Access to Asian Vegetables
Shaping the Future
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CHINESE CABBAGE

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This collaborative research project by Queensland Department of Primary Industries (lead agency), Adelaide University, Agriculture Victoria, the Beijing Vegetable Research Centre and Hangzhou University of Commerce is sponsored by the Australian Centre for International Agricultural Research (ACIAR). The experimental work was carried out on Chinese cabbage cultivar 'Yuki' by postgraduate student Kerry Porter.

1. OPTIMISING PREHARVEST PRACTICES

The final quality and storage life of Chinese cabbage is heavily dependant on a number of growing practices and selection of appropriate cultivars. The main growing-related disorders are tipburn, bolting, and gomasho, also called black fleck or petiole spotting. Control of these disorders can be in part by using resistant varieties and in part by using appropriate cultural practices. Advice on appropriate cultivars is available (eg. *Access to Asian Vegetables Newsletter* issue 6, January 1998; and from seed suppliers).

Bolting is avoided by not growing in cold temperatures, using plastic row covers or maintaining a raised temperature (above 18°C) during seedling production.

Gomasho is promoted by high nitrogen application (especially ammonium nitrate) in the field and may be reduced by harvesting in warm weather when N turnover is highest. It is also exacerbated by a soil pH of 8 or above, high levels of phosphorous and high tissue copper and low tissue boron levels. However, cultivar selection may have a bigger effect as some cultivars, for example 'Kasumi 11', 'Hong Kong', 'Orient Express', are very sensitive to this disorder, while others, for example 'China Pride' and 'Treasure Island,' show good tolerance at low temperatures. Proper storage conditions are also important to slow down the development of symptoms.

Tipburn is caused by poor translocation of calcium into the young, inner leaves and is associated with rapid growth and high transpiration through the outer leaves. It may also be caused by the developing floral parts after cold temperature exposure competing for the available calcium. Increased nitrogen fertilisation, regardless of type, reduced tipburn in one study, but ammonium toxicity may be responsible for tipburn when applied during head formation. Control of tipburn can also be achieved by increasing the humidity at night by spraying water or by using plastic covers; this reduced outer leaf transpiration and allowed increased calcium accumulation of the inner leaves. Foliar application of calcium had limited success in controlling this disorder. Using repeated application of calcium and NAA or daminozide were other useful control methods.

Transient water stresses, simulating insufficient irrigation, were applied to Chinese cabbages during growth and heading stages. Soil moisture levels were monitored using tensiometers and cabbages were irrigated when readings were -35 to -40 kPa for 'no stress', -55 to -60 kPa for 'medium stress', and -75 to -80 kPa for 'high stress'. All treatments were fully irrigated 24 hours prior to harvest.

Chinese cabbages with tensiometer

Cabbage heads were then harvested, stored at 0°C for up to 9 weeks, and assessed at regular intervals. The water stress treatments did not affect the postharvest physiological responses or shelf life of the cabbages. No differences in weight

loss, trimming loss, quality, and energy substrate levels were found. Chinese cabbage plants are resilient to water stress and recover from any temporary under-watering. However, this is only valid as long as plants are not so severely stressed that leaf and head damage occurs.

2. OPTIMISING HARVEST PRACTICES

Time of day at harvest is known to influence the water status and accumulated sugar levels in crops. It is desirable to have turgid leaves at harvest; this should be the case early in the morning. Water loss can also be reduced by harvesting at a cool part of the day and by rapid precooling. On the other hand, sugar levels should be highest in the afternoon, after a full day of photosynthesis. This could result in a better storage life due to more nutrients being available.

However, the time of day of harvest (dawn, midday, dusk) did not influence quality (e.g. trimming loss, disorders) or storage life of Chinese cabbage. No differences in water status or sugars at different harvest times were found. Neither did a delay in cooling harvested cabbages, left in the field for 30 minutes in temperatures ranging from 6°C to 20°C, have an effect.

The reason for the Chinese cabbage head being so resilient is, that it is reasonably well insulated against temperature fluctuations. The wrapper and outer leaves were most affected by temperature extremes, while the bulk of the head experienced much less and delayed temperature changes (see figure below). As the wrapper and some of the outer leaves are trimmed at harvest, only the protected remainder of the head is stored. Therefore, Chinese cabbages can be harvested through most of the day, as long as temperatures on that day do not exceed normal conditions of about 22°C. Heads should be taken to refrigerated storage within 30 minutes.

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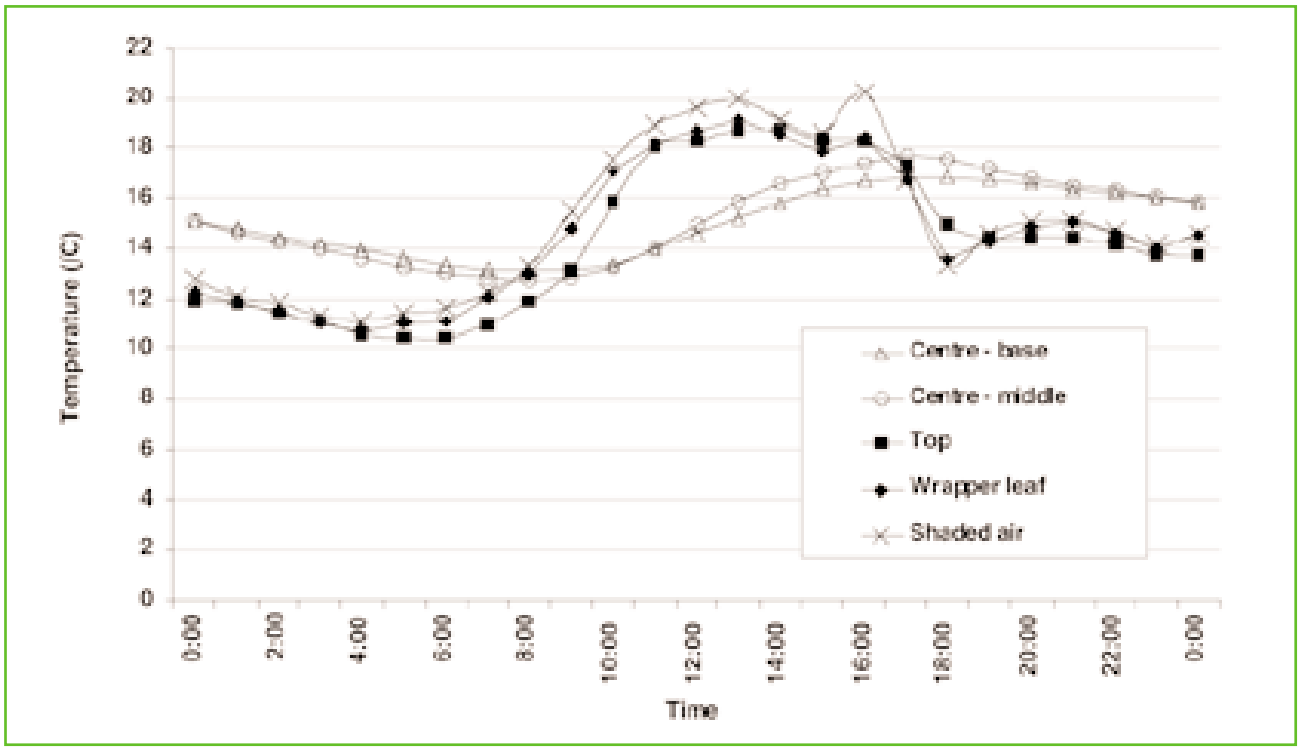
A third article by Dr Klieber on Postharvest Practices for Chinese cabbage will appear in a future edition of this newsletter.



Temperature fluctuations of various positions in Chinese cabbage heads growing in the field. Minimum and maximum air temperatures were 13°C and 22°C.

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