POPCULATION APPROACH TO SELECTION OF VARIETIES FOR SUGARCANE BEETLE BORER RESISTANCE

S. C. Prasad, J. Subarmaniam and A. S. Masilaca

Agricultural Experiment Station, Fiji Sugar Corporation Limited, Lautoka, Fiji

ABSTRACT

Sixteen Saccharum officinarum cultivars resistant to sugarcane beetle borer, Rhabdoscelus obscurus Boisd., were obtained using the principle of population approach to variety selection.

The method could also be used to screen varieties for rat damage resistance. The resistant varieties thus obtained can also be utilized as source of gemplasm for breeding purposes.

The damage caused by the larval stage of the beetle borer increases fiber % fresh weight and decreases Brix of fresh juice.

INTRODUCTION

The sugarcane beetle borer, Rhabdoscelus obscurus Boisd was first introduced into Fiji through Australia in the 1890s, (Veitch 1919). During the early days as many as three million insects were collected in the Nausori Mill area alone (Knox). The sugarcane beetle borer can be found in all parts of the sugarcane growing areas of Fiji.

The tunnelling and ingestion of the internal tissues by the grub stage of the beetle borer destroy much of the interior of the cane and in some cases the infestation is so heavy as to render the cane stalks worthless. This results in a marked reduction in the yield of sugar. The loss of sugar is, however, not only confined to the tissue actually consumed, but also by the susceptibility of such cane to break and lodge thus allowing further infestation and rotting. The secondary infestation of worms, ants, bacteria and fungi accelerates deterioration. It has also been observed that borer infestation is very closely related to rat damage. The rat eaten stalk affords easy oviposition for the adult female weevil.

After successfully using the population method by Daniels et al1,2 for selecting varieties for commercial release, it was felt that these principles could be applied in selecting sugarcane varieties for beetle borer resistance. It was that the continuous propagation of clones showing resistance in the test population could
eliminate the susceptible clones.

MATERIALS AND METHODS

Two experiments were conducted at Labasa and Rarawai mill centers using the population approach for selections. These were located at known sugarcane beetle borer infested areas.

A foundation population of some 356 S. officinarum clones from LF70 series were used for these trials. Homer, Mana Ragnar, Mali and Vomo were planted as standard varieties. Ragnar and Homer were used as high sugar yielding varieties, Vomo and Mana as medium sugar varieties and Mali as low sugar variety. As for beetle borer damage assessment, Homer and Mana were used as susceptible standards, Ragnar as moderately resistant and Mali and Vomo as resistant.

The test varieties were planted in single stools replicated twice. The distance between stools was 45 cm in rows 1 meter apart. The varieties were allowed to stool freely. Cultivation was normal and adequate fertilizer was applied.

The beetle borer population was supplemented by collecting adult beetles with the aid of ‘split bundle traps’. An average of twenty females and five males were ‘dumped’ per stool. Split bundle traps were prepared by splitting 45 cm of sugarcane stalk lengthwise and wrapping about 10 to 15 such split pieces with newspaper with the ends being open. These were placed in borer infested fields and collected after 4 to 6 days. This method yielded a large number of adult beetles of both sexes.

One hundred stalks of each standard variety were brixed and regression analysis done against the established ratings of these varieties. The discard level for brix was set at one rating lower than the lower rating obtained for any standard variety. The brix results of the two replications of the test varieties were averaged and the rating determined. The ratings used were 0 to 9 scale as described by Daniels et al where 0 was used for high sugar varieties and 9 for low sugar varieties.

The discard level for beetle borer infestation was determined on a percentage basis. The same set of standard varieties were used for this purpose. Each standard was sorted out into two piles. ‘Pile’ ‘A’ consisted of stalks which were apparently clean. Stalks from ‘Pile’ ‘B’ were split lengthwise and examined for borer damage. The infested stalks were added on to ‘Pile’ ‘A’. Percent borer infestation was expressed by the number of infested and uninfested stalks against the 100 stalk samples taken.

The discard level was based at the average percentage obtained for Mali and Vomo, the two resistant varieties. As for the test varieties, the total number of stalk of the two replications were taken into account. Varieties which had acceptable brix rating were used for percent beetle borer determination. The selected
varieties were replanted for further evaluation. The experiments were continued for four years.

Random eighteen stalk sample of eleven varieties were also analysed for % fibre and brix at the small mill. The cane stalks were fibrated using a Jeffco cutter/grinder and juice obtained to determined % brix and fiber (Stevenson et al.).

RESULTS

Table 1 presents the selection of varieties over the four years that the trials have been in progress.

**TABLE 1. Number of varieties selected**

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>326</td>
<td>111</td>
<td>23</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

During the 1978 processing of the trial, the sixteen varieties planted were found to be almost free from any beetle borer damage. Only one stalk from one replication of variety LF70-1561 was found to have the last basal internode damage.

Table 2 shows the % fiber and brix analysis carried out on eleven varieties selected at random, constituting about 10% of the total population of 111 during 1976 harvest.

**TABLE 2. Small Analysis — % Fiber**

<table>
<thead>
<tr>
<th>Variety</th>
<th>% Bored stalks</th>
<th>Bored</th>
<th>Clean</th>
<th>Increase in % fiber</th>
<th>Bored</th>
<th>Clean</th>
<th>% decrease in brix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ragnar</td>
<td>50</td>
<td>15.2</td>
<td>12.4</td>
<td>2.7</td>
<td>15.7</td>
<td>20.5</td>
<td>4.8</td>
</tr>
<tr>
<td>LF70-458</td>
<td>80</td>
<td>11.0</td>
<td>9.5</td>
<td>1.5</td>
<td>12.0</td>
<td>20.0</td>
<td>8.0</td>
</tr>
<tr>
<td>LF70-466</td>
<td>100</td>
<td>10.8</td>
<td>9.7</td>
<td>1.1</td>
<td>9.0</td>
<td>20.0</td>
<td>11.0</td>
</tr>
<tr>
<td>LF70-1370</td>
<td>86</td>
<td>11.7</td>
<td>10.4</td>
<td>1.3</td>
<td>15.4</td>
<td>16.8</td>
<td>1.4</td>
</tr>
<tr>
<td>LF70-1405</td>
<td>77</td>
<td>19.2</td>
<td>14.5</td>
<td>4.7</td>
<td>17.4</td>
<td>21.0</td>
<td>3.6</td>
</tr>
<tr>
<td>LF70-1452</td>
<td>85</td>
<td>12.7</td>
<td>11.5</td>
<td>1.2</td>
<td>14.8</td>
<td>22.0</td>
<td>7.2</td>
</tr>
<tr>
<td>LF70-1454</td>
<td>75</td>
<td>13.3</td>
<td>13.2</td>
<td>0.1</td>
<td>15.6</td>
<td>19.4</td>
<td>3.8</td>
</tr>
<tr>
<td>LF70-1521</td>
<td>35</td>
<td>16.7</td>
<td>11.9</td>
<td>4.8</td>
<td>12.0</td>
<td>20.0</td>
<td>8.0</td>
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<tr>
<td>LF70-1594</td>
<td>60</td>
<td>14.5</td>
<td>14.5</td>
<td>9.0</td>
<td>18.0</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>LF70-1650</td>
<td>100</td>
<td>15.5</td>
<td>13.0</td>
<td>3.2</td>
<td>15.0</td>
<td>20.0</td>
<td>5.0</td>
</tr>
<tr>
<td>LF70-1754</td>
<td>50</td>
<td>12.5</td>
<td>12.3</td>
<td>2.2</td>
<td>16.0</td>
<td>19.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>
DISCUSSIONS

The population approach provides an opportunity for screening large numbers of clones for objective, metrical, measurable characteristics at all stages. In the current experiments the technique to develop beetle borer resistance in commercial sugarcane was used. As shown on Table 1, the susceptible clones were eliminated and the resistant ones left to demonstrate their superiority at subsequent stages. The population method also provides a cheap and ready selection method to eliminate susceptible or mediocre varieties.

The damage caused by beetle borer infestation generally increased the % fiber as compared to total fresh weight. This is mainly due to the fact that the grub or larval stage of the sugarcane beetle chews fresh tissue leaving dry and dead fibrous tissue after ingestion. This ingestion of internal tissue also renders the rind dry and hard.

The decrease in juice is also a direct result of ingestion of sugarcane tissue by the beetle borer. The infested portions of the sugarcane stalk dries out. In certain cases the stalk breaks at the point of infestation and dries out. This causes the brix to decline depending on the degree of infestation and tunnelling. Loss of sugar is due to the increase in fiber and secondary infestation. The secondary infestation also leads to increases in dextran and other polysaccharides, thus increasing the imputing load during the processing in the mill.

The population approach as outlined in this paper can also be used for assessing resistance to rat damage. The selected resistant clones can be profitably used as germplasm for breeding purposes.

REFERENCES


EL CONCEPTO DE LA POBLACIÓN DEL ESCARABAJO BARRENADOR DE LA CAÑA DE AZÚCAR COMO UN MEDIO PARA LA SELECCIÓN DE VARIEDADES RESISTENTES.

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RESUMEN

El principio del concepto de población para la selección de variedades puede también ser utilizado para la obtención de cañas resistentes al escarabajo o mayate barrenador, *Rhabdoscelus obscurus* Boisd.

Los experimentos realizados han dado como resultados la obtención de 16 formas resistentes del *Saccharum officinarum*. El daño causado por la larva del barrenador aumenta el porcentaje de fibra en el peso fresco de la caña, y disminuye los sólidos solubles en el jugo fresco.

Este método se podría también utilizar en la selección de variedades resistentes a daños de roedores. Las cañas así obtenidas podrían utilizarse como progenitores potenciales en programas de cruzamientos.