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ACHENE GERMINATION OF ETHEPHON-TREATED SUNFLOWER LINES

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SUMMARY

Achene germination of sunflower lines (*Helianthus annuus* L.) treated with ethephon are presented. Four different maintainer lines were treated with five concentrations of ethephon (2.0ml·l^{-1}, 3.0ml·l^{-1}, 4.0ml·l^{-1}, 5.0ml·l^{-1}, 6.0 ml·l^{-1}). Plants were treated before flowering and openpollinated. The percentage of viable, abnormal and non-viable germs was determined with a strong genotypical reaction being observed. It was possible to rank the lines by sensibility to ethephon. The optimal achene number per plot can be determined based on characters of germination of genotypes.

Keywords: **Ethephon treatment for male sterility, germination parameters, sunflower**

INTRODUCTION

Obtaining information about combining ability of lines by crossing in an early generation is an important process in the development of new inbred lines. The crossing can be rather complicated when the male test-lines are used as female partners. It is well-known that male sterility can be induced using gibberellic acid or ethylene (Sykorova and Kovacik, 1978; Schuster and Liu, 1983; Škoric, 1988). This non-heritable form of male sterility can be useful for producing new test-hybrids. Ethephon as an ethylene generator has been used for many years in our breeding program to investigate and generate male sterility in sunflower for new synthetics but not for test hybrid production (in trials the suitable germination quality is required). Germination of achenes from ethephon--treated plants was the focus of this study. The objective was to determine the variability of achene germination in these genotypes.

Table 1: The influence of ethephon concentrations on viable germ of genotypes (%).

Concentrations of ethephon	Genotypes			
($ml \cdot l^{-1}$)	A	B	C	D
0.0	85.2	59.9	85.3	82.0
2.0	50.0	54.9	44.0	75.7
3.0	31.9	54.8	46.0	68.5
4.0	14.2	54.2	24.9	68.0
5.0	0.0	49.1	26.2	74.8
6.0	0.0	35.4	18.7	69.5
	LSD(0.05)= 8.8			

Underlined data: fully-malesterile plants due to ethephon treatment

Table 2: Variance analysis of percentage of viable germ.

Source of variance	SS	FD	MS
Total	45691.3	71	643.5
Replication	121.3	2	50.6
Treatment	44740.3	23	1945.2 ***
Ethephon conc.	17379.8	5	3475.9 ***
Genotype	17661.6	3	5887.2 ***
Etheph. / Genot.	9698.8	15	646.6 ***
Error	829.6	46	

Table 3: The influence of ethephon concentrations on abnormal germ of genotypes (%).

Concentrations of ethephon	Genotypes			
($ml \cdot l^{-1}$)	A	B	C	D
0.0	7.4	15.7	9.7	12.4
2.0	10.6	18.5	21.4	12.4
3.0	12.4	15.5	20.1	18.9
4.0	14.6	13.1	22.7	20.7
5.0	20.2	16.0	20.7	15.7
6.0	25.0	20.6	26.5	20.2
	LSD(0.05)= 12.1			

Underlined data: fully-malesterile plants due to ethephon treatment

MATERIALS AND METHOD

Four different sunflower genotypes (designed as A=TKI-3, B=TKI-21, C=TKI-30, D=TKI-36,) were investigated. The genotypes were inbred lines (single-headed, maintainer) selected from different synthetic populations of PATE TKI in Hungary. Lines were planted in a randomized complete block design with 3 replications (0.7m row spacing, 0.3m plant spacing, plant density 4,76 plant·m^{-2}, 12 plant·plot^{-1}). The ethephon treatments were applied at 5 concentrations (2.0ml·l^{-1}, 3.0ml·l^{-1}, 4.0ml·l^{-1}, 5.0ml·l^{-1}, 6.0ml·l^{-1}) accompanied by the untreated check. Before flowering (in R-2 stage, according to Schneiter and Miller, (1981), ethephon was injected into the buds (1ml·plant^{-1}). The plants were openpollinated. At maturity, the heads were harvested individually (12 head per plot) and achene samples were prepared for evaluation. After dormancy the achenes were germinated in a wet-box at 25^{o}C for 72 hours. The percentage of viable, abnormal or non-viable germs was recorded. (Viable germ : healthy germ, normal - longer than 2cm - root of seedling. Abnormal germ : healthy or infected germ, deformed and too short root of seedling. Non-viable germ : healthy or infected germ, no root of seedling.) The variance analysis was realized by Excel for Windows according to Svab, 1981.

RESULTS

The results of the germination test concerning percentage of viable germ are summarized in Table 1. Fully sterile plants were obtained with ethephon treatments of 5.0ml·l^{-1} and 6.0ml·l^{-1}. The underlined data indicate fully male sterile plants due to ethephon treatments. The variance analysis of percentage of viable germs is presented in Table 2. High level of significant differences (p=0.001) was indicated by the analysis of variance among genotypes, concentrations of ethephon treatments, and interactions. There were very strong effects of ethephon concentration, genotype and their interaction to variability of viable germ percentage. Figure 1 shows the influence of ethephon concentrations on viable germ percentage of the genotypes. The inbred lines can be ranked based on their sensibility to ethephon (A>C>B>D).

Germination percentages of abnormal germs as influenced by ethephon concentration are presented in Table 3 and Figure 2. Increased ethephon concentration generally increased abnormal germs germination opposite that of viable germs. There was no significant difference among data of B and D genotypes. The results of variance analysis regarding percentage of abnormal germ (Table 4) suggested that the percentage of abnormal germ was controlled by ethephon concentration, primarily. There was unconvincing genotype effect detected.

Influence of ethephon concentration on the percentage of non-viable germs of different lines is shown in Table 5 and Figure 3. It is of interest to note that the percentage of non-viable germ of D genotype did not change significantly due to increased ethephon concentration. Considerable effects of genotype, ethephon concentrations and their interaction were revealed by variance analysis (Table 6).

Table 4: Variance analysis of percentage of abnormal germ

Source of variance	SS	FD	MS
Total	3212.9	71	45.3
Replication	84.6	2	42.3
Treatment	1559.2	23	67.8 *
Ethephon conc.	1284.5	5	256.9 ***
Genotype	221.4	3	73.8 †
Etheph. / Genot.	53.2	15	3.5
Error	1569.1	46	34.1

Table 5: The influence of ethephon concentrations on non-viable germ of genotypes (%).

Concentrations of ethephon	Genotypes			
($ml \cdot l^{-1}$)	A	B	C	D
0.0	7.4	24.4	5.0	5.6
2.0	39.4	26.6	34.5	11.9
3.0	55.7	29.7	33.9	12.6
4.0	71.2	32.6	52.3	11.3
5.0	79.9	34.9	53.1	9.4
6.0	75.1	44.0	54.8	10.3
	LSD(0.05)= 16.8			

Underlined data: fully-male sterile plants due to ethephon treatment

Table 6: Variance analysis of percentage of non-viable germ.

Source of variance	SS	FD	MS
Total	37314.2	71	525.6
Replication	208.6	2	104.3
Treatment	34059.2	23	1480.8 ***
Ethephon conc.	10491.3	5	2098.3 **
Genotype	16046.7	3	5348.9 ***
Etheph. / Genot.	7521.3	15	501.4 ***
Error	3046.3	46	66.2

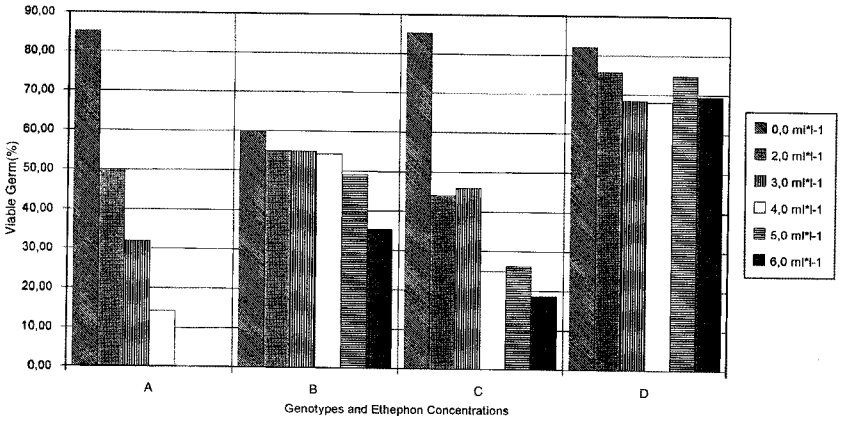

Figure 1. Influence of ethephon concentrations on percentage of viable germs of different genotypes

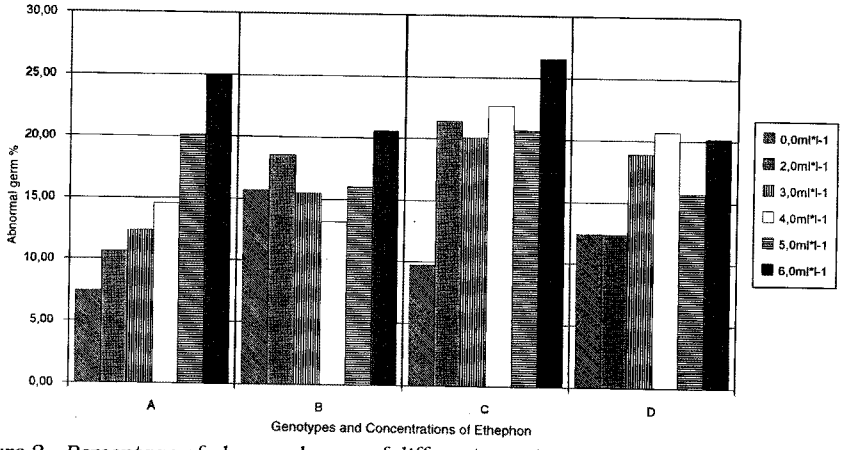

Figure 2. Percentage of abnormal germ of different genotypes

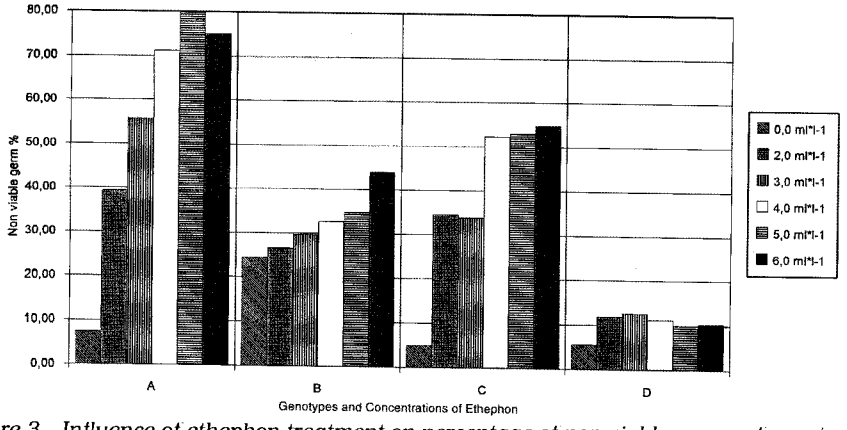

Figure 3. Influence of ethephon treatment on percentage of non viable germs of genotypes

CONCLUSIONS

Strong genotypical variability was detected in ethephon reaction of the investigated genotypes. Genotype A proved to be most susceptible to high concentration of ethephon. Germination was practically reduced to zero by ethephon concentrations of 5.0ml·l^{-1}. Genotype D was the most tolerant (smallest germination reduction) one with a germination of 65-70% at the highest concentration of ethephon (6.0ml·l^{-1}).

The change of abnormal germ percentage depended on the change of ethephon concentration, primarily. Percentages of viable and non-viable germs were controlled by concentration of ethephon, genotype and their interaction too. The most important practical result from this study was that the applied ethephon concentrations caused male sterility reducing germination by 46-68% in the genotypes investigated. This would indicate that if the next generation sowed with twice the number of achenes as needed, the method would be applied safely to obtain the necessary number of plants for trials.

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GERMINACIÓN DE AQUENIOS EN LÍNEAS DE GIRASOL TRATADAS CON ETEPHON.

RESUMEN

Esta breve comunicación presenta el resultado de la germinación de aquenios de girasol (*Helianthus annuus* L.) en líneas tratadas las con etephon. Cuatro líneas fueron testadas con 5 concentraciones de etephon (2.0 ml l^{-1}, 3.0 ml l^{-1}, 4.0 ml l^{-1}, 5.0 ml l^{-1}, 6.0 ml l^{-1}). Las plantas fueron tratadas antes de la floración y estuvieron en polinización libre.

El porcentaje de plántulas vivas, anormales y muertas fué determinado y se observó una fuerte reacción genotípica. Fué posible clasificar las líneas por sensibilidad a etephon.

GERMINATION DES AKÉNES CHEZ DES LIGNÉES DE TOURNESOL TRAITÉES À L'ÉTEPHON

Cette courte communication présente les résultats sur la germination des akénes de tournesol (*Helianthus annuus* L.) dans l'étephon (2.0 $ml \cdot l^{-1}$, 3.0 $mL \cdot l^{-1}$, 4.0 $ml \cdot l^{-1}$, 5.0 $ml \cdot l^{-1}$, 6.0 $ml \cdot l^{-1}$). Les plantes traitées avant la floraison ont été laissées en fécondation libre. Le pourcentage de germes viables, anormaux et morts a été détecté et de fortes réactions génotipiques observées. Il est possible de classer les lignées pour leur sensibilité à l'étephon.