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INFLUENCE OF ACTIVATOR ON MEIOSIS OF TOMATO (*LYCOPERSICON ESCULENTUM* MILL.)

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Absract

The cytogenetic effects of activator Act-2 (based in compounds of addition hydro soluble of K-vitamin group a new and specific organic metabolic activator) on meiosis of tomato (*Lycopersicon esculentum* Mill.) were studied. The activator was applied to tomato plant grown in greenhouse at the dosage (150 cc/100 water) recommended by the manufacturing company and double the recommended dosage (300 cc/100 water) as well. It was observed that all dosages of the activator gave rise to some changes in cell shapes, chromosome structures, cell division patterns and cell sizes of tomato pollen. As a consequence of chromosomal anomalies sterile pollens were produced that affected yield negatively.

Adequate pollination and fertilization are critical in agricultural crops where fruit or seed are the final product. These have been identified as factors those limiting yield and crop quality (e.g. fruit size, shape, sugar content and storage ability) in many economically important crops (Yı *et al.* 2003). Critical events are associated with fertility in higher plants. Tomato (*Lycopersicon esculentum* Mill.) is one of the economically important cropes in the world. Therefore, the fertile pollen percentage of the plant have important role for obtaining higher yield.

Chemicals that are used in agriculture may have harmful effects on pollen structure. The abnormalities which occur during meiosis are very important because they cause sterility in pollens (Ignacimuthu and Babu 1989, Mann 1978, Singh 1992, Reddy and Annadurai 1992) and genetic damage that can be transmitted to the offspring via male gametes, leading to congenital abnormalities (Cohen 1969).

Many cytological studies have been carried out to detect the harmful effect of different chemicals on different plants (Ruiz *et al.* 2003). It was stated that diathane and aldrin fungicides caused cytogenetic changes in *Vicia faba* (Njagi and Gopalan 1981). Many insecticides cause chromosomal anomalies in various plants both in mitosis and meiosis (Nicloff and Kappas 1987). Moreover, the selective herbicide 2,4-D caused meiotic and mitotic abnormalities in barley, wheat and rice in greenhouse and in fields (El-Khodary *et al.* 1989, Gianessi and Anderson 1995).

In the present study effects of different concentrations of ACT-2 activator-K-vitamin group on pollen meiosis of tomato (*Lycopersicon esculentum* Mill.) were studied in greenhouse condition.

Flower buds of tomato were collected from a 970 m² - greenhouse in the village of Karaçulha, Fethiye. Healtly tomato seedlings were obtained from M-38 F_1 type domestic seeds. The activator used in the trial was ACT-2 (based in compounds of addition hydro soluble of K-vitamin group, a specific organic metabolic activator). A total of 4 applications, 150 cc/100 liter tap water as recommended by the manufacturing company on the label and 300 cc/100 l tap water as double the recommended dosage were made on ten days interval. Flower bud samples were randomly collected from different plants and were fixed in Carnoy's fluid. Anthers were stained with 2% aceto-orcein before being smeared (Östergren and Heneen 1962).

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For meiotic division, cell shapes, cell division patterns, cell sizes and bivalent arrangements in a total of 100 pollens from each group were studied and photographed using a Jena microscope. Statistical analysis of the values obtained from all the measurements in the study were made on a SPSS 20.0 for Windows Statistical Program and the variance analyses was made using the Chi-square test, a nonparametric test widely utilized in such procedures. Tables 1 - 2 show that the differences among control (a), 150 cc/ 100 l ACT-2 group (b), and 300 cc/100 l ACT-2 (c) group are statistically significant ($p < 0.05$).

Data of the cell shapes of pollens in the control and the treatment plants are given in Table 1. The values related to the number of round pollens in the application groups were lower than those in the control, whereas the numbers of oval and abnormal shaped pollens were higher in the application group. These fluctuations in the values were also significant as compared to the control. When the application groups were assessed among one another, the number of round pollens decreased as the dosage increased.

Table 1. Cell shapes of pollens in control and activator application groups.

Application groups	Cell shape				
	Round	Oval	Triangular	Rectangular	Abnormal cells
Control	86 [bc]	11 [bc]	0	0	3 [bc]
Act-2 (150 cc/100 l)	24 [ac]	34 [a]	1	1	40 [a]
Act-2 (300 cc/100 l)	12 [ab]	39 [a]	2	2	45 [a]

"a" indicates the significant difference between "a" and control group. "b" indicates the significant difference between "b and 150 cc/100 l group. "c" indicates the significant difference between "c" and 300 cc/100 l group.

The 40 g/100 l dosage of the fungicide Chorus 50 WG (50% Cyprodinil) applied to tomato caused some kind pollen morphological structure those were not seen in the control group (Öztürk Çalı 2005). Furthermore, some pollen morphological structures of tomato plants in 60 g/100 l and 120 g/100 l dosages of Switch 62.5 WG (37.5% Cyprodinil and 25% Fludioxonil) were different from the pollen structure observed in the control group (Tort *et al.* 2005). Amer and Farah (1987) stated that abnormal pollen in *Vicia faba* resulted from Methamidophos treatment. In this study, the activator Act-2 gave rise to change in pollen cell shape and increased the number of abnormal pollen shape.

The results of the arrangement of bivalents in pollens of the control and the treated plants are shown in Table 2. According to these results, the number of distinct bivalents in the treated plants was lower as compared to the control plants, whereas the number of indistinct ones higher in the treated plants.

Parmjit and Grover (1985) reported a positive relationship between the increase in pesticide concentrations and the number of abnormalities in plants. Similarly, in the present study there was a positive relationship between the number of chromosome abnormalities and the increase in pesticide concentrations. Treatment with certain insecticide had caused chromosome anomalies in *Hordeum vulgare* (Pusztai 1983), while treatment with Ekalux had led to chromosome anomalies in the form of binding in red pepper (Lakshmi *et al.* 1988). However, Nitralin was responsible for abnormal polarization in *Allium cepa* (Badr 1979). According to Devadas *et al.* (1986) there was a positive relationship between chromosomal damage and pollen sterility. It is obvious that chromosomal degeneration in Act-2 groups will affect pollen fertility as a consequence of negative impact on yield.

Table 2. Arrangement of bivalents in pollens of control and activator application groups.

Application groups	Arrangement of bivalents						
	Distinct	Indistinct	Thread-like	Ring shaped	Linear	Binding	Polar distortion
Control	83 [bc]	17 [bc]	2 [bc]	3 [bc]	2 [bc]	3 [bc]	0
Act-2 (150 cc/100 l)	28 [ac]	72 [a]	21 [ac]	26 [ac]	29 [ac]	33 [ac]	31 [c]
Act-2 (300 cc/100 l)	15 [ab]	85 [a]	41 [ab]	43 [ab]	46 [ab]	52 [ab]	65 [b]

"a" indicates the significant difference between "a" and control group. "b" indicates the significant difference between "b and 150 cc/100 liter group. "c" indicates the significant difference between "c" and 300 cc/100 liter group.

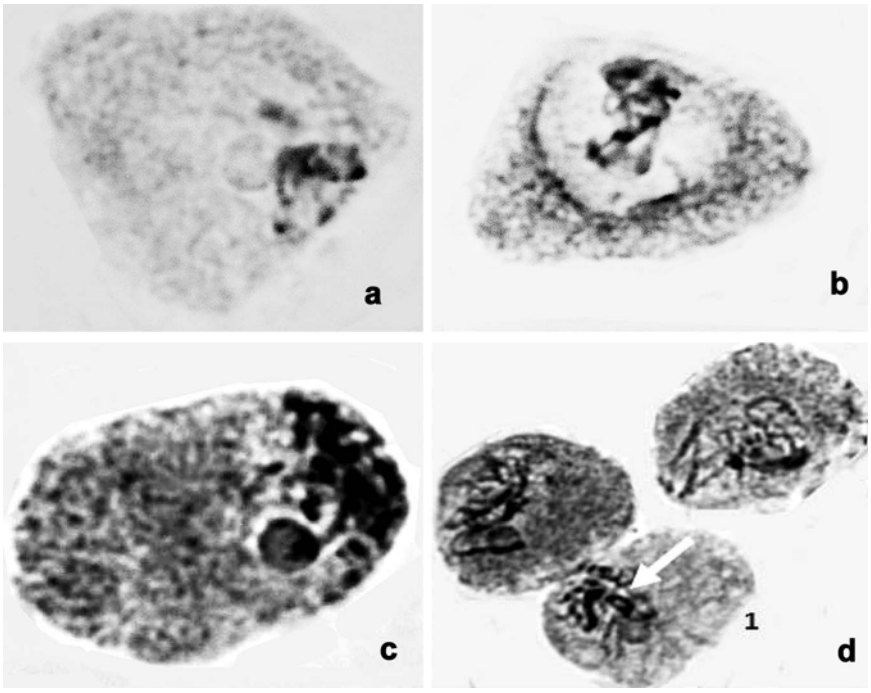

Fig. 1. Meiotic division abnormalities in 150 cc/100 l and 300 cc/100 liter groups. Binding chromosomes in 150 cc/100 liter group (a,b) and in 300 cc/100 liter group (c,d); Polar distortion in 150 cc/100 liter group (a,b) and in 300 cc/100 liter group (c,d); Ring-shaped chromosomes in 300 cc/100 liter group d (1).

Cell division pattern and cell size related to the control and the treatment groups are given in Table 3. The number of properly divided cells and normal size cells decreased in the 300 cc/100 l Act-2 group, whereas the number of the improperly divided as well as large and small cells increased in both dosages of treatment groups. The decrease and the increase in the values were significant. The number of normal size cells decreased as the dosage increased in the treated groups, in contrast to the number of cells with improper division and large and small cells.

It was stated that benzoylphenyl urea had prevented cell division (Abdel-Rahem and Ragab 1989). Large and small cells also determined in some chemical applications (Ajay and Sarbhoy 1987).

Table 3. Cell division patterns and cell sizes of pollens in control and activator application groups.

Application groups	Cell division patterns		Cell Size		
	Proper	Improper	Normal	Large	Small
Control	98 [c]	2 [bc]	99 [c]	1 [bc]	0
Act-2 (150 cc/100 l)	87	13 [ac]	95 [c]	2 [ac]	3 [c]
Act-2 (300 cc/100 l)	73 [a]	27 [ab]	70 [ab]	16 [ab]	14 [b]

"a" indicates the significant difference between "a" and control group. "b" indicates the significant difference between "b and 150 cc/100 l group. "c" indicates the significant difference between "c" and 300 cc/100 l group.

The above discussion indicated that the activator influenced meiotic behaviour of tomato resulting pollen sterility followed by loss of yield.

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