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CHECKING PERFORMANCE OF FIELD CORN INBREDS AS DONORS OF FAVORABLE ALLELES TO IMPROVE EARLY VIGOR AND ADAPTATION OF SWEET CORN HYBRIDS TO EUROPEAN CONDITIONS

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ABSTRACT - Field corn inbreds adapted to the European Atlantic coast are being used to improve early vigor and adaptation of sweet corn. In a previous work, we used the methods of identifying field corn inbred lines for use in improving parents of sweet corn single crosses, and we predicted that EP42 was the best potential donor of favorable alleles for improving early vigor and adaptation of V679 × EP60 and I5125 × EP60, followed by A632, and W64A. Our objective was to compare realized results with predictions of different methods to identify field corn inbreds as potential donors of favorable alleles for improving early vigor and adaptation to the European Atlantic coast. Estimate of favorable dominant alleles present in the donor but not in the hybrid (μG') or predicted three-way cross (PTC) were contrasted with realized results of testcross populations derived from crosses among field corn donor inbreds and sweet corn recipient inbreds. Early vigor, plant weight, and adult vigor could be improved simultaneously for the sweet corn hybrid V679 × EP60 by producing inbreds from the field corn inbred donor A632 and the sweet corn inbred recipient EP60. Early vigor, plant weight, and plant height of the sweet corn hybrid I5125 × EP60 could be improved by releasing inbreds from the field corn inbred donor EP42 and the sweet corn recipient inbred EP60. This work shows that predictions confirm the results for plant weight and height to some extend, but are completely inaccurate for early and adult vigor. However, it should be possible to improve early vigor and adaptation of these sweet corn hybrids using the field corn inbreds A632 or EP42 as donors.

KEY WORDS: Maize; Sweet corn; Early vigor; Adaptation.

INTRODUCTION

In the European Atlantic coast, commercial sweet corn hybrids frequently suffer uneven emergence and maturation, and some hybrids produce non-commercial ears (ORDAS *et al.*, 1994). American field corn is used to improve agronomic performance of sweet corn in the US (TRACY, 1994). American and European field corn populations (CARTEA *et al.*, 1996a, b) and inbred lines (MALVAR *et al.*, 1997a, b) are being used to improve sweet corn yield, agronomic performance, vigor, and adaptation to European conditions.

Classically, methods such as predicted three-way crosses (PTC) (SPRAGUE and EBERHART, 1977), have been successfully used to identify potential donors of favorable alleles for improving recipients. DUDLEY (1984, 1987) developed a statistical procedure for estimation of the relative number of loci (μG') for which a donor line is different from each parent of an elite single cross to be improved. Other methods have been developed as alternatives to Dudley's method (GERLOFF and SMITH, 1988a, b; BERNARDO, 1990; METZ, 1994).

Several authors have reported high theoretical correlations between most of the estimators, and presented a different estimator as the most appropriate for each study for field corn hybrids (GERLOFF and SMITH, 1988a, b; MISEVIC, 1989a, b; ZANONI and DUDLEY 1989a; BERNARDO, 1990; STOJSIN and KANNENBERG, 1995; DUDLEY *et al.*, 1996), for sweet corn hybrids (CARTEA *et al.*, 1996a, b; MALVAR *et al.*, 1997a, b), and for sunflower (MERCY *et al.*, 1999).

ZANONI and DUDLEY (1989b), PFARR and LAMKEY (1992a, b), and HOGAN and DUDLEY (1991) have published experimental validations of the methods for identifying donors for improving elite hybrids. These authors found that methods for identifying donors for improving elite hybrids reliably predicted the performance of the best and worst potential donors of favorable alleles. MALVAR *et al.* (2001) also found a good agreement between predictions of donors for improving yield and realized results. Pre-

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vious reports deal with yield and agronomic performance, but none investigates adaptation of sweet corn.

MALVAR *et al.* (1997a) used the previously mentioned methods of estimation of favorable alleles to identify elite US and European field corn inbreds to improve yield and agronomic performance of sweet corn hybrids. These authors found that the US inbred A632 and the European inbred EP42 were the best potential donors for improving agronomic performance of sweet corn hybrids. MALVAR *et al.* (2001) checked the predictions of the methods of estimation of favorable alleles and found that particularly µG' reasonably predicted the best donors and recipients, particularly A632 was identified as the best donor of favorable alleles for improving yield and agronomic performance of sweet corn hybrids. MALVAR *et al.* (1997b) identified field corn inbreds to improve the same sweet corn hybrids for early vigor and adaptation to European conditions. They found that EP42 was the best potential donor for improving early vigor and adaptation of sweet corn hybrids. Since the experimental comparison of the predictions of methods to identify donors has been performed for yield, and early vigor and adaptation are as important as yield in the northwest of Spain, our objective was to compare observed results and predictions of methods to identify potential donors for improving early vigor and adaptation of sweet corn hybrids.

MATERIALS AND METHODS

MALVAR *et al.* (1997b) evaluated eleven European and US field corn inbreds adapted to the European Atlantic coast (W64A, A632, A619, H99, EP29, H104W, A188, F2, EP1, EP32, and EP42) as donors of favorable alleles for improving early vigor and adaptation, and seven sweet corn inbreds parents of seven sweet corn hybrids to be improved. The seven sweet corn inbreds were five *su* (EP58, EP59, EP60, V679, and I5125) and two *su se* (IL767b and IL778d).

Two sweet corn hybrids (V679 × EP60 and I5125 × EP60), that showed the best quality in previous trials among those used by MALVAR *et al.* (1997b), were chosen. The field corn donor inbreds included in the experiment were EP42 (the best field corn inbred as donor for vigor and adaptation), A632 (a field corn inbred with medium value as donor), and W64A (the worst donor) (MALVAR *et al.*, 1997a). These authors found that EP42 was the best potential donor of early vigor for both V679 × EP60 and I5125 × EP60, because EP42 had the highest PTC and µG' estimates for improving early vigor of both sweet corn hybrids, followed by A632, though W64A had the same PTC value than A632 for the sweet corn hybrid V679 × EP60.

For the sweet corn hybrid V679 × EP60, we took the crosses donor × EP60 and donor × V679 from the previous work (MALVAR *et al.*, 1997a), and for the sweet corn hybrid I5125 × EP60, the crosses donor × EP60. These nine crosses (among three donors and three recipients) were selfed in 1996 to obtain nine F_2 populations. The sugary grains from each F_2 were selected and sown in 1997. For the hybrid V679 × EP60, at least 50 individual sugary plants from (donor × V679)F_2 were crossed to EP60 and 50 individual plants from (donor × EP60)F_2 were crossed to V679. For the hybrid I5125 × EP60, 50 individual plants from (donor × EP60)F_2 were crossed to I5125. Therefore, nine testcross populations were obtained.

Thirty testcrosses randomly chosen from each of the nine testcross populations, along with the two original sweet corn hybrids were planted in one of nine sets. Trials consisted in sets within replication designs with two replications, and were sown in 1998 at two locations in northwestern Spain, Pontevedra (42º25'N, 4º57'W, 20 m above sea level) and Pontecaldelas (42º23'N, 4º50'W, 300 m above sea level). Both locations have a humid climate with an annual rainfall of about 1600 mm. Each experimental plot consisted of one row of 20 hills with two kernels per hill. Rows were spaced 0.80 m apart and hills 0.21 m. Hills were thinned to one plant with a final plant density of approximately 60 000 plants ha^{-1}.

Traits recorded at the five-leaf stage were early vigor (from 1=poor to 9=excellent) and plant weight (dry weight of plants at the five leaves stage), and, at full development stage, traits were adult vigor (from 1=poor to 9=excellent), and plant height (cm from the soil to the top of the tassel). The analysis of variance, considering testcross populations as fixed effects and any other effect as random, showed significant differences between different plots for each sweet corn tester. For that reason, the mean of the two sweet corn testers in each set was used as covariable for adjusting the means of the 30 testcrosses from each testcross population of each set for environmental differences among sets within replications. However, the covariance analysis for plant weight did not allow calculating the adjusted means for adult vigor because of some inaccuracies in the comparison among testcross populations due to field variability.

The testcrosses were compared to the correspondent sweet corn hybrid $P_1 \times P_2$. The genetic variance for each testcross population was computed using the VARCOMP procedure (method REML) of SAS (SAS Institute Inc., 1989). The standard error of estimates of variance were computed by taking the square root of the variance estimates. The broad sense heritability and confidence intervals were calculated following KNAPP *et al.* (1985). According to ZANONI and DUDLEY (1989b), the criterion to compare efficiency of a potential donor was $(X_{TC}-X_C)/\sigma_G$, being X_{TC} the mean of the testcross population, X_C the mean of the check, and σ_G the square root of the genetic variance of the testcross population. All the analyses were done with SAS (SAS INSTITUTE INC., 1989).

RESULTS AND DISCUSSION

The goal of this work was to evaluate the predictions of the estimators of favorable alleles for improving adaptation of two sweet corn hybrids, reported by MALVAR *et al.* (1997b). The previous article showed that most estimators of favorable alleles were highly correlated to µG' (DUDLEY, 1987). However, µG' was not possibly estimated for some traits, while predicted three-way cross (PTC) (SPRAGUE and EBERHART, 1977) can be calculated irrespectively of

TABLE 1 - *Mean and standard error, genetic (σ^2_G) and genotype × location (σ^2_{GxL}) variance, and standard error, broad sense heritability (h^2), number of families significantly above the check ($F>T_C$) at $P=0.05$, and deviation from the check ($(X_{TC}-X_C)/\sigma_G$) and error for early vigor of nine testcross populations for two sweet corn hybrids to be improved (checks) grown at two locations in northwestern Spain.*

Population	Mean	σ^2_G	σ^2_{GxL}	h^2	$F>T_C$	$(X_{TC}-X_C)/\sigma_G$
	(1 - 9)					
V679×EP60	5.16±0.80					
(A632×EP60)F_2×V679	6.76±0.78	0.23*±0.11	0.03±0.09	0.60*	21	3.36±0.93
(A632×V679)F_2×EP60	5.15±0.78	0.30*±0.14	0.14±0.11	0.60*	0	−0.02±0.42
(EP42×EP60)F_2×V679	5.93±0.78	0.17 ±0.12	0.19±0.14	0.40	9	1.88±0.49
(EP42×V679)F_2×EP60	5.45±0.78	0.19*±0.09	0.00	0.56*	1	0.66±0.52
(W64A×EP60)F_2×V679	5.35±0.78	0.42*±0.15	0.00	0.76*	0	0.29±1.08
(W64A×V679)F_2×EP60	3.72±0.78	0.48*±0.20	0.03±0.12	0.73*	0	−2.07±0.73
I5125×EP60	4.94±0.80					
(A632×EP60)F_2×I5125	4.57±0.78	0.37*±0.14	0.00	0.69*	0	−0.61±0.33
(EP42×EP60)F_2×I5125	6.73±0.78	0.55*±0.19	0.00	0.77*	23	2.41±0.67
(W64A×EP60)F_2×I5125	6.09±0.78	0.24*±0.10	0.00	0.63*	18	2.37±0.43

* Estimate significantly different from zero. Significance of variances was determined using the corresponding F from the ANOVA. Significance of heritabilities was determined using the confidence intervals.

the presumably fails of the assumptions of the model used for estimating favorable alleles. Besides, PTC was highly correlated with most of the estimators. Therefore, μG' estimates are compared with the realized results presented for early vigor, and PTC for the other traits.

Early vigor

MALVAR *et al.* (1997a) predicted that EP42 would be the best potential donor of early vigor for both V679 × EP60 and I5125 × EP60, followed by A632, and W64A, though these last inbreds did not differ significantly for V679 × EP60. The present results show that all genetic variances (σ^2_G) were significantly different from zero for early vigor (Table 1). Variances were not significantly different among testcross populations from both sweet corn hybrids. For the sweet corn hybrid V679 × EP60, the donor EP42 had higher expected σ^2_G for early vigor than A632 (MALVAR *et al.*, 1997b), contrarily to the observed results (Table 1). For the sweet corn hybrid I5125 × EP60, the field corn donor EP42 was expected to have the highest variance and actually had the highest σ^2_G. Coincidences between observed and expected genetic variances were not general, though the wide confidence intervals for observed variances did not allow a precise comparison. The genotype × location variance (σ^2_{GxL}) was not significantly different from zero for most populations for the hybrid V679 × EP60 and from all populations for the hybrid I5125 × EP60. Estimates of heritability (h^2) were generally high and significant. Accordingly, previous reports have shown that additive genetic effects are most important for early vigor (MORENO-GONZÁLEZ, 1988; REVILLA *et al.*, 1999).

MALVAR *et al.* (1997b) predicted that the field corn inbred EP42 would be the best donor of early vigor because it had the highest μG' and PTC for both sweet corn hybrids. In the predictions for the hybrid V679 × EP60, neither μG' nor PTC were able to distinguish A632 and W64A, but for the hybrid I5125 × EP60, the donor A632 had higher values of μG' and PTC than W64A. However, for the hybrid V679 × EP60, results showed that if the recipient was EP60, the estimate of $(X_{TC}-X_C)/\sigma_G$ was higher when the donor was A632, than when the donor was EP42 (Table 1). The number of testcrosses to EP60 that significantly surpassed the early vigor of V679 × EP60 was also higher for A632 (21) than for EP42 (9). None of the testcross populations was significantly more vigorous than the sweet corn hybrids for early vigor. However, the testcross population (A632 × EP60)F_2 × V679 had the highest early vigor for the hybrid V679 × EP60. For the hybrid I5125 × EP60, the testcross population (EP42 × EP60)F_2 × I5125 had the highest $(X_{TC}-X_C)/\sigma_G$ and the highest number of families above the check (Table 1).

These results show that predictions failed to designate the best recipient, thought it is possible to improve early vigor of both sweet corn hybrids if sweet corn inbreds are released from the cross A632 × EP60 and then crossed to V679 to improve the

TABLE 2 - *Mean and standard error, genetic (σ^2_G) and genotype × location (σ^2_{GxL}) variance, and standard error, broad sense heritability (h^2), number of families significantly above the check ($F>T_C$) at P=0.05, and deviation from the check ($(X_{TC}-X_C)/\sigma_G$) and error for plant weight of nine testcross populations for two sweet corn hybrids to be improved (checks) grown at two locations in northwestern Spain.*

Population	Mean	σ^2_G	σ^2_{GxL}	h^2	$F>T_C$	$(X_{TC}-X_C)/\sigma_G$
	(g)					
V679×EP60	1.09±0.52					
(A632×EP60)F_2×V679	1.59±0.51	0.044 ±0.053	0.102*±0.061	0.30	4	2.38±1.56
(A632×V679)F_2×EP60	0.93±0.51	0.039*±0.018	0.022 ±0.015	0.60*	1	−0.81±0.35
(EP42×EP60)F_2×V679	1.52±0.51	0.139*±0.060	0.069*±0.043	0.65*	7	1.18±0.34
(EP42×V679)F_2×EP60	1.26±0.51	0.024 ±0.041	0.027 ±0.060	0.20	2	1.18±0.91
(W64A×EP60)F_2×V679	1.19±0.51	0.027 ±0.027	0.040 ± ¿?	0.37	5	0.67±0.48
(W64A×V679)F_2×EP60	1.68±0.51	4.801*±1.598	0.00	0.97*	8	0.26±0.20
I5125×EP60	1.09±0.52					
(A632×EP60)F_2×I5125	1.16±0.51	0.071*±0.033	0.041*±0.025	0.63*	6	0.23±0.31
(EP42×EP60)F_2×I5125	1.37±0.51	0.077*±0.046	0.048 ±0.045	0.52*	5	1.01±0.36
(W64A×EP60)F_2×I5125	0.90±0.51	0.029*±0.022	0.040*±0.020	0.48*	0	−1.18±1.40

*Estimate significantly different from zero. Significance of variances was determined using the corresponding F from the ANOVA. Significance of heritabilities was determined using the confidence intervals.

hybrid V679 × EP60, or if sweet corn inbreds are released from EP42 × EP60 and crossed to I5125 to improve the hybrid I5125 × EP60. The predictions based on the estimators μG' and PTC did not fit the actual ranking of donors.

Plant weight

MALVAR *et al.* (1997a) predicted that EP42 would be the best potential donor of plant weight for V679 × EP60, while A632 and W64A did not differ significantly, EP42 would be the best donor for I5125 × EP60, though did not differ significantly from A632. In the present results, the σ^2_G was always significant for plant weight and σ^2_{GxL} was significant for all populations except one (Table 2). The values of h^2 were variable for the populations related to the hybrid V679 × EP60, though they were medium and significant for the populations related to I5125 × EP60. Only (W64A × V679)F_2 × EP60 had average plant weight significantly higher than the hybrid V679 × EP60. None of the populations had significantly higher average plant weight than the hybrid I5125 × EP60.

The donor EP42 had the highest PTC for plant weight for both hybrids, followed by W64A for V679 × EP60 and by A632 for V679 × EP60 (MALVAR *et al.*, 1997b). The inbred EP42 had the only significant positive estimate of $(X_{TC}-X_C)/\sigma_G$ for both hybrids, though A632 had the highest estimate, and W64A had the highest number of families above the check (Table 2). The donor inbred EP42 had the highest estimate of $(X_{TC}-X_C)/\sigma_G$ for I5125 × EP60, followed by A632 (Table 2). Therefore, it is possible to improve plant weight of these sweet corn hybrids using EP42 as a donor. The expected value (PTC) reasonably matched the realized value, $(X_{TC}-X_C)/s_G$, of these field corn inbreds as donor of favorable alleles for improving plant weight of both sweet corn hybrids.

Adult vigor

MALVAR *et al.* (1997a) predicted that EP42 would be the best potential donor of adult vigor for V679 × EP60, while A632 and W64A did not differ significantly, EP42 would be the best donor for I5125 × EP60, though did not differ significantly from A632. Actual results show that σ^2_G was significantly different from zero for six of the nine populations for adult vigor, while σ^2_{GxL} was only significant for three populations (Table 3). The heritability was not significant for most populations (Table 3). None of the populations related to EP42 had average adult vigor significantly higher than the respective sweet corn hybrid.

The donor EP42 had higher PTC than A632 and W64A for adult vigor for both sweet corn hybrids, though A632 and W64A did not significantly differ from EP42 for I5125 × EP60 and V679 × EP60, respectively (MALVAR *et al.*, 1997b). The donor A632 had the highest $(X_{TC}-X_C)/\sigma_G$ when the recipient was EP60 for the hybrid V679 × EP60 (Table 3) and EP42 had the lowest estimates of $(X_{TC}-X_C)/\sigma_G$. For I5125 × EP60, the donor W64A had the highest estimate of $(X_{TC}-X_C)/\sigma_G$. The number of families signifi-

TABLE 3 - *Mean and standard error, genetic (σ^2_G) and genotype × location ($\sigma^2_{G\times L}$) variance, and standard error, broad sense heritability (h^2), number of families significantly above the check (F>T_C) at P=0.05, and deviation from the check ((X_{TC}-X_C)/σ_G) and error for adult vigor of nine testcross populations for two sweet corn hybrids to be improved (checks) grown at two locations in northwestern Spain.*

Population	Mean	σ^2_G	$\sigma^2_{G\times L}$	h^2	F>T_C	(X_{TC}-X_C)/σ_G
	(1-9)					
V679×EP60	4.92±0.47					
(A632×EP60)F_2×V679	5.97±0.43	0.08 ±0.10	0.07±0.14	0.26	8	3.75±1.78
(A632×V679)F_2×EP60	6.25±0.44	0.00	0.00	10^{-18}	11	a
(EP42×EP60)F_2×V679	5.13±0.43	0.14 ±0.18	0.09±0.24	0.26	1	0.59±0.97
(EP42×V679)F_2×EP60	5.04±0.43	0.00	0.00	0.00	0	a
(W64A×EP60)F_2×V679	5.55±0.43	0.25*±0.14	0.00	0.49*	7	1.26±0.44
(W64A×V679)F_2×EP60	5.32±0.44	0.04 ±0.15	0.00	0.09	1	2.00±2.65
I5125×EP60	5.03±0.47					
(A632×EP60)F_2×I5125	6.27±0.43	0.00	0.24±0.24	0.00	5	a
(EP42×EP60)F_2×I5125	5.14±0.43	0.16 ±0.12	0.00	0.40	1	0.25±0.54
(W64A×EP60)F_2×I5125	5.82±0.43	0.17 ±0.12	0.00	0.39	10	1.91±0.62

* Estimate significantly different from zero. Significance of variances using the corresponding F from the ANOVA. Significance of heritabilities was determining using the confidence intervals.
[a] The estimate could not be calculated because σ^2_G=0.

cantly above the check supported the previous elections of donors. Therefore, the predictions did not match at all with the results. However, as previously explained, the covariance analysis could not be calculated for this trait. So the comparison among testcross populations could have been imprecise. Anyway, the means show that adult vigor of both sweet corn hybrids could be improved by using these inbreds as donors, particularly A632 and W64A.

Plant height

MALVAR *et al.* (1997a) predicted that A632 would be the best potential donor of plant height for both V679 × EP60 and I5125 × EP60, followed by EP42, and last W64A. Current results show that plant height of the two sweet corn hybrids to be improved was not significantly lower than that of any testcross population (Table 4). Most σ^2_G were significantly different from zero, while $\sigma^2_{G\times L}$ and h^2 were not significant for most populations (Table 4).

TABLE 4 - *Mean and standard error, genetic (σ^2_G) and genotype × location ($\sigma^2_{G\times L}$) variance, and standard error, broad sense heritability (h^2), number of families significantly above the check (F>T_C) at P=0.05, and deviation from the check ((X_{TC}-X_C)/σ_G) and error for plant height of nine testcross populations for two sweet corn hybrids to be improved (checks) grown at two locations in northwestern Spain.*

Population	Mean	σ^2_G	$\sigma^2_{G\times L}$	h^2	F>T_C	(X_{TC}-X_C)/σ_G
	(cm)					
V679×EP60	187.7±11.1					
(A632×EP60)F_2×V679	197.2±10.6	23.5±26.4	22.0±35.4	0.29	1	1.99±3.83
(A632×V679)F_2×EP60	208.5±10.6	27.6±34.7	0.00	0.23	12	3.96±0.76
(EP42×EP60)F_2×V679	200.5±10.6	49.5±39.2	0.00	0.35	4	1.83±1.18
(EP42×V679)F_2×EP60	193.9±10.6	0.00	0.00	0.00	0	a
(W64A×EP60)F_2×V679	188.2±10.6	45.6±34.9	0.00	0.35	0	0.08±1.03
(W64A×V679)F_2×EP60	197.7±10.6	0.00	0.00	10^{-17}	0	a
I5125×EP60	186.0±11.1					
(A632×EP60)F_2×I5125	174.2±10.6	68.0*±46.0	0.00	0.41	0	-1.42±0.53
(EP42×EP60)F_2×I5125	202.2±10.6	54.0*±33.5	0.00	0.44	8	2.21±0.59
(W64A×EP60)F_2×I5125	191.6±10.6	80.8*±37.1	0.00	0.59*	3	0.44±0.61

* Estimate of heritability significantly different from zero. Significance of variances using the corresponding F from the ANOVA. Significance of heritabilities was determining using the confidence intervals.
[a] The estimate could not be calculated because σ^2_G=0.

The estimates of h^2 were lower than previously reported by HALLAUER and MIRANDA (1988).

The donor inbred A632 had the highest PTC, followed by EP42, while W64A had the lowest PTC for plant height for both hybrids (MALVAR *et al.*, 1997b). The donor A632 had the only significant $(X_{TC}-X_C)/\sigma_G$ for the hybrid I5125 × EP60, and the donor EP42 had the only significant $(X_{TC}-X_C)/\sigma_G$ for the hybrid V679 × EP60 (Table 4). The inbred W64A had non-significant estimates of $(X_{TC}-X_C)/\sigma_G$ for either hybrid. The number of families significantly above the check supported the previous ranking. Therefore, the results reasonably match the predictions for the first sweet corn hybrid, but failed for the second hybrid.

Therefore, early vigor, plant weight, and adult vigor could be improved simultaneously for the hybrid V679 × EP60 by producing inbreds from the cross A632 × EP60 and crossing them to V679. Early vigor, plant weight, and plant height of the hybrid I5125 × EP60 could be improved by releasing inbreds from the cross EP42 × EP60 and crossing them to I5125.

Eating quality should be checked at some point, but it cannot be reliably checked at early stages of the breeding program because of the massive number of samples and presumed off-flavors that often appear when field corn is crossed with sweet corn. MALVAR *et al.*, (1997b) warned that the use of a mixture of sweet and field corn for predicting the performance of sweet corn assumes some risks because performance could change in a sweet corn background. MALVAR *et al.*, (2001) concluded that this was not a problem for predictions of yield and its components, and ZANONI and DUDLEY (1989b) found a reasonable agreement between predictions and realized results for field corn hybrids. PFARR and LAMKEY (1992a) also found that the estimators did not identify the best donors for a trait when additive or epistatic effects are important. HOGAN and DUDLEY (1991), PFARR and LAMKEY (1992b), and MALVAR *et al.*, (2001) found that the method identified the best donors for yield. This work shows that predictions are supported by the results for plant weight and height to some extend, but predictions are completely inaccurate for early and adult vigor. This disagreement is not surprising since the estimators of favorable alleles were designed for yield and the model (DUDLEY, 1984, 1987) used for the estimators of favorable alleles assumes complete dominance and no epistasis, whereas the genetic regulation of early vigor involves additive, dominance, and reciprocal effects. However, it should be possible to improve early vigor and adaptation of these sweet corn hybrids using the field corn inbreds A632 or EP42 as donors.

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REFERENCES

BERNARDO R., 1990 An alternative statistic for identifying lines useful for improving parents of an elite single cross. Theor. Appl. Genet. **80:** 105-109.

CARTEA M.E., R.A. MALVAR, P. REVILLA, A. ORDÁS, 1996a Identification of field corn populations to improve sweet corn for Atlantic European conditions. Crop Sci. **36:** 1506-1512.

CARTEA M.E., R.A. MALVAR, P. REVILLA, A. ORDÁS, 1996b Improvement of early vigor and adaptation of sweet corn to the European Atlantic coast with open-pollinated field corn populations. Maydica **41:** 119-125.

DUDLEY J.W., 1984 A method of identifying lines for use in improving parents of a single cross. Crop Sci. **24:** 355-357.

DUDLEY J.W., 1987 Modification of methods for identifying inbred lines for improving parents of elite single crosses. Crop Sci. **27:** 944-947.

DUDLEY J.W., K.R. LAMKEY, J.L. GEADELMANN, 1996 Evaluation of populations for their potential to improve three maize hybrids. Crop Sci. **36:** 1553-1559.

GERLOFF J.E., O.S. SMITH, 1988a Choice of method for identifying germplasm with superior alleles 1. Theoretical results. Theor. Appl. Genet. **76:** 209-216.

GERLOFF J.E., O.S. SMITH, 1988b Choice of method for identifying germplasm with superior alleles 2. Computer simulation results. Theor. Appl. Genet. **76:** 217-227.

HALLAUER A.R., J.B. MIRANDA FO, 1988 Quantitative genetics in maize breeding. 2nd ed. Iowa State Press, Ames, Iowa, USA.

HOGAN R.M., J.W. DUDLEY, 1991 Evaluation of a method for identifying sources of favorable alleles to improve an elite single cross. Crop Sci. **31:** 700-704.

KNAPP S.J., W.W. STROUP, W.M. ROSS, 1985 Exact confidence intervals for heritability on a progeny mean basis. Crop Sci. **25:** 192-194.

MALVAR R.A., M.E. CARTEA, P. REVILLA, A. ORDÁS, 1997a Identification of field corn inbreds adapted to Europe to improve agronomic performance of sweet corn hybrids. Crop Sci. **37:** 1134-1141.

MALVAR R.A., P. REVILLA, M.E. CARTEA, A. ORDÁS, 1997b Field corn inbreds to improve sweet corn hybrids for early vigor and adaptation to European conditions. Maydica **42:** 247-255.

MALVAR R.A., M.E. CARTEA, P. REVILLA, P. SOENGAS, A. ORDÁS, 2001 Verification of predictions from estimators of favorable alleles to improve yield of sweet corn hybrids. Crop Sci. (submitted).

MERCY T., J.F. CHERES, S. KNAPP, 1999 Donor inbred lines for enhancing the performance of single-cross sunflower hybrids. Crop Sci. **39:** 1325-1331.

METZ G., 1994 Probability of net gain of favorable alleles for improving an elite single cross. Crop Sci. **34:** 668-672.

MISEVIC D., 1989a Identification of inbred lines as a source of new alleles for improvement of elite maize single crosses. Crop Sci. **29:** 1120-1125.

MISEVIC D., 1989b Evaluation of three test statistics used to identify maize inbred lines with new favorable alleles not present in elite single cross. Theor. Appl. Genet. **77:** 402-408.

MORENO-GONZÁLEZ J., 1988 Diallel crossing system in sets of flint and dent inbred lines of maize (*Zea mays* L.). Maydica **33:** 37-49.

ORDÁS A., P. REVILLA, R.A. MALVAR, M.E. CARTEA, 1994 Development of sweet corn hybrids adapted to the environmental conditions of the northwest of Spain. Maydica **39:** 171-175.

PFARR D.G., K.R. LAMKEY, 1992a Evaluation of theory for identifying populations for genetic improvement of maize hybrids. Crop Sci. **32:** 663-669.

PFARR D.G., K.R. LAMKEY, 1992b Comparison of methods for identifying populations for genetic improvement of maize hybrids. Crop Sci. **32:** 670-677.

REVILLA P, A. BUTRÓN, R.A. MALVAR, A. ORDÁS, 1999 Relationships among kernel weight, early vigor, and growth in maize. Crop Sci. **39:** 654-658.

SAS INSTITUTE INC., 1989 SAS/STAT user's guide, Version 6, 4th ed., Vols. 1 and 2. SAS Institute Inc., Cary, North Carolina, USA.

SPRAGUE G.F., S.A. EBERHART, 1977 Corn breeding. pp. 305-362 *In* G.F. Sprague (Ed.) Corn and corn improvement. 2nd ed. Amer. Soc. Agron., Masidon, Wisconsin USA, **18:** 305-362.

STOJSIN D., L.W. KANNENBERG, 1995 Evaluation of maize populations as sources of favorable alleles for improvement of two single-cross hybrids. Crop Sci. **35:** 1353-1359.

TRACY W.F., 1994 Sweet corn. pp. 147-187. *In:* A.R. Hallauer (Ed.) Specialty types of maize. CRC, Boca Raton, FL. USA.

ZANONI U., J.W. DUDLEY, 1989a Comparison of different methods of identifying inbreds useful for improving elite maize hybrids. Crop Sci. **29:** 577-582.

ZANONI U., J.W. DUDLEY, 1989b Testcross evaluation of F_2 populations from maize inbreds selected for unique favorable alleles. Crop Sci. **29:** 589-595.