



Determination of Effect of Chemical Mutagen EMS on TAEK A-3 and TAEK C-10 Mutant Soybean Varieties in M₁ Generation

Zafer SAGEL* M. İhsan TUTLUER Hayrettin PESKİRCİOĞLU Yaprak KANTOĞLU Burak KUNTER

TAEA, Sarayköy Nuclear Research and Training Center, Sarayköy, Ankara, Turkey

* Corresponding author e-mail: zafer.sagel@gmail.com

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ABSTRACT

Today beside ionizing radiation, chemical mutagens are also used in crop improvement and Ethylmethanesulphonate (EMS) is one of the most widely used chemical mutagens in the field of plant breeding. This research work was carried out to determine the effect of chemical mutagen (EMS) on seedling height. TAEK A-3 and TAEK C-10 soybean varieties were used as the test plants and effect of presoaking time determined. In greenhouse and field experiments five different EMS doses (0 (Control), 0,025, 0,050, 0,075 ve 1,0 M) and in greenhouse 3 different presoaking time (0, 6 and 18 hours), in the field 2 different presoaking time (0 and 6hours) were applied. After chemical mutagen application in the green house germination percentage and seedling height base EMS dose and presoaking time effect had been determined. Effects of EMS in M₁ germination of soybean for different characteristics (no. of plants, plant height, no of pods and seedyield) were determined under field condition. As a result it can be said that in both soybean varieties, seedling height was reduced as the EMS concentration increased. But there was no distinct influence of presoaking time on the seedling height in both soybean varieties. In both soybean varieties the average percentage of germination increased with increasing pre-soaking time. Based on results obtained in field experiment, it was concluded that by 6 hours presoaking the harmful physiological effect of EMS could be decreased.

Keywords: Soybean, Induced mutation, mutation breeding, chemical mutagen, EMS.

Introduction

In TAEK, SANAEM, Nuclear Agriculture Division mutation breeding activities have been carried out on wheat, barley, soybean, tobacco, lentil, chickpea, potato, rapeseed, and sunflower between 1982-2014.

Today beside ionizing radiation, chemical mutagens are also used in crop improvement and EMS is one of the most widely used chemical mutagen in the field of plant mutation breeding (Anonymous 1977, Sağel, Z. 1994). As a source of physical mutagen, gamma irradiation source is not always possible to reach easily. When the security and applications are fulfilled, chemical mutagens are easily accessible and applicable. Chemical mutagens are a indispensable tool to create variation in plant breeding (Maluszynski,

M, 2000) as chemical mutagen to use base analogs is preferable for plant breeders to induce point mutations and have great capacity. A very high mutation rate invariably causes high sterility so plant breeders aim at the more mutagenic effect and the less physiological damage (Konzak, *et al.*, 1965). Therefore this research Project was planned and conducted.

Material and Methods

This research work was carried out to determine the effect of chemical mutagen (EMS) on seedling height TAEK A-3 ve TAEK C-10 mutant soybean varieties were used as the test plants. Germination percentages of seed of test genotypes was 99% and 50 seed were used for each treatment. For EMS treatments

O (control), 0.025, 0.050, 0.075 ve 0.100 M EMS concentrations were used. After the seeds were pre-soaked for 0, 6 and 18 hours they were treated with EMS for 3 hours at room temperature. Then they were post washed with running tap water for 6 hours (Sağel, 1994, Savin, *et al.*, 1968).

In the greenhouse the seeds were planted in 45x30x30 cm wooden cases according to split plot design with 3 replications. They were placed to grow in optimum conditions. After 12 days, germination percentage was determined. After 14 days of growth seedlings were uprooted and seedling height was determined on the first leaf (Constantin, *et al.*, 1976, Peşkircioğlu, 1995).

For field experiment as the test plants TAEK A-3 ve TAEK C-10 mutant soybean varieties were used. First the seeds of these plants were presoaked for 0 and 6 hours then they were treated with O (control), 0.025, 0.050, 0.075 ve 0.100 M EMS for 3 hours. After these treatments seeds were postwashed for 6 hours with running tap water (Doll and Sandfaer, 1969).

In field experiment for each treatment 300 seeds were used. Totally 6000 seeds including control and treated with EMS (1200 seeds for were kept as control and 4800 seeds were treated with EMS) were used. All the seeds were planted in the field in rows spaced 50 cm apart with 10 cm distance between plants.

Results and Discussion

In Tables 1 and 2 effect of pre soaking time and various EMS concentration on percentage of germination and on seedling height are presented, respectively.

As it is seen from Table 1, presoaking time and mutagen doses on the germination percentage were determined to be significant at 1% level. However, as shown in Table 1 and Figure 1, the average percentage of germination increased with increasing pre-soaking time.

The Germination percentage did not decrease in the TAEK A-3 variety compared to the control, when pre-soaking time was "0" hours in 0,100 M EMS dose, when pre-soaking time is "6" hours in all EMS doses, when pre-soaking time "18" hours in all EMS doses except 0,050 M EMS doses. Likewise, in TAEK C-10 soybean variety depending on EMS doses, on different pre-soaking time there was non significant effect on germination percentage (Anonymous, 1977, Sağel, 1994).

According to the Table 2 values of presoaking time, seedling height and mutagen dose were determined to be statistically significant at the 1% level between cultivars. When pre-soaking time was "0"

and "6" hours there was no significant difference in seedling height but it was determined seedling height at "18" hours of pre-soaking increased.

As shown in Figure 2, statistically significant differences at 1% level were apparent in both soybean varieties for seedling height, parallel to increase with increasing EMS concentration, as compared to control.

According to the values in Table 3 and Figure 3, results of the field experiment, as compared with control for TAEK A-3 number of plants did not change when presoaking was "0" hours and at 0.025, 0.050 and 0.075 M EMS concentration. Whereas at 1.00 M EMS treatment the number of plant was reduced. On the other hand for TAEK A-3 as compared with control, plant height, number of pods and seed yield were also reduced at 0.025, 0.050 and 0.075 M EMS.

As compared with control for TAEK C-10 soybean variety when presoaking time was "0" hour, number of plant was also reduced with 0.075 and 0.100 M EMS treatments, whereas plant height was not affected and number of pods were reduced only at 0.100 M EMS concentration. On the other hand seed yield was decreased as the concentration of EMS increased (Constantin, *et al.*, 1976)

Although number of survived plants was less than TAEK C 10 for TAEK A-3. Because of the increase in branching and increased area per plant the seed yield was more in TAEK A3 soybean variety.

When presoaking time was 6 hours, as compared with control for TAEK- A3, number of plants was decreased at 0.050 and 0.100 M EMS concentrations. Whereas plant height, No. of pods and seed yield were decreased from 0.050 M EMS concentration.

For TAEK C-10 soybean variety as compared with control when presoaking time was "6" hour, No. of plant did not change, but plant height and No. of pods were decreased at 0.100 M EMS. Seed yield was also decreased at 0.075 M and 0.100 M EMS treatment.

When presoaking time was "0" hours, for TAEK- A3 soybean variety, effect on seed yield, No. of pods and plant height physiological effect was not much, whereas when presoaking time was 6 hours, as compared with control for TAEK- A3, these traits were decreased at 0.050 M EMS concentrations.

When presoaking time was "0" hours, as compared with control for TAEK- C10, yield was decreased. from EMS concentrations.

When presoaking time was 6 hours, as compared with control for TAEK- C-10, yield was decreased from 0.075 M EMS concentrations

Chemical mutagens, especially EMS have high mutagenic effect on seeds but main criteria is to find maximum physiological damage.

The result of the greenhouse experiment revealed that in TAEK A-3 and TAEK C-10 soybean varieties seedling height decreased with increasing mutagen dose, but presoaking time did not have any significant

effect. In both soybean varieties the average percentage of germination increased with increasing pre-soaking time (Zakri, *et al.*, 1982)

As evident from results of the field experiment, with 6 hours presoaking, physiological damage decreases in M_1 generation after EMS treatment.

Table 1. Influence of presoaking time and EMS concentration on germination percentages of seeds in TAEK A-3 ve TAEK C-10 mutant soybean varieties

| EMS Doses (M) | Varieties | Germination percentages of seeds | | |
|---------------|-----------|----------------------------------|----------------|---------------|
| | | Presoaking time | | |
| | | "0" hours | "6" hours | "18" hours |
| 0 (Control) | TAEK A-3 | 37,0 (74,0) | 43,0 (86,0) | 38,3 (76,6) |
| | TAEK C-10 | 39,3 (78,6) | 39,3 (78,6) | 42,7 (85,4) |
| 0,025 | TAEK A-3 | 49,3 (98,6) | 34,7 (69,4) | 46,0 (92,0) |
| | TAEK C-10 | 36,0 (72,0) | 49,7 (99,4) | 44,0 (88,0) |
| 0,050 | TAEK A-3 | 40,0 (80,0) | 31,3 (62,6) | 33,7 (67,4) |
| | TAEK C-10 | 46,3 (92,6) | 39,3 (78,6) | 46,3 (92,6) |
| 0,075 | TAEK A-3 | 43,3 (86,6) | 41,3 (82,6) | 41,3 (82,6) |
| | TAEK C-10 | 31,3 (62,6) | 48,3 (96,6) | 45,0 (90,0) |
| 0,100 | TAEK A-3 | 35,3 (70,6) | 41,3 (82,6) | 49,0 (98,0) |
| | TAEK C-10 | 49,7 (99,4) | 48,3 (96,6) | 43,7 (87,4) |
| | | 40,8 (81,6) C | 41,7 (83,4) B | 42,9 (85,8)A |

Figure 1. Influence of presoaking time on germination percentages of seeds in TAEK A-3 ve TAEK C-10 mutant soybean varieties

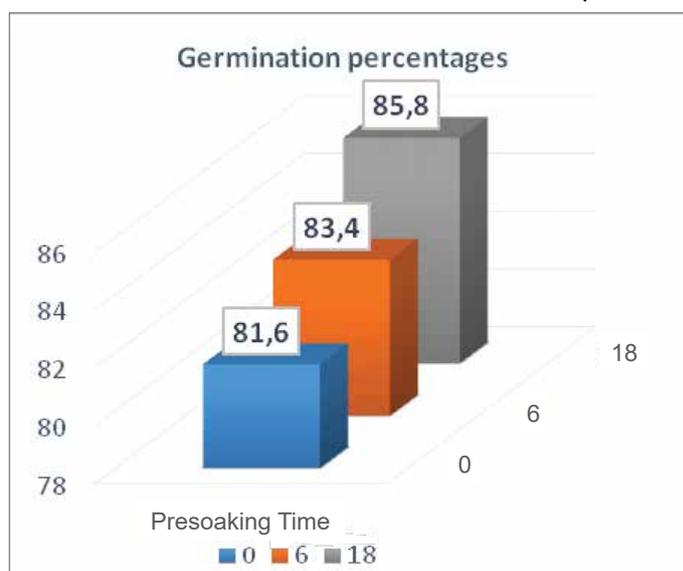


Table 2. Influence of presoaking time and EMS concentration on seedling height of seeds in TAEK A-3 and TAEK C-10 mutant soybean varieties

| EMS Doses (M) | Varieties | Seedling height (cm) | | | | |
|---------------|-----------|-------------------------|---------------|----------------|-----------------|--|
| | | Presoaking time (hours) | | | EMS Doses (M) | |
| | | "0" hours | "6" hours | "18" hours | | |
| 0 (Control) | TAEK A-3 | 9,35 (100,0) | 9,75 (100,0) | 9,83 (100,0) | 10,03 A (100,0) | |
| | TAEK C-10 | 10,25 (100,0) | 10,48 (100,0) | 10,52 (100,0) | | |
| 0,025 | TAEK A-3 | 8,55 (91,5) | 8,77 (89,9) | 10,45 (106,3) | 9,58 B (95,5) | |
| | TAEK C-10 | 10,22 (99,7) | 10,41 (99,3) | 9,01 (85,6) | | |
| 0,050 | TAEK A-3 | 8,30 (88,8) | 8,04 (82,4) | 9,04 (92,0) | 8,79 C (87,6) | |
| | TAEK C-10 | 9,65 (94,1) | 9,30 (88,7) | 8,41 (79,9) | | |
| 0,075 | TAEK A-3 | 7,85 (83,9) | 7,73 (79,3) | 9,79 (99,6) | 8,67 D (86,4) | |
| | TAEK C-10 | 8,98 (87,6) | 9,28 (88,5) | 8,37 (79,6) | | |
| 0,100 | TAEK A-3 | 7,53 (80,5) | 6,29 (64,5) | 8,43 (85,7) | 7,89 E (78,7) | |
| | TAEK C-10 | 8,57 (83,6) | 8,80 (84,0) | 7,73 (73,5) | | |
| | | 8,93 B (97,3) | 8,88 B (96,8) | 9,17 A (100,0) | | |

Figure 2. Influence of presoaking time on germination percentages of seeds in TAEK A-3 and TAEK C-10 mutant soybean varieties

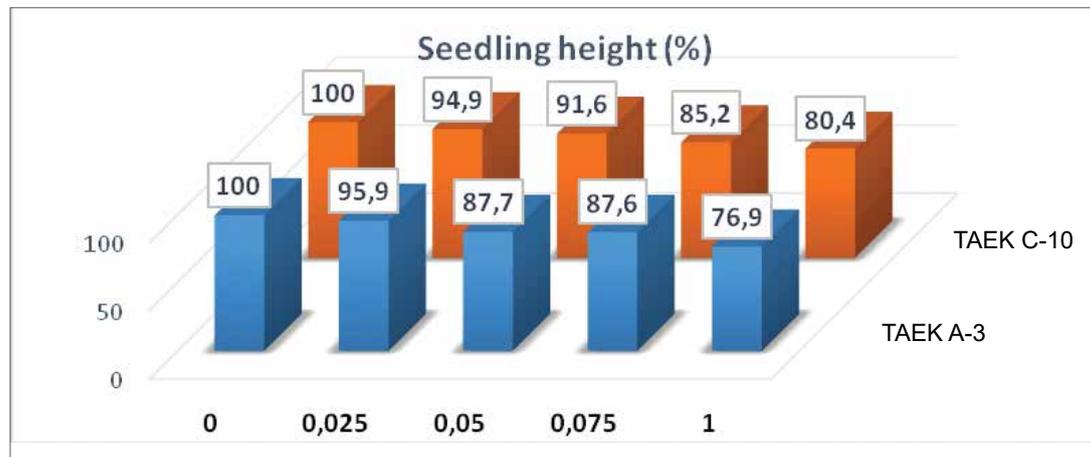
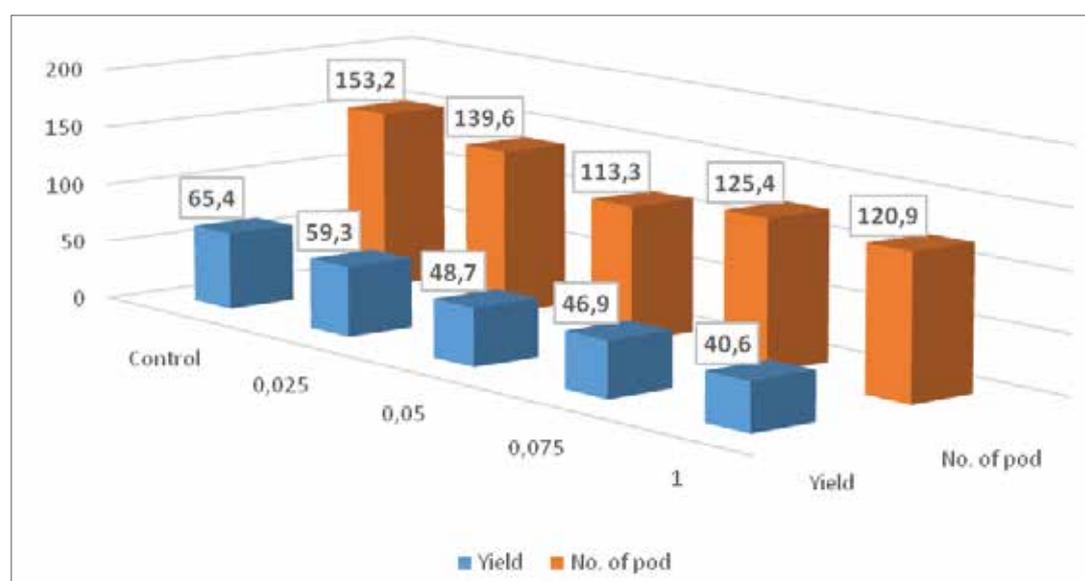


Table 3. Effect of presoaking time and chemical mutagen (EMS) on average No. of plants, plant height, No. of pods and seed yield.

| EMS Doses (M) | Varieties | No. of plant | | | Plant height (cm) | | No. of pod (pod/plant) | | | Yield (g/plant) | | |
|---------------|-----------|-------------------------|--------|--------|-------------------|-------|------------------------|---------|---------|-----------------|--------|--------|
| | | Presoaking time (hours) | | | | | | | | | | |
| | | 0 | 6 | Ort | 0 | 6 | 0 | 6 | Ort | 0 | 6 | |
| Control 1 | TAEK A-3 | 22 | 17 | 42,8 C | 66,23 | 62,12 | 212,55 | 220,21 | 153,2 A | 93,79 | 86,87 | 65,4 A |
| | TAEK C-10 | 78 | 54 | | 67,09 | 62,96 | 88,80 | 91,16 | | 41,56 | 39,22 | |
| 0,025 | TAEK A-3 | 31 | 24 | 56,3 A | 61,52 | 63,63 | 144,68 | 230,55 | 139,6 B | 63,45 | 95,18 | 59,3 B |
| | TAEK C-10 | 92 | 78 | | 66,42 | 64,90 | 91,46 | 91,72 | | 40,94 | 37,60 | |
| 0,050 | TAEK A-3 | 36 | 13 | 48,0 B | 55,64 | 60,38 | 97,97 | 150,29 | 113,3 E | 43,99 | 61,22 | 48,7 C |
| | TAEK C-10 | 78 | 65 | | 66,28 | 67,45 | 103,60 | 101,49 | | 40,36 | 42,18 | |
| 0,075 | TAEK A-3 | 26 | 28 | 48,8 B | 58,46 | 55,14 | 153,96 | 158,92 | 125,4 C | 66,62 | 57,81 | 46,9 D |
| | TAEK C-10 | 77 | 64 | | 67,01 | 65,59 | 93,04 | 95,55 | | 38,02 | 32,26 | |
| 1,00 | TAEK A-3 | 10 | 12 | 35,0 D | 66,20 | 53,00 | 228,10 | 101,00 | 120,9 D | 77,56 | 34,82 | 40,6 E |
| | TAEK C-10 | 59 | 59 | | 67,53 | 60,44 | 85,85 | 68,53 | | 30,89 | 19,08 | |
| | | 50,9 A | 41,4 B | | | | | | | 53,7 A | 50,6 B | |
| Varieties | TAEK A-3 | 21,8 B | | | | | | 169,8 A | | 68,1 A | | |
| | TAEK C-10 | 70,4 A | | | | | | 91,1 B | | 36,2 B | | |

Figure 3. Effect of chemical mutagen (EMS) on average No. of pods and seed yield.



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