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SEED SET AND POLLEN TUBE GROWTH IN SUNFLOWER STYLES

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SUMMARY

This research determined the percentage of seed set and pollen tube growth in styles of six sunflower cultivars, under self-pollination conditions. Three days before anthesis, plants of the tested material were bagged with paper bags to ensure selfp-ollination. The bagged plants were randomly divided in two equal groups. One was harvested after physiological maturity and seed set percentage was measured. From the other group, 48 hours after self-pollination, styles were removed and observed with microscope, in order to examine pollen tubes in the lower part.

Results proved that strong relationship exists between sed set and penetrated styles percentage in the tested material. So, self-compatibility degree that is determined from seed set percentage under self pollination, could also be determined by the percentage of penetrated styles from pollen tubes.

INTRODUCTION

Sunflower is a typical cross-pollinated plant. Cross-pollination percentage depends mainly on genotype and it varies from 0 to 100%. Morphological and physiological features of disk flowers favor cross-pollination, which is effected primarly by insects.

Seed set under self-pollination conditions is strongly correlated with self-compatibility degree (Beg et al., 1987). This phenomenon is common in sunflower, and in some populations or cultivars is nearly complete (Fick, 1978). Wild species of genus Helianthus maintain self-incompatibility. Sericys (1985) selfed 30 annual and 8 perennial ecotypes and found that seed set per head was between zero and two.

Prior to cytoplasmic male sterility investigations, self-incompatibility had been used in hybrid seed production (Vranceanu and Stoenescu, 1969) and the former should certainly be considered as an advantage. In current breeding programs for hybrids, self-incompatibility is an undesirable feature which involves obstacles in development, evaluation and maintenance of inbred lines. The majority of new sunflower hybrids are free of self-incompatibility, thanks to strong selection for this objective. So, seed yield depends much less on pollinating insects (Škorić, 1988).

Pollen grain germination and pollen tube penetration in the style are the first steps in a successful fertilization. Sunflower belongs to the family Compositae, whose pollen grains carry three nuclei. In this family, the pollen grain germination is suspended in stigmatic surface (Lewis, 1954). If this procedure takes place in sunflower, pollen tubes will develop only in compatible pollinations.

The objective of this research was to study seed set and polen tubes percentage in styles of some cultivars under self-pollination condition.

MATERIALS AND METHODS

Four o.p. varieties and two single cross hybrids were chosen for this study, which was carried out at Sindos in 1990 (Table 1). Cavissos is well-adapted and used largely in Greece, under dry conditions. Mirodato and Rodopi are domestic, confectionery type o.p. varieties of limited interest for the Greek agriculture. All cultivars were sown in a randomized complete block design with four replications. Three days before anthesis, twenty randomly selected heads from each plot were bagged with special paper bags. Half of these heads were harvested at the stage of physiological maturity and seed set percentage was measured.

Table 1. Some characteristics of the tested cultivars.

Cultivar	Owner	Type	Origin	Use
Veraflor	Rustica	Single Hybrid	France	oil
Hysun-33	Pacific Seeds	"	Australia	"
GK-70	CRI, Szeged	Open-pollinated	Hungary	"
Cavissos	CIPI, Sindos	" "	Greece	"
Mirodato	" "	" "	"	confectionery
Rodopi	" "	" "	"	"

The other half of the covered heads was selfed by hand with small pieces of cotton at the stage of stigma division. Three days after self-pollination, 40 to 50 styles from each head were removed successively and put in 1:1:8 FAA solution for 24 hours. After careful washing, styles were transferred into NaOH solution, 8N concentration, for 4 hours, carefully washed again and stained in a solution of 0,1% aniline blue, dissolved in 0,1N K_3PO_4 (Kho, 1968). In this solution, the styles were kept for at least 24 hours. Observations of the lower parts of the styles were made with the aid of a microscope and light waves 350-400 m.u. Pollen tubes were clearly recognizable by their fluorescent wall, due to the presence of callose (Figure 1).

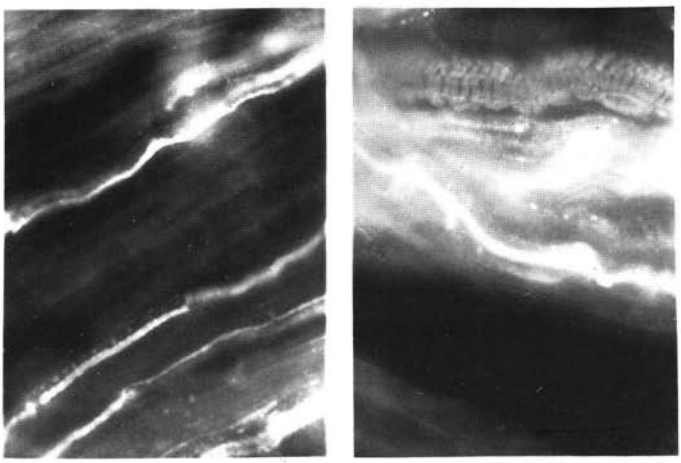

Fig 1. Sunflower pollen tubes in self-compatible pollinations

Penetrated styles and seed set percentage were measured for each tested cultivar. Correlation coefficients were also calculated, in order to check coincidence of these percentages.

RESULTS AND DISCUSSION

Percentages of seed set and penetrated styles are presented in Table 2. The hybrids showed high seed set percentage as compared with the o.p. varieties which had low seed setting. Particularly the two confectionery type cultivars, Mirodato and Rodopi, had very low seed set percentages. Beg at al. (1987) defined seed set percentage, in selfed cultivars, as self-compatibility degree. They found that hybrids had higher seed percentage as compared with o.p. varieties. This conclusion may also be drawn from the results in Table 2. Self - incompatibility was almost complete in the o.p. varieties GK-70, Cavissos, Mirodato and Rodopi.

Table 2 Mean percentage of seed set and penetrated styles in selfed cultivars. Correlation coefficients between the percentages

Cultivar	Seed set %	Penetrated styles %	Correlation coefficient[1] r,
Veraflor	88.4	90.1	0.604 **
Hysun-33	86.7	91.9	0.776 **
GK-70	12.8	15.8	0.706 **
Cavissos	17.4	19.9	0.675 **
Mirodato	6.9	8.8	0.808 **
Rodopi	5.5	6.4	0.764 **

[1] Computed from 40 pairs.

Pollinating insects are very important for these cultivars, in order to ensure the seed yield. The hybrids Veraflor and Hysun-33 are free from the presence of self-incompatibility, and seed set seems to be independed of pollinators.

The styles penetrated by pollen tubes in selfed heads of the cultivars had similar percentages of seed set. The open-pollinated varieties had a much lower percentage of penetrated styles than the two hybrids. The confectionery type cultivars had the lowest penetrated styles percentage.

Correlation coefficients between seed set and penetrated styles percentage for each cultivar are presented in Table 2. The high values of the coefficients (significants at 99% level) indicate a perfect linear correlation between the two percentages. The remarkable coincidence between seed set and penetrated styles percentage indicates that if a pollen tube penetrates the style, a seed will develop. This also indicates that if self-incompatibility exists, the pollen tube growth suspension will probably take place in the style. If the suspension took place after the penetration of the lower part of the style, (as this part was within the observation field of the microscope), the differences between the two percentages would be much higher and the correlation coefficients would not be significant. The tested material was very limited and so the conclusion drawn above must be checked by further investigation.

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NOMBRE DE GRAINES FORMÉES ET CROISSANCE DU TUBE POLLINIQUE

RÉSUMÉ

Cette étude a déterminé la relation entre le nombre de graines formées et la croissance du tube pollinique dans les styles de six cultivars de tournesol, dans des conditions d'auto pollinisation. Trois jours avant l'anthèse, les plantes testées ont été ensachées avec des sacs de papier pour assurer l'autofécondation. Les plantes ensachées ont été divisées en deux groupes égaux. Le premier a été récolté aprés la maturité physiologique pour établir le pourcentage de graines formées. A partir de l'autre groupe, quarante huit heures aprés l'autofécondation, le styles ont été retirés et observés sous microscope afin de déterminer la présence du tube pollinique dans leur partie inférieure.

Au niveau du matériel testé, les résultats prouvent l'existence d'une forte corrélation entre la formation des graines et le pourcentage de styles pénétrés. Aussi le degré d'auto pollinisation pourrait être estimé par le pourcentage de styles pénétrés par des tubes polliniques.

FORMACION DE SEMILLA Y CRECIMIENTO DEL TUBO POLINICO EN ESTILOS EN GIRASOL

RESUMEN

En esta investigación se determinó el porcentaje de formación de semilla y crecimiento de tubo polínico en estilos de seis cultivares de girasol, bajo condiciones de autofecundación. Tres días antes de antesis, las plantas del material testado fueron enbolsadas con bolsas de papel para asegurar la autopolinización. Las plantas embolsadas fueron divididas al azar en dos grupos iguales. Uno fué recolectado después de la maduración fisiológica y fué medido el porcentaje de semilla formada. En el otro grupo, 48 horas después de la autopolinización, los estilos fueron separados y observados en el microscopio para determinar los tubos polínicos en la parte más baja.

Los resultados probaron que existe una fuerte relación entre la formación de semilla y estilos con tubos polínicos en le material testado. Por tanto el grado de autocompatibilidad que se determina por el porcentaje de semilla formada bajo autopolinización podría tambien ser determinado por el porcentaje de estilos penetrados por los tubos polínicos.