TIPBURN - A MAJOR PROBLEM OF CABBAGE IN THE HIGHLANDS AND SOME RECOMMENDATIONS FOR ITS CONTROL.

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ABSTRACT

Tipburn is a disorder of cabbages, cauliflower and lettuce usually caused by deficiency of calcium. A trial carried out on cabbage (Var. Green Coronet) showed that all treatments containing boron (in the form of Solubor) significantly reduced the number of plants affected by tipburn. The reason for this is that the efficient uptake and transport of calcium depends on boron availability. Both boron and calcium are generally deficient in soils in the highlands of Papua New Guinea.

Key words: *Tipburn, cabbage, boron, calcium*

INTRODUCTION

Nutrient deficiencies as possible causes of tipburn.

Calcium is a main constituent of cell walls and membranes. When in short supply cell membranes become leaky, cell division and the development of the growing point and root tips are affected. Calcium plays a key role in protecting the cell from toxins and in slowing the aging process. Calcium is not very mobile in the plant, so deficiency symptoms typically show as the death of the growing point, root tips, young leaves or developing fruits.

Tipburn (Figure 1) is a disorder of cabbage, cauliflower and lettuce caused by calcium deficiency (Weir & Cresswell 1993, Simon 1978). Calcium deficiency is also responsible for blossom end rot in tomatoes and capsicum, black heart in celery and internal browning in Brussels sprouts.

Calcium deficiency in crops like tomatoes and capsicum (blossom end rot) and cauliflower (tipburn) can be controlled by weekly sprays of calcium nitrate or calcium chloride applied throughout fruit formation in the case of tomato and capsicum, or from three weeks before flowering begins until three weeks before harvesting in the case of cauliflower. These sprays are ineffective for hearting vegetables such as lettuce, brussels sprouts and cabbage, as the calcium solution cannot reach the enclosed leaves, which are most prone to injury (Weir & Cresswell 1993).

Control of tipburn in cabbage is achieved by selection of tolerant varieties, better irrigation (severity of tipburn is positively correlated with soil moisture levels at harvest) and other management practices including carefully monitored fertiliser usage, and liming the soil where the soil is excessively acidic (Weir & Cresswell 1993; Walker *et. al.* 1961, Imai *et. al.* 1988). There is also some evidence to suggest that the disorder is more prevalent in plants that have been left for a longer time in the field, such as cabbages used in the manufacture of sauerkraut (Walker *et. al.* 1961).

Urea may increase the severity of tipburn as it promotes the sudden rapid growth of leaves which may result in localized calcium deficiency at the leaf margins as calcium is not readily transported from older to younger tissues. It has also been suggested that excessive nitrogenous fertlisers may inhibit the uptake of calcium from the soil. This is particularly true for NH_4^+ - nitrogen fertilisers (Imai *et. al.* 1988), possibly because calcium and ammonium - nitrogen fertilisers appear to compete with each other for entry sites into the plant (Chattergee 1988). It has been widely reported that the efficient uptake and transport of calcium by the plant depends on boron availability (Incitec 1992). This is further backed up by experiments carried out on cabbage plants grown in Hoagland solutions with normal and reduced levels of boron. Plants grown with insufficient boron showed slightly higher severity of tipburn (Walker *et. al.* 1961). Boron deficiency in a number of vegetable crops has been described by Gupta (1979). It has been linked to tipburn in strawberry (Mason & Guttridge 1974) and lettuce (Crisp *et al.* 1976).

Tipburn problems in the PNG highlands.

Tipburn has become a major problem with cabbage grown in the highlands of Papua New Guinea. The reasons for this are:

1. The disorder can only be detected by cutting the cabbage open and looking to see if the symptoms are present (i.e. destructive testing), and then obviously the cabbage cannot be sold.

2. Not all of the cabbages will be affected to the same degree. Within the trial a wide variation in severity scores within the same plot was

noticed.

The nature of this disorder leads to problems affecting the whole cabbage growing and marketing industry in PNG. The farmers were supplying cabbages that were affected by tipburn, but the wholesalers were unable to ascertain how severe the problem was until the cabbages were sold, and then rejected by the consumers (after the wholesaler had incurred large transport costs). These costs were being recouped by dropping the price of the cabbages from around 40t/kg to as little as 18t/kg (source: AD, Goroka 1996) reducing the farmers profit margin. This caused many farmers who had been growing cabbage to give up[1]

The Trial

A trial to investigate the effects of boron, calcium and urea application on the number of plants affected by tipburn and its severity was carried out at Mr. John Wak's farm in Kelowa No. 2, 10 km north of Mount Hagen. Mr. Wak has been growing cabbages commercially for about eight years.

Cabbage (cv. Green Coronet) which had been raised in an open nursery by Mr. Wak were planted in 1 metre wide beds with a plant spacing of 75 cms x 40 cms. Each plant received a basal dressing of 30 g NPK (12:12:17 + 2.5 MgO). The trial used a randomised complete block design with four replicates and eight treatments.

The treatments used were calcium applied as either a side dressing or a foliar spray, foliar applied boron as Solubor (H" 20 % boron), urea as a side dressing, or a combination of these. (Note: combinations of two side dressings or two foliar sprays were not used in the trial). Calcium was applied either as a side dressing or a foliar spray, but not both. An untreated control was included for comparison (Table 1).

RATES

Boron Spray - 37g Solubor in 15l water with 10ml SPREADSTIK. Applied 21 days after transplanting.*

* 1 litre of each solution was sufficient to spray approximately 25 plants (0.1g Solubor / plant or 0.7 kg / ha boron, and 0.32g $CaNO_3$ / plant or 4.3 kg / ha calcium).

Calcium nitrate spray - 120g Calcium nitrate in 15l water with 10ml SPREADSTIK. Applied 21 days after transplanting. *

Urea Side Dressing - 150 kg / ha = 4g / plant. Applied 20 days after transplanting.

Calcium ammonium nitrate (CAN) Side Dressing - 480 kg / ha = 13g / plant. Applied 20 days after transplanting.

At harvest all of the cabbages were cut open and the severity of tipburn was scored on a scale of 0 to 10, 0 being no tipburn and 10 being severe tipburn. The weight of each cabbage was also recorded.

Table 1. **Trial treatments.**

TRT	sprays		side dressing	
No.	Solubor	$CaNO_3$	Urea	CAN
1	Control			
2			P	
3				P
4	P		P	
5	P			P
6		P	P	
7	P			
8		P		

RESULTS AND DISCUSSION

None of the treatments had a significant effect on the average yield per plot.

All treatments containing boron had significantly lower numbers of plants affected by tipburn (Table 2). This in turn reduced the average severity of tipburn in the boron treatments.

It should be noted that in the treatments Boron & Urea (treatment 4), and Boron (treatment 7) only two and one plants per entire treatment showed any signs of being affected by tipburn respectively, and the Boron & CAN treatment had no plants affected by tipburn.

The urea alone (treatment 2) had fewer plants affected by tipburn than all other treatments that did not receive boron, but a higher number than all treatments that did receive boron, although these differences were not statistically significant. The reason for this is unclear, and it had been suggested that increased N might promote tipburn (Klaas Osinga, personal communication). This result could be in part due to the fact that the urea benefited the

[1] This problem is exacerbated in PNG as the majority of the farmers are not keeping any record of their finances over successive crops, but rather they tend to consider each crop as a single "batch" and have to feel that they make a profit on each of them (personal observation). It may be argued that if the farmers that gave up had kept better financial records, or were better able to understand them, they would be able to survive the poor prices paid during periods where tipburn was prevalent.

Figure 1. **Tip burn cabbage (a) and healthy cabbage (b)**

(a)

(b)

Table 2. **The effect of different nutrient applications on the occurrence and severity of tipburn.**

Treatment	% Plant affected	Average tipburn severity
Boron & CAN	0.0	0.00
Boron	5.0	0.10
Boron & Urea	8.3	0.29
Urea	38.3	1.32
Calcium nitrate & Urea	51.3	2.44
Calcium nitrate	53.3	2.31
Control (untreated)	73.3	2.24
CAN	75.0	4.49
L.S.D. (5%)	47.6	2.65

Scores: 0 - no tipburn, 10 - severe tipburn.

plants overall health, enabling them to partially overcome the effects of boron deficiency. Since the differences between all treatments were not significant one should not read too much into the slight reduction of tipburn incidence in the plots which received urea.

The CAN alone (treatment 3) showed significantly higher severity of tipburn than treatments 2, 4, 5, and 7. It has been reported (Imai *et. al.*, 1988) that NH_4 - Nitrogen applications are associated with increased tipburn severity. This could be borne in mind when carrying out further trials on tipburn, as it should be possible to increase the chances of inducing tipburn in a trial, which may be necessary as tipburn appears so sporadically.

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