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Tiprot in asparagus

A report prepared for the
New Zealand Asparagus Council

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1 EXECUTIVE SUMMARY

Tests were carried out on asparagus propagated from plants selected for resistance to tiprot to establish the genetic nature of this resistance and to identify other differences associated with tiprot resistance.

Characteristics observed in plants with resistance included higher levels of sugars in the spear tips, slower spear growth rate, and slower development of lateral buds.

Assessment of electrolyte leakage as an objective screening test indicated that although it does provide a measure related to developing tiprot it is probably too cumbersome to be used as a screening test. Direct observation of symptoms or measurement of spear growth rate may provide the most efficient measure of tiprot resistance.

Selection and breeding of asparagus for increased resistance to tiprot is a definite prospect. However, conflict may occur between the aims of breeding for postharvest performance and yield if the character of slow height growth of spears is closely linked with crop yield.

2 INTRODUCTION

Tiprot is a significant postharvest disorder of asparagus which can cause serious losses in export markets. Although the symptoms of the disorder are similar to those of bacterial soft rots, we believe the initial lesion is caused by intense physiological changes occurring in tip tissues after harvest. Previous studies have demonstrated that tiprot is more likely to occur in spears that are growing rapidly, e.g. in warm conditions.

We also have an indication that plants vary in their susceptibility to tiprot; three clones selected for resistance and three for susceptibility to tiprot have been established in field plots in Levin. Confirmation that there are genetic factors controlling the disorder will open the possibility of selecting for tiprot resistance. Screening large numbers of plants in the field would then be necessary to identify plants with resistance suitable for breeding work. This process requires a method for quickly evaluating development of tiprot, and we have identified electrolyte leakage from the tips of harvested spears as a technique with potential for this.

In this project we evaluate this clonal material for differences, and investigate methodology that might assist in screening plants in the field for tiprot resistance.

3 METHOD

Spears from the 6 clones were monitored for height growth rate. The tips of some harvested spears were excised into liquid nitrogen, freeze-dried, and analysed for sugar content. The tips of other spears were dissected into bracts, buds and stem tissues to quantify variations in the structure of the tip. These measures were related to the tiprot resistance of the clones.

Spears with high and low tiprot resistance were produced from plants forced at 13 or 20°C and held at 20°C and assessed for electrolyte leakage after four, seven and nine days. Tips cut from the spears were soaked in 0.3 M mannitol. The conductivity was measured after one and two hours. The tip was then boiled for five minutes in a microwave oven, water added to make up any lost, and the conductivity measured. Electrolyte leakage per hour was expressed as a percentage of the total electrolytes present in the tip.

4 RESULTS

4.1 Clones

Spear tips from the clones resistant to tiprot contained significantly higher levels of sugars from spear tips from susceptible clones (Table 1). This was evident for glucose, fructose and sucrose.

Height growth rate of spears from resistant clones was significantly less than growth rates for susceptible clones (Table 1).

Table 1: Sugars (mg/g DW) in tips of spears from resistant and susceptible clones measured at harvest.

Tiprot resistance	Glucose	Fructose	Sucrose	Growth (mm/day)	Tiprot (%)
Resistant	26.1	35.0	32.9	33.9	72
Susceptible	17.0	26.3	45.9	45.9	96
S.e.d.	1.9	2.6	3.7	3.7	

Dissections of spear tips revealed that harvested spears of resistant clones had less well developed buds and a higher proportion of central stem tissue spears than did spears of susceptible clones. Bract tissues made up a similar proportion of the total in both resistant and susceptible plants.

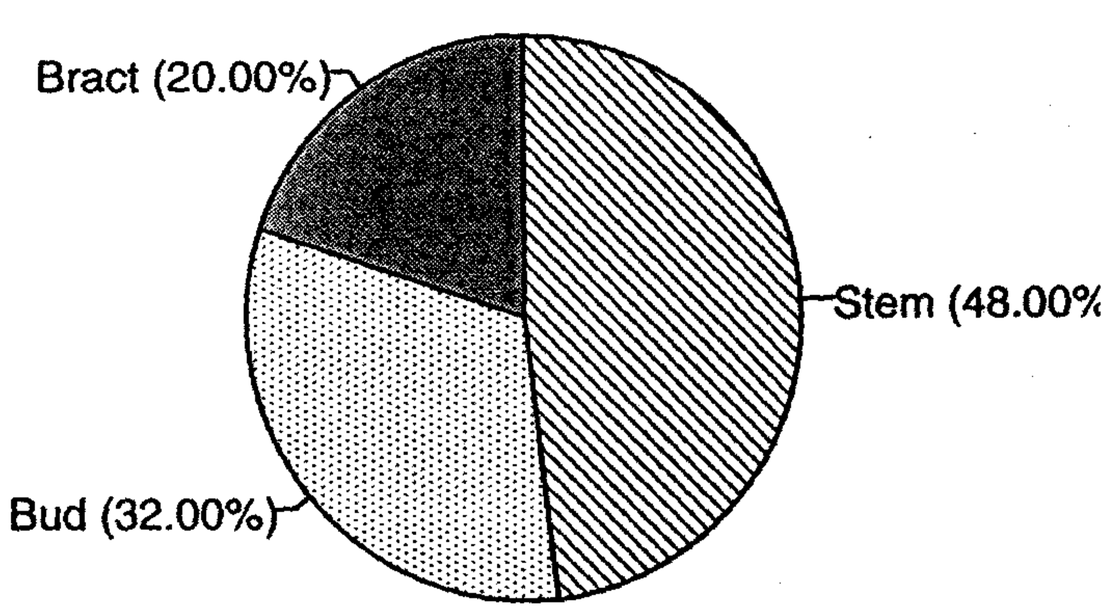

Fig 1: Proportions of spear tissue types in spears from resistant and susceptible clones.

4.2 Electrolyte leakage

Tips from tiprot resistant spears exhibited lower rates of electrolyte leakage than susceptible spears throughout the nine day postharvest period, but the difference was much greater (7 fold) on the ninth day (Table 2). Variability tended to be greater amongst susceptible spears.

Table 2: Relative electrolyte leakage[1] (%) from resistant and susceptible spear tips (grown under controlled temperature conditions) during a nine day postharvest period.

Tiprot resistance	Electrolyte leakage (%) after harvest			Growth (mm/day)	Tiprot (%)
	4 days	7 days	9 days		
Resistant	0.34	0.50	0.79	21.0	40
Susceptible	0.90	1.84	5.57	72.6	93
S.e.d.	1.62	1.62	1.62	3.4	

[1] Electrolyte leakage per hour expressed as percentage of total electrolytes present in tip.

5 DISCUSSION

Substantial differences in sugar content and tissue structure of the spear tip, and growth rate exist between the tiprot-resistant clones and those susceptible to tiprot. These results are quite consistent with measurements made in other experiments comparing tiprot resistant and susceptible spears and indicate that development of tiprot is caused by the underlying functionality of the spear. It may be that the key determinant is spear growth rate, and in selecting for tiprot resistance we selected plants with low spear growth rate. Associated with the slower growth rate is higher sugar content in the tips and slower development of the buds.

This genetic control offers the opportunity to breed and select for plants with tiprot resistance. However, the question which will need answering is whether height growth rate is so tightly linked to yield that the aims of higher yield and lower tiprot are incompatible.

In our evaluation of electrolyte leakage we observed that spears susceptible to tiprot did indeed exhibit a higher level of leakage than resistant spears before any outward symptoms of the disorder. The test is useful therefore as an objective measure, and to obtain an indication of tiprot before the physical symptoms show. However, it is more time consuming, and hence less suitable for large scale screening, than anticipated. Observations on physical development or measurement of relative growth rate would be more economical.