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Temperature influences tiprot development in asparagus

A report prepared for
New Zealand Asparagus Council

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CONTENTS

1 SUMMARY

Tiprot is a postharvest disorder of asparagus which causes problems in export markets. Our investigations of factors affecting the development of the disorder have shown that the temperature of the growing plants in the field may be important. This experiment has confirmed the seasonal effect observed previously and we have attempted to relate this to growing temperature.

Only 19% of spears harvested early in the season developed tiprot whereas late in the season tiprot developed in all spears. Temperature at crown level in the early harvest ranged from 7 to 13°C over the 4 day harvest period, whereas in the two harvests later in the season crown temperature ranged from 15 to 26°C. Spear temperature in the early harvest ranged from 0 to 23°C, whereas spears in the later harvests ranged from 7 to 26°C.

We believe that temperature of the growing plant is in some way predisposing the plant to develop tiprot. Potted plants have been established to continue this investigation to determine the relative importance of crown or spear temperature under controlled conditions.

2 INTRODUCTION

Tiprot is a physiological disorder which develops in asparagus spears during postharvest handling and marketing. It causes problems from time to time in the market where it is also known as melting tip. Investigation of the disorder has shown that there may be genetic variation in susceptibility (Lill & van der Mespel 1991).

An experiment is currently in progress in which plants identified as susceptible and resistant have been clonally propagated and established in the field. If the tiprot resistance character can be identified in these clonally propagated plants, it will establish the genetic basis for the resistance, and open the way to selection of resistant lines.

Compositional analysis of these plants indicated that low carbohydrate and high protein content in the tips was associated with higher levels of tiprot. Further investigation of this observation has not given good confirmation of these relationships. When spears are available from the clonally propagated plants with high and low resistance to tiprot, this will be tested further. A compositional marker would greatly assist the selection of plants for tiprot resistance.

Temperature was identified as a potentially important factor in an experiment in which potted plants were forced at different temperatures. Spears from plants forced at 17°C developed a significant amount of tiprot whereas spears from plants forced at 13°C developed no tiprot at all (Lill & van der Mespel 1992).

This project continues an investigation of the role of temperature of the growing plant in the predisposition of spears to develop tiprot. Two approaches have been taken. In the first we have used seasonal and diurnal temperature changes, harvesting spears at three times during the season and two times during the day. In the second we have established plants in pots for forcing under conditions in which the temperature of the crown and the growing spears are controlled separately.

3 METHODS

Asparagus spears (cv. Limbras 10) were harvested at 2 pm and 2 am daily over three 4-day periods; 28 September-2 October, 9-13 November, and 14-18 December. Thirty spears (180 mm) were trimmed and packed in perforated film bags, stored for 4 weeks at 0°C, and assessed for tiprot over a 5 day shelf-period at 20°C. Tiprot was judged to be present when the spear tip was soft to the touch and initial colour changes associated with tiprot were observed in the tip (greying, darkening of tip bracts).

Temperatures of crowns and spears during each harvest period were record. A temperature probe inserted 100 mm into the ground was used to represent temperature of the crowns, and spear temperature was obtained by inserting a probe in a spear tip.

One-year crowns of cv. Jersey Giant were planted in planter bags (PB40) in a bark-based potting medium. These plants will be available in the 1994 season for controlled-temperature forcing tests.

4 RESULTS

Tiprot developed in spears harvested in September at levels ranging from 3 to 37% for individual harvests (Table 1). There was no difference in tiprot development between spears harvested at 2 pm (20%) and spears harvested at 2 am (17.5%), despite a marked diurnal fluctuation in temperature of crown and spear (Figs 1 and 2).

Spears harvested in November and December all developed tiprot, indicating a much higher level of susceptibility. Temperature records show much higher crown temperatures, and much higher minimum spear temperatures (Figs 1 and 2). In September, spear temperature fell close to freezing on three of the four nights, whereas minimum spear temperatures in the later harvests reached 7°C on one occasion, but were mostly in the range 12 to 15°C. There were no clear differences in temperatures between the November and December harvests.

5 DISCUSSION

Data from this experiment gives some support to the hypothesis that growing temperature influences the predisposition of asparagus spears to tiprot. Spears harvested in September when crown temperature and minimum spears temperatures were just sufficient to support growth developed much less tiprot than spears harvested under the much warmer conditions of the November and December harvests. Shelf-life of asparagus declines during the season (Hurst et al. 1993), and this may be related to the increase in susceptibility to tiprot observed here.

There was, however, no influence of diurnal temperature fluctuations. In a previous experiment we have shown that spear quality measured as shelf-life at 20°C does show marked diurnal rhythm, presumably in response to diurnal temperature fluctuations. This may mean that tiprot does not relate quite as directly to other aspects of spear quality as we thought. Shelf-life quality appears to respond very quickly to the growing environment. Results from this experiment indicate that predisposition to tiprot may respond more slowly.

Another factor which may be influencing predisposition to tiprot is the storage reserves available to the plant from crown and storage roots. These are known to decline substantially during the harvest period so it is possible that declining availability of storage reserves during the November and December harvests could have increased susceptibility to tiprot.

The next phase of this investigation which is planned for the 1994 season is an experiment using potted plants forced under controlled temperature conditions. Temperature of the pots and growing spears will be controlled separately so that the relative importance of the crown as supplier of sugars for growth and spear as demander can be determined.

6 REFERENCES

Hurst, P.L.; W.M. Borst; Hannan, P.J. 1993: Effect of harvest date on the shelf-life of asparagus. *New Zealand Journal of Crop and Horticultural Science* (in press).

Lill, R.E., van der Mespel, G.J. 1991: Asparagus: a study of tiprot, its physiological and genetic basis. *Report to the New Zealand Asparagus Council :* 17.

Lill, R.E., van der Mespel, G.J. 1992: Asparagus: effect of temperature during spear growth on subsequent tiprot development. *Report to the New Zealand Asparagus Council:* 8.

7 Figure legends

Figure 1: Temperature at crown level (100mm) during three harvest periods in the 1992 asparagus season.

Table 1: Postharvest development of tiprot (%) in asparagus spears harvested over four days early in the 1992 season.

Month	Day	Time of day	
		2 am	2 pm
September	28	-	3.3
	29	10	10
	30	3.3	37
October	1	27	30
	2	30	-
Mean (± SE)		17.5 (6.5)	20 (8.0)

Figure 1: Temperature at crown level (100mm) during three harvest periods in the 1992 asparagus season.

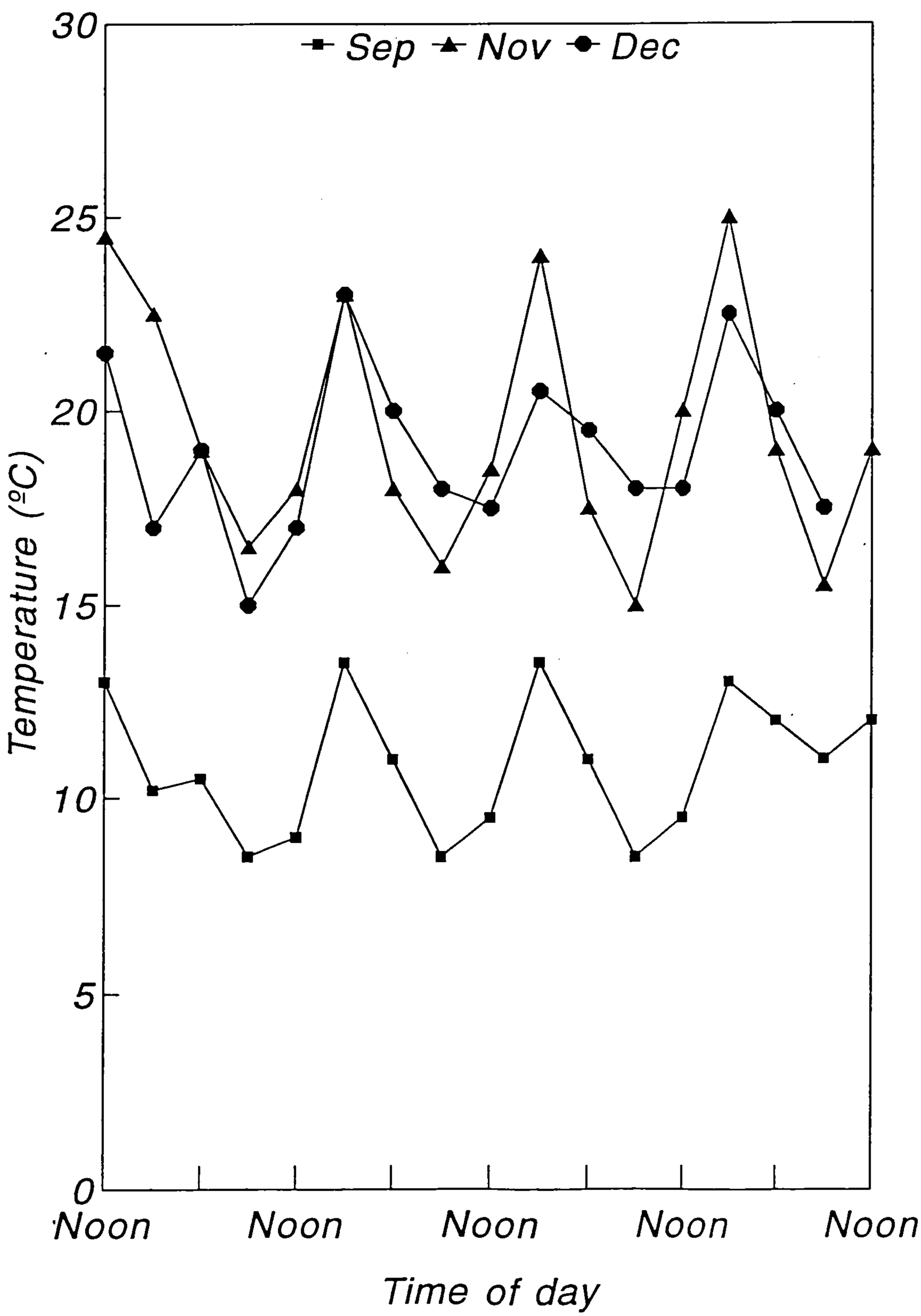

Figure 2: Spear temperature during three harvest periods in the 1992 asparagus season.