

# CONTENTS

	Page
<b>1. INTRODUCTION</b>	<b>1</b>
<b>2. REVIEW OF LITERATURE</b>	<b>5</b>
<b>3. MATERIALS AND METHODS</b>	<b>34</b>
<b>4. RESULTS AND DISCUSSIONS</b>	<b>42</b>
<b>I- Effect of chemical mutagens on seed germination percent</b>	<b>42</b>
<b>II - Vegetative growth</b>	<b>45</b>
1. Plant height	45
2. Branch number	48
3. Plant fresh weight	50
4. Plant dry weight	54
<b>III- YIELD COMPONENTS</b>	<b>56</b>
1. Flowers number/plant	56
2. Fruit set percentage	58
3. Total number of capsules/plant	61
3. 1- Filled capsules number/plant	64
3. 2- Empty capsules number/plant	68
3. 3- Filled capsules number percent/plant	70
3. 4- Empty capsules number percent/plant	74
4. Capsules weight ( gm )	76
5. Seed index	79
6. Seed yield/plot	82

<b>IV - CHEMICAL DETERMINATIONS</b>	<b>85</b>
1. Nitrogen content	<b>85</b>
1. 1- Nitrogen percentage	<b>85</b>
1. 2- Protein percentage	<b>85</b>
2. Leaf pigments	<b>87</b>
3. Oil content	<b>90</b>
3. 1- Fixed oil percent	<b>90</b>
3. 2- Volatile oil percent	<b>92</b>
3. 3- 1- Essential oil composition	<b>92</b>
<b>V - GENETIC STUDIES</b>	<b>102</b>
1. Giant plant	<b>102</b>
2. Dwarf plant	<b>105</b>
3. Chlorophyll mutation	<b>111</b>
4. Number of locules/capsule	<b>111</b>
<b>VI - SUMMARY</b>	<b>119</b>
<b>VII- REFERENCES</b>	<b>125</b>
<b>ARABIC SUMMARY</b>	

## SUMMARY

The improving of crop plants through mutation breeding is a valuable supplement to conventional plant breeding methods. So, breeding is the effective way for increasing yield with high quality and obtained irregular types which may be useful in breeding programs.

This investigation was carried out at the experimental farm of South El-Tahrir Horticulture Research Station (ARC) during four successive seasons, from 1996/1997 to 1999/2000 on black cumin (*Nigella sativa L.*). The used mutagens were, sodium nitrite, at two concentration, 0.5 and 1.0%, Diethylamine, at two concentration, 0.1 and 0.2% and Ethyl Methan Sulfonate (E. M. S.) at 0.1 and 0.2%.

This study was investigated the following points :-

### **1- Germination :-**

Mutagenes adversely affected black cumin germination of parent plants, sodium nitrite gave the lowest seed germination. While, mutagenes did not significantly affected seed germination of  $F_1$ ,  $F_2$  and  $F_3$ .

### **2- Vegetative growth parameters :-**

#### **1-plant height (cm) :-**

Plant height of parent black cumin plants was not affected significantly by different mutagenes compared with control. Meanwhile, Ethyl Methan Sulfonate produced the tallest plants.

## **2-Branch number/plant :-**

The highest branch number/parent plant was possessed by sodium nitrite. While the highest branching of  $F_1$ ,  $F_2$  and  $F_3$  result from Diethylamine.

## **3- 1- Fresh weight (gm) :-**

Sodium nitrite produced the highest fresh weight of parent black cumin plants but the difference was not significant compared with control. Fresh weight of  $F_1$ ,  $F_2$  and  $F_3$  increased when Ethyl Methan Sulfonate was used.

## **3- 2- Dry weight (gm) :-**

Sodium nitrite produced significant increasing of parent dry weight of black cumin plants. The effect of mutagenes on plant dry weight of  $F_1$ ,  $F_2$  and  $F_3$  of black cumin was not significant. However, the highest dry weight result from Diethylamine.

## **III- Yield components :-**

### **1- Flowers number/plant :-**

Mutagenes did not significantly affect flowers number/plant of parent plants. However, control gave the highest flowers number/plant. Also, in  $F_1$ ,  $F_2$  and  $F_3$ , control produced the highest flowers number/plant followed by Diethylamine.

## **2- Fruit set percent :-**

Fruit set percent of parent plants was not significantly affected by different mutagenes, Anyway, sodium nitrite possessed the highest fruit set percent. On other hand, Ethyl Methan Sulfonate significantly increased fruit set percent  $F_1$ ,  $F_2$  and  $F_3$  of black cumin compared with control.

## **3- Total capsules number/plant :-**

Mutagens adversely affected total capsules number/plant of parents, However, control significantly increased total capsules number/plant. While, Diethylamine maximized total capsules number/plant of  $F_1$  and  $F_2$  plants, while, the highest total capsules number/plant of  $F_3$  resulted from Ethyl Methan sulphonate.

### **3- 1- Filled capsules number/plant :-**

control plants significantly increased filled capsules number/plant followed by Diethylamine, while, Ethyl Methan Sulfonate significantly maximized filled capsules number/plant of  $F_1$ ,  $F_2$  and  $F_3$  compared with control.

### **3- 2- Empty capsules number/plant :-**

Ethyl Methan Sulfonate significantly increased empty capsules number/parent plant. While, sodium nitrite produced the highest empty capsules number/plant of  $F_1$ ,  $F_2$  and  $F_3$ .

### **3- 3- Filled capsules percent :-**

Mutagenes significantly reduced filled capsules number percent of parent,  $F_1$ ,  $F_2$  and  $F_3$  plants compared with control.

### **3- 4- Empty capsules number percent :-**

Mutagenes significantly increased empty capsules number percent of parent,  $F_1$ ,  $F_2$  and  $F_3$  plants compared with control.

### **4- Capsule weight (gm) :-**

Capsule weight was not significantly affected by mutagenes in parent and  $F_1$  plants, while, sodium nitrite significantly increased capsule weight of  $F_2$  and  $F_3$  compared with control.

### **5- Seed index :-**

Mutagenes did not significantly affected seed index of parent and  $F_1$ . While, sodium nitrite significantly increased seed index of  $F_2$  and  $F_3$ .

### **6- Seed yield/plot :-**

There were a negatively relationship between mutagenes and seed yield/plot of parent plants, control significantly increased seed yield/plot. Differences of seed yield/plot of  $F_1$  were not significant. While, Ethyl Methan Sulfonate significantly increased seed yield/plot compared with control in  $F_2$  and  $F_3$ .

#### IV- Chemical determinations :-

##### 1- Nitrogen and protien :-

Ethyl Methan Sulfonate significantly increased both Nitrogen and Protien.

##### 2- Determination of leaf photosynthetic pigments:-

Mutagenes affected photosynthetic pigments. Diethylamine produced the highest value of chlorophyll-a, chl.-b and chl-(a+b) while, sodium nitrite gave the highest value of carotenoids compared with control.

##### 3- 2- Fixed oil percent :-

Diethylamine possessed the highest Fixed oil % of black cumin, while, Ethyl Methan Sulfonate gave the lowest percent of fixed oil.

##### 3- 2- 1. Essential oil percent :-

Sodium nitrite significantly increased essential oil percent of black cumin seeds compared with control.

##### 3- 2- 2. Essential oil content :-

Essential oil of black cumin seeds analysis to  $\alpha$ -pinene, B-pinene, P-cymene, Limoniene, sabinene, o-terpin and thymoquinene. Ethyl Methan Sulfonate

gave the maximum value of thymoquinene, major component of the essential oil.

### V- Morphogenetical changes :-

Treated black cumin with mutagen resulted in observation many types of abnormalities.

- 1- Giant plant, resulted from treated seed with Ethyl Methan Sulphonate at 0.1%.
- 2- Dwarf plant, resulted from treated seed with Ethyl Methan Sulphonate at 0.2%.
- 3- Bifurcation, stem anomalies with erect nature of the stem resulted from treated seeds by Ethyl Methan Sulphonate at 0.1%.
- 4- Chlorophyll abnormalities resulted from Ethyl Methan Sulphonate at 0.2%.
- 5- Number of locules/capsule :-

Number of locules/capsule varied according to mutagene used from 2 locules to 9 locules/capsule.

- 6- The case of physical and chemical changes in  $M_1$  seedlings were related to the mutagenic effect of Ethyl Methan Sulphonate on DNA through the cell divisions.
- 7- The characters changes stability in  $F_2$  and  $F_3$  may be related to changes in one gene or one linked group.