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STUDIES ON IMMEDIATE EFFECT OF FOREIGN POLLEN (XENIA) ON RESULTING F_0 SEED CHARACTERISTICS IN SUNFLOWER (*Helianthus annuus* L.)

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SUMMARY

Studies were made on thirty crosses (F_0) involving three CMS lines and 10 restorer parents. The influence of different pollen sources on the female parents was positive and significant for all the characters studied. Five pollen parents R 6D-1, R X-13, R 857, RLC 2Br and R IV 83 were found to influence all seed characters when pollinated on three CMS lines. The percent increase of F_0 seed values over mean sibbed values of females ranged from 5.67 to 21.51 for 1000 seed weight, 0.79 to 9.04 for oil content, 2.72 to 20.39 for seed density, 0.18 to 13.61 for volume weight, -0.45 to 13.00 for K/H ratio and -0.99 to 7.39 for hull content. These results indicated the stimulating effect of foreign pollen on resulting seed characters at the F_0 level.

Key words: xenia, metaxenia, F_0, seed characters

INTRODUCTION

Sunflower has been established as a potential oil seed crop in India with 2.0 million hectares in acreage and 1.4 million tonnes of annual production. In allogamous crops like sunflower, pollen source and maternal influence assumes greater importance in determining seed yield as well as oil yield. Habura (1957) reported the sporophytic type of self-incompatibility mechanism in sunflower. It is a know fact that in cross-pollinated crops a foreign pollen can germinate much faster than their own pollen. The importance of foreign pollen is of great practical significance in the crossed seed/fruit characters in several crops. The immediate effect of foreign pollen on embryo and endosperm of the crossed seed (xenia) and its effect on the maternal tissue and other endosperm (metaxenia) has been reported in many crop species (Brink & Cooper, 1947). Although commercial exploitation of heterosis has been made possible in sunflower, very few reports are available on xenia effects.

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MATERIAL AND METHODS

A total of 30 hybrids derived from crossing 10 restorer lines with 3 CMS lines formed base material for the present study. In this experiment care was taken to provide sufficient pollen for complete fertilization and seed setting in the entire capitulum irrespective of sib- or cross-pollination. Cloth bags were used for strict pollination control so as to prevent contamination with foreign pollen and cloth bags were removed soon after fertilization of the entire head. This experiment was conducted in 1994 at Regional Research Station, Raichur. Five rows of each of the three female parents were raised out of which four rows were earmarked for cross pollination with 10 pollen parents and 3 maintainer lines of the female parents were planted separately in 3 rows each. Ten plants were involved in crossing/sibbing in each treatment. In all, 30 crosses (F_0) and three sibs per female parent were obtained. Observations were recorded for six seed characters, *viz.*, 1000-seed weight, oil content, seed density, volume weight, K/H ratio and hull content. The mean F_0 values all crosses of each pollen parent over three female parents were compared with that of mean sibbed values of three females and percentage increase or decrease were worked out.

RESULTS

The treatments showed significant differences for the six seed characters under study. The mean values for all six characters as influenced by pollen source in crossed F_0 seeds, sibbed female parents and percent increase of F_0 values over mean sibbed values of three female parents are presented in Table 1. Significant pollen effect in the crossed seed was observed for the seed characters compared with the values of sibbed female parents. In general, mean values of the crosses were higher than those of the parents as all seed characters were largely influenced by pollen genotype. The net influence of all pollen parents on the resulting F_0 seeds was positive for most of the seed characters indicating that the foreign pollen had in general stimulating effect on the seed characters.

For 1000-seed weight, the influence of pollen parents ranged from 5.67 to 21.51%. All pollen parents significantly influenced the 1000-seed weight. R 6D-1 had the maximum influence (21.51%) followed by RLC 2Br (19.32%).

For oil content, six pollen parents had significant positive influence. R X-13 showed maximum influence (9.04%), followed by R 6D-1 (7.37%). All pollen parents except R IV-83 had significant and positive influence on seed density. R 857 had maximum influence, to the extent of 20.39%. For volume weight all pollen parents exhibited significant positive influence except R IV-43. The pollen parent RLC 2Br exhibited maximum influence of 13.61%.

Out of the ten pollen parents, half of them had significant positive influence on K/H ratio. R IV-83 had the maximum positive influence, to the extent of 13.00%.

Four pollen parents, RHA-274, R 6D-1. R V-34 and RLC 2Br, had significant positive influence on hull content, from 3.98% to 7.37%. R X-13 showed significant negative influence, reducing the hull content by 3.53%.

Table 1: Mean values of hybrids (F_0) and parents for six seed characteristics in sunflower

Cross / parent	1000-seed weight (g)	Oil content (%)	Seed density (g/cc)	Volume weight (g)	K/H ratio	Hull (%)
CMS 234 x R 8297	48.63	37.63	0.572**	37.77**	2.17	31.00**
CMS DSF 15 x R 8297	49.19	37.32	0.523	35.53	2.39	29.46
CMS 4546 x R 8297	49.87**	37.28**	0.502	35.90**	2.28**	30.62
Mean of crosses	49.23**	37.41	0.532**	36.40**	2.28	30.36
% increase over female sibbing mean	5.67	2.44	3.30	7.25	2.24	3.16
CMS 234 x R 857	51.93	38.84**	0.521	37.30**	2.56*	28.10**
CMS DSF 15 x R 857	56.97**	41.20**	0.672	36.27**	2.29	27.18
CMS 4546 x R 857	49.72**	35.55**	0.666**	36.40**	2.17	31.00
Mean of crosses	52.87**	38.53**	0.620**	36.66**	2.34	28.76
% increase over female sibbing mean	13.48	5.50	20.39	8.01	4.93	-2.28
CMS 234 x R 274	53.40**	37.74	0.612**	39.67**	2.68*	27.18*
CMS DSF 15 x R 274	53.05**	40.37**	0.536	35.11*	2.23	30.99**
CMS 4546 x R 274	51.57**	38.40**	0.583**	35.40**	2.22*	33.62*
Mean of crosses	52.67**	38.84**	0.577**	36.73**	2.38*	30.60*
% increase over female sibbing mean	13.05	6.35	12.04	8.22	6.73	3.98
CMS 234 x RLC 2Br	54.80**	36.14	0.621**	38.97**	2.02	33.07**
CMS DSF 15 x RLC 2Br	57.57**	35.31	0.574**	38.37**	2.24*	28.67
CMS 4546 x RLC 2Br	54.40**	33.35	0.548**	38.33**	2.02	33.07
Mean of crosses	55.59**	34.93	0.581**	38.56**	2.09	31.60**
% increase over female sibbing mean	19.32	-4.35	12.82	13.61	-6.28	7.37
CMS 234 x R 6D-1	55.62**	40.67**	0.552**	36.87**	2.26	30.59**
CMS DSF 15 x R 6D-1	66.10**	40.52**	0.557**	38.87**	2.34	29.97
CMS 4546 x R 6D-1	48.10**	36.44**	0.503	33.87	2.05	32.98
Mean of crosses	56.61**	39.21**	0.537**	36.54**	2.22	31.18**
% increase over female sibbing mean	21.51	7.37	4.27	7.66	-0.45	5.95
CMS 234 x R V 34	50.87	38.58*	0.522	36.37*	2.14	31.80**
CMS DSF 15 x R V 34	46.77	38.46	0.547**	34.23	2.39	28.68
CMS 4546 x R V 34	57.37**	33.40	0.519*	37.07**	1.99	33.43
Mean of crosses	51.67**	36.81	0.529**	35.89**	2.17	31.30**
% increase over female sibbing mean	10.90	0.79	2.72	5.75	-2.69	6.35
CMS 234 x R IV 43	50.29	38.35	0.527**	35.14	2.62*	28.05*
CMS DSF 15 x R IV 43	55.60**	38.56	0.622**	35.23*	2.62*	27.68*
CMS 4546 x R IV 43	46.63**	34.51	0.518*	31.63	2.26*	30.85
Mean of crosses	50.84**	37.14	0.556**	34.00	2.50*	28.86*
% increase over female sibbing mean	9.12	1.70	7.96	0.18	12.11	-1.94

Table 1: Mean values of hybrids (F_0) and parents for six seed characteristics in sunflower

Cross / parent	1000-seed weight (g)	Oil content (%)	Seed density (g/cc)	Volume weight (g)	K/H ratio	Hull (%)
CMS 234 x R VI 78	52.17	37.69	0.528**	38.47**	2.43*	29.13**
CMS DSF 15 x R VI 78	47.67	38.33	0.580**	37.37	2.33	30.09
CMS 4546 x R VI 78	50.10**	36.75**	0.612**	36.57**	2.54*	28.21*
Mean of crosses	49.98**	37.59*	0.573**	37.47**	2.43*	29.14*
% increase over female sibbing mean	7.28	2.93	11.26	10.40	8.97	-0.99
CMS 234 x R IV 83	46.79	41.62**	0.527**	37.23**	2.69*	27.20
CMS DSF 15 x R IV 83	60.66**	38.65	0.528	34.27	2.42	29.20
CMS 4546 x R IV 83	49.80**	35.72**	0.519*	35.90**	2.46**	28.90
Mean of crosses	52.42**	38.66**	0.525	35.80**	2.52**	28.43
% increase over female sibbing mean	12.51	5.86	1.94	5.48	13.00	-3.40
CMS 234 x R X 13	55.63**	39.02**	0.534**	37.70**	2.49**	27.33
CMS DSF 15 x R X 13	55.71**	41.61**	0.713**	35.57**	2.56**	28.10
CMS 4546 x R X 13	46.13**	38.82**	0.526**	36.53**	2.39**	29.75
Mean of crosses	52.49**	39.82**	0.591**	36.60**	2.48**	28.39*
% increase over female sibbing mean	12.66	9.04	14.76	7.84	11.21	-3.53
Mean of 30 crosses	52.43**	37.89**	0.562**	36.39**	2.35	29.86
% increase over female sibbing mean	12.53	3.75	9.12	7.21	5.38	1.46
Female sibbing:						
CMS 234	51.46	37.41	0.512	35.17	2.29	26.33
CMS DSF 15	48.92	38.20	0.527	33.82	2.32	29.52
CMS 4546	39.38	33.95	0.507	32.82	2.08	32.44
Mean	46.59	36.52	0.515	33.94	2.23	29.43
CD at 5%	1.39	1.05	0.011	1.19	0.14	1.03
CD at 1%	1.83	1.38	0.015	1.57	0.19	1.36
CV(%)	2.14	1.28	1.62	1.49	4.86	2.64

*, ** - Significant at 5% and 1% probability respectively compared with respective female sib

DISCUSSION

In general, the influence of foreign pollen tends to increase 1000-seed weight, oil content, seed density, volume weight, K/H ratio and hull content, the scope of influence depending on the type of pollen involved in fertilization. Similar effect of pollen on seed characters like seed weight and oil content was reported for maize (*Zea mays* L.) by Alexander and Lambert (1968), for rape seed by Downey and Harvey (1963) and for oleiferous *Brassicae* by Singh (1957), Asthana and Singh (1973), and for sunflower by Seetharam *et al.* (1977). The increase in 1000-seed weight, oil content, seed density and volume weight of F_0 crossed seed was also reported for sunflower by Kini and Seetharam (1994).

The increase in seed characters in the crossed seed is largely due to hybridity. Nevertheless, Brink and Cooper (1947) while reviewing the role of endosperm in seed development suggested the use of the term xenia when pollen influence the endosperm characters and metaxenia when the effect of pollen is on fruit or seed other than the endosperm. In the present study also, the hull content (maternal tissue) was also influenced significantly by the type of pollen parent used indicating the metaxenia effects. Habura (1957) reported the sporophytic type of self-incompatibility mechanism in sunflower. In such situations the foreign pollen influence can play significant role in breaking the barries of self-incompatibility. These xenia effects can be exploited in sunflower improvement for increasing seed and oil yields by selecting appropriate pollen parents.

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ESTUDIO SOBRE EL EFECTO DIRECTO DE POLEN EXTRAÑO A LAS CARACTERISTICAS DE LA SEMILLA F_0 DE GIRASOL (*Helianthus annuus* L.)

RESUMEN

Treinta cruces (F_0) entre tres lineas CMS y diez restauradores-padres han sido estudiados. La influencia de diversas fuentes de polen sobre la componente materna era positivo e importante para todas caracteristicas estudiadas. Fué constatado que cinco donadores-padres de polen, R 6D-1, R X-13, R 857, RLC 2Br y R IV 83, tenian efecto sobre todas caracteristicas de semillas de tres lineas CMS polinizadas. Los porcentajes de aumento de semilla F_0 con relación a los valores medios de las lineas maternas variaban de 5.67 a 21.51 para el peso de 1000 semillas, de 0.79 a 9.04 para el contenido de aceite, de 2.72 a 20.39 para densidad de siembra, de 0.18 a 13.61 para el peso de volumen, de -0.45 a 13.00 para la relación de K/H y de -0.99 a 7.39 para el contenido de cáscara. Los resultados siñalan el efecto estimulativo de polen extraño sobre la caracteristicas de semilla al nivel F_0.

ÉTUDES SUR L'EFFET IMMÉDIAT DU POLLEN ÉTRANGER (XENIA) SUR LES CARACTÉRISTIQUES F_0 DE LA GRAINE DE TOURNESOL (*Helianthus annuus* L.)

RÉSUMÉ

Trente croisements (F_0) de trois lignes CMS et dix parents-restorers ont été étudiés. L'influence des différentes sources de pollen sur les parents femelle s'est montré positif et significatif pour toutes les caractéristiques étudiées. Il a été confirmé que cinq parents donneurs de pollen R 6D-1, R X-13, R 857, RLC 2 Br et R IV 83 avaient eu une influence sur toutes les caractéristiques des graines quand la pollinisation avait été faite sur trois lignes CMS. Le pourcentage d'augmentation de valeur de graine F_0 par rapport aux valeurs moyennes des lignes femelles allaient de 5.67 à 21.51 pour le poids de 1000 graines, de 0.79 à 9.04 pour le contenu d'huile, de 2.72 à 20.39 pour la densité de la graine, de 0.16 à 13.61 pour le poids volumique, de -0.45 à 13.00 pour le rapport K/H et de -0.99 à 7.39 pour le contenu de l'écale. Les résultats obtenus démontrent l'effet stimulant du pollen étranger sur les caractéristiques de la graine au niveau F_0.