

EVALUATION OF ADVANCED GENERATIONS OF EARLY FLOWERING AND HEAVY BRANCHING/HIGH YIELDING MUTANTS OF EGYPTIAN LUPINE:

I- BEHAVIOUR AND PERFORMANCE OF MUTANTS

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ABSTRACT

The plant materials used in this investigation include five true breeding families belong to two different mutant types (two early flowering and three heavy branching/high yield) derived from Egyptian lupine cv. Giza 2 after treating seeds with either EMS or SA (Hassan 1991 and 1998). These mutants were raised to study their behaviour and performance, compared to the control (original lupine cultivar Giza 2) in M6 and M7 generations.

The field work was carried out in Agricultural Experiments and Researches Station, Faculty of Agriculture, University of Cairo, Giza, Egypt during the two growing seasons of 1998/1999 and 1999/2000, representing M6 and M7 generations; respectively. In early flowering mutants, the obtained results indicated that the number of days elapsed from sowing till the appearance of the first flower in both EMS and SA early flowering mutants was significantly lower than the control and ranged from 66 to 75 days in M6 and from 66 to 74 days in M7. Meanwhile, the flowering onset for control plants ranged from 80 to 88 days in both studied generations. Such result means that the two early flowering mutants under investigation proved to be true deviants transmitted from M5 to M6 and from M6 to M7 as discontinuous variates not overlapping with the control and this may confirm their homozygosity and stability. Moreover, the two early flowering mutants produced higher seed yield compared to the control. The increase in seed yield over the control was always significant, being 34.9 and 32.3% for EMS mutant (G2 EMS EF1) and being 28.9 and 30.4% for SA mutant (G2 SA EF2) in M6 and M7; respectively.

In heavy branching/high yield mutants, the obtained results indicated that the number of branches, number of pods, seed yield per plant and 100-seed weight of any of these mutants were significantly higher than those of the control plants either in M6 or in M7-generation. Number of branches per plant in the progeny of each selected mutant, through the two studied generations M6 and M7, ranged from 5 to 9 branches against 3 to 4 branches in the control plants. Also, number of pods per plant ranged from 52 to 73 in the progenies of heavy branching/high yielding mutants against 24 to 40 in the control plants. Seed yield per plant ranged from 64.7 to 87.6g in the progenies of heavy branching/high yield mutants against 23.6 to 46.9g in the control plants through M6 and M7 generations. Hundred seed weight ranged from 33.1 to 37.4g in the progenies of heavy branching/high yield mutants against 26.8 to 32.9g in the control plants through M6 and M7 generations. These results indicate that the four attributes (number of branches, number of pods, seed yield and 100-seed weight) were transmitted from M5 to M6 and from M6 to M7 as discontinuous variates not overlapping with the control and this may ensure their homozygosity. Therefore, it could be stated that all heavy branching/high yield mutants proved true breeding and stable up to M7-generation.

The significant increase in number of branches per plant of these mutants over the control ranged from 100.0% (G2 EMS HB/HY4) to 113.5% (G2 EMS HB/HY6) in M6-generation, and from 100.0% (G2 SA HB/HY3) to 107.9% (G2 EMS HB/HY6) in M7-generation. Whereas, the significant increase in number of pods per plant of these

mutants over the control ranged from 88.9%(G2 SA HB/HY3) to 99.1% (G2 EMS HB/HY6) in M6-generation, and from 87.8% (G2 SA HB/HY3) to 97.0% (G2 EMS HB/HY6) in M7-generation. While, the significant increase in seed yield per plant of these mutants over the control ranged from 117.5% (G2 EMS HB/HY3) to 125.9% (G2 EMS HB/HY6) in M6-generation, and from 109.6% (G2 SA HB/HY3) to 119.2% (G2 EMS HB/HY6) in M7-generation. The significant increase in 100-seed weight of these mutants over the control ranged from 11.7 % (G2 EMS HB/HY3) to 13.0% (G2 EMS HB/HY6) in M6-generation, and from 10.3% (G2 EMS HB/HY4) to 12.2% (G2 EMS HB/HY6) in M7-generation.

Microscopical examinations indicate that the main stem diameter at the eleventh internode was wider in the early flowering and heavy branching/high yield mutants than the control. This increment in internode diameter was mainly due to the prominent increase in the thickness of stem wall and in the diameter of hollow pith cavity. All included tissue areas (thickness of epidermis, cortex, fibre strands, vascular tissues and parenchymatous area of the pith) shared to different extents in increasing the thickness of stem wall of the early flowering and heavy branching/high yield mutants. Likewise, the leaflet lamina in the heavy branching/high yield mutant type was thicker than that of the control. Both of the palisade and spongy tissues as well as leaflet midvein were increased in thickness and the midvein bundle was increased in size. Whereas, the leaflet lamina, in the early flowering mutant type of mutation, was nearly similar to that of the control.

Keywords: Evaluation, early flowering, heavy branching/high yielding, mutants, Egyptian lupine, behaviour and performance, advanced generations

INTRODUCTION

Lupinus is a genus of the family Fabaceae consists of about 200 species (Cronquist, 1981 and Jones and Luchsinger, 1987). Lupine is tolerant towards a wide variation of soils and of climatic conditions. It is grown as an aestival crop in cold temperate areas and as a winter crop in temperate and warm temperate ones; it tolerates frost and drought. It requires sandy and silt-sandy soils from strongly acid to calcareous ones with preference for moderately acidic. Its nitrogen-fixing capacity causes a saving of fertilizers which is estimated at up to 80-100kg N per hectare (Gladstones, 1970).

Lupinus termis Forssk.is cultivated in the Mediterranean region for its edible seeds, as a rotation crop, as a green manure, especially in the newly cultivated land, as a medical plants, as an ornamental plant and the seeds are widely used in Egypt and Middle East as a food after having been debittered by leaching out the alkaloids by soaking the seeds for several days in a flow of water. Lupine flour has been used in bread making, substituting 10-20% of wheat flour (Gross *et al.*, 1983; Ballester *et al.*, 1984 and Beiro da Costa, 1984). Lupines are also employed in biscuit and cake making, pastas, lactic substitutes, precooked foods,snacks, hamburger and even incorporated into baby foods (Belteky and Kovacs, 1984 and Lopez-Bellido and Fuentes, 1986) as well as a good stuff for animals, such as broiler chickens, laying hens, pigs, dairy cows, steers, lambs, deer, fish, horses, rabbits and milking goats(Hill, 1990).

Mutants are the genetic resources for developing improved cultivars. It appears to be particularly relevant that enlarged variability caused by mutants in our breeding material is very necessary. Now and then the genetic basis in the crops is limited as it is found for instance in lupine. Therefore, mutation

induction as a modern breeding method can create new variation in directions not found favoured by previous natural or human selection. Induced mutants can be utilized directly for new cultivars or indirectly by using them for cross breeding programmes.

By using numerous chemical and physical mutagens many workers have obtained various mutant types, which are economically promising in lupines. Pakendorf (1974), Fartushnyak (1974), Jayasekera (1981), Harrison and Williams (1982), Williams *et al.* (1984), Klochko *et al.* (1992), Gataulina (1994), have obtained mutants with various characteristics such as low alkaloid forms, high fruiting capacity, early flowering, high yielding, high protein and oil content and many other economical characteristics, after using mutagenic agents on different lupine species. These results, therefore, suggest that considerable improvement in the rather restricted range of variation, available in lupine species, can be affected by the induction of mutations.

The author (1991) studied the mutagenic effects of the two chemical mutagens ethylmethane sulphonate(EMS) and sodium azide(SA) on Egyptian lupine cv. Giza 2 in an attempt to induce mutations, hoping to be of valuable productivity. The investigation was carried out through mutation breeding programme initiated at Department of Agricultural Botany, Faculty of Agriculture, Cairo University since 1987. The investigation traced the plants up to the third generation in order to select promising mutants, which might show more desirable characteristics for improving the productivity of lupine crop. The obtained results gave in total 75 different mutant families, in M3-generation, classified under eight different macromutant types (giant, dwarf, high yield, heavy branching/high yield, early flowering, late flowering, small seed and large seed). Some of these mutants are of high economic importance and /or with breeding value. Evaluation of this new germplasm, with respect to yield performance and stability during subsequent generations, is very necessary for release.

The author (1998) evaluated sixteen true breeding M3-mutant families belong to five different mutant types (giant, dwarf, early flowering, high yield and heavy branching/high yield) derived from Egyptian lupine cv. Giza 2 after treating seeds with either EMS or SA (Hassan,1991). These mutants were raised to study their behaviour and performance, compared to the parental lupine cultivar Giza 2, in M4 and M5 generations.

The present work was conducted to complement such mutation breeding programme to select and evaluate the mutants of high economic value for release as new lupine cultivars. Therefore, five true breeding M5-mutant families belong to two different mutant types (two early flowering and three heavy branching/high yield mutants) were raised to study their behaviour and performance, compared to the parental lupine cultivar Giza 2, in M6 and M7 generations. For each selected mutant, beside the deviant character(s), which characterizes the mutant type, seed yield was also evaluated. Moreover, the evaluation of selected mutants includes anatomical studies.

MATERIALS AND METHODS

1-The source of plant materials:

The plant materials used in this investigation include five true breeding M5-mutant families belong to two different mutant types derived from Egyptian lupine cv. Giza 2 by treating seeds with any of the two chemical mutagens ethylmethane sulphonate (EMS) and sodium azide(SA), Hassan (1991 and 1998).The mutant types are: two early flowering mutants (G2 EMS EF1 and G2 SA EF2) derived from 0.10% EMS and 2×10^{-3} M SA; respectively and three heavy branching/high yield mutants, two of them (G2 EMS HB/HY4 and G2 EMS HB/HY6) derived from 0.20 and 0.25% EMS; respectively and one (G2 SA HB/HY3) derived from 2×10^{-3} M SA. These types of mutations were previously selected during a long term of mutation breeding programme initiated at Department of Agricultural Botany, Faculty of Agriculture, Cairo University since 1987. Details of the cultivar characteristics, concentrations and method of the chemical mutagens application and handling the materials during the successive M1 to M5 generations are stated by Hassan (1991 and 1998).

2-Field work procedure:

The field work was carried out in Agricultural Experiments and Researches Station, Faculty of Agriculture, University of Cairo, Giza, Egypt, during the two growing seasons of 1998/99 and 1999/2000, representing M6 and M7-generations; respectively.

A) M6-generation:

Random seed samples, comprised 720 seeds, from bulked seeds of each M5-selected family within each mutant type as well as from the control (normal lupine cv. Giza2), obtained from M5-plants, were sown on 10th November, 1998 to provide the experimental plant materials of M6-generation. The lay out of the experiment was randomized complete block design in three replicates. The five mutants beside the control required that the experimental land of each replicate is divided into 6 plots, each contained one genotype. The plot contained six ridges, 4 meters in length and 70 cms apart with two seeds per hill. Data were recorded at flowering with respect to early flowering mutants and at harvest with heavy branching/high yield mutants. For each selected mutant within each mutant type and for control, data were recorded on 90 individual plants (30 plants from each replicate) taken at random with respect to the deviant character(s) which characterizes the mutant type beside the yield of seeds per plant.

B) M7-generation:

Random seed samples, comprised 720 seeds, from bulked seeds of each M6-progeny within each mutant type and the same number of seeds from control plants were sown on 15th November, 1999 to provide the experimental plant materials of M7-generation. The experiment was made in randomized complete block design with three replicates similar to that of M6-generation. The procedure of recording various data was identical to that reported in M6-generation. In addition, anatomical studies were done on selected mutant types.

3-Anatomical studies:

For each selected mutant and control plants, specimens were taken from the eleventh internode on the main stem as well as from the median leaflet of the corresponding leaf at the age of 80 days from sowing; i.e. at flowering stage. Specimens were killed and fixed for at least 48 hr. in F.A.A. (10 ml. Formalin, 5 ml. Glacial acetic acid and 85 ml. Ethyl alcohol 70%). The selected materials were washed in 50% ethyl alcohol, dehydrated in a normal butyl alcohol series, embedded in paraffin wax of 56 °C melting point, sectioned to a thickness of 20 microns, double stained with crystal violet-erythrosin. Cleared in xylene and mounted in Canada balsam (Nassar and El-Sahhar, 1997). Sections were examined to detect histological manifestations of the chosen mutants.

4-Statistical analysis:

Data on M6-generation as well as on M7-generation were subjected to various conventional methods of statistical analysis according to Snedecor and Cochran (1982).

RESULTS AND DISCUSSION

Two early flowering and three heavy branching /high yield mutants derived from Egyptian lupine cv. Giza 2 after treating seeds with either EMS or SA (Hassan, 1991 and 1998) were raised to study their behaviour and performance, compared to the parental lupine cultivar Giza 2, in M6 and M7-generations. For each selected mutant, beside the deviant character(s), which characterizes the mutant type, seed yield was also evaluated. Moreover, the evaluation of selected mutants includes anatomical studies.

I-Behaviour and performance of mutant types:

1-Early flowering mutants:

Data pertaining to flowering onset and yield performance of the two selected early flowering mutants and their parental lupine cv. Giza 2 in M6 and M7-generations are presented in Table (1)

It is realized that the two different early flowering mutants (G2 EMS EF1 and G2 SA EF2) were statistically indifferent with respect to flowering onset, either in M6 or in M7-generation, and they were extremely earlier in flowering than in the control (Figure,1). It is worthy to note that the early flowering mutant of EMS (G2 EMS EF1) surpassed early flowering mutant of SA (G2 SA EF2) in seed yield and both exceeded significantly control plants in M6 and M7-generations.

It is clear that the number of days elapsed from sowing till the appearance of the first flower in any of these mutants was significantly lower than in the control and ranged from 66 to 75 days in M6 and from 66 to 74 days in M7 for both early flowering mutants under investigation. Whereas, the range for control plants was from 80 to 88 days in both studied generations. This means that these mutants proved to be true deviants transmitted from M5 to M6 and from M6 to M7 as discontinuous variates not overlapping with the control. This may confirm their homozygosity and stability. The coefficient of variability of each mutant progeny was slightly higher than that of the

control and all entries recorded C.V% values of small magnitude either in M6 or in M7 confirming the homozygosity that occurred within progeny of each genotype with respect to flowering onset.



Figure (1): A photograph illustrates early flowering mutant type (shown to the right) with the normal lupine plant (shown to the left) at the age of 10 weeks. At this age, flowering starts only in early flowering mutant type.

Table(1): Descriptive values of early flowering mutants induced in Egyptian lupine by EMS or SA, and control plants of lupine cv. Giza 2 in M6 and M7-generation

Mutant type	M6-generation				M7-generation			
	Flowering onset (days) X' ± S.E. Range C.V.%	Seed yield g/plant X' ± S.E	Flowering onset (days) X' ± S.E. Range C.V.%	Seed yield g/plant X' ± S.E				
Control (Giza2)	83.88±0.28 80-87 3.20	35.76±0.53	82.74±0.28 80-88 3.20	36.34±0.56				
G2 EMS EF1	68.16±0.33 66-75 4.59	48.23±0.35	69.68±0.28 67-74 3.80	48.08±0.38				
G2 SA EF2	67.69±0.28 67-74 3.92	46.09±0.44	68.31±0.25 66-73 3.44	47.37±0.49				
L.S.D. (0.05)	0.99	2.80	1.07	2.45				

Data in Table (1) also indicate that all early flowering mutants produced higher seed yield compared to the normal plants of lupine cv. Giza 2. The increase in seed yield over the control was always significant, being 34.9 and 32.3% for EMS mutant and being 28.9 and 30.4% for SA mutant in M6 and M7; respectively.

From the aforementioned results, it could be stated that both EMS and SA early flowering mutants proved true breeding and their progenies in M6 as well as in M7-generation reached high degree of homozygosity and stability. Previously, Jayasekera (1981) induced mutations in *Lupinus albus* and *Lupinus mutabilis* by using different concentration of EMS. He isolated early flowering mutants in M2, which showed bred true in M4. In this connection,

Bansal (1972) obtained seven early dwarf mutants by using EMS on *Hordeum vulgare* cv.NP113. These mutants showed their stability for earliness and straw length over a wide range of environments up to M5-generation. One of these mutants (BM21), which was earlier by 24 days and shorter by 32 cm. than the control, was found to have high yielding potential. Likewise, Sharma *et al.* (1974) tested 11 early maturing mutants of rice along M4 and M5-generations and reported that the tested mutants proved bred true, flowered 17 to 30 days earlier and produced high yield compared to their controls. Similarly, Prasad (1976) using EMS on *Vigna radiata* isolated early flowering mutants in M2, which flowered earlier by 18 days than the parental variety RS4 and proved true breeding along M3 to M6-generations. Also, Gamal-El-Din (1980) obtained early flowering mutants by using EMS or SA on *Phaseolus vulgaris* L. cv. Contender. The mutants were selected from M3-generation and raised to study their behaviour during M4, M5 and M6-generations. He stated that, in M6-generation, 5 early flowering mutants retained the behaviour they showed in the previous generations and some of them surpassed the control in seed yield. In this respect, Dixit and Dubey (1986) isolated early flowering dwarf mutant after treating seeds of lentil cv.T-36 with chemical and physical mutagens. This mutant proved true breeding up to M6-generation, flowered earlier 10 days than the control and reached a reasonable degree of homozygosity and stability. Comparable induced early flowering mutants in soybean were also recorded by Baradjanegara and Lukman Umar (1988) as well as by Metha *et al.* (1994). The recorded early flowering mutants of soybean proved true breeding in advanced generations. All, being in agreement with the present findings.

2- Heavy branching/high yield mutants:

Data on M6 and M7-generations of heavy branching/high yield mutants and their original lupine cultivar Giza 2 are given in Table (2).

Results in Table (2) reveal that three different heavy branching/high yield mutants of which two were resulted from EMS (G2 EMS HB/HY4 and G2 EMS HB/HY6) and the other from SA (G2 SA HB/HY3) treatments were selected from M5-generation and raised to study their behaviour and performance, compared to the control, in M6 and M7-generations. It is obvious that any of these heavy branching/high yielding mutants (Figure, 2) exceeded significantly the original lupine cultivar Giza 2 in number of branches per plant, number of pods per plant, seed yield (g) per plant and 100-seed weight (g) per plant. It is worthy to note that the differences, in 100-seed weight (g) per plant among these mutants were insignificant in both studied generations. The heavy branching/high yield EMS mutant (G2 EMS HB/HY6) surpassed significantly the other two heavy branching/high yield mutants in number of pods per plant and both exceeded significantly control plants, in M6 and M7-generations. In M6-generation, the heavy branching/high yield mutant of EMS (G2 EMS HB/HY6) surpassed significantly heavy branching/high yield of SA (G2 SA HB/HY3) in seed yield (g) per plant, which exceeded significantly control plants. Whereas, in M7-generation, the heavy branching/high yield mutant of EMS (G2 EMS HB/HY6) surpassed significantly the other two

Table (2): Descriptive values of selected heavy branching / high yield mutants, induced in Egyptian lupine by EMS or SA, and control plants of lupine cv. Giza 2 in M6 and M7 generation

Mutant type	M6-generation											
	No. of branches/plant			No. of pods/plant			Seed yield (g)/plant			100-seed weight		
	$\bar{X} \pm S.E.$	Range	CV%	$\bar{X} \pm S.E.$	Range	CV%	$\bar{X} \pm S.E.$	Range	CV%	$\bar{X} \pm S.E.$	Range	CV%
Control (Giza 2)	3.7±0.1	3-4	19.4	31.7±0.4	24-39	11.1	34.8±0.5	23.6-46.9	14.4	30.7±0.2	26.8-32.8	4.4
G2 EMS HB/HY4	7.4±0.1	5-8	9.5	60.9±0.5	54-70	7.3	76.7±0.5	66.3-85.7	6.1	34.5±0.1	33.5-36.3	2.5
G2 EMS HB/HY6	7.9±0.1	6-9	9.8	63.1±0.5	54-72	7.2	78.6±0.6	67.5-86.8	6.6	34.7±0.1	33.3-36.8	2.7
G2 SA HB/HY3	7.5±0.1	6-8	10.6	59.9±0.5	52-68	7.9	75.7±0.6	64.7-84.7	6.8	34.3±0.1	33.4-36.2	2.8
L.S.D.(0.05)	0.3			2.0			2.3			0.6		

Mutant type	M7-generation											
	No. of branches/plant			No. of pods/plant			Seed yield (g)/plant			100-seed weight		
	$\bar{X} \pm S.E.$	Range	CV%	$\bar{X} \pm S.E.$	Range	CV%	$\bar{X} \pm S.E.$	Range	CV%	$\bar{X} \pm S.E.$	Range	CV%
Control (Giza 2)	3.8±0.1	3-4	18.8	32.9±0.3	27-40	8.7	36.4±0.4	28.7-43.7	11.0	31.2±0.2	28.2-32.9	4.7
G2 EMS HB/HY4	7.8±0.1	5-8	10.8	62.3±0.5	54-72	6.9	77.2±0.5	68.3-85.4	5.8	34.4±0.1	33.2-36.9	2.6
G2 EMS HB/HY6	7.9±0.1	6-9	10.8	64.8±0.5	53-73	7.0	79.8±0.5	67.1-87.6	5.8	35.0±0.1	33.1-37.4	2.3
G2 SA HB/HY3	7.6±0.1	6-8	9.9	61.8±0.4	53-70	6.8	76.3±0.6	65.5-84.7	6.8	34.6±0.1	33.2-36.4	2.6
L.S.D.(0.05)	0.3			2.4			2.0			1.2		

heavy branching/high yield mutants in seed yield (g) per plant and both exceeded significantly control plants in this respect.

It is obvious that the significant increase in number of branches per plant of these mutants over the control ranged from 100% (G2 EMS HB/HY4) to 113.5% (G2 EMS HB/HY6) in M6-generation, and from 100% (G2 SA HB/HY3) to 107.9% (G2 EMS HB/HY6) in M7-generation. Whereas, the significant increase in number of pods per plant of these mutants over the control ranged from 88.9 % (G2 SA HB/HY3) to 99.1% (G2 EMS HB/HY6) in M6-generation, and from 87.8% (G2 SA HB/HY3) to 97.0% (G2 EMS HB/HY6) in M7-generation. Also, the significant increase in seed yield per plant of these mutants over the control ranged from 117.5% (G2 SA HB/HY3) to 125.9% (G2 EMS HB/HY6) in M6-generation, and from 109.6% (G2 SA HB/HY3) to 119.2% (G2 EMS HB/HY6) in M7-generation. The significant increase in 100-seed weight over the control ranged from 11.7% (G2 SA HB/HY3) to 13.0% (G2 EMS HB/HY6) in M6-generation, and from 10.3% (G2 EMS HB/HY4) to 12.2% (G2 EMS HB/HY6) in M7-generation.

Through the two studied generations, number of branches per plant ranged from 5 to 9 in the progenies of heavy branching/high yielding mutants against 3 to 4 in the control plants. Number of pods per plant ranged from 52 to 73 in the progenies of heavy branching/high yielding mutants against 24 to 40 in the control plants. Seed yield (g) per plant ranged from 64.7g to 87.6g in the progenies of heavy branching/high yielding mutants against 23.6g to 46.9g in the control plants. Hundred seed weight ranged from 33.1g to 37.4g in the progenies of heavy branching/high yielding mutants against 26.8g to 32.9g in the control plants. These results reveal that the four attributes (higher number of branches, number of pods, seed yield and 100-seed weight) were transmitted from M5 to M6 and from M6 to M7 as discontinuous variates not overlapping with the control and this ensure their homozygosity and stability. Thus, it could be stated that all EMS and SA heavy branching/high yielding mutants proved true breeding and stable up to M7-generation.

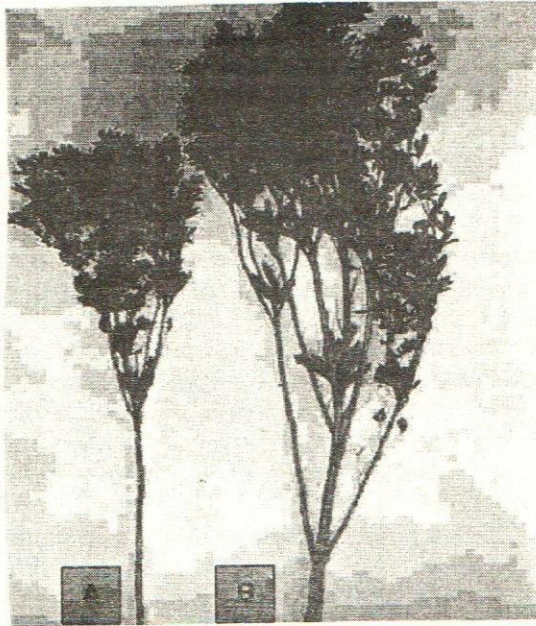


Figure (2): A photograph of mature lupine plants at the age of 20 weeks.

A: Normal plant of lupine cv. Giza 2.

B: A plant of heavybranching/high yield mutant type.

Variability in judgment on the progenies of the evaluated heavy branching/high yielding mutants through the two successive generations, M6 and M7, ascertained by coefficient of variability (C.V.%) of each deviant character which showed values of small magnitude as compared with those of control plants. Such results confirming the homozygosity that occurred within the progeny of each of the tested mutants. In this respect, Dixit and Dubey (1986) isolated compact mutant (A.M.10) after treating seeds of lentil cv.T-36 with chemical and physical mutagens. In M6-generation, the compact mutant A. M. 10 proved true breeding and characterized by higher number of secondary and tertiary branches and produced higher seed yield. Likewise, Singh and Raghuvanshi (1987) obtained heavy branching/high yield mutants after treating seeds of *Vigna mungo* cv.T-9 with 0.25% EMS. The obtained mutants proved true breeding in M6-generation and surpassed control with respect to number of branches and seed yield.. All, being in accordance with the present findings.

II-Anatomical studies :

Microphotographs illustrating transverse section through the eleventh internode on the main stem and transverse section through the blade of the median leaflet from the eleventh leaf developed on the main stem of early flowering, heavy branching/high yield mutants and lupine cv. Giza 2 at flowering stage are shown in Figure (3).

It is clear that the main stem diameter at the eleventh internode was wider in the early flowering and heavy branching/high yield mutants than the control. This increment in internode diameter was mainly due to the prominent

increase in the thickness of stem wall and in the diameter of hollow pith cavity. All included tissues (thickness of epidermis, cortex, fibre strands, vascular tissues and parenchymatous area of the pith) shared to different extents in increasing the thickness of stem wall of the early flowering and heavy branching /high yield mutants. It is obvious that the increment in cortex thickness was attributed to the increase in number of cell layers. The larger thickness of vascular cylinder was due to the larger amount of conducting elements especially xylem which was characterized by considerably larger vessels. The cambial activity was obviously stimulated since wider phloem and xylem tissues were produced.

Likewise, the leaflet lamina in the heavy branching/high yield mutant type was thicker than that of the control. Both of the palisade and spongy tissues as well as leaflet midvein were increased in thickness and the midvein bundle was increased in size. Whereas, the leaflet lamina, in the early flowering mutant type of mutation, was nearly similar to that of the control.

As far as the author is aware, previous information concerning the anatomical structure, in advanced generation, of early flowering and heavy branching/high yield mutants induced in lupine is not available in the literature.

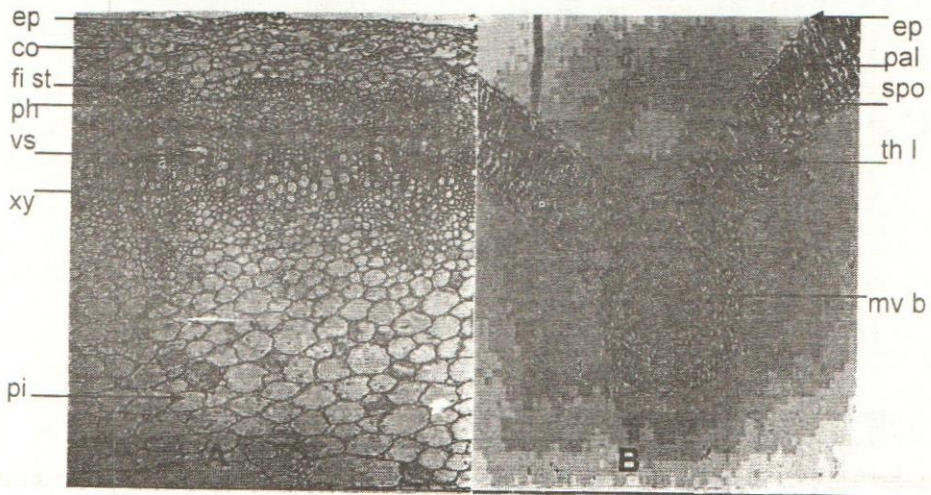


Figure (3): Transverse sections through the eleventh internode on the main stem and the blade of the median leaflet from leaf developed on the main stem of lupine cv. Giza 2(control), early flowering and heavy branching/high yield mutants in M7-generation, 80 days old (X 52)
A-Main stem of control. **B-**Leaflet of control.

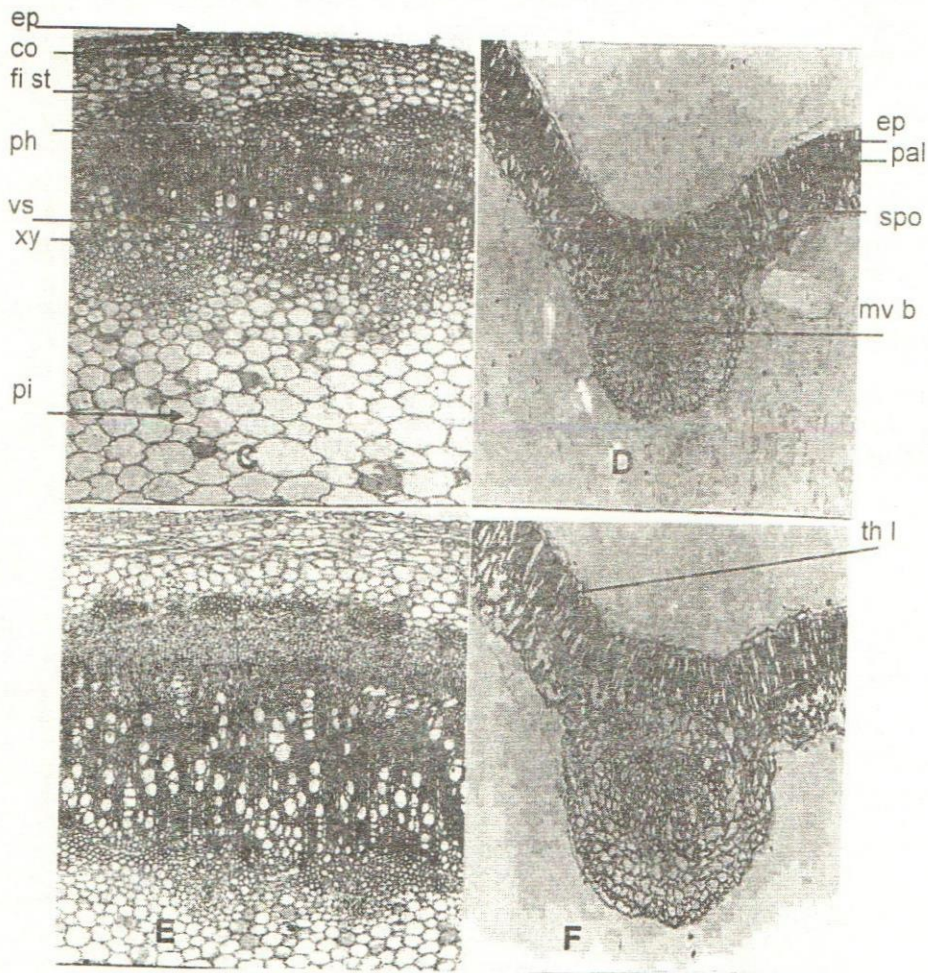


Figure (3): cont. (X 52)
 C-Main stem of early flowering. D-Leaflet of early flowering.
 E-Main stem of heavy branching/high yield.
 F-Leaflet of heavy branching/high yield.

Details: cx, cortex; ep, epidermis; fi st, fibre strands; h pi, hollow pith;
 ph, phloem; pi, pith; vs, vessel; xy, xylem; mv b, midvein
 bundle; pal, palisade tissue; spo, spongy tissue and th l,
 thickness of lamina.

(Cont.)

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تقييم طفرات مبكرة التزهير و غزيرة التفريع/عالية المحصول في الأجيال المتقدمة من الترمس المصري

1- سلوك الطفرات و كفاءتها الإنتاجية

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اشتملت المواد النباتية المستخدمة في هذه الدراسة على خمس طفرات من الترمس صادقة التوالد تنتمي إلى طرازين مختلفين من الطفرات (2 مبكرة التزهير و 3 غزيرة التفريع/عالية المحصول) اشتملت من الترمس المصري صنف جيزة 2 كنتيجة لمعاملة بذوره بأي من المطفرين الكيميائيين ايثايل ميثان سلفونات(EMS) و الصوديوم آزبايد (SA) و ذلك خلال برنامج للتربية باستحداث الطفرات (حسن، 1991 و 1998). تم متابعة هذه الطفرات المنتخبة من الجيل الخامس لدراسة سلوكها و كفاءتها الإنتاجية في كل من الجيل السادس و الجبل السابع مقارنة بصنف الترمس المصري جيزة 2.

أجرى هذا البحث في محطة التجارب التابعة لكلية الزراعة - جامعة القاهرة بالجيزة خلال موسم الزراعة 1999/1998، 2000/1999. تم تقييم الطفرات على أساس الصفة المميزة لكل طفرة بالإضافة إلى متوسط محصول نباتها من البذور مقارنة بالصنف الأصلي جيزة 2، كما اشتمل التقييم على دراسات تشريحية. ويمكن تلخيص أهم النتائج التي تم الحصول عليها فيما يلي:-

1 - سلوك الطفرات و كفاءتها الإنتاجية :

أ - الطفرات مبكرة التزهير:

أظهرت النتائج أن عدد الأيام من الزراعة حتى ظهور أول زهرة في كل من طفرة ال EMS و SA مبكرة التزهير قد نقص معنويا مقارنة بالكنترول ، و تراوح بين ٦٦ إلى ٧٥ يوما في الجيل السادس و من ٦٦ إلى ٧٤ يوما في الجيل السابع. بينما سجل ميعاد التزهير في نباتات الكنترول مدى يتراوح ٨٠ إلى ٨٨ يوما في كلا الجيلين تحت الدراسة. تشير هذه النتائج إلى ثبات و تجانس كلا الطفرتين بالنسبة لصفة التكيير فى التزهير حيث انهما كانتا صادقة التوالد حتى الجيل السابع. كما سجلت زيادة معنوية في محصول النبات من البذور عن الكنترول بمقدار ٣٤,٩-٣٢,٣% لطفرة ال EMS مبكرة التزهير (G2 EMS EF1) و ٢٨,٩ و ٣٠,٤% لطفرة ال SA مبكرة التزهير (G2 SA EF2) أعلى من نباتات المقارنة في الجيل السادس و السابع على التوالي.

ب - الطفرات غزيرة التفريع /عالية المحصول:

تشير النتائج إلى أن عدد الأفرع للنبات، عدد القرون للنبات ، محصول النبات من البذور و وزن المائة بذرة في أى من الطفرات الثلاث غزيرة التفريع/عالية المحصول أعلى معنويا مقارنة بنباتات الكنترول فى كل من الجيل السادس و السابع.

عدد الأفرع للنبات في نسل كل طفرة تراوح بين ٥ إلى ٩ مقابل ٣ إلى ٤ فروع لنباتات الكنترول خلال الجيلين السادس و السابع. بينما تراوح عدد القرون للنبات بين ٥٢ إلى ٧٣ مقابل ٢٤ إلى ٤٠ لنباتات الكنترول. أيضا تراوح محصول النبات من البذور بين ٦٤,٧ إلى ٨٧,٦ جم بالمقارنة بنباتات الكنترول و الذى تراوح بين ٢٣,٦ إلى ٤٦,٩ جم خلال الجيلين السادس و السابع. كما تراوح وزن المائة بذرة بين ٣٣,١ إلى ٣٧,٤ جم مقابل ٢٦,٨ إلى ٣٢,٩ جم في نباتات الكنترول في الجيل السادس و السابع. تشير النتائج إلى ثبات و تجانس الطفرات غزيرة التفريع/عالية المحصول بالنسبة لصفة التفريع ، عدد القرون ، محصول النبات من البذور و وزن المائة بذرة حيث أنها كانت صادقة التوالد و ثابتة وراثيا حتى الجيل السابع.

تراوحت الزيادة المعنوية في عدد الأفرع للنبات لهذه الطفرات بين ١٠٠% (G2 EMS HB/HY4) إلى ١١٣,٥% (G2 EMS HB/HY6) أعلى من نباتات الكنترول في الجيل السادس ، و بين ١٠٠% (G2 SA HB/HY3) إلى ١٠٧,٩% (G2 EMS HB/HY6) أعلى من نباتات الكنترول في الجيل السابع. بينما تراوحت الزيادة المعنوية في عدد القرون للنبات بين ٨٨,٩% (G2 SA HB/HY3) إلى ٩٩,١% (G2 EMS HB/HY6) في الجيل السادس و بين ٨٧,٨% (G2 SA HB/HY3) إلى ٩٧% (G2 EMS HB/HY6) في الجيل السابع. كما تراوحت الزيادة المعنوية في محصول النبات من البذور في هذه الطفرات بين ١١٧,٥% (G2 EMS HB/HY3) إلى ١٢٥,٩% (G2 EMS HB/HY6) أعلى من نباتات المقارنة في الجيل السادس و بين ١٠٩,٦% (G2 SA HB/HY3) إلى ١١٩,٢% (G2 EMS HB/HY6) أعلى من نباتات المقارنة في الجيل السابع. أيضا تراوحت الزيادة المعنوية في وزن المائة بذرة بين ١١,٧% (G2 SA HB/HY3) إلى ١٣% (G2 EMS HB/HY6) في الجيل السادس و بين ١٠,٣% (G2 EMS HB/HY4) إلى ١٢,٢% (G2 EMS HB/HY6) في الجيل السابع.

٢ - الدراسات التشريحية:

أخذت العينات النباتية المستخدمة في الدراسة التشريحية من السلامة الحادية عشر للساق الرئيسية و الوريقة الوسطى للورقة المقابلة لها في عمر ثمانون يوما لنباتات الجيل السابع من الطفرات مبكرة التزهير و غزيرة التفريع و من نباتات المقارنة (الترمس المصرى صنف جيزة ٢). تشير النتائج إلى ازدياد قطر الساق الرئيسية في الطفرات غزيرة التفريع/عالية المحصول مقارنة بالكنترول نتيجة للزيادة الملموسة في سمك جدار الساق بالإضافة إلى زيادة قطر فجوة النخاع ، و قد ساهمت جميع الأنسجة المشتركة في تركيب جدار الساق (البشرة - القشرة - الأشرطة الليفيّة - الأنسجة الوعائية - النخاع البارنشيى) بدرجات مختلفة في زيادة سمك جدار الساق. كما أوضحت الدراسة التشريحية أن هناك زيادة في سمك نصل الوريقات في الطفرات غزيرة التفريع/عالية المحصول مقارنة بالكنترول ، و أن الزيادة في سمك النصل ترجع إلى الزيادة الحادثة في سمك كل من النسيج العمادى و الإسفنجى هذا بالإضافة إلى حدوث زيادة في سمك العرق الوسطى و زيادة في حجم الحزمة الوعائية. بينما لوحظ أن سمك نصل الوريقات في الطفرة مبكرة التزهير لا تختلف كثيرا عن نباتات الكنترول.