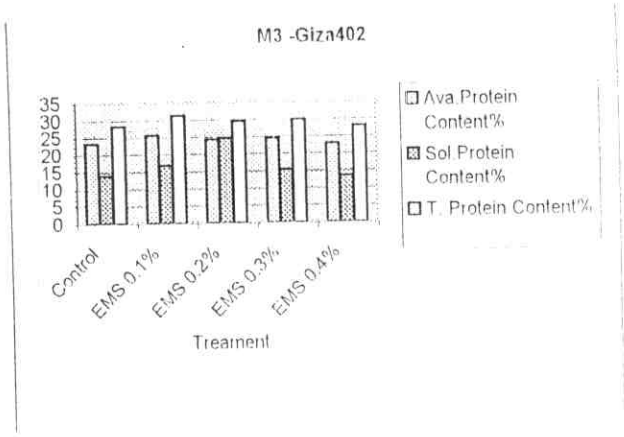
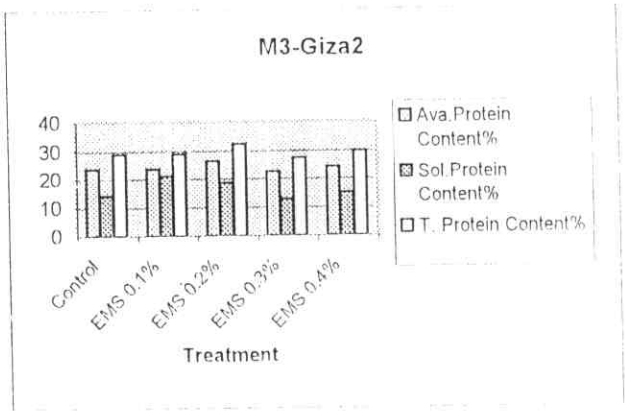


Figure (6):Effect of EMS concentration in M_2 generations in Giza402,Giza2 and Giza3 for Total protein content %, Soluble protein content % and available protein content %.





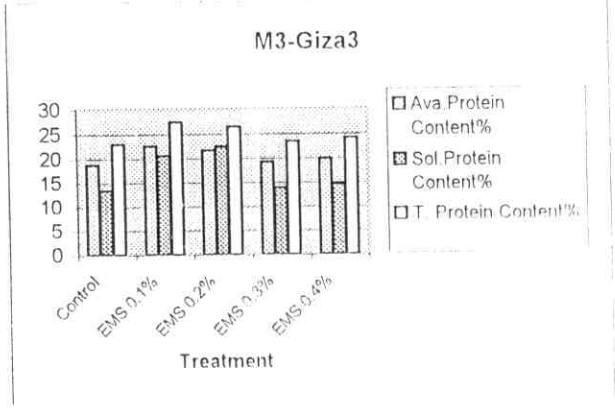


Figure (7):Effect of EMS concentration in M_3 generations in Giza402,Giza2 and Giza3 for Total protein content %, Soluble protein content % and available protein content %.

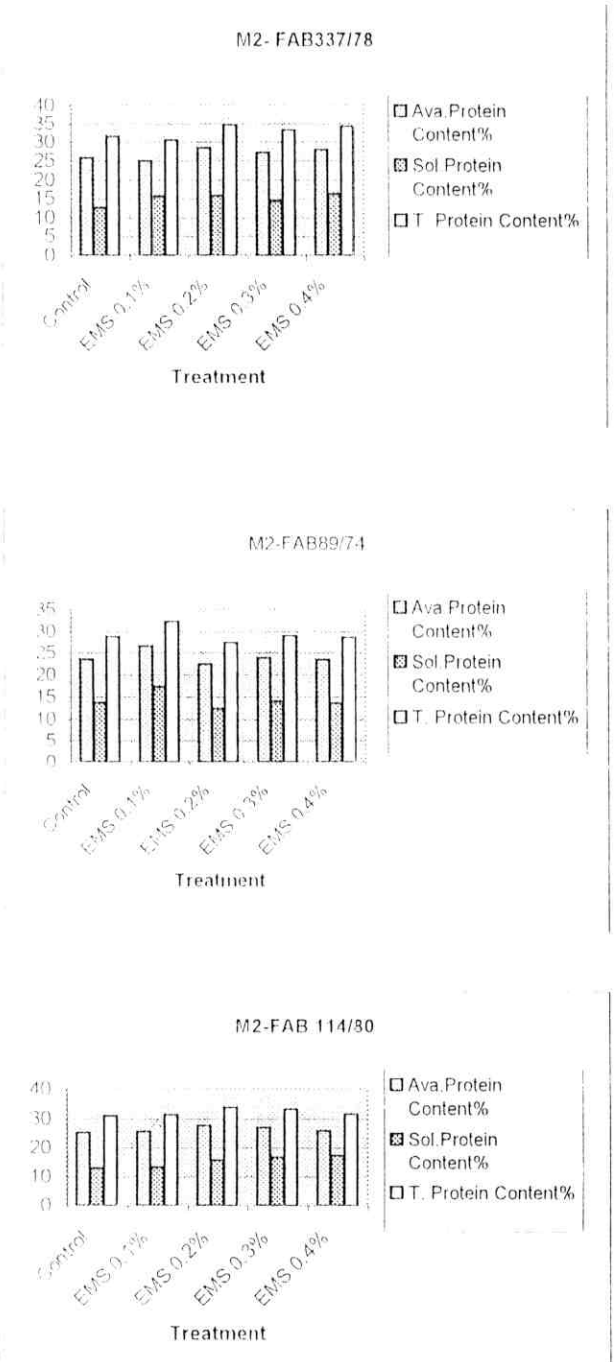


Figure (8): Effect of EMS concentration in M_2 generations on FAB337/78,FAB89/74 and FAB114/80 for Total protein content %, Soluble protein content % and available protein content % .

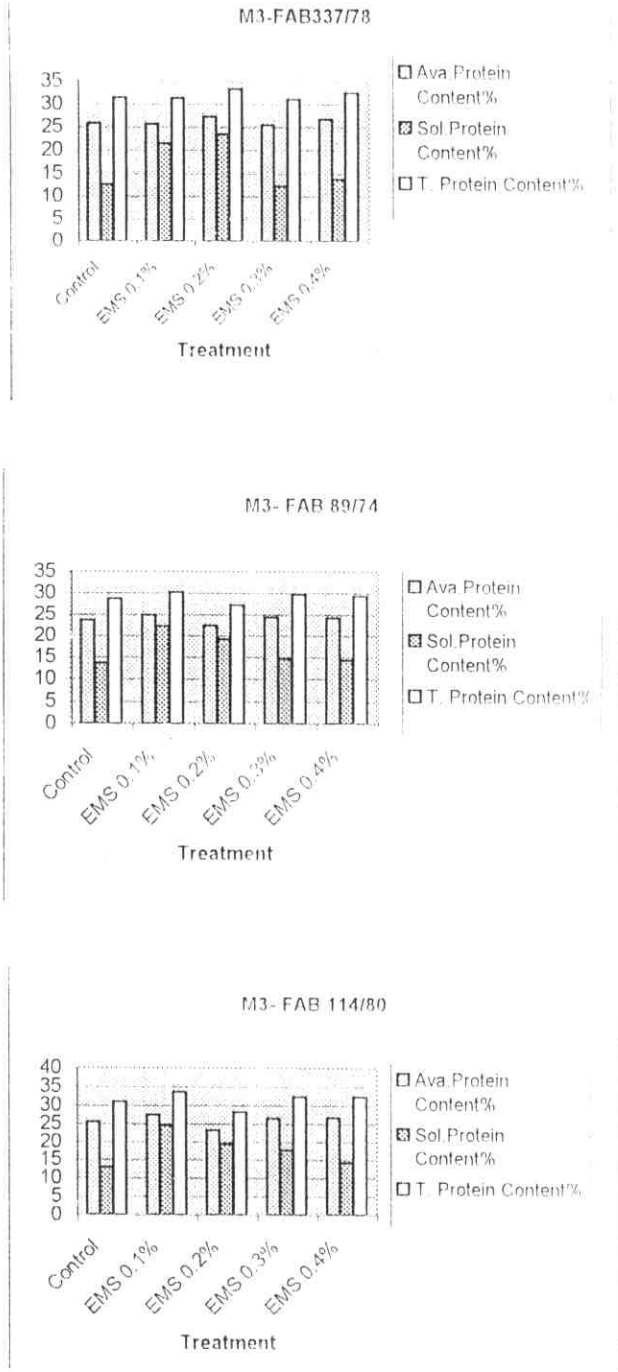


Figure (9): Effect of EMS concentration in M_3 generations on FAB337/78,FAB89/74 and FAB114/80 for Total protein content %, Soluble protein content % and available protein content % .

2-Giza 2:

In M_2 population high percentage of total protein 31.50% at 0.2% concentration of EMS was revealed , while the soluble protein % was 16.83 at the same time, the available protein % was 25.83 at the same concentration of EMS as compared to control. Also, in M_3 population found that high total protein % was 32.20, soluble protein % 18.53 and available protein % 26.40 at 0.2% concentration of EMS as compared to control. In addition to, I was observed different content of trypsin inhibitor between higher or low levels 3397.16, 2891.20 and 2999.62 U/1g dry seed weight at 0.1% and 0.2% concentration of EMS as compared to control in M_2 and M_3 generation.

3-Giza 3:

In M_2 population high percentage of total protein (26.03 and 26.19 %) at 0.1 and 0.4% concentration of EMS, while the soluble protein % was (16.50 and 16.66%) at the same time, the available protein % was (21.34 and 21.48%) at the same concentration of EMS as compared to control. Also, M_3 population high total protein % was (27.46 and 26.50%) , soluble protein % (20.56 and 22.46%) and available protein % (22.52 and 21.73%) at 0.1 and 0.4% concentration of EMS as compared to control. In addition to, I was observed higher low of trypsin inhibitor content 2378.20 U/1g dry seed weight at 0.1% concentration of EMS as compared to control in M_2 generation. Also, I was observed different content of trypsin inhibitor between higher or low levels 2024 and 2099.90 U/1g dry seed weight at 0.1 and 0.2% concentration of EMS as compared to control in M_3 generation.

4-FAB 337/78:

In M_2 population high percentage of total protein (34.61 and 34.12 %) at 0.2 and 0.4% concentration of EMS, while the soluble protein % was (15.79 and 16.30%) at the same time, the available protein % was (28.38 and 27.98%) at the same concentration of EMS as compared to control. Also, M_3 population high total protein % were (33.33 and 32.55%) , soluble protein % (23.51 and 13.73%) and available protein % (22.52 and 21.73%) at 0.2 and 0.4% concentration of EMS as compared to control. In addition to, I was observed nearly to other in all concentration of trypsin inhibitor content but the lower measure was 1762.50 and 1500 U/1g dry seed weight at 0.1% concentration of EMS as compared to control in M_2 and M_3 generation.

5-FAB 89/74:

In M_2 population high percentage of total protein (32.31%) at 0.1% concentration of EMS, while the soluble protein % was (17.30%) at the same time, the available protein % was (26.49 %) at the same concentration of EMS as compared to control. Also, M_3 population high total protein % were (30.17 %), soluble protein % (22.16%) and available protein % (24.74%) at 0.1% concentration of EMS as compared to control.

In addition to, I was observed nearly to other in all concentration of trypsin inhibitor content but the lower measure was 1573.56 U/1g dry seed weight at 0.1% concentration of EMS as compared to control in M_2 generation. Also, I was observed 1339.20 and 1389.42 U/1g dry seed weight at 0.1 and

0.2% concentration of EMS as compared to control in M_3 generation.

6-FAB 114/80:

In M_2 population was revealed that high percentage of total protein (33.79 and 33.10 %) at 0.2 and 0.3% concentration of EMS, while the soluble protein % was (15.79 and 16.78%) at the same time, the available protein % was (27.71 and 27.14%) at the same concentration of EMS as compared to control. Also, in M_3 population found that high total protein % was (33.46, 32.17 and 32.29%), soluble protein % (24.46, 17.71 and 14.29%) and available protein % (27.44, 26.38 and 26.48%) at 0.1, 0.3 and 0.4% concentration of EMS as compared to control. In addition to, I was observed very nearly to other in all concentration of trypsin inhibitor content but the lower measure was 1516.22 and 1290.40 U/1g dry seed weight at 0.1% concentration of EMS as compared to control in M_2 and M_3 generation.

It was selected any mutant lines of faba bean low in total protein % but was higher in the soluble protein % and available protein % .for example, Giza-402 at 0.2 % concentration, Giza-2 at 0.2% concentration, Giza-3 at 0.1%, FAB 337/78 and FAB 89/74 at 0.4% concentration and FAB 114/80 at 0.2% concentration of EMS as compared to control and found strong relationship between total, soluble and available protein % and improvement trypsin Inhibitor content with improve grain yield characters all results observed above tables and figures were according to (**Fillippetti, 1979; Laarhoven, *et al.*,1983; Naidu and Chhabva, 1985; Robertson, *et al.*, 1985; Semenyuk, *et al.*, 1989; El-Shakankery, *et al.*,1991; Kumari and Srivastava, 1996 and Naik, *et al.*, 2000).**

II.2 Protein Markers For Identification of Faba Bean *(Vicia faba L.)* Quality Characters: -

Faba bean seeds, like those of many other grain legumes, contain a relatively high proportion, typically 25% of protein. Faba bean seed protein falls into classical solubility fractions ***(Osborne, 1924)***, the majority being globulin (i.e. protein is soluble in dilute salt, but insoluble in water) and the remainder being water soluble albumin.

The globulins are synthesized during seed development, stored in the dry seed in organelles termed protein bodies and are hydrolyzed on germination to provide carbon skeletons and nitrogen for the developing seedling; consequently the two terms "globulin and storage protein " have been used interchangeably.

Faba bean seed proteins characteristically contain a relatively high proportion of nitrogen (being rich in lysine, arginine, glutamine and asparagine) resulting in a relatively low factor for the conversion of total nitrogen content to protein content for faba bean seeds. The globulin also has low contents of the sulfur containing amino acids cysteine and methionine; the albumin fraction is relatively sulfur-rich and containing a large number of minor proteins, some of which have important biotechnological implications.

Now, SDS -PAGE can be. used to classify and screening banding patterns from total soluble proteins according to

different types of polypeptide by using ***Rm.*** *(Relative Mobility)* **Fayed, (1989); Boulter and Thurmam (1968)** and the percentage of similarity indices according to **Hadacova *et al.* (1980).** The Six *Vicia faba L.* varieties examined in the present study included representatives of the three main taxonomic groups of this species; i.e. Sp. Mediterranean (Giza-402, Giza-2 and Giza-3), Minor (FAB 337/78 and FAB 114/80) and Major (FAB 89/74).

The quantity of total protein content %, soluble protein content %, available protein content % and actively of trypsin inhibitor for these taxonomic types and mutant selected lines are showed in table (19). Studied on green and dry seeds was performed in M_3 generation.

II.2.1 Classification of The Protein Banding Patterns From Green Seeds Treated with EMS in M_3 Generation:

From table (20) and figure (10 a, b) high differences between Giza-402 variety and the 9 mutant selected lines *(T1/112, T1/119, T1/1111, T2/2114, T2/215, T2/312, T3/312,T3/3115 and T4/414)*were recorded. The proteins identification separated to between ranged from ***Rm.*** *(0.07-0.58)* and showed the new many bands present ***Rm.*** *(0.08, 0.10, 0.11, 0.12, 0.13, 0.16, 0.17, 0.20, 0.21, 0.24, 0.26, 0.27, 0.31, 0.37, 0.40 and 0.50)* in different mutant selected lines used and absent in the Giza -402 variety.

Also, found high difference among Giza-2 variety and 8 mutant selected lines *(T1/124, T1/1214, T2/229, T2/223, T2/227,*

Table (20): Classification of the SDS-PAGE banding patterns from total soluble proteins according to *Rm (Relative Mobility)* of different genotypes of faba bean treated with EMS in M_3 green seeds generation.

Band Rm	Giza 402	T1\1112	T1\119	T1\1111	T2\2114	T2\215	T2\312	T3\312	T3\3115	T4\414
0.07	*L*	*D*	*L*	*L*	*D*	*D*	*D*	*L*		
0.08		*L*	*D*	*L*	*L*		*L*		*L*	*L*
0.10				*D*		*D*				*L*
0.11					*D*					
0.12				*D*		*D*				
0.13					*D*	*D*				
0.14	*L*			*D*						
0.16		*D*						*L*		
0.17			*D*				*VD*		*D*	*D*
0.19	*D*		*D*						*D*	*D*
0.20		*D*						*L*		
0.21			*D*		*D*		*D*			
0.22	*D*									
0.24		*VD*					*D*	*L*	*VD*	
0.26					*D*	*VD*				
0.27			*D*	*VD*						*VD*
0.31								*D*		
0.36	*VD*	*VD*	*D*	*VD*	*VD*	*VD*		*L*	*D*	
0.37							*VD*			*VD*
0.40		*L*	*L*	*L*	*L*	*L*			*L*	*L*
0.47	*VD*	*D*								
0.50			*L*	*VD*	*D*	*D*	*D*	*D*	*D*	*VD*
0.56	*D*									
0.57		*D*	*D*		*D*			*L*	*L*	
0.58				*D*		*D*	*D*			*D*

Band R_m	Giza 2	T1\124	T1\1214	T2\229	T2\223	T2\227	T3\321	T3\328	T4\421	
0.08	*L*	*D*	*D*							
0.09	*L*			*L*	*L*	*L*	*L*	*L*	*L*	
0.16								*L*		
0.17	*D*		*D*	*L*	*L*	*L*	*L*		*D*	
0.18		*VD*								
0.20	*D*		*L*	*L*	*L*					
0.21		*D*					*D*	*L*		
0.24			*VD*		*VD*	*D*		*D*		
0.26				*VD*			*D*		*VD*	
0.28	*VD*	*VD*								
0.36			*D*	*D*	*D*	*D*	*VD*	*D*	*VD*	
0.37	*VD*									
0.38		*VD*								
0.49		*L*						*D*	*VD*	
0.54	*D*		*L*	*L*	*L*	*L*	*D*			
0.58	*D*	*D*	*L*	*L*	*L*	*L*	*L*	*L*	*VD*	

T3/321, T3/328 and T4/421). The proteins identification separated to ranges between Rm. (*0.8-0.58*) and showed the new many bands present ***Rm.*** *(0.16, 0.18, 0.21, 0.24, 0.26, 0.36, 0.38 and 0.49 respectively)* in the different mutant selected lines used and absent in the Giza-2 variety.

The percentage of similarity between Giza 402 variety and nine mutant lines are presented in table (21). Comparison between the Giza - 402 and mutant line belonging to controversial in formation within and between the plants selective; high percent of similarity was found between Giza-402 and lines *(T1/119 and T1/111) 13.3%*; mean while the lowest degree *(10.0%)* was shown among *(T2/321),* followed by *(6.3,6.7 and 7.1%)* between Giza-402 and remainder mutant lines; In addition, the similarity between nine mutant lines ranged from *(0.0-35.7%).*

Also, the percentage of similarity between Giza-2 variety and eight mutant lines are presented in table (21) comparisons between the Giza-2 and mutant lines belonging to controversial information within and between the any mutant lines selected; High percent of similarity was found between Giza-2 and mutant lines *(T4/421) 16.6%*; while the lowest degree *(7.1%)* was shown among *(T1/1214, T2/229, T2/223 and T3/328)*, followed by *12.4%* between Giza-2 and the remainder mutant lines; In addition, the similarity between eight mutant lines ranged from *(0.0 - 75%).*

Table (21): Similarity from total soluble protein identification of different genotypes of faba bean separated by SDS-PAGE treated with EMS in M_3 green seed s generation.

GENOTYPES	Giza 402	T1\1112	T1\119	T1\1111	T2\2114	T2\215	T2\312	T3\312	T3\3115	T4\414
Giza 402	100	6.7	13.3	13.3	6.3	6.7	0.0	7.1	7.1	6.7
T1\1112		100	11.8	18.8	35.7	20	13.3	0.0	21.4	12.5
T1\119			100	11.1	5.3	5.6	5.9	5.9	28.6	18.8
T1\1111				100	17.6	35.7	12.5	5.9	12.5	35.7
T2\2114					100	35.7	28.6	5.9	20	11.8
T2\215						100	21.4	6.3	6.3	12.5
T2\312							100	6.6	14.3	21.4
T3\312								100	14.3	0.0
T3\3115									100	30.8
T4\414										100

GENOTYPES	Giza 2	T1\124	T1\1214	T2\229	T2\223	T2\227	T3\321	T3\328	T4\421	
Giza 2	100	15.4	7.1	7.1	7.1	7.7	15.4	7.1	16.6	
T1\124		100	7.7	0.0	0.0	0.0	0.0	0.0	0.0	
T1\1214			100	40	55.5	30	7.7	16.7	8.3	
T2\229				100	75	62.5	33.3	33.3	18.2	
T2\223					100	62.5	27.3	27.3	8.3	
T2\227						100	30	44.4	9.1	
T3\321							100	16.7	18.1	
T3\328								100	8.3	
T4\421									100	

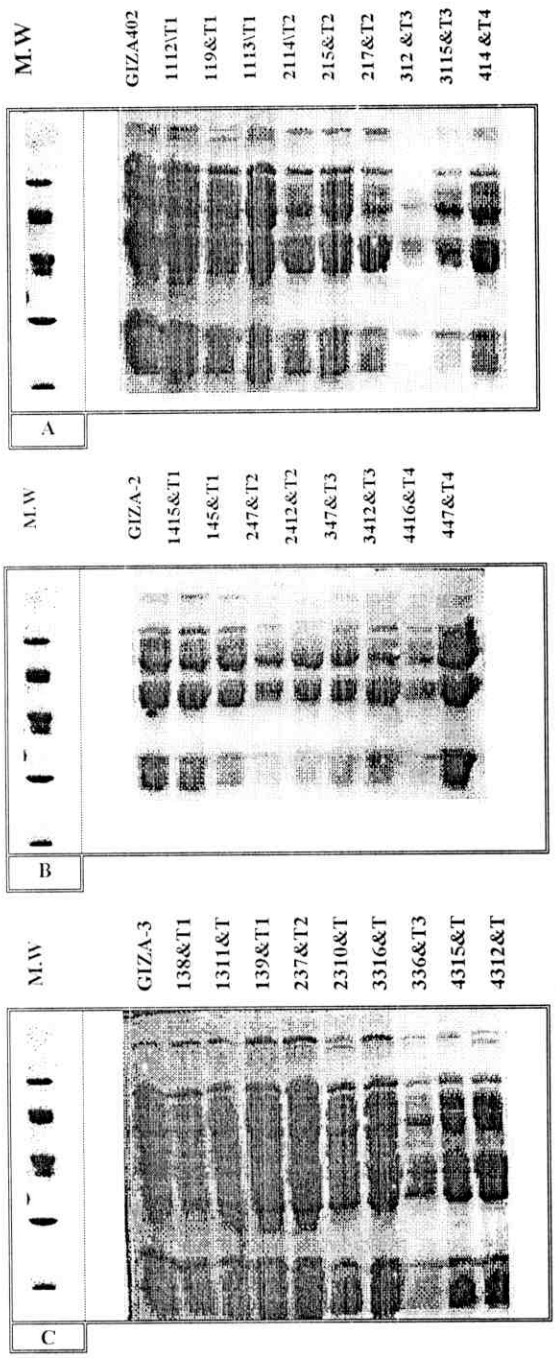


Fig (10a, b, c.): SDS-PAGE of total soluble protein extracted from M_3 generation green seed of faba bean *(Vicia faba L.)* treated with EMS.

From table (22) and figures (10-c and 11-a) found high differences between Giza-3 variety and the nine mutant selected lines *(T1/138, T1/1311, T1/139, T2/237, T2/2310, T2/236, T3/3316 and T4/4315)* were recorded. The protein identification was separated to between ranged from ***Rm.****(0.09-0.66)* and showed a number of new bands present with the ***Rm.*** *(0.09, 0.11, 0.12, 0.19, 0.28, 0.29, 0.33, 0.43, 0.48, 0.50, 0.56, 0.60 and 0.66 respectively)* in the different mutant selected lines used and absent in the Giza-3 variety.

Also, there was high difference between FAB 337/78 introduction Ethiopian variety and eight mutant selected lines *(T1/1214, T2/229, T2/223, T3/321, T3/323, T4/421 and T4/423)*; the fraction of protein was separated to ranges between ***Rm.*** *(0.09-0.66)* and showed a number of new bands present ***Rm.*** *(0.09, 0.11, 0.19, 0.24 and 0.43 respectively)* in the any different mutant selected lines used and absent in the FAB337/78 Minor variety.

The percentage of similarity between Giza-3 variety and the nine mutants selected lines are presented in table (23). Comparison between the Giza-3 and mutant lines had controversial information within and between the lines selective. High percent of similarity was found between Giza-3 and mutant lines *(T1/138) 33.3%;* While the lowest degree *(5.6%)* was shown among *(T1/1311)*, followed by *(26.7,26.3,25,20,15 and 11.8 % respectively)* between Giza-3 and remainder mutant lines; In addition, the similarity between the nine mutant lines ranged from *(5.6-35.7%)*.

Table (22): Classification of the SDS-PAGE banding patterns from total soluble proteins according to *Rm* (*Relative Mobility*) of different genotypes of faba bean treated with EMS in M_3 green seeds generation.

Band Rm	Giza 3	T1\138	T1\1311	T1\139	T2\237	T2\2310	T2\236	T3\3316	T3\336	T4\4315
0.09				VD	VD					L
0.10	L	D	D		L	L	VD	L	D	L
0.11					L					
0.12				D		L				
0.19					D			D	D	L
0.20	D	D	D	D	D	D	D			
0.22	D	D		D	D	D	D	L		
0.24	D	D		D	D	D			D	D
0.27	VD				VD	D		D		
0.28		D	D	D						
0.29						VD	D		VD	D
0.32	D	D					D	L	D	
0.33			D	VD	D	D				
0.36	D	D	VD					D	VD	
0.40	D			VD	VD	VD	D	D		VD
0.43		D	D	VD	VD	D	VD		VD	D
0.48			D	L	VD		D			
0.50						L				
0.54	VD		D	D				D	VD	
0.56		D		VD	D	D	L		D	D
0.60						D				
0.64	D				VD			D	D	
0.66		L	L	VD		D	L			D

Band Rm	FAB337\78	T1/1214	T2/229	T2/223	T2/227	T3/321	T3/323	T4/421	T4/423	
0.09				D			D		D	
0.10	L	D	D	L	D			L		
0.11						L				
0.13	L								D	
0.17	L									
0.19		D	D	D			VD	D		
0.20	D				D	L				
0.22	D	L	D	D	D		D	D	D	
0.23	D									
0.24		D	D	D	D	D				
0.28	D	D			D	D	VD	D	D	
0.30	VD		D	D				D	D	
0.33	D	L	D	D	L	L	D			
0.39	D	D	VD	VD	VD	D	D	VD		
0.43		D	VD	VD	VD	D	D	D	VD	
0.44	D									
0.57	D	D	D	D	VD	L	L	D	D	
0.66	D	D	VD	D	VD	D	D	D	VD	

Table (23): Similarity from total soluble protein identification of different genotypes of faba bean separated by SDS-PAGE treated with EMS in M_3 green seeds generation.

GENOTYPES	**Giza 3**	**T1\138**	**T1\1311**	**T1\139**	**T2\237**	**T2\2310**	**T2\236**	**T3\3316**	**T3\336**	**T4\4315**
Giza 3	100	33.3	5.6	15	26.3	20	25	26.7	25	11.8
T1\138		100	35.7	21.1	20	26.3	25	5.6	25	18.8
T1\1311			100	15.8	4.5	15	18.8	5.9	11.8	5.9
T1\139				100	28.6	17.4	15	4.8	9.5	10
T2\237					100	27.3	14.3	9.5	20	21.1
T2\2310						100	9.1	9.1	14.3	35.3
T2\236							100	5.6	11.1	5.6
T3\3316								100	11.8	5.9
T3\336									100	11.8
T4\4315										100
GENOTYPES	*FAB337\78*	*T1\1214*	*T2\229*	*T2\223*	*T2\227*	*T3\321*	*T3\323*	*T4\421*	*T4\423*	
FAB 337\78	100	21.1	9.5	26.3	15	15.8	22.2	29.4	16.7	
T1\1214		100	25	23.5	17.6	26.1	11.5	20.8	7.7	
T2\229			100	61.5	42.9	3.6	7.4	20.8	21.7	
T2\223				100	23.5	25	25	42.9	35.7	
T2\227					100	11.8	5.6	18.8	28.6	
T3\321						100	20	20	6.3	
T3\323							100	20	13.3	
T4\421								100	30.8	
T4\423									100	

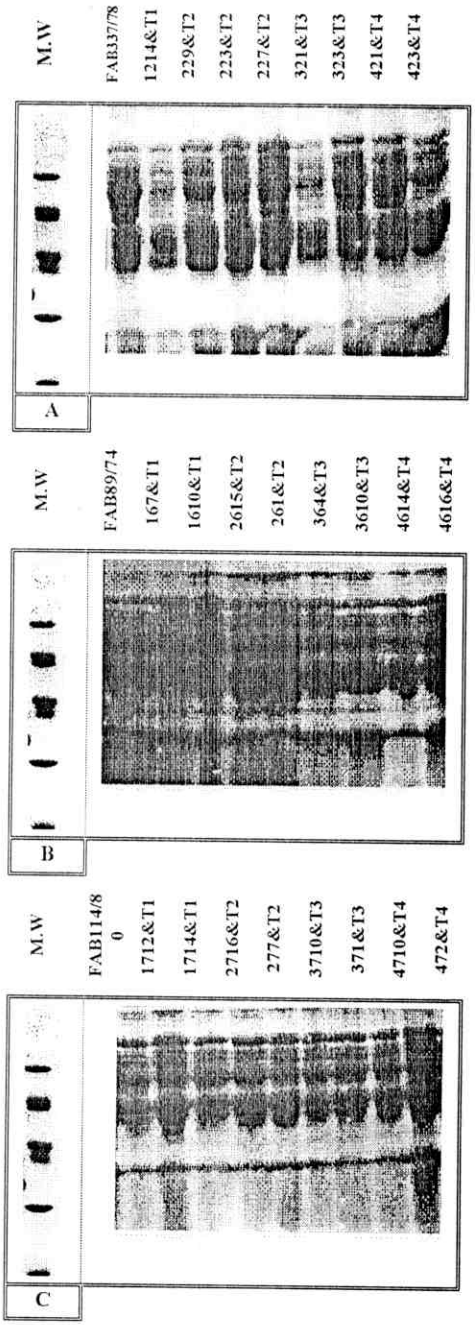


Fig (11a, b, c.): SDS-PAGE of total soluble protein extracted from M_3 generation green seed of faba bean *(Vicia faba L.)* treated with EMS.

Also, the percentage of similarity between FAB 337/78 Ethiopian variety and eight mutant selected lines; high percent of similarity was found between FAB337/78 and mutant lines *(T4/421) 29.4%;* while the lowest degree *(9.5%)* was shown among *(T2/229)*, followed by *(26.3, 22.2, 21.1, 16.7, 15.8 and 15% respectively)* between FAB 337/78 and the remainder mutant lines; In addition, the similarity the eight mutant lines ranged from *(6.3 - 61.5%)*.

From table (24) and figure (11b-c) high differences between FAB89/74 and the 8 mutant selective lines *No. (T1/16, T2/1610, T2/2615, T3/261, T3/364, T3/3610, T4/4614 and T4/4616)* were recorded. The identification banding patterns proteins separated to rage between ***Rm.*** *(0.09 - 0.52)* and showed the new bands present ***Rm.****(0.17, 0.29, 0.32, 0.40 and 052)* in the any different mutant selective lines and absent in the FAB 89/74 Major variety. Also, found high difference between FAB114/80 Germany variety and mutant selected lines *(T1/1712, T1/1714, T2/2716, T2/277, T3/3710, T3/371, T4/4710 and T4/472)*.

The identification banding patterns of protein was separated to range between ***Rm.*** *(0.08-0.51)* and showed a number of new bands present ***Rm.*** *(0.8, 0.13, 0.17, 0.20, 0.27, 0.32, 0.33, 0.39, 0.43 and 0.46)* in the any mutant selective lines and absent in the FAB 114/80 minor variety.

The percentage of similarity between FAB89/74 and the eight mutant lines are presented in table (25). Comparisons between the FAB 89/74 and mutant lines.

Table (24): Classification of the SDS-PAGE banding patterns from total soluble proteins according to ***Rm*** (*Relative Mobility*) of different genotypes of faba bean treated with EMS in M_3 green seeds generation.

Band Rm	*FAB89/74*	*T1\167*	*T11610*	*T2\2615*	*T2\261*	*T3\364*	*T33610*	*T4\4614*	*T4\4616*
0.09	*L*	*L*	*D*	*VD*	*D*	*D*	*D*	*D*	*D*
0.12	*D*	*D*							
0.13	*D*		*D*	*D*	*D*	*D*		*D*	*D*
0.17		*D*	*D*				*D*	*D*	
0.18				*D*	*D*	*D*	*D*	*D*	*D*
0.22	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*
0.29				*VD*				*VD*	*VD*
0.30	*VD*	*VD*				*VD*	*VD*		*VD*
0.32			*VD*	*VD*	*VD*		*VD*	*D*	
0.34	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*
0.39	*VD*								
0.40		*VD*	*VD*	*D*	*VD*	*VD*	*VD*	*VD*	*VD*
0.50	*L*	*L*							
0.52			*D*	*L*	*L*	*L*	*L*	*L*	*L*

Band Rm	FAB114/80	*T1\1712*	*T1\1714*	*T2\2716*	*T2\277*	*T3\3710*	*T3\371*	*T4\4710*	*T4\472*
0.08		*D*	*L*	*L*	*D*	*D*	*D*	*VD*	*VD*
0.09	*L*			*L*					
0.13								*D*	*D*
0.14	*D*	*D*	*D*						
0.17		*D*	*D*	*D*	*D*	*D*	*D*	*VD*	*VD*
0.18	*D*	*D*	*D*	*D*	*D*	*D*	*D*		
0.20									*VD*
0.22	*D*	*D*	*VD*	*D*	*VD*	*D*	*D*	*VD*	
0.27					*VD*	*VD*	*VD*	*VD*	*VD*
0.31	*D*	*VD*			*VD*				
0.32						*VD*	*VD*		
0.33			*L*	*D*	*L*	*L*	*L*	*D*	*D*
0.39						*VD*	*VD*	*VD*	*VD*
0.40	*D*	*D*	*D*	*D*	*D*				
0.46									
0.51						*L*	*L*		

Table (25): Similarity from total soluble protein identification of different genotypes of faba bean separated by SDS-PAGE treated with EMS in M_3 green seeds generation.

GENOTYPES	*FAB89/74*	*T1\138*	*T1\1311*	*T2\139*	*T2\237*	*T3\2310*	*T3\236*	*T4\3316*	*T4\336*
FAB 89\74	100	60.0	23.1	21.4	23.1	33.3	13.3	20.0	30.8
		100	33.3	13.3	23.1	23.1	41.7	28.6	30.8
			100	30.8	60.0	45.5	54.5	50.0	41.7
				100	54.5	41.7	38.5	35.7	50.0
					100	77.8	70.0	63.6	70.0
						100	70.0	63.6	88.9
							100	38.9	63.6
								100	72.7
									100
GENOTYPES	**FAB114/80**	*T1\1712*	*T1\1714*	*T2\1711*	*T2\174*	*T3\1710*	*T3\2716*	*T4\277*	*T4\3710*
FAB114\80	100	50.0	36.4	50.0	23.1	14.3	14.3	0.0	0.0
		100	45.5	45.5	54.5	30.8	30.8	0.0	0.0
			100	45.5	41.7	21.4	21.4	6.7	0.0
				100	30.8	21.4	21.4	6.7	6.7
					100	38.5	38.5	13.3	6.3
						100	100	13.3	13.3
							100	13.3	13.3
								100	77.8
									100

High percent of similarity was found between FAB 89/74 and mutant line. *(T1/138) 60%;* While the lowest degree *(13.3%)* was shown among *(T3/236),* followed by *(33.3, 30.8, 23.1, 21.4 and 20% respectively)* between the FAB 89/74 and the remainder mutant lines; In addition, the similarity between the eight mutant lines ranged from *(13.3 -77.8%).*

Also, the percentage of similarity between FAB 114/80 and the eight mutant selected lines are presented in table (25). Comparisons between the FAB 114/80 and mutant lines, found revealed percent of similarity between FAB114/80 and mutant lines *(T1/1712and T2/1711) 50%;* While the lowest degree *(0.0%)* was shown among *(T4/277 and T4/3710),* followed by *(36.4, 23.1 and 14.3%)* between the FAB 114/80 and the remainder mutant lines; In addition, the similarity between eight mutant lines ranged from *(0.0-100%).(* **Panitz *et al.*1995;Wobus *et al.* 1994;Borowaska *et al.*1994 and Tucci *et al.*1993).**

II.2.2 Classification of The Protein Banding Patterns From Dry Seeds Treated with EMS in M_3 Generation:

Low differences between Giza402 and the mutant selected lines in the protein banding were identified table (26) and figure (12a, b); the protein banding patterns these mutant into four groups. Group1, ***Rm.*** *(0.11, 0.20, 0.42 and 0.67)* present in the all plants, group2 ***Rm.*** *(0.13)* present in the lines *(T2/215,T3/314 and T3/3115),* group3 ***Rm.*** *(0.14)* present in only one line *(T4/416)* and Group4 ***Rm.*** *(0.30)* absent in Giza-402 variety without treatment

Table (26): Classification of the SDS-PAGE banding patterns from total soluble proteins according to ***Rm*** (*Relative Mobility*) of different genotypes of faba bean treated with EMS in M_3 dry seeds generation..

Band Rm	*Giza 402*	T1\1112	T1\119	T1\1113	T2\2114	T2\215	T2\217	T3\314	T3\3115	T4\414	T4\411	T4\416
0.11	*VD*	*VD*	*L*	*VD*	*L*	*L*	*VD*	*D*	*VD*	*D*	*VD*	*D*
0.13						*VD*		*D*	*D*			
0.14												*L*
0.20	*D*	*D*	*L*	*L*	*L*	*D*	*D*	*D*	*D*	*L*	*VD*	*D*
0.30		*D*	*L*	*L*	*L*	*D*	*D*	*D*	*VD*	*L*	*VD*	*D*
0.42	*VD*	*VD*	*L*	*VD*	*L*	*VD*	*VD*	*VD*	*VD*	*L*	*VD*	*D*
0.67	*VD*	*VD*	*L*	*VD*	*L*	*VD*	*VD*	*VD*	*VD*	*L*	*VD*	*D*
Band Rm	*Giza 2*	T1\1415	T1\145	T2\247	T2\2412	T3\347	T3\341	T4\4416	T4\447	T4\4410		
0.13								*VD*	*D*	*D*		
0.14	*D*											
0.15		*VD*			*D*	*D*	*D*					
0.16			*VD*	*VD*								
0.28	*D*	*D*	*D*	*D*	*D*	*D*	*D*		*D*	*L*		
0.30								*D*				
0.39	*D*	*D*	*D*	*D*								
0.41					*D*	*D*	*D*		*D*	*L*		
0.42								*D*				
0.53	*D*	*VD*	*VD*	*D*	*VD*	*VD*	*VD*	*D*	*D*	*L*		
0.56		*VD*	*VD*	*D*	*VD*	*VD*	*VD*	*D*	*D*	*L*		
0.84	*D*	*VD*	*VD*	*D*	*VD*	*VD*	*VD*	*D*	*D*	*L*		
0.95		*D*	*L*	*L*	*L*	*L*	*L*	*L*				

High differences between Giza-2 and mutant selected lines in the proteins banding patterns were separated into 12 groups of bands, group1 ***Rm.*** *(0.53 and 084)* present in the all plants, group2 ***Rm.*** *(0.13)* present in the lines *(T4/4416,T4/447 and T4/4410)*, group3 ***Rm.*** *(0.14)* present in only Giza-2 variety, group4 ***Rm.*** *(0.15)* present in the lines *(T1/145,T2/2412, and T3/341)*, group5 ***Rm.*** *(0.16)* present in only two lines *(T1/145 and T2/247)*, group6 ***Rm.*** *(0.28)* absent in only one lines *(T4/4416)*, group7 ***Rm.*** *(0.30)* present in line *(T4/4416)*, group8 ***Rm.*** *(0.39)* present in the three lines *(T1/1415, T1/145 and T2/247)* and Giza-2 variety, group9 ***Rm.*** *(0.41)* present in five mutant lines *(T2/2412,T3/347,T3/341,T4/447 and T4/4410)* group10 ***Rm.*** *(0.42)* present in the only *(T4/4416)*, group11 ***Rm.*** *(0.56)* absent in Giza2 variety and group12 ***Rm.*** *(0.95)* absent in the two mutant lines *(T4/447 and T4/4410)* and Giza-2 variety.

The percentage of similarity was showed in Giza-402 variety and the 11 mutant selected lines are presented in table (27). Comparisons between the Giza-402 and mutant lines belonging to controversial information within and between the lines selected. High percent of similarity was found between Giza-402 and mutant lines. *(T1/112 and T2/217) 80%;* While the lowest degree *(0.0%)* was shown among *(T1/114, T2/2114 and T4/414)*, followed by *(66.7, 50, 42.9 and 11.1% respectively)* between Giza-402 the remainder mutant lines.

Table (27): Similarity from total soluble protein identification of different genotypes of faba bean separated by SDS-PAGE treated with EMS in M_3 dry seed s generation.

GENOTYPES	Giza 402	T1\112	T1\119	T1\1113	T2\2114	T2\215	T2\217	T3\314	T3\3115	T4\414	T4\411	T4\416
Giza402	100	80.0	0.0	50.0	0.0	42.9	80.0	42.9	66.7	0.0	50.0	11.1
T1\112		100	0.0	42.9	0.0	57.1	100	57.1	57.1	0.0	42.9	22.2
T1\119			100	25.0	100	10.0	0.0	0.0	0.0	66.7	0.0	10.0
T1\1113				100	0.0	22.2	42.9	22.2	37.5	25.0	42.9	0.0
T2\2114					100	10	0.0	0.0	0.0	66.7	0.0	10.0
T2\215						100	57.1	66.7	57.1	37.5	0.0	20.0
T2\217							100	57.1	57.1	57.1	0.0	22.2
T3\314								100	50.0	10.0	22.2	33.3
T3\3115									100	0.0	57.1	10.0
T4\414										100	0.0	10.0
T4\411											100	0.0
T4\416												100

GENOTYPES	Giza 2	T1\1415	T1\145	T2\247	T2\2412	T3\347	T3\341	T4\4416	T4\447	T4\4410		
Giza 2	100	20.0	20.0	50.0	9.1	9.1	9.1	20.0	33.3	0.0		
T1\1415		100	55.6	16.7	40.0	40.0	40.0	0.0	8.3	0.0		
T1\145			100	40.0	55.6	55.6	55.6	7.7	8.3	0.0		
T2\247				100	16.7	16.7	16.7	7.7	44.4	0.0		
T2\2412					100	100	100	7.7	18.2	0.0		
T3\347						100	100	7.7	18.2	0.0		
T3\341							100	7.7	16.7	0.0		
T4\4416								100	30.0	0.0		
T4\447									100	9.1		
T4\4410										100		

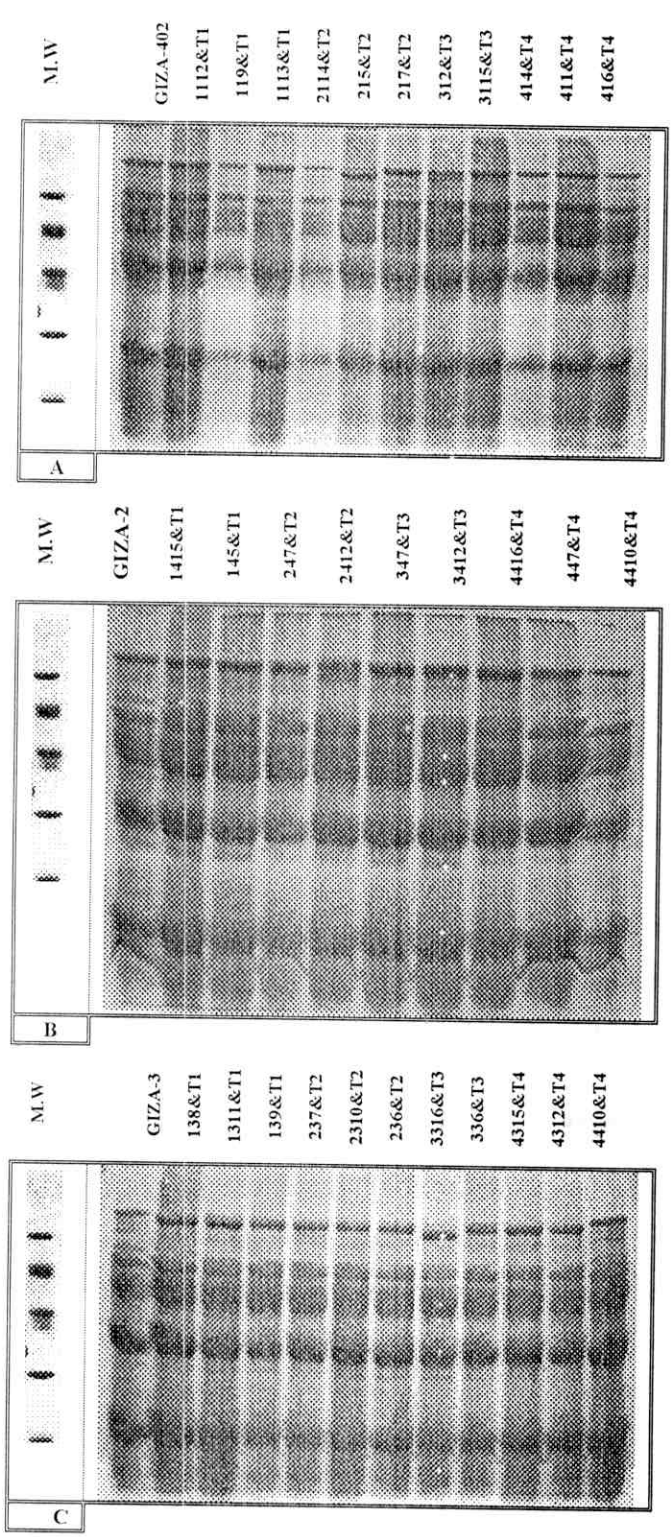


Fig (12a,b, c.): SDS-PAGE of total soluble protein extracted from M_3 generation dry seed of faba bean *(Vicia faba L.)* treated with EMS.

In addition, the similarity between the 11 mutant lines ranged *from (0.0 and 100%).*

Also, the percentage of similarity between Giza-2 variety and the nine mutant selected lines. Found high percent of similarity was found between Giza-2 and mutant lines *(T2/247) 50.0%;* while the lowest the *(0.0%)* was shown among *(T4/4410),* followed by *(33.3, 20.0 and 9.1%*) between Giza2 and remainder mutant lines In addition, the similarity between the nine mutant lines ranged from (0.0-100%).

Medium differences between Giza-3 and the 11 mutant selected lines in the protein banding were identified table (28) and figures (12c and 13a); the protein patterns these mutanted into nine groups of bands, groups1 ***Rm.*** *(0.29, 0.39, 0.52, 0.55, 0.76 and 0.89 respectively)* present in the all lines, group2 ***Rm.*** (0.16) present in Giza3 and line (T4/4310), ***Rm.****(0.18)* absent in the five lines *(T2/236 ,T3/3316 ,T3/336, T4/4315)* and Giza-3 variety, group4 ***Rm.****(0.19)* present only in *(T3/3316, T3/336, T4/4315, T4/4312 and T4/4310)* , Group5 ***Rm.*** *(0.02)* present in five lines *(T1/138, T1/1311, T1/139 and T2/237)* and Giza-3 , group6 ***Rm.*** *(0.22)* present in the three lines *(T3/336, T4/4315 and T4/4312)* , group7 ***Rm.*** *(0.23)* present in only one (*T2/236*),group8 ***Rm.*** *(0.24)* absent in five lines*(T2/236, T3/3316, T3/336, T4/4315 and T4/4312)* and final group 9 ***Rm.****(0.27)* present in the two lines *(T4/4315 and T4/4312)* .

Table (28): Classification of the SDS-PAGE banding patterns from total soluble proteins according to *Rm (Relative Mobility)* of different genotypes of faba bean treated with EMS in M_3 dry seeds generation. .

Band Rm	Giza 3	T1\138	T1\1311	T1\139	T2\237	T2\2310	T2\236	T3\3316	T3\336	T4\4315	T4\4312	T4\4310
0.16	D											VD
0.18		VD	VD	VD	D	D						L
0.19								VD	VD	VD	VD	L
0.20	L	L	L	L	L	L						
0.22									L	L	L	
0.23							D					
0.24	L	L	L	L	L	L						L
0.27										L	L	
0.29	D	D	D	D	D	D	D	D	D	D	D	VD
0.39	D	VD	VD	D	D	D	D	D	D	D	D	VD
0.52	VD	VD	VD	VD	VD	VD	VD	VD	VD	VD	VD	VD
0.55	L	L	L	L	L	L	L	L	L	L	L	D
0.76	VD	VD	VD	D	VD	VD	D	D	D	VD	VD	VD
0.89	L	L	D	L	L	L	L	L	D	D	D	VD

Band Rm	FAB337/78	T1\124	T1\1214	T2\229	T2\223	T2\227	T3\321	T3\328	T4\421	T4\423	T4\4210	
0.10			VD	D	D	L	L	L	D	D		
0.11	L										D	
0.12		VD						L				
0.13			VD		D	VD		L				
0.14				VD	L		L					
0.16	D	D	L					D	VD	VD		
0.17								D			D	
0.18				L	L	D	D		L	L		
0.21	D	L	L	L	L	L	D	D	L	L	D	
0.24	D	VD	VD	VD	VD	VD	D	D				
0.26					D				VD	VD	D	
0.28	D	VD	VD	D		D						
030								D			D	
0.31							D		VD	VD		
0.33		VD	VD	D	D	D	D				L	
0.34									VD	VD		
0.38				L	D	D	L	L	D	D		
0.39											D	
0.43	D						VD					
0.44				VD	VD			D			D	
0.46		VD	VD			VD			VD	VD		
0.61			L	L	L	L	L	L	L	L	L	
0.67	D	VD										
0.72		VD	D	D	D	D	D	D	VD	VD	D	
0.83	L	D	L	L	L	L	L	L	D	D	L	
0.89	L	L	L	L	L	L	L	L	L	L	L	

Highly different between FAB337/78 Ethiopian variety and the ten mutant selected lines identification and density bands proteins; found that ***Rm.*** *(0.21, 0.83 and 0.89)* present in the all lines, ***Rm.*** *(0.1)* absent in the two lines *(T1/124 and T4/4210)* and FAB 337/78, ***Rm.*** *(0.12)* present only in *(T1/124 and T3/328)*, ***Rm.*** *(0.13)* present in the four lines *(T1/1214, T2/223, T2/227 and T3/328)*, ***Rm.*** *(0.14)* present in the three lines *(T2/229, T2/223 and T3/321)*, ***Rm.*** *(0.16)* absent in five lines *(T2/229, T2/223, T2/227, T3/321 and T4/43210)*, ***Rm.****(0.17)*present only *(T3/328 and T4/4210)*, ***Rm.****(0.18)* present in the six lines *(T2/229, T2/223, T2/227, T3/321,T4/421 and T4/423)*, ***Rm.*** *(0.24)* absent in the three lines.*(T4/421 ,T4/423 and T4/4210)* , ***Rm.*** *(0.26)* present in four lines *(T2/223, T4/421,T4/423 and T4/4210)*, ***Rm.*** *(0.28)* present in *(T1/124, T1/1214, T2/229 and T3/321)* and FAB 337/78, ***Rm.****(0.30)* present in the two lines *(T3/328 and T4/4210)*, ***Rm.****(0.31)* present in the three lines *(T3/321, T4/421 and T4/423)*, ***Rm.*** *(0.33)* absent in the three lines *(T3/328,T4/421 and T4/423)* and FAB 337/78, ***Rm.*** *(0.34)* present in the lines *(T4/421 and T4/423)*, ***Rm.****(0.38)* absent in the *(T1/124,T1/1214 and T4/4210)* and FAB 337/78, ***Rm.*** *(0.39)* present in only one line *(T4/4210),****Rm.****(0.43)* present in only one line *(T3/321)* and FAB 337/78, ***Rm.****(0.44)* present in the four lines (T2/229, T2/223, T3/328 and T4/4210), ***Rm.****(0.46)* present in five lines.*(T1/124, T1/1214, T2/227, T4/423),****Rm.****(0.61)* absent only in the two lines FAB337/78 and *(T1/124)*, ***Rm.****(0.67)*present in one line *(T1/124)* and FAB 337/78 and ***Rm.****(0.72)* absent in only one FAB 337/78 variety .

Table (29): Similarity from total soluble protein identification of different genotypes of faba bean separated by SDS-PAGE treated with EMS in M_3 dry seed s generation.

GENOTYPES	Giza 3	T1\138	T1\1311	T1\139	T2\237	T2\2310	T2\236	T3\3316	T3\336	T4\4315	T4\4312	T4\4310
Giza 3	100	63.6	50.0	38.4	80.0	80.0	45.5	45.5	30.8	38.4	38.4	11.8
T1\138		100	80.0	63.6	63.6	63.6	33.3	33.3	21.4	28.6	28.6	18.8
1\1311			100	50.0	50.0	50.0	23.1	23.1	21.4	38.5	38.5	26.7
T1\139				100	63.6	63.6	45.5	60.0	41.7	28.6	28.6	11.8
T2\237					100	100	45.5	45.5	30.8	38.5	38.5	11.8
T2\2310						100	45.5	45.5	30.8	38.5	38.8	18.8
T2\236							100	75	50.0	33.3	33.3	5.6
T3\3316								100	54.5	45.5	45.5	6.3
T3\336									100	70.0	70.0	5.9
T4\4315										100	100	11.8
T4\4312											100	11.8
T4\4310												100

GENOTYPES	FAB337/78	T1\124	T1\1214	T2\229	T2\223	T2\227	T3\321	T3\328	T4\421	T4\423	T4\4210	
FAB337/78	100	11.1	10.5	15.8	9.5	10.0	22.2	27.8	4.8	4.8	23.5	
T1\124		100	35.3	14.3	13.6	14.3	4.3	4.2	20.0	26.3	0.0	
T1\1214			100	31.6	30.0	47.1	19.1	18.2	19.1	19.1	9.1	
T2\229				100	42.1	28.6	16.7	22.7	28.6	23.8	9.1	
T2\223					100	36.8	22.7	18.2	23.8	19.1	9.1	
T2\227						100	42.1	8.3	8.3	25	19.1	
T3\321							100	8.0	8.0	44.4	25	
T3\328								100	100	8.7	18	
T4\421									100	100	8.7	
T4\423										100	8.7	
T4\4210											100	

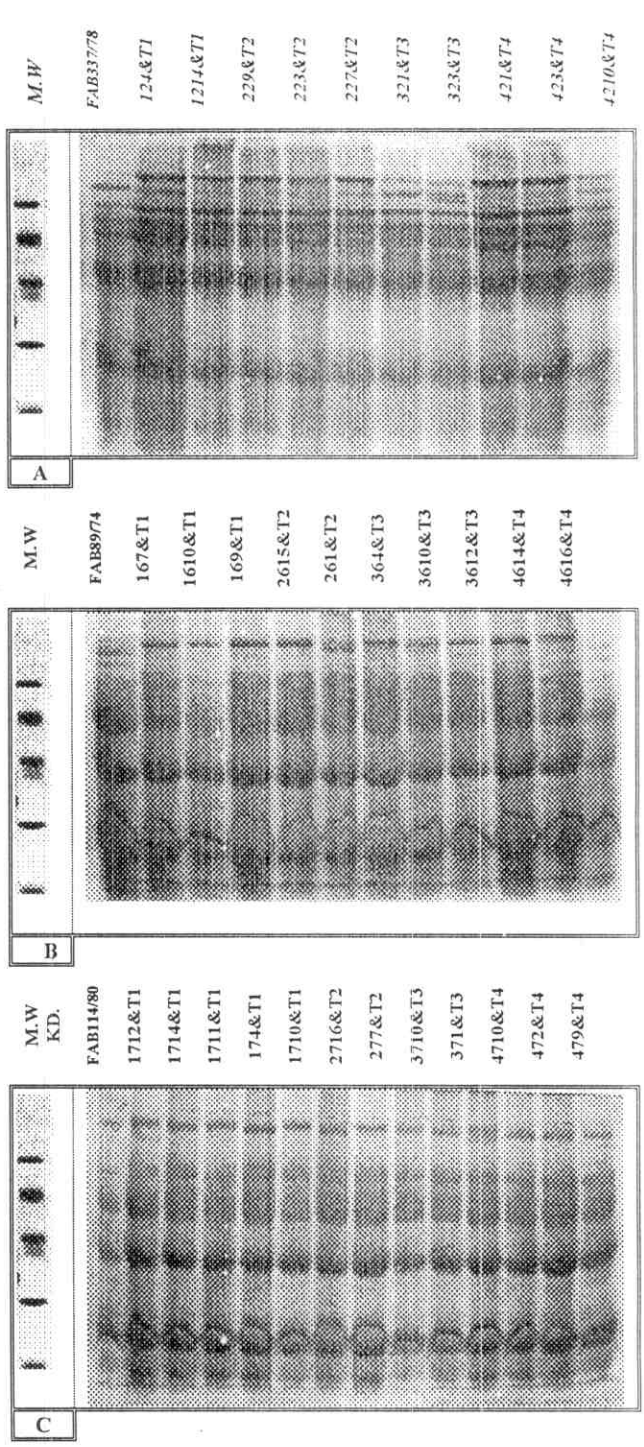


Fig (13a,b, c.): SDS-PAGE of total soluble protein extracted from M_3 generation dry seed of faba bean *(Vicia faba L.)* treated with EMS .

The percentage of similarity between Giza-3 and the 11 mutant selected lines. found in table (29) high different percent of similarity was found between Giza-3 and lines*(T2/2310 and T2 236) 80%;* while the lowest degree *(11.8%)* was shown among *(T4 4310)* ,followed by (*63.6, 50, 45.5, 38.4 and 30.8%)* between Giza-3 and the reminder mutant selected lines; In addition , the similarity between the 11 mutant lines ranged from *(5.6-100%)* .

Also, the percentage of similarity between FAB337/78 and the ten mutant selected lines are presented in table (29)which show comparison between the FAB 337/78 and mutant lines; High percent of similarity was found between FAB337/78 and *(T3 328) 27.8%;* while the lowest degree *(4.8%)* was shown among *(T4/421and T4/423),* followed by *(23.5, 22.2, 15.8, 11.1, 10.5, 10.0 and 9.5%)* between FAB 337/78 and remainder mutant lines; In addition, the similarity between the ten mutant lines ranged from (0.0 to 100%).

Table (30) and figure (13b-c), show low differences between FAB 89/74 and the ten mutant selected lines found difference in identification banding patterns and different in density level.

The banding patterns for proteins has been separated to six groups, group1 with ***Rm.****(0.22, 0.33, 0.47, 0.70, 0.78 respectively) are* present in all lines and FAB 89/74, group2 with ***Rm.****(0.1)* was absent in the three lines *(T2/236,T3/336 and T4/4312),* group3 with ***Rm.****(0.11)* absent in the five lines*(T1/138,*

Table (30): Classification of the SDS-PAGE banding patterns from total soluble proteins according to *Rm* (*Relative Mobility*) of different genotypes of faba bean treated with EMS in M_3 dry seeds generation.

Band Rm	**FAB89/74**	**T1\138**	**T1\1311**	**T1\139**	**T2\237**	**T2\2310**	**T2\236**	**T3\3316**	**T3\336**	**T4\4315**	**T4\4312**	
0.10	*L*	*VD*	*L*	*VD*	*VD*	*L*		*D*		*VD*		
0.11	*L*					*VD*	*VD*		*D*	*VD*	*L*	
0.12							*VD*					
0.14								*L*	*L*			
0.17										*L*	*L*	
0.22	*L*	*D*	*L*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*L*	
0.33	*D*	*D*	*L*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*L*	
0.47	*VD*	*VD*	*D*	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*	*D*	
0.70	*VD*	*VD*	*D*	*VD*	*VD*	*VD*	*VD*	*D*	*D*	*VD*	*D*	
0.78	*D*	*D*	*D*	*VD*	*D*	*D*	*VD*	*VD*	*D*	*VD*	*D*	
Band Rm	**FAB114/80**	*T1\1712*	*T1\1714*	*T1\1711*	*T1\174*	*T1\1710*	*T2\2716*	*T2\277*	*T3\3710*	*T4\4710*	*T4\472*	*T4\479*
0.11	*D*				*D*							
0.12		*D*	*D*				*D*	*L*	*D*			
0.13				*VD*		*VD*						
0.14										*D*		
0.27	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*
0.38	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*
0.51	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*	*D*	*VD*	*D*	*VD*	*VD*
0.67				*VD*		*VD*	*VD*			*VD*	*D*	*L*
0.68	*VD*	*VD*	*VD*						*VD*			
0.69					*VD*							
0.70								*VD*				
0.72										*VD*	*VD*	*VD*
0.74								*D*	*D*			
0.76	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*					
0.81	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*	*VD*	*L*	*D*	*VD*	*VD*	*VD*
0.83	*VD*	*D*	*D*	*VD*	*L*	*VD*	*D*	*L*	*L*	*D*	*D*	*D*

Table (31): Similarity from total soluble protein fractions of different genotypes of faba bean separated by SDS-PAGE treated with EMS in M_3 dry seed s generation.

GENOTYPES	FAB89/74	T1\138	T1\1311	T1\139	T2\237	T2\2310	T2\236	T3\3316	T3\336	T4\4315	T4\4312	
FAB8974	100	44.4	30.0	30.0	44.4	55.6	27.3	27.3	27.3	25	16.7	
T1\138		100	9.1	71.4	100	62.5	44.4	44.4	62.5	55.6	8.3	
T1\1311			100	0.0	9.1	18.2	0.0	8.3	18.2	0.0	62.5	
T1\139				100	71.4	44.4	62.5	44.4	30.0	75.0	0.0	
T2\237					100	62.5	44.4	44.4	62.5	55.6	8.3	
T2\2310						100	55.6	33.3	40	50	7.7	
T2\236							100	40.0	27.3	66.7	0.0	
T3\3316								100	55.6	36.4	7.7	
T3\336									100	25.0	16.7	
T4\4315										100	7.1	
T4\4312											100	

GENOTYPES	FAB1148O	T1\1712	T1\1714	T1\1711	T1\174	T1\1710	T2\2716	T2\277	T3\3710	T4\4710	T4\472	T4\479
FAB1148O	100	60.0	60.0	60.0	60.0	60.0	45.5	33.3	23.1	33.3	36.4	36.4
T1\1712		100	100	45.5	45.5	45.5	60.0	14.3	45.5	33.3	50.0	50.0
T1\1714			100	45.5	45.5	45.5	77.8	14.3	33.3	33.3	50.0	50.0
T1\1711				100	45.5	100	60.0	14.3	23.1	23.1	36.4	36.4
T1\174					100	45.5	45.5	23.1	33.3	23.1	36.4	36.4
T1\1710						100	60.0	14.3	23.1	33.3	36.4	36.4
T2\2716							100	14.3	33.3	45.5	50.0	50.0
T2\277								100	33.3	23.1	15.4	15.4
T3\3710									100	14.3	15.4	25
T4\4710										100	50.0	50.0
T4\472											100	75.0
T4\479												100

T1/1311, T1/139, T2/237 and T3/3316), group4 ***Rm.*** *(0.14)* are present in only two lines. *(T3/3316 and T3/336),* group5 ***Rm.****(0.12)* present in only one line.*(T2/236),* group6 ***Rm.****(0.17) are* present in the two lines *T4/4315 and T4/4312).*

There was also, high difference between FAB 114/80 and the eleven mutant selected lines in identification banding patterns and density level; the banding patterns for protein has been separated to many groups, with ***Rm.*** *(0.27, 0.38, 0.51, 0.81 and 0.38 respectively)* .Which were present in all mutant lines and FAB 114/80, ***Rm.****(0.11)* present in the only mutant *(T1/1741)* and FAB 114/80,***Rm.****(0.12)* are present in the five lines *(T1/1712, T1/1741, T2/2716, T2/227 and T3/3710),* with ***Rm.*** *(0.13)* present in the two lines *(T1/1711 and T1/1710),* ***Rm.****(0.14)* present in only one line *(T4/4710),* ***Rm.****(0.67) was* absent in five lines *(T1/1712, T1/1714, T1/174, T2/277 and T3/3710)* and FAB 114/80, ***Rm.****(0.69)* present in only line *(T2/277),* ***Rm.***(0.72) present in the three lines *(T4/4710,T4/472 and T4/479),* with ***Rm.****(0.74)* are present in only two lines *(T2/277 and T3/3710),* ***Rm.***(0.76) absent in five lines *(T2/277, T3/3710, T4/471, T4/472 and T4/479) .*

The percentage of similarity between Fab89/74 Major variety and ten mutant selective lines are presented in table (31) comparisons between FAB89/74 and mutant lines; Found high percent of similarity was found between FAB 89/74 and only line *(T2/2310) 55.6%;* While the lowest degree *(16.7%)* was shown among *(T4/4312),* followed by (*44.3, 30.0, 27.3 and 25%)* between FAB 89.74 and the remainder mutant selected lines.

In addition, the similarity between the ten mutant lines raged from *(0.0 to 71.4%).*

Also, the percentage of similarity between FAB 114/80 and the eleven mutant are presented in table (31). Comparisons between FAB 114/80 and mutant lines and found high percent of similarity between FAB 114/80 and mutant lines. *(T1/1712, T1/1714, T1/1711, T1/174 and T1/1710) 60%;* While the lowest degree *(23.1%)* was shown among *(T3/3710),* followed by *(45.5, 36.4 and 33.3%)* between FAB 114/80 and remainder mutant lines; In addition, the similarity between the eleven mutant lines ranged from *(14.3-100 %).*

I had selected the best mutant lines from six varieties of *Vicia faba L* ; the high protein content ,the identification banding patterns proteins and low percent of similarity in the dry seeds were observed in the lines (T1/119, T2/2114, T4/414, T2/2412, T4/4410, T3/347, T3/341, T4/4310, T1/124, T1/1214, T2/223, T2/227, T4/421, T4/423, T4/4312, T4/4315, T3/3316, T3/336 and T3/3710). **(Ladizinsky, 1975; ladizinsky and Hymowitz, 1979; Yamamoto and Plitmann, 1980; Hussein and Salam, 1985; Gamal El-Din *et al.* 1988 and Ghandorah and El-shawaf, 1993).**

19 faba bean (***Vicia faba L.)*** selective mutant lines of total globulin content isolated in M_3 generation by SDS-PAGE was according to **(Matta *et al.*, 1981);** Showed in the table (32) the two low molecular weight (20.0and 24.4 K_{Da}) were present only in the all lines and absent band (17.0 K_{Da}) in the three lines (2,5

and 8); the band (28.3K_{Da}) absent in the five lines (5, 7, 11, 12 and 15 respectively).

Also, the medium molecular weight (30.0,32.0,33.4,34.0 and 37K_{Da}) were observed in the any mutant lines; the band (30.0K_{Da}) present in the all lines and band (32.0 K_{Da}) present in the lines (2, 5, 6, 7, 8, 10, 11, 12 and 15 respectively); the band (33.4K_{Da}) observed in the lines (2, 5, 6, 7, 8, 10, 11, 12 and 13); band (34.0K_{Da}) present in the lines (1, 3, 4, 9, 13, 14, 16, 17, 18 and 19 respectively). The high molecular weight (48.0 and 44.0 K_{Da}) were observed in the all mutant lines, the band (46.5 K_{Da}) absent in line (8), the band (40.0 K_{Da}) were present in the seven lines (1, 2, 6, 8, 12, 15 and 19 respectively).

The protein patterns of the 19 mutant lines separated to three main bands are demonstrated corresponding to the three major component vicilin, covicilin and legumin. It's apparent that concentration of these components is not the some in the different lines: in particular the low concentration of vicilin in line (8) is quite evident.

Electrophoretic results after SDS_PAGE showed in table (32) and figure (14a ,b), which simultaneously indicates the band position and the percentage of the band optical densities, demonstrates quantitative and qualitative differences among the lines, its possible to identify five types of vicilin patterns (48.0,46.5,44.0,28.3, and 17.0 K_{Da}), four types of covicilin (34.0,33.4,32.0 and 30.0 K_{Da}) and three types of legumin

Table (32): SDS_PAGE of total globulin extracted from dry seeds of 19 selective mutant lines of *Vicia faba L.* treated with in M_3 generation.

Band Mw(KD_a)	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6	Line 7	Line 8	Line 9	Line 10	Line 11	Line 12	Line 13	Line 14	Line 15	Line 16	Line 17	Line 18	Line 19
48.0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
46.5	+	+	+	+	+	+	+	—	+	+	+	+	+	+	+	+	+	+	+
44.0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
40.0	+	+	—	—	—	+	—	+	—	—	—	+	—	—	+	—	—	—	+
37.0	+	—	—	—	—	+	+	+	—	+	—	—	+	—	—	+	—	—	+
34.0	+	—	+	+	—	—	—	—	+	—	—	—	+	+	—	+	+	+	+
33.4	—	+	—	—	+	+	+	+	—	+	+	+	—	—	+	—	—	—	—
32.0	+	—	+	+	—	—	—	—	+	—	—	—	+	+	—	+	+	+	+
30.0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
28.3	+	+	+	+	—	+	—	+	+	+	—	—	+	+	—	+	+	+	+
24.4	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
20.0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
17.0	+	—	+	+	—	+	+	—	+	+	+	+	+	+	+	+	+	+	+

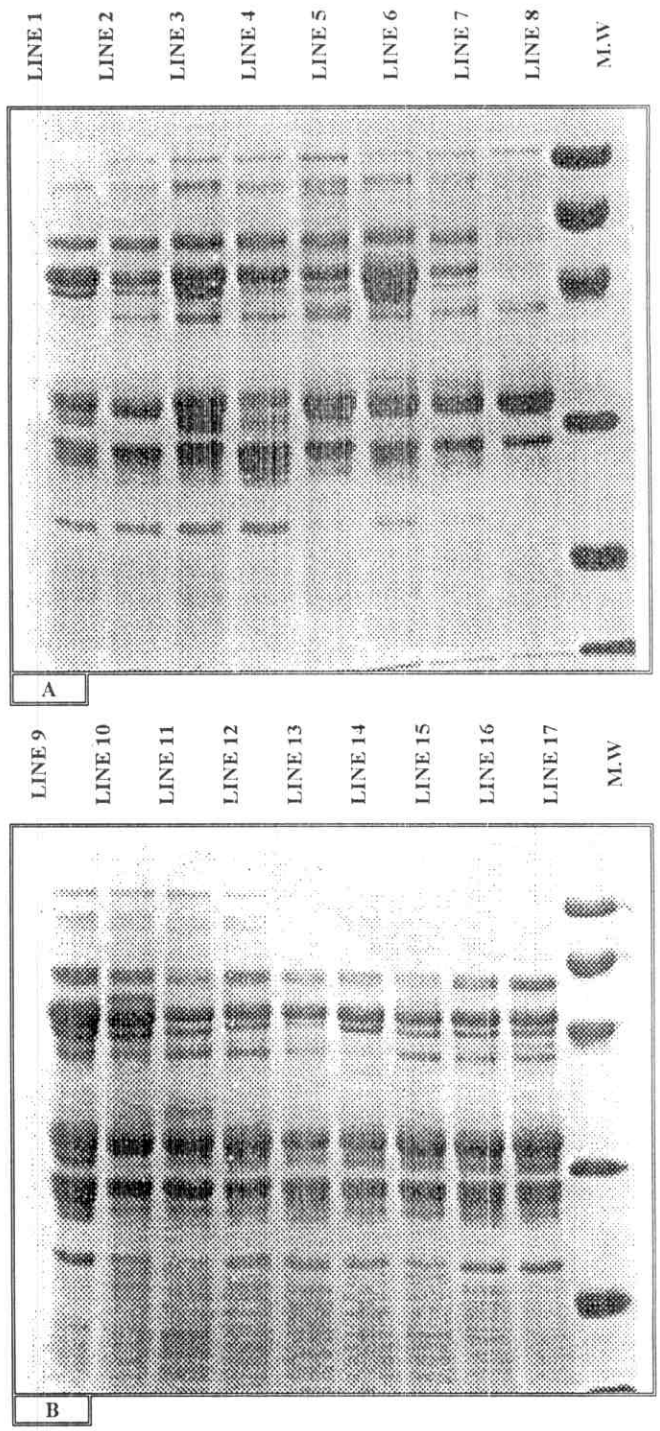


Fig (14a,b.): SDS-PAGE of total globulin protein extracted from 19 Selective mutant Lines in M_3 generation dry seed of faba bean *(Vicia faba L.)* treated with EMS.

(40.0,37.0 and 20.0 K_{Da}). Also after SDS_PAGE, the line (8) showed a low content of vicilin subunit.

Two types of covicilin SDS_PAGE patterns were demonstrated with quantitative difference .as far as between low vicilin content results are confirmed by analyses of total storage proteins which demonstrate qualitative and quantitative differences among lines . Seed protein analyses could also be useful for genetic improvement based on selection for genetic endogenous variability or for induced point or framshift mutation in the storage protein subunit. For higher albumin levels associated with enhanced available methionine concentration in faba bean lines. Moreover, showed in some case a high variation in vicilin and legumin and covicilin ratio: for example, line (8) shows high covicilin and legumin concentration, while line (6) and (9) contain higher levels of vicilin were very good in the high protein quality; this results according to **(Guldager, 1978; Millerd *et al.*, 1978; Croy *et al.*, 1980b; Ersland *et al.*, 1983; Gatehouse *et al.*, 1982 and 1986; Chandler *et al.*, 1984; Higgins 1984 and 1986; Boulter *et al.*, 1987; Chambers *et al.*, 1992; Casey et al. 1986 ; Muntz *et al.*, 1987 and 1989; Scott *et al.*, 1992; Shimada *et al.*, 1994;Nielsen *et al* .,1989;Borroto and Dure III,1978; Gibbs *et al.*, 1989; and Shutov *et al.*, 1995).**

III. DNA Molecular Markers For Identification of Faba Bean *(Vicia faba L.)* Protein Quality :

Change in DNA content of particular plant species accrued during the evolution selection and any artificial improvements **(Holiday, 1970)** reviewed that large change s in DNA per genome can evolve quit rapidly. Significant variations in DNA content per genome have been reported in different *Vicia faba* plant genotypes **(Miksche, 1968 and 1971;Schweizer and Davies, 1972)** included some mutants. Significant differences in DNA content were demonstrated between some species of Vicia **(Chooi, 1971a;Yamamoto, 1973 and 1977; Yamamoto and Plitman, 1980; Youssef, 1981; Hesemann, 1982).**

The relationships between *Vicia faba L.* 19 selective mutant lines based on the similarity of fingerprints DNA by specific PCR methods. In this way, a total of 189-band position revealed by label oligonuclotide primers (OP1, OP2, OP3 and OP4) were scored (data matrix available or request).

Detected bands were excluded from the analysis since the extent of intra-varieties and inter-mutant lines variation were highest with this label primers. Specific PCR analysis using SigmaGel Software **(Sneath and Sokal, 1973;Van de Peer and De Wachter, 1993)** is depicted in Figure (15) showed in table (33) a primer combinations produced 189 bands of these 170 were clearly polymorphic among the 19 mutant selective lines with 89.95% of the total products scored.

Table (33): Fingerprint DNA to 19 selective mutant lines of faba bean *(Vicia faba L.)* with primer combination illustrated in Fig.15 by Specific - PCR method.

Mutant Lines	*Varieties*	*Origin*	*Specific banding pattern*
Line 1	*Giza 402*	*Egyptian*	**Bands of 6500, 3500, 2000, 1600, 1400 and 500bp missing.**
Line 2	*Giza 402*	*Egyptian*	**Bands of 9000, 7000, 6500, 6100, 4000, 2000, 1600, 1400 and 1300 bp missing,**
Line 3	*Giza 402*	*Egyptian*	**Bands of 7000, 6100, 4000, 1300 bp missing,**
Line 4	*Giza 2*	*Egyptian*	**Bands of 8500, 7000, 5500, 4500, 4000 and 2000 bp missing,**
Line5	*Giza 2*	*Egyptian*	**Bands of 8500, 7500, 6100, 5500 and 4000 bp missing,**
Line6	*Giza 2*	*Egyptian*	**Bands of 7500, 7000, 6500, 5000, 4500 and 2000 bp missing,**
Line 7	*Giza 2*	*Egyptian*	**Bands of 8500, 7000, 6100, 5000, 4500, 3800 and 2000 bp missing,**
Line8	*Giza 3*	*Egyptian*	**Bands of 9000 6500,6100, 3800, 3500,1400 500 bp missing**
Line 9	*FAB337/78*	*Ethiopians*	**Bands of 6500, 6400, 4800, 4500, 3800, 3200 and 1400 bp missing.**
Line 10	*FAB337/78*	*Ethiopians*	**Bands of 9000, 6500, 6400, 3800, 3500, 1400 and 500 bp missing.**
Line 11	*FAB337/78*	*Ethiopians*	**Bands of 9000, 7000, 6400, 6000, 4800, 4500, 3800, 3000, 2000, 1600, 1300 and 500 bp missing,**
Line 12	*FAB337/78*	*Ethiopians*	**Bands of 9000, 6500, 6000, 4800, 4500, 4000, 3500, 3000,1600, 1300 and 500 bp missing.**
Line 13	*FAB337/78*	*Ethiopians*	**Bands of 9000, 6500, 6000, 4800, 4500, 3800, 3500, 3200, 2000, 1600, 1400, 1300 and 500 bp missing.**
Line 14	*FAB337/78*	*Ethiopians*	**Bands of 9000, 6500, 6000, 4800, 4500, 3800, 3500, 3200, 2000, 1600, 1400, 1300, and 500 bp missing.**
Line 15	*FAB89/74*	*Netherlands*	**Bands of 9000, 6000, 4000 and 3500 bp missing.**
Line 16	*FAB89/74*	*Netherlands*	**Bands of 9000, 7000 and 6000 bp missing.**
Line 17	*FAB89/74*	*Netherlands*	**Bands of 7000, 4500, 4000, 3800 and 3500 bp missing,.**
Line 18	*FAB89/74*	*Netherlands*	**Bands of 9000, 6500, 4500, 4000, 3800 and 3500 bp missing.**

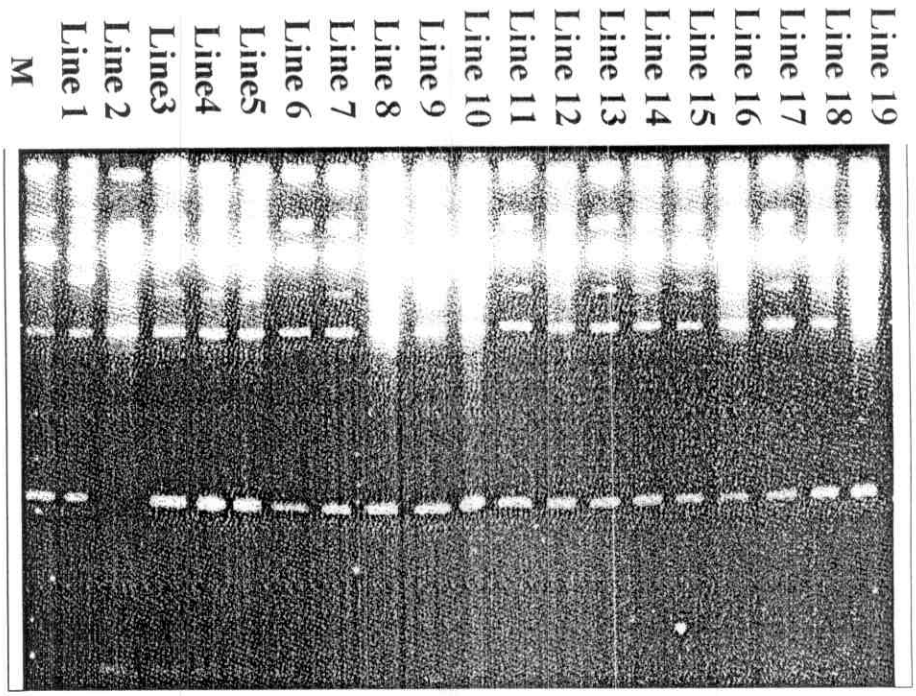


Figure (15): Fingerprint DNA for 19 individuals selective mutant lines of faba bean (*Vicia faba L.)* after *Hind III* digested DNA in M_3 generation.

This is a high level of polymorphic expressed by Specific PCR both (OP1) primer and the better than OP2, OP3, OP4 primers and combination compared to the results already reported in faba bean (**De Curcel *et al.*, 1989; Ainsworth and Sharpe, 1989; Khairallah *et al.*, 1989; Ainsworth and Sharpe, 1989; Khairallah *et al.*, 1990; Van de Ven *et al.*, 1991 and Scallan, 1993).**

The number of polymorphic markers from the OP1 primer combination and the size of amplification products varied from 500 to 9000 bp. 19 mutant selective lines and their banding patterns are described in table (34) could be clearly distinguished from all other lines with the OP1 primer. For instance the lines selective of Giza-402, Giza-2, Giza-3, FAB 337/78, FAB 89/74 and FAB 114/80) gave specific banding patterns with almost the OP1 primer.

In general, it can be concluded that sufficient polymorphism exists to allow distinction between the faba bean genotypes tested. The indices of genetic similarity among 19 mutant lines of faba bean genotypes are presented in table (35), this analysis clearly distinguished the 19 mutant lines genotypes from all other varieties; it showed the different similarity values with all other mutant lines tested. This result is quite expected, considering the diverse origin and characteristics of these mutant lines compared to other. Among the other genotypes, showed high level of genetic similarity with values ranging from 50 to 86%, also showed low level of genetic similarity values less than 50%. Indicated those mutant lines selective from Giza-2, FAB

Table (34): Fingerprint DNA (Specific –PCR) data obtained after *Hind III* digested DNA from different selective mutant lines of *Vicia faba L.* in M_3 generation.

M.W(bp)	Line1	Line2	Line3	Line4	Line5	Line6	Line7	Line8	Line9	Line10	Line11	Line12	Line13	Line14	Line15	Line16	Line17	Line18	Line19
9000	+		+						+								+		
8500						+		+	+	+	+	+	+	+	+	+	+	+	+
8000	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
7500				+			+	+											+
7000	+				+			+	+	+		+	+	+	+			+	+
6500			+	+	+		+				+			+	+	+	+		+
6400												+	+						
6100	+			+															
6000	+	+	+	+	+	+		+	+	+							+	+	+
5500	+	+	+			+	+	+	+	+	+	+	+						+
5000	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+
4800										+									
4500					+			+		+				+	+	+			
4000	+					+	+	+	+	+	+		+			+			+
3800				+	+							+		+	+	+			
3500		+	+						+		+					+			
3200											+	+							
3000	+	+	+	+	+	+	+	+	+	+			+	+	+	+	+	+	+
2000			+		+			+	+	+		+							+
1600			+					+	+	+									+
1400			+								+	+		+	+	+	+	+	+
1300	+			+	+	+	+	+	+	+									
500		+	+	+	+	+	+		+										

Table (35): Similarity index of 19 Faba bean selective mutant lines by Specific- PCR analysis in M_3 generation.

Genotypes	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6	Line 7	Line 8	Line 9	Line 10	Line 11	Line 12	Line 13	Line 14	Line 15	Line 16	Line 17	Line 18	Line 19
Line1	1.0	0.42	0.47	0.33	0.40	0.50	0.38	0.53	0.64	0.53	0.27	0.33	0.46	0.27	0.27	0.25	0.38	0.42	0.44
Line2		1.0	0.58	0.42	0.38	0.50	0.36	0.33	0.43	0.25	0.23	0.21	0.33	0.23	0.23	0.31	0.36	0.40	0.33
Line3			1.0	0.47	0.53	0.43	0.43	0.47	0.67	0.47	0.31	0.29	0.24	0.24	0.24	0.29	0.43	0.27	0.53
Line4				1.0	0.50	0.38	0.50	0.35	0.77	0.28	0.27	0.25	0.19	0.36	0.36	0.33	0.38	0.31	0.35
Line5					1.0	0.36	0.36	0.50	0.41	0.50	0.25	0.40	0.40	0.54	0.54	0.43	0.36	0.38	0.41
Line6						1.0	0.60	0.50	0.50	0.50	0.31	0.29	0.42	0.21	0.31	0.29	0.33	0.36	0.40
Line7							1.0	0.40	0.31	0.31	0.21	0.20	0.31	0.21	0.21	0.29	0.23	0.15	0.40
Line8								1.0	0.73	0.86	0.29	0.44	0.47	0.38	0.38	0.35	0.31	0.43	0.73
Line9									1.0	0.73	0.38	0.44	0.47	0.29	0.29	0.35	0.40	0.43	0.67
Line10										1.0	0.29	0.44	0.47	0.38	0.38	0.35	0.31	0.43	0.63
Line11											1.0	0.27	0.29	0.29	0.29	0.46	0.33	0.23	0.29
Line12												1.0	0.46	0.27	0.36	0.18	0.20	0.31	0.44
Line13													1.0	0.50	0.50	0.46	0.42	0.60	0.57
Line14														1.0	1.0	0.58	0.55	0.60	0.47
Line15															1.0	0.58	0.55	0.60	0.47
Line16																1.0	0.50	0.42	0.44
Line17																	1.0	0.67	0.50
Line18																		1.0	0.54
Line19																			

337/78 and FAB 89/74 reflect lower genetic similarity and diversity than Giza-402, Giza-3 and FAB 114/80 in Specific PCR analysis.

The complexity of the profiles and the limited range of 19 mutant lines selective analyzed could account for the low levels of polymorphism's observed in this study; similar in low level of mutant DNA variation, using Specific PCR and Restriction Fragment Length Polymorphism differences have been observed in other species i.e. Pearl millet **(Chowdhury and Smith, 1988)**, Sugar beet *(***Ecke and Michaelis, 1990***)*, Oat **(Rines et al., 1988)** and Soybean **(Sisson *et al.*, 1978*)***. This contrasts with high levels of intraspecific variation observed in carrot, maize and teosinate *(* **Ichikawa *et al.*,1989;Timothy *et al.*,1979;Kemble *et al.*,1983;Cruz_Garcia, *et al.*1995; Van Pijlen, *et al.* 1995; Sivritepe and Dourado, 1994;Ghosh and Chaudhuri, 1984.**