Association of sunflower achene color and other achene characters with bird preference

Walter Dedio
Agriculture Canada Research Station
Morden, Manitoba, Canada, R0G 1J0

ABSTRACT

Sunflower lines derived from a Yugoslavian line, NS 39, which was segregating for color (striping) were used to determine the association of bird preference with achene color and other achene characters. Forty-seven selections, which were increased in 1989, varied considerably in color, bird preference, kernel oil and kernel content. Bird preference was strongly correlated with achene color (r = -.610), achene oil (r = .670) and kernel content (r = .616). Achene oil content in turn was highly correlated with kernel content and kernel oil content. Multiple regression equation indicated that color had a major effect on bird preference, with birds preferring dark color. Further evidence for association of color with bird preference was obtained by comparing consumption of dark and light colored selections with similar oil content. The preference was significantly higher for dark colored achenes.

INTRODUCTION

The achene color of the sunflower hull varies and is related to the market it is intended for. For the oilseed market, achenes are mostly black or black with grey stripes. Non-oil types, which are used for in-

shell consumption, confection use after hulling or as bird and pet food, have considerable less oil and are usually lighter colored with black or white striping.

The striping coloration in the non-oil group, particularly for in-shell consumption and birdfeed, is preferred for aesthetic reasons only. It would seem logical that a light colored striped cultivar with high oil would be desirable for the birdfeed market. Such a cultivar could also be sold for the oilseed market if the economics are better. In order to proceed with breeding of this type of cultivar, more information is required about the association of the achene color with other achene characteristics and bird preference. The object of this study was to determine these associations.

MATERIALS AND METHODS

A sunflower line, NS 39, obtained from Yugoslavia was selfed for several generations. The original NS 39 was predominated striped, but upon inbreeding, the segregants ranged from completely black-colored achenes to pronounced striping. After 4 generations of selfing 47 lines were selected at random and used in this study. In 1989, the lines were increased in a two-replicate randomized block test. Achene oil content, kernel content, kernel oil content, achene weight and density were determined on the harvested seed. The degree of striping and coloration of the lines were determined by measuring Hunter coordinates on a Hunterlab tristimulus colorimeter, model D25 L-9 (Hunter Associates Laboratory, Inc., Reston, VA), calibrated against a black tile with Hunter coordinate 90.88. Thus, the higher the L reading, the more striping the achenes have.

In March, 1991, and April, 1992, bird preference studies of these lines were done by stapling 47 waxed boxes, 6 x 9 cm, on a platform which was mounted about 75 cm above the ground and placed at the end of the residential area in Morden, Manitoba. The samples of 30 g in 1991 and 25 g in 1992 were randomly distributed in the boxes for the birds to feed until almost half of the achenes were consumed. This usually took 1 to 3 days. Birds visiting the feeding station were mostly house sparrows (Passer domesticus L.) with a few blue jays (Cyanocetta cristata L.) and chickadees (Parus atricapillus). The trial was repeated 5 times each year.

To determine the interrelationships among the achene characters and bird preference, correlation coefficients between all variables were determined. Multiple regression equation was obtained associating bird preference with different achene characters. Multiple regression equations were also obtained relating achene oil content with other achene characteristics.

To further verify the effect of color on bird preference, 3 groups of sunflower lines that varied in amount of striping, but with a similar oil content (380 g kg^{-1}), were selected from the 1990 crop. The L numbers of the 3 groups were 21 (dark), 28 (stripes at edges only) and 35 (pronounced striping). Two or three 20 g subsamples from each group were placed in boxes and a bird feeding trial with 5 replications was carried out in April, 1991, as in the previous experiment.

RESULTS AND DISCUSSION

The variability in achene characters in the 1989 grown lines derived from NS 39 was considerable (Table 1). The range in achene oil content of 272 to 437 g kg^{-1} was very high considering that these were

Table 1. Bird preference and achene characters of 47 selec from NS 39 sunflower produced in 1989.

	Bird Preference % Consumedg	Achene Oil kg^{-1}	Kernel Content g kg^{-1}	Kernel Oil g kg^{-1}	Color L reading mg	Achene Weight kg	Achene Density m^{-3}
Mean	35.4	356	670	490	27.8	612	399
Range	14.7-69.8	272-437	552-757	428-554	23.2-33.8	450-838	336-467
SD	15.4	154	39.7	27.2	2.76	9.6	33.0

Table 2. Correlation coefficients among bird preference and achene characters in 47 lines derived from NS 39

	Bird Preference Density	Achene Oil	Kernel Content	Kernel Oil	Achene Weight	
Achene oil	.670**					
Kernel content	.616**	.805**				
Kernel oil	.477**	.754**	.373*			
Achene weight	-.242	-.073	.100	.010		
Density	-.455**	-.042	-.034	-.142	.382**	
Color	-.610**	-.445**	-.606**	-.004	-.048	.043

* significant at the 5% level of probability
** significant at the 1% level of probability

Table 3. Linear Multiple Regression equations relating bird preference (BP) with achene characters and achene oil (AO) content with other achene characters.

Equation 1:
BP = 48.00 + 0.074 AO + 0.045 K - 2.512 C + 0.151 KO = 0.143 SW = 0.164 D

Variable	T-value	SE	
AO	.526	.1408	
K (kernel content)	.594	.0759	
C (color)	-4.121	.6094	
KO (kernel oil)	1.421	.1065	
SW (seed weight)	-.883	.1624	
D (density)	-.3755	.0438	R^2 = .759

Equation 2:
AO = -243.5 + .439 K - 1.235 C + .664 KO - .594 SW + .126 D

	T-value	SE	
K	8.907	.0493	
C	-1.884	.6557	
KO	11.628	.0571	
SW	-3.800	.1562	
D	2.790	.0450	R^2 = .927

Equation 3:
AO = -271.4 + .486 K + .615 KO

	T-value	SE	
K	10.994	.0442	
SE	9.533	.0645	R^2 = .887

related lines and were extracted from a supposedly already inbred line. Kernel content and kernel oil content apparently contributed to the variability of achene oil content as the variability of these was also high.

Bird preference was highly correlated with achene oil, kernel content and color of the hull (Tale 2). The latter association is surprising as there is no reason to believe that birds would prefer certain color. Multiple regression equations (Table 3) also indicate that color as well as density contribute significantly to bird preference. Perhaps the birds associate hull color with kernel content as the latter is correlated with bird preference.

Further evidence of preference by birds for dark colored achenes was obtained when lines with varying amounts of striping but the same oil level and presumably similar kernel content were compared (Table 4). Eighty-five percent (85%) of the dark colored achenes and 33% of the striped lines were consumed after about a day and a half. In fact, even less of the striped lines may have been consumed as there was evidence that some of these achenes were taken from the box and then dropped outside.

The study also confirmed our earlier work (Dedio, 1982) that kernel oil as well as kernel content contribute to achene oil content. The correlation of these characters with achene oil was high (Table 2) and regression equations also showed significant contributions of kernel content and oil of kernel to achene oil (Table 3).

Hull color appears to be linked to achene oil content (Table 2). More study needs to be done to establish the genetic nature of this linkage.

Light colored achenes could have an advantage for sunflower growers as they might afford some protection against bird predation.

Table 4. Comparison of bird preference of sunflower achenes with similar oil content, but varying degree of color (striping).

Color (L reading)	Oil Content, g kg^{-1}	% Consumed
21.5 (dark)	38.4	84.5a
29.3	38.4	46.6b
35.4 (light)	38.8	33.4b

a,b Within columns, means followed by the same letter do not differ significantly at the 5% level of probability by the Duncan Multiple Range Test.

Birds, particularly red-winged blackbirds (Agelaius phoeniceus L.) often result in considerable losses in the field before the achenes are harvested. More investigation is needed to determine whether the same preference occurs with the blackbirds feeding in the field as with sparrows feeding from boxes in winter.

Literature cited

Dedio, W. 1982. Variability in hull content, kernel oil content, and whole see content of sunflower hybrids and parental lines. Can. J. Plant Sci. 6 54.