V. SUMMARY

The experiments of this study were conducted at Sids Agricultural Research Station, Agricultural Research Center (ARC), Egypt, during the two successive seasons 2004/05 and 2005/06. Two faba bean (*Vicia faba* L.) cultivars (Misr 1 and Giza 429) were used to study the effect of Gamma rays (40 and 80 Gray), Sodium azide (0.001 or 0.002 %) and all possible combination between the radiation and chemical mutagenic, on yield and yield components and chlorophyll mutations.

5.1. First mutagenic generation (M_1).

Significant mean squares due to cultivars were detected for all traits except flowering date, number of branches per plant and seed yield/plant. While mutagenic treatments had highly significant differences in all characters under study except 95 % pods maturity. Only plant height, numbers of pods/plant, seed yield/plant and survival plant percentage were significant in the interaction between cultivar and mutagenic treatments.

Faba bean varieties have differences in mutagenic sensitivity; Giza 429 gave significantly the highest mean values for all traits except maturity date, 100 - seed weight and survival plants when compared with mean of Misr 1. Also, all faba bean characters significantly affected by mutagenic treatments except number of days from sowing to 95% pods maturing. Treated faba bean by mutagenic materials caused significant and negative effects on yield and yield components in M_1 plants compared with untreated plants.

The reduction in seed yield components associated with increasing in doses or concentrations of mutagenic treatments or their combinations was obtained. Seed yield/plant of treatments 40 Gy + 0.002% SA and 80 Gy + 0.002% SA produced 30.36 and 31.67g, respectively compared with control 39.15g.

Survival plant percentages indicated that Giza 429 was more sensitive than Misr 1 which percentage of survival plant of these cultivars was 36.86 and 53.37%, respectively. Otherwise survival plants decreased with increased Gamma radiation doses and concentrations of Sodium azide either alone or in their combination. Treatments 40 Gy, 80 Gy, 0.001% and 0.002% SA gave 42.43, 40.07, 36.53 and 33.76 %, respectively. In this study Giza 429 with treatments 0.002% SA, 80 Gy + 0.002% SA and 0.001% SA recorded the lowest survival plants percentage 25.31, 27.50 and 28.00 %, respectively.

5.2. Second mutagenic generation (M_2).

Varietal differences in response to mutagenic treatments were found to be significant for all the studied traits except number of days to 50% flowering and 95% pods maturity and number of seeds/pod. Also, Mean squares associated with mutagenic treatment were highly significant for number of days to 95 % pods maturity, plant height, number of pods, number of seeds, seed yield/plant and 100 – seed weight. While the interactions between cultivars and mutagenic treatments were significant for 95% days to maturity, plant height, number of seeds/plant, 100 – seed weight and seed yield/plant.

For 95% maturity the combination of Gamma – rays and SA insignificantly affects compare with Gamma – rays or SA

when used alone. Generally, the Sodium azide gave the earliest than other treatments. Treatments faba bean produced highest seed yield/plant in Misr 1 with 40 Gy + 0.001% SA, 40 Gy and Giza 429 with 40 Gy + 0.001% SA recorded 21.85, 23.68 and 23.55g / plant, respectively.

The percentages of total M_2 mutated plants increased by increasing radiation dose from 40 Gy to 80 Gy or concentrations of SA from 0.001 to 0.002. The combination of gamma – rays (40 Gy and 80 Gy) and each of SA (0.001% and 0.002% SA concentrations) gave higher percentage of M_2 mutated plants with chlorophyll deficiencies than the same dose of gamma – ray or SA when it used alone. These percentages were 2.24, 2.22, 3.06 and 3.26 in the case of 40 Gy + 0.001% SA, 40 Gy + 0.002% SA, 80 Gy +0.001% SA and 80 Gy + 0.002% SA, respectively.

The variety Giza 429 gave less percentage of mutated plants with chlorophyll mutation in the M_2 generation than the second variety Misr 1 over all treatments. And the two varieties clearly differed than each other in their reaction to different mutagenic treatments.

The percentages of M_2 mutated families increased by increasing radiation dose from 0.0 to 80 Gy. These percentages were 0.00, 23.93 and 28.99 % for controls, 40 Gy and 80 Gy, respectively. The same trend was found in concentrations SA. But combination of gamma – rays (40 Gy) and each of Sodium azide 0.001% and 0.002 % gave higher percentages of M_2 mutated families with chlorophyll**.**

For all mutagenic treatments, the percentages of mutation types were increased than that of mutated families in M_2. The percentages of mutation types were 0.00, 31.62, 35.66, 38.66, 38.83, 40.58, 42.47, 44.23, 39.18 and 45.98 % for control, 40 Gy , 40 Gy + 0.001 % SA , 40 Gy + 0.002 % SA , 80 Gy , 80 Gy + 0.001 % SA , 80 Gy + 0.002 % SA , 0.001 % SA and 0.002 % SA, respectively .

It is apparent that the variety Misr 1 is more mutable types (the mutated families in M_2 was 44.95 %) than the variety Giza 429 (34.52 %). The treatment 0.002 % SA gave increased mutation types in each varieties Miser 1 or Giza 429. The percentages of mutated families were 37.5 and 28.57 , 40.63 and 30.77 , 45.1 and 32.70 , 47.62 and 37.5 , 51.52 and 35.0 , 50.0 and 40.0 , 41.51 and 36.36 and 46.94 and 44.74 % for Misr 1 and Giza 429 when treated with 40 Gy , 40 Gy + 0.001 % SA , 40 Gy +0.002 % SA , 80 Gy , 80 Gy + 0.001 % SA , 80 Gy + 0.002 % SA , 0.001 % SA and 0.002 % SA , respectively .

Types of chlorophyll mutations observed in this study were albina (A), zantha (X), and viridis (V). The spectrum of chlorophyll mutation plants was affected by Gamma – rays doses. This, at the lowest dose 40 Gy the albina type was 0.86 % while at the high dose 80 Gy was 0.91 %. Also, xantha and viridis types were increased by increasing dose of Gamma – rays from 40 Gy to 80 Gy. The plant mutation types were increased by increasing SA. The percentages of different types of plant mutation types were 0.88, 0.68 % and 0.60 at 0.001% SA and 1.40, 0.88 and 0.70 % at 0.002 % SA for albina, xantha and viridis, respectively.

Although it was found that the albina type was the dominant and followed by xantha and than by viridis. Also, all types of chlorophyll plant mutations were increased with combination treatments than the effect of Gamma – ray or SA alone.

The mutation spectrum from families was clearly affected by the two concentrations of SA. The mutation types were increased by increasing SA from 0.001 to 0.002 %. Also, the albina type was the highest followed by xantha and than by viridis. The percentages of families mutated were 16.49, 12.37 and 10.31 % at 0.001 % SA, 19.54, 14.94 and 11.49% at 0.002 % SA for albina, xantha and viridis, respectively.

Combinations of Gamma – rays 40 Gy and each of 0.001 or 0.002 % SA gave albina type more than other types, and it was increased than the same concentration in treatments with Gamma – rays. Also, the effect of combination of Gamma – ray 80 Gy with SA (0.001 or 0.002 %) gave albina type more than the same dose of Gamma – ray 80 Gy when used separately while , it gave the same percentages when compared with SA (0.001 or 0.002 %) alone. Also, the same trend was obtained for xantha and viridis types.

The variety Misr 1 gave more percentages of the three types of chlorophyll mutation in the M_2 (albina , xantha and viridis) than the second variety Giza 429. Misr 1 with treated of each 80 Gy + 0.001 % SA and 80 Gy + 0.002 % SA and Giza 429 treated by 0.002 % SA gave the highest percentages of albina type. These percentages were 21.21, 22.73 and 21.05 % in the same order. While, variety Misr 1 when treated with 80 Gy or

80 Gy + 0.001 % SA gave the highest percentages of xantha type (19.05 and 18.18 %).

The phenotypic variance of all characters under study were found to by increased by increasing Gamma rays (from 40 to 80 Gy), SA (from 0.001 to 0.002%) and combination between them. Also, these variances were more than the untreated (control) populations and radiations were more effective than chemicals.

High heritability values were detected for all characters at different mutagenic treatments in both varieties. High heritability values were associated with high genetic advance as percentage of the mean (Δg %). Moreover, is no great differences between the phenotypic and genotypic variance could be detected which would indicate the possibility of improving most characters. Therefore, it could be concluded that selection for number of pods and seeds/plant would be effective and satisfactory in the successive generations. Heritability estimates in seed yield/plant ranged from 71 to 86 % in Giza 429 with 0.001% SA and Misr 1 with 80 Gy + 0.002 SA while genetic advance ranged from 8.01 to 15.83 for the same treatments.