Further Studies on the Reestablished Populations Derived from Chinta and the New Sweet Corn Composite

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INTRODUCTION

Three types of recurrent selection methods, namely (a) S₁ line breeding (b) simple recurrent selection based on roguing undesirable S₁ plants in a bulk population and (c) recurrent selection based on S₁ progeny test were carried out in a locally bred sweet corn variety, Chinta, aiming for further yield improvement as it has reached ceiling performance after five cycles of mass selection since its establishment (Yap and Graham, 1972). The preliminary results showed that the yielding ability of Chinta could be slightly increased by these selection methods after one cycle of selection (Yap and Tan, 1974). However, as the evaluation was based on first generation of intercross among selected S₁ plants (Syn₁) the better yield performance could be due to heterosis and it might disappear in the progeny populations due to inbreeding. In order to examine this point of view, the remnant seeds of these reestablished Syn₁ populations were multiplied in an isolated area and trials were carried out to examine whether there was any yield difference between Syn₁ of the reestablished populations and their respective progeny populations (Syn₂). In addition, a new composite developed from the 4×4 diallel population, (as mentioned in the materials and methods) was also included to compare its general performance with the other populations.

MATERIALS AND METHODS

Eight populations used in the present study were Chinta, six reestablished populations derived from Chinta and a newly developed composite variety. The development of these populations are briefly described in the following:

Chinta: This variety was developed from crossing Hawaiian Sugar with Local Flint,
Metro and Antigua (Graham and Yap, 1972). The eighth generation of the composite cross was released for commercial production as yield trials had shown that this generation had reached its ceiling performance (Yap and Graham, 1972).

**Population of simple recurrent selection based on roguing \( S_i \) plants (SRS):** Before anthesis, about 50% of individuals which showed unhealthy growth, thin stem, considerable leaf disease and borer infestation were rogued in a population of about 1000 \( S_i \) plants derived from 92 selfed ears (\( S_i \)) of Chinta in an isolated area. Seeds obtained from the crossing block are designated as SRS population.

**Population of progenies of SRS population (SRS'):** This is the progeny seeds of the SRS population grown in an isolated area.

**Population of recurrent selection based on the \( S_t \) progeny test (RSH):** Based on the result of the yield trial of 92 \( S_t \) lines of Chinta, 30 seeds obtained from each of the 15 top-yielding \( S_t \) ears were bulked and grown in an isolated area. The seeds of these selected \( S_t \) plants formed the population of RSH.

**Population of progenies of RSH population (RSH'):** This population was made up of the progenies of RSH population grown in an isolated area.

**Population of \( S_t \) line breeding (OPPH):** This population was formed by the bulk of the open-pollinated seeds per se of the 15 top-yielding \( S_t \) lines from the 92 \( S_t \) progeny trial.

**Population of progenies of OPPH population (OPPH'):** This population comprised the progenies of OPPH population grown in an isolated area.

**New composite:** This new composite was originally developed from a four-parent diallel-cross population. The four parents were Chinta, Hawaiian Supersweet 4, Hawaiian Sugar and Guatemala. Among these varieties, the former three are sweet corn whereas the fourth is a starchy type. Earlier genetic studies of this diallel population had shown that general combining ability played an important role in controlling yield and it was suggested that selection would prove effective (Yap and Tan, 1974). It was found that Guatemala when used as male parents gave better yield than their reciprocals (Tan and Yap, 1973); therefore, in the present study the new composite was a bulk of crosses using Guatemala as male parents and other crosses made between sweet corn varieties. Screening of starchy kernels and selection for healthy plants type were carried out at every generation of multiplication. The sixth generation seeds of the composite were used in this study.

Evaluation of these breeding materials was conducted in March and July, 1975 at the farm of the Faculty of Agriculture, University of Malaya. The crop was regularly sprayed with Benlate and Bildrin 24 to control fungal and insect pest diseases. Nitrophoska Blue (12% N, 12% \( P_2O_5 \), 17% \( K_2O \), 2% MgO and trace elements) was used at the rate of 900 kg/ha.

Field practices and crop maintenance were similar for the two trials except that six replications were used in the first trial and four in the second trial. There were four rows per plot each 610 cm in length. Planting distances between and within rows were 76.2 cm and 30.5 cm respectively. Allocation of populations in each trial was in a randomized complete block design pattern. Two seeds were sown per point and later thinned down to one plant when the seedling was about 30 cm in height.

Data obtained and reported here are:

- **Fresh husked ear yield per plot (kg):** This is the total weight of the husked ears on the middle two rows excluding the first two plants at each end of the row.

- **Ear length (cm):** This was measured from the base to the tip of the husked ears harvested in the middle two rows.

- **Ear diameter (mm):** This was measured at the thickest region of the ear after husking by means of a vernier calipers.

- **Plant height (cm):** This was measured from the surface of the ridge to the flag leaf node of the plant two weeks after tasselling.

- **Ear height (cm):** This was measured from the surface of the ridge to the node which produced the first fertile ear at the time the plant height measurement was taken.

- **Tasselling date (day):** This is the number of days counted from the date of planting to the date when 50% of the plants within each plot had tasselled.
SWEET CORN BREEDING

RESULTS

No significant differences among populations were found for all the characters studied in the first trial but significant differences were found in days to tasselling and ear diameter in the second trial. Mean values of all the characters measured in the two trials are presented in Table 1. With the exception of OPPH', all other entries yielded slightly higher than Chinta. Differences in other agronomic characters were also not very great for the two trials. The combined analysis of variance for the two trials done followed the method proposed by Cochran and Cox (1957).

Results of the combined analysis indicated that with the exception of tasselling date all other characters showed no significant differences among entries (Table 2). However, significant differences were found for husked ear yield, ear height, ear length and tasselling date in respect of the two seasons of planting, indicating that different growth conditions affected the experimental results. Furthermore, except for ear yield and plant height, no significant genotype-environment interactions were found for other characters. This showed that among all the characters studied in these populations, only ear yield and plant height responded differently to environmental changes. Other characters such as tasselling date, ear height, ear length and ear diameter responded in the same way even though the absolute values of these characters were different (Table 1).

Results of the two trials show that recurrent selection based on the S₁ progeny test gave better yields than those from populations derived by roguing undesirable individuals before anthesis.”

<table>
<thead>
<tr>
<th>Population</th>
<th>Chinta</th>
<th>OPPH</th>
<th>OPPH'</th>
<th>SRS</th>
<th>SRS'</th>
<th>RSH</th>
<th>RSH'</th>
<th>New Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Husked ear yield/plot (kg)</td>
<td>2.94a</td>
<td>3.50a</td>
<td>2.25a</td>
<td>3.87a</td>
<td>3.54a</td>
<td>3.77a</td>
<td>4.46a</td>
<td>3.90a</td>
</tr>
<tr>
<td></td>
<td>2.74a</td>
<td>2.85a</td>
<td>2.84a</td>
<td>2.78a</td>
<td>2.93a</td>
<td>3.03a</td>
<td>3.27a</td>
<td>3.30a</td>
</tr>
<tr>
<td>Ear length (cm)</td>
<td>15.8a</td>
<td>15.2a</td>
<td>14.4a</td>
<td>17.0a</td>
<td>14.0a</td>
<td>15.2a</td>
<td>15.0a</td>
<td>14.8a</td>
</tr>
<tr>
<td></td>
<td>17.2a</td>
<td>16.9a</td>
<td>16.9a</td>
<td>16.8a</td>
<td>17.4a</td>
<td>17.2a</td>
<td>17.4a</td>
<td>17.6a</td>
</tr>
<tr>
<td>Ear diameter (mm)</td>
<td>39.3a</td>
<td>39.5a</td>
<td>35.0a</td>
<td>40.0a</td>
<td>37.0a</td>
<td>40.5a</td>
<td>39.6a</td>
<td>38.8a</td>
</tr>
<tr>
<td></td>
<td>36.9c</td>
<td>36.9c</td>
<td>37.8bc</td>
<td>37.6a</td>
<td>37.9abc</td>
<td>38.1abc</td>
<td>37.1ab</td>
<td>37.6a</td>
</tr>
<tr>
<td>Plant height (cm)</td>
<td>171.1a</td>
<td>170.2a</td>
<td>145.6a</td>
<td>179.3a</td>
<td>161.1a</td>
<td>160.3a</td>
<td>173.1a</td>
<td>157.8a</td>
</tr>
<tr>
<td></td>
<td>149.8a</td>
<td>159.2a</td>
<td>162.4a</td>
<td>159.5a</td>
<td>165.9a</td>
<td>159.6a</td>
<td>162.0a</td>
<td>164.6a</td>
</tr>
<tr>
<td>Ear height (cm)</td>
<td>65.5a</td>
<td>64.6a</td>
<td>61.1a</td>
<td>72.4a</td>
<td>69.0a</td>
<td>64.2a</td>
<td>83.4a</td>
<td>67.8a</td>
</tr>
<tr>
<td></td>
<td>54.3a</td>
<td>57.9a</td>
<td>56.0a</td>
<td>56.3a</td>
<td>59.5a</td>
<td>61.8a</td>
<td>65.0a</td>
<td>66.6a</td>
</tr>
<tr>
<td>Days to tassel</td>
<td>49.6a</td>
<td>49.1a</td>
<td>49.8a</td>
<td>47.5a</td>
<td>48.5a</td>
<td>48.6a</td>
<td>47.6a</td>
<td>47.3a</td>
</tr>
<tr>
<td></td>
<td>51.8a</td>
<td>50.0ab</td>
<td>50.5ab</td>
<td>51.0ab</td>
<td>50.0ab</td>
<td>50.8ab</td>
<td>48.8ab</td>
<td>48.9b</td>
</tr>
</tbody>
</table>

I = Trial I II = Trial II.

Mean values in the same row followed by the same letter are not significantly different at the 5% level of probability, based on Duncan's new multiple range test.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>Ear yield</th>
<th>Ear length</th>
<th>Ear diameter</th>
<th>Plant height</th>
<th>Ear height</th>
<th>Days to tassel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Populations (P)</td>
<td>7</td>
<td>0.34</td>
<td>0.33</td>
<td>1.52</td>
<td>46.72</td>
<td>48.42</td>
<td>1.62*</td>
</tr>
<tr>
<td>Seasons (S)</td>
<td>1</td>
<td>1.26*</td>
<td>16.00*</td>
<td>6.00</td>
<td>78.76</td>
<td>311.52**</td>
<td>11.73**</td>
</tr>
<tr>
<td>P × S</td>
<td>7</td>
<td>0.16**</td>
<td>0.59</td>
<td>2.03</td>
<td>91.74*</td>
<td>19.18</td>
<td>0.41</td>
</tr>
<tr>
<td>Error</td>
<td>56</td>
<td>0.02</td>
<td>0.52</td>
<td>1.08</td>
<td>42.05</td>
<td>11.32</td>
<td>0.49</td>
</tr>
</tbody>
</table>

* P < 0.05  ** P < 0.01
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in the population, or the S₁ line breeding. Differences between the reestablished populations and their respective progeny populations did not show the same sign for the three selection methods and the magnitudes of difference were not great.

DISCUSSION

In our country sweet corn is mainly consumed as grain-on-the-cob after boiling. Hence fresh husked ear yield and ear length and diameter are reported so that a better indication of the yielding potential of the breeding materials may be given. In this study, as significant difference among populations was not found for most of the characters studied in both trials, it is difficult to draw a definite conclusion. However, earlier studies have shown that populations selected for high yield performed better than the original population; and those selected for low yield performed worse than the original populations, suggesting that selection would effectively change the mean of the population (Yap and Tan, 1974). In the small magnitude of change of one cycle of selection it would be difficult to obtain statistical significance especially with only a few replications.

In earlier studies, (Yap and Tan, 1974), it was found that OPPH followed by SRS and RSH yielded better than Chinta. In the present study, however, a reverse trend occurred. The findings in the present study would seem to indicate that genotype-environment interactions played an important role since varieties performed differently under different seasonal conditions; and genotype-environment interactions were significant (Table 2). There was no clear trend to show that Syn₂ performed worse than Syn₁ which would lead us to suggest that farmers could save their own seeds for further generations of planting. The results of two trials show that all Syn₁ populations gave higher yields than Chinta which further confirms our view that the three methods could be used for further improvement of Chinta. The correlated responses with respect to other agronomic characters in relation to ear yield were also not great.

It is worth noting that the yield of the newly developed composite sweet corn yielded higher than Chinta. This has been confirmed in recent trials carried out in the field at Universiti Pertanian Malaysia, Serdang. This new composite sweet corn, therefore, shows promise of becoming another new sweet corn variety for commercial production.

REFERENCES


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