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SEED YIELD, TEST WEIGHT AND OIL CONTENT IN SUNFLOWER GENOTYPES AS INFLUENCED BY VARIOUS POLLINATION METHODS AND SEASONS

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SUMMARY

The influence of imposed pollination methods *viz*., clothbag, cloth + assisted pollination, clothbag + bulk pollen pollination and open pollination was assessed for seed yield, 100-seed weight and oil content in 22 sunflower genotypes over two seasons. In general, the genotypes, in general, recorded higher seed yield, test weight and oil content in summer as compared with rainy season. In both seasons, seed yield was highest under open pollination and lowest under cloth bag. Seed yield was significantly improved under cloth bag with assisted pollination and cloth bag with bulk pollen pollination and cloth bag with bulk pollen pollination compared with seed yield under cloth bag. Increased test weight under cloth bag was related to low seed yield. Decreased oil content of genotypes in cloth bag treatment was ascribed to increased husk content as a consequence of low seed yield.

Key words: oil content, pollination methods, seed yield, test weight

INTRODUCTION

In India, poor seed set in sunflower cultivars has been one of the limiting factors that caused low productivity. According to Miller and Fick (1997), the degree of self-incompatibility and self-fertility depends on three factors, *viz*., genetic control, environment and floral structures. In the presents study, 22 genotypes were evaluated over two seasons to assess the influence of imposed pollination methods on seed yield, test weight and oil content.

MATERIAL AND METHODS

Material for the study included four hybrids (KBSH-1, DSH-255, MSFH-17 and DSH-1), 17 inbred comprising five maintainer lines (NDOL-2, DSF-2, NDOL-3,

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4546-B and 822-B), eight pollen fertility restorers (RLC-4, RHA-274, V-20, IX-11, X-13, VI-60, IV-65 and IV-55), four mutant lines (TS-84, TS-42-2-8, TS-10 and TS-31-2) and one open pollinated variety (Morden). All 22 genotypes were planted during rainy (July, 1999) and summer (January, 2000) seasons in split plot design replicated three times. Genotypes were treated as main plots and pollination methods imposed were treated as sub-plots. In a replication, each genotype was planted in two rows of 5 m length in which the four treatments were each allotted the two rows at random. The inter- and intra-row spacing of 60 cm and 30 cm, respectively, was adopted. In each genotype four pollination methods were imposed by allotting 3 random plants under each pollination method. The plants were tagged. Pollination methods imposed were cloth bag, cloth bag + assisted pollination, cloth bag + pollination with bulk pollen of sister lines and open pollination. The bagging treatments were imposed as soon as the first ray floret opened in the capitulum. In the treatment cloth bag + assisted pollination, the cloth bag was smeared gently on the head in order to ensure pollen movement within the capitulum. In the of cloth bag + bulk pollen pollination treatment, each capitulum was pollinated with bulk pollen of sister lines by camel hairbrush and later the heads were again covered with cloth bag. Assisted pollination and pollination with bulk pollen of sister lines was carried out daily from the day of anthesis till complete flowering between 8^{30} am and 11^{00} am uniformly in all genotypes. In both seasons, data was collected on seed yield (g) 100-seed weight (g) and oil content (%) and mean values were used for statistical analysis. Oil content was estimated on dry seed weight basis using nuclear magnetic resonance spectrometer.

RESULTS AND DISCUSSION

The difference due to genotype and pollination method were significant in both seasons of the study for seed yield, seed weight and oil content (Table 1). The difference due to interaction of genotype × pollination method was significant for yield and oil content, while it was non-significant for seed weight (Table 1). Data on seed yield over seasons (Table 1) revealed that the genotypes, in general, recorded significantly higher seed yield in summer season irrespective of pollination treatment. Environmental factors like number of rainy days, rainfall, temperature, relative humidity, longer day length played an important role on final seed yield. During rainy season, rainfall during peak flowering period brought about poor pollen movement in both exposed and covered heads resulting in poor seed yield. In contrast, the crop raised during summer under irrigation ensured favorable conditions like high temperature, low relative humidity, more sunshine hours and low disease incidence during flowering and seed setting period resulting in increased seed set and seed yield. Vrânceanu *et al.* (1978) reported seasonal influence on seed yield. Based on our results, it may be concluded that for the maintenance of the germplasm lines, inbreds and for hybrid seed production, summer season is favorable

Table 1: Mean seed yield, seed weight and oil content of sunflower genotypes under different pollination methods over seasons

Season/treatment	Seed yield (g)				Seed weight (g)				Oil content (%)			
Rainy	Hybrids	Inbreds	Morden (OPV)	Mean	Hybrids	Inbreds	Morden (OPV)	Mean	Hybrids	Inbreds	Morden (OPV)	Mean
Cloth bag	22.58	7.22	11.50	10.21	5.26	4.69	5.97	4.85	35.42	30.40	32.35	31.40
Cloth bag + assisted pollination	29.19	11.33	14.94	14.74	5.17	4.34	5.71	4.55	36.56	31.50	33.50	32.51
Cloth bag + bulk pollen pollination	35.68	14.62	25.97	18.96	4.76	4.08	5.61	4.27	37.30	32.61	34.25	33.54
Open pollination	54.39	20.41	32.46	27.14	4.63	3.79	5.34	4.02	38.74	33.74	35.81	34.74
Mean	35.46	13.39	21.22	17.76	4.96	4.22	5.66	4.42	37.00	32.06	33.98	33.05
Summer	30.44	15.87	12.03	18.35	5.39	4.75	6.01	4.92	34.60	32.09	34.27	32.65
Cloth bag												
Cloth bag + assisted pollination	37.91	18.70	22.57	22.57	5.39	4.69	5.42	4.85	35.87	32.96	35.36	33.60
Cloth bag + bulk pollen pollination	43.82	20.38	21.60	24.70	5.06	4.30	4.97	4.47	36.66	33.97	36.47	34.57
Open pollination	49.62	23.55	31.57	28.50	4.82	3.94	4.62	4.13	37.38	34.84	37.46	35.42
Mean	40.44	19.28	21.94	23.48	5.16	4.42	5.26	4.59	36.13	33.42	35.89	34.06

	Seed yield								Seed weight								Oil content							
	Rainy				Summer				Rainy				Summer				Rainy				Summer			
	SEm ±	CD at 5%	CD at 1%	CV (%)	SEm ±	CD at 5%	CD at 1%	CV (%)	SEm ±	CD at 5%	CD at 1%	CV (%)	SEm ±	CD at 5%	CD at 1%	CV (%)	SEm ±	CD at 5%	CD at 1%	CV (%)	SEm ±	CD at 5%	CD at 1%	CV (%)
Between two mains	0.74	2.12	2.84	14.50	0.91	2.60	3.48	13.46	0.17	0.49	0.65	13.33	0.12	0.35	0.47	9.33	0.11	0.31	0.42	10.15	0.18	0.53	0.70	10.87
Between two submeans	0.28	0.79	1.04	12.92	0.38	1.05	1.39	13.02	0.05	0.14	0.18	9.01	0.06	0.16	0.21	10.0	0.05	0.14	0.18	10.25	0.05	0.13	0.17	10.1
Between two submeans at the same main	1.33	3.71	4.89		1.76	4.93	6.51		0.23	0.64	0.85		0.27	0.74	0.98		0.28	0.64	0.84		0.22	0.61	0.80	
Between two main means at same or different submean	1.37	3.82	5.05		1.78	4.98	6.57		0.26	0.73	0.97		0.26	0.73	0.96		0.23	0.83	0.83		0.26	0/74	0.97	

as compared with rainy season. The hybrids recorded maximum seed yield compared with inbreds and Morden and these results are in accordance with Swamy Gowda and Giriraj (1995). The mean seed yield recorded in open pollination was undoubtedly higher and significant over the other three treatments in both rainy and summer seasons follower by clot bag with bulk pollen pollination, cloth bag with assisted pollination and cloth bag. Increased mean seed yield recorded in open pollination was due to pollination by insects, mainly honeybees. Lower seed set under autogamous pollination was due to the lack of pollen movement to stigmatic surface, self incompatibility nature and high relative humidity within the capitulum. Virupakshappa *et al.* (1992) reported that pollen availability is a limiting factor for seed set under autogamous condition. According to Alam *et al.* (1989), presence of honeybees plays a decisive role on the seed-yield-contributing characters of sunflower. Low seed yield in cloth bag might be due to reduction in photosynthesis since cloth bag excluded light and affected normal photosynthesis. Te lack of light intensity and limited air circulation under cloth bag created an unfavorable environment for anthesis, fertilization and embryo growth (Robinson, 1980). In the case of cloth bag with assisted pollination and cloth bag with bulk pollen pollination, seed set was higher compared with cloth bag. This was due to artificial pollination *viz*., pollen movement from one floret to stigmatic surface of neighboring florets within the capitulum that affected the pollination. Nasir and Syed (1992) reported that bagging had a detrimental effect on seed setting. In other words, increased seed set was due to increased pollination by way of floral manipulation (George *et al.*, 1982). Of the two seasons, summer may be preferred for the maintenance of genotypes / inbreds and crossing program.

Seed weight, which is one of the important components of seed yield showed interesting result. The majority of genotypes irrespective of pollination method recorded higher seed weight in summer as compared with rainy season. Amongst the pollination methods, self-pollination using cloth bags recorded the higher test weight in both season. Robinson (1980) and Freund (1988) reported similar results. The highest seed weight under cloth bag was followed by cloth bag with assisted pollination, cloth bag with bulk pollen pollination and open pollination in both seasons (Table 1). It was reported earlier that there was a significant reduction in seed yield under cloth bag as compared with seed yield under open pollination. Decrease in seed yield increased the seed weight in capitulum covered with bags due to greater nutrient supply to developing seeds (Robinson, 1980). The genotypes covered with cloth bag + assisted pollination and cloth bag + bulk pollen pollination and open pollination recorded lower seed weight because hand pollination promoted seed filling thus increasing seed yield with low test weight.

Oil yield is an end economic product. The different pollination treatments and also season had significant effect on oil content of the genotypes. In general, the genotypes recorded higher oil content in summer as compared with rainy season (Table 1). Lakshminarayana *et al.* (1984), Virupakshappa *et al.* (1992) and Swamy

Gowda and Giriraj (1995) also reported similar results in sunflower. In both seasons, the genotypes recorded maximum oil content under open pollination. Followed by cloth bag + bulk pollen pollination, cloth bag + assisted pollination and cloth bag. Low oil content in bagged conditions was due to low seed yield and associated high test weight due to increased husk content (Swamy Gowda and Giriraj, 1995). A negative relationship between oil and husk content has been already established (Giriraj *et al.,* 1979; Dedio, 1982). The study revealed that the oil content of genotypes under bagged condition will be invariably low and it may not depict the true potential of the line for oil content. Under such conditions, it was suggested to take into consideration the oil content of lines recorded under open pollination (Swamy Gowda and Giriraj, 1995).

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INFLUENCIA DE DIFERENTES MÉTODOS DE POLINIZACIÓN Y DE TEMPORADA EN EL RENDIMIENTO DE SEMILLA, MASA EN HECTOLÍTRICA Y EL CONTENIDO DE ACEITE EN LOS GENOTIPOS DE GIRASOL

RESUMEN

En el trabajo se ha investigado la influencia de varios métodos de polinización limitada (sacos de textil, textil + polinización adicional, sacos de textil + mezcla de polen y polinización libre) en el rendimiento de semilla, masa de

100 semillas y el contenido de aceite en 22 genotipos de girasol en el curso de dos temporadas. Los genotipos generalmente tenían mayor rendimiento de semilla, la masa hectolítrica y el contenido de aceite en la temporada veraniega en relación con la de lluvias. En ambas temporadas, el rendimiento de semilla fue el mayor en la polinización libre, y el más pequeño bajo los sacos de textil. La utilización de los sacos de textil con la polinización libre y de los sacos de textil con mezcla de polen, aumentó significativamente el rendimiento de semilla, en relación con las variantes en las cuales se usaron solamente los sacos de textil. Una mayor masa hectolítrica bajo los sacos de textil, era vinculada con bajo rendimiento de semilla. Más bajo contenido de aceite de genotipos en la variante bajo sacos de textil, se ha contribuido al contenido aumentado de la vaina, que ha sido causado por el bajo rendimiento de semilla.

INFLUENCE DE DIFFÉRENTES MÉTHODES DE FÉCONDATION ET INFLUENCE DES SAISONS SUR LE RENDEMENT DES GRAINES, LA MASSE PAR HECTOLITRE ET LE CONTENU D'HUILE DANS LES GÉNOTYPES DE TOURNESOL

RÉSUMÉ

Cet article examine l'influence de quelques méthodes de fécondation limitée (sacs de toile, toile + fécondation supplémentaire, sacs de toile + mélange de pollen et fécondation libre) sur le rendement des graines, la masse de 100 graines et le contenu d'huile dans 22 génotypes de tournesol au cours de deux saisons. Les génotypes ont généralement eu un plus grand rendement des graines, une plus grande masse par hectolitre et un plus grand contenu d'huile en été en comparaison avec la saison des pluies. Dans les deux saisons, le rendement des graines a été le plus grand au cours de la fécondation libre et le plus faible sous sacs de toile. L'utilisation de sacs de toile avec fécondation supplémentaire et de sacs de toiles avec mélange de pollen a augmenté de façon importante le rendement des graines en comparaison avec les variantes où seuls les sacs de toile avaient été utilisés. Un plus grande masse par hectolitre sous sacs de toile était liée à un faible rendement des graines. Le faible contenu d'huile des génotypes dans la variante sous sacs de toile a été attribué à un contenu plus grand d'écailles qui est de son côté, causé par le faible rendement des graines.