ENVIRONMENTAL EFFECTS ON SELFFERTILITY IN OILSEED SUNFLOWER (*HELIANTHUS ANNUUS* L.)[1]

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INTRODUCTION

Commercial oilseed sunflower production in the U.S. is dependent upon the cyto-sterile, fertility restorer system for hybrid seed production. Most of these hybrids are highly fertile, with fertility restoration being conditioned by at least two dominant allels (Dominguez and Fick, 1975). Selfincompatability varies from completely self-sterile to nearly completely selffertile (Fick, 1978).

Partial seed set has been reported by commercial producers throughout the northern sunflower-growing area, resulting in a possible yield reduction. Lack of insect pollination could explain some of the reduction in seed set but environment also appears to be important. These trials were designed to determine the effects of environment on seed set.

MATERIALS AND METHODS

Three commercial sunflower hybrids and their fertile inbred parental lines were planted at five locations in the 1978 and 1979 crop seasons. These locations were Bushland, TX; York, NB; Redfield,

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SD; Casselton, ND; and Langdon, ND. The 1978 trial at Redfield, SD, and the 1979 trial at Casselton, ND, were not harvested.

The trials were established in a split plot design, with single row subplots and four replications with entries (hybrids and inbreds) as main plots and treatments (bagged and unbagged) as subplots. Five heads were randomly selected from one of the paired rows and bagged just prior to anthesis. After anthesis, five heads from the other of the paired rows were bagged to minimize the effects of the bags. Percent seed set was determined two ways: first, by the number of viable achenes (seed) divided by the number of viable plus nonviable achenes (seed); and second, by the weight of viable achenes divided by weight of viable plus non-viable achenes. In 1978, five heads per treatment were used to determine percent seed set. In 1979, achenes from five heads were bulked, and the percent seed set was determined.

RESULTS AND DISCUSSION

Percent number of viable seed, for Hybrid 3 and for its B-line inbred was reduced significantly by bagging at three environments (Table 1). Also, seed set of bagged heads of this hybrid was significantly less than that of the other two hybrids at two of these locations and less than its B-line inbred at three of these environments.

The percent seed set by number of Hybrid 2 was significantly reduced by bagging at two environments, also as was the case with its B-line inbred at one location (Table 1).

Determining percent seed set by weight substantiated these results, especially for Hybrid 3, which had reduced seed set under bags at five environments (Table 2). Bagged heads of the B-line inbred of Hybrid 3 had significantly less seed set than its unbagged heads at four locations. Seed set of bagged heads of Hybrid 3 was less than that of the other hybrids at five locations and seed set of its B-line was less than the other two B-lines at four locations.

The number of viable seed of Hybrid 2 or its B-line was not reflected in reduced weight (Tables 1 and 2).

Bagging had no significant effect on seed set of Hybrid 1, its B-line inbreds, nor on any of the R-line inbreds (Tables 1 and 2).

The different results obtained from the individual environments were substantiated by combined analysis in which the main effects of enviroments, entries (hybrid and inbreds) and treatment (bagged and

unbagged) and the interactions involving environments were significant.

Seed set of Hybrid 3 and its B-line inbred was most influenced by bagging (Table 3). Overall mean seed set under bags was nearly equal for Hybrid 3 and its B-line. This indicates that the reduction in seed set of Hybrid 3 may be conditioned by self-incompatibility inheritied as dominant factors from its B-line. However, seed set of Hybrid 3 under bags was significantly less than that of its B-line at some of the individual environments (Tables 1 and 2), indicating that partial fertility restoration of the cyto-sterile system and possibly other factors may also be affecting seed set. More research attempting to delineate the reasons for poor seed set is underway.

Mean seed set of all bagged entries was significantly less than mean seed set of all unbagged entries according to individual environment and combined analysis (Tables 1 through 3).

The percent seed set, as determined by number, is consistently less than seed set determined by weight, either from bagged or unbagged heads. The relatively low number of fertile seed might be a source of potential yield increase.

ABSTRACT

Incomplete seed set of certain commercial sunflower hybrids may be caused by self-incompatability, partial fertility restoration, or other factors which could be affected by environment. Three commercial hybrids and their fertile inbred parents were planted at five locations across the central plains area of the U.S. during 1978 and 1979. Relative number and weight of viable seed were determined from eight of these environments. Little difference in fertility was observed between bagged and unbagged heads of two of the hybrids and their inbred parents. The bagged heads of the third hybrid and its B-line inbred parent had consistently lower seed set. Environment affected seed set significantly. The percent number of viable seed was consistently less than the percent weight of viable seed.

REFERENCES

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TABLE 1

Percent seed set as determined by number at four locations, 1978-1979

Location/ year	Hybrid	Bagged *				Unbagged *			
		B-line inbred	F_1 hybrid	R-line inbred	Mean bagged entries	B-line inbred	F_1 hybrid	R-line inbred	Mean unbagged entries
Casselton, ND 1978	1	50.7 bc	55.3 abc	58.4 ab		69.2 ab	75.1 a	54.4 ab	
	2	54.1 bc	37.6 c	60.8 ab		70.0 ab	70.6 ab	61.5 ab	
	3	14.7 d	15.5 c	57.8 ab	45.2 y	51.4 bc	65.7 ab	64.8 ab	65.3 x
Langdon, ND 1978	1	51.4 ab	67.5 ab	58.6 ab		62.1 ab	71.3 a	51.6 ab	
	2	56.2 ab	48.2 ab	69.1 a		61.0 ab	63.9 ab	60.0 ab	
	3	36.9 ab	16.9 c	70.2 a	53.4 y	46.0 ab	71.9 a	62.7 ab	60.9 x
York, NB 1978	1	39.5 abc	52.0 ab	39.2 abc		69.9 ab	78.9 ab	43.0 abc	
	2	29.2 bc	39.9 abc	44.8 abc		66.1 ab	80.1 a	43.6 abc	
	3	0.9 c	33.6 abc	40.8 abc	35.6 y	57.7 ab	59.6 ab	59.6 abc	60.1 x
Bushland, TX 1979	1	50.4 ih	71.6 abc	63.4 def		70.9 bed	70.3 bed	68.4 cde	
	2	54.9 hg	59.4 fg	60.9 efg		65.6 cde	79.0 a	64.8 cdef	
	3	44.1 i	19.6 j	62.6 efg	54.1 y	60.4 fg	76.6 ab	61.6 efg	68.6 x

* Values followed by like letters within each location do not differ at the 5% probability level according to least significant difference test.

TABLE 2

Percent seed set as determined by weight at six locations, 1978-1979

Location/ year	Hybrid	Bagged *				Unbagged *			
		B-line inbred	F_1 hybrid	R-line inbred	Mean bagged entries	B-line inbred	F_1 hybrid	R-line inbred	Mean unbagged entries
	1	88.6 a	92.2 a	95.5 a		96.9 a	95.5 a	95.1 a	
Casselton, ND	2	94.9 a	89.0 a	95.8 a		96.9 a	97.2 a	96.5 a	
1978	3	65.7 b	41.5 c	95.3 a	85.0 y	91.7 a	95.4 a	96.4 a	95.8 x
	1	95.9 a	97.0 a	89.9 a		96.0 a	96.6 a	93.8 a	
Langdon, ND	2	94.0 a	95.9 a	97.3 a		93.7 a	97.3 a	95.4 a	
1978	3	83.2 a	54.5 b	97.8 a	89.9 y	87.5 a	97.6 a	95.7 a	94.8 x
	1	84.5 a	94.9 a	93.6 a		92.9 a	97.2 a	94.0 a	
York, NB	2	86.0 a	88.7 a	92.8 a		91.9 a	97.7 a	93.7 a	
1979	3	6.8 b	50.8 ab	89.1 a	77.7 y	92.4 a	81.8 a	94.2 a	93.0 x
	1	95.2 ab	95.9 ab	96.4 ab		95.2 ab	93.0 ab	95.0 ab	
Bushland, TX	2	93.5 ab	95.7 ab	97.3 ab		95.4 ab	98.4 a	97.0 ab	
1979	3	90.3 b	62.1 c	95.4 ab	91.3 y	92.9 ab	96.7 ab	96.8 ab	95.6 x
	1	95.3 a	95.8 a	93.1 ab		96.5 a	96.5 a	94.2 a	
Langdon, ND	2	95.1 a	92.5 ab	80.9 bc		96.0 a	96.8 a	90.1 abc	
1979	3	78.0 c	64.8 d	96.6 a	88.0 y	94.4 a	91.2 ab	95.2 a	94.5 x
	1	94.4 a	91.2 ab	93.9 a		97.2 a	98.1 a	95.5 a	
Redfield, SD	2	95.1 a	91.8 ab	94.7 a		97.1 a	97.7 a	96.3 a	
1979	3	80.6 b	57.0 c	98.0 a	88.6 y	95.1 a	97.1 a	98.1 a	96.9 x

* Values followed by like letters within each locatin do not differ at the 5% probability level according to least significant difference test.

TABLE 3

Mean percent seed set

Percent number of fertile -average of eight locations

Hybrid	Bagged *				Unbagged *			
	B-line inbred	F_1 hybrid	R-line inbred	Mean bagged entries	B-line inbred	F_1 hybrid	R-line inbred	Mean unbagged entries
1	46.5 bed	58.4 abc	53.4 abc		67.9 abc	75.1 a	53.2 abc	
2	48.2 bed	44.7 cd	58.3 abc		66.6 abc	72.0 ab	57.4 abc	
3	23.5 d	25.6 d	57.9 abc	46.5 y	53.7 abc	65.4 abc	61.0 abc	63.7 x

Percent weight of fertile seed - average of seven locations

Hybrid	Bagged				Unbagged			
	B-line inbred	F_1 hybrid	R-line inbred	Mean bagged entries	B-line inbred	F_1 hybrid	R-line inbred	Mean unbagged entries
1	89.9 a	94.1 a	92.9 a		95.5 a	96.3 a	94.5 a	
2	91.6 a	90.7 a	94.3 a		94.6 a	98.0 a	95.2 a	
3	59.9 b	52.7 b	94.3 a	84.9 y	91.4 a	92.8 a	95.9 a	94.9 x

* Values followed by like letters are significantly different at the 5% probability level according to least significant difference test.