Sweet Potato Blister, a Disease Associated with Boron Nutrition[1]

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Abstract. Sweet potato (*Ipomoea batatas* L.) blister is primarily a superficial disease that develops in stored roots. The cultivar 'Nugget' is particularly susceptible and was used to investigate the role of mineral nutrition of the growing plant on the development of the disease. Results from greenhouse and field experiments demonstrated that the disease developed in roots that received excesses of N, K, and Mg during growth and the disease was prevented by including B in the fertilizer program.

A DISEASE of unknown cause affecting sweet potato roots was described and designated blister by Nielsen (1). The superficial symptoms developed in roots stored 30 or more days and were protruding necrotic hypertrophies under the periderm of affected roots (Fig. 1). The blistered areas ranged from a single small spot to more than half of the root surface. The root surface may have been rough, as in 'Nugget', or smooth, as in 'Goldrush' and 'Centennial'. No organism was associated with the disease nor was it transmitted by core grafting or through sprouts from affected roots. Exposing roots to solar irradiation, warm temperatures, ozone, ultra-violet light and desiccation did not induce symptom development (1). In those studies, blister developed only in 'Nugget' roots grown in pot culture. Therefore, mineral nutrition experiments were initiated. This paper reports the results from greenhouse and field nutritional studies of sweet potato blister.

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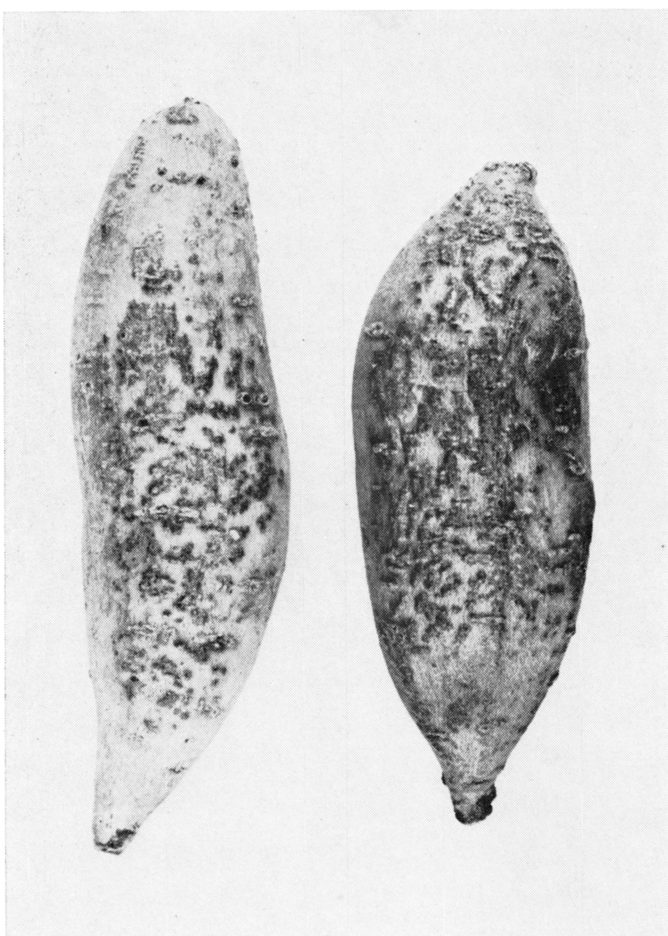

Fig. 1. Blister symptoms on surface of 'Nugget' sweet potato roots.

Materials and Methods

The possible role of plant nutrition on the development of sweet potato blister was tested in sand culture under greenhouse conditions. Single plants of blister-susceptible 'Nugget' were grown in 11-qt plastic pots containing quartz sand. The plants were set June 17, 1963, and received complete nutrient solution for 2 wk. Differential treatments were then started with N, Ca, P, K, Mg, and a mixture of microelements, Zn, Cu, B, and Mn, as the variables. Each pot received 600 ml of distilled water each morning and afternoon except Monday and Thursday afternoons when 600 ml of the differential nutrients were applied.

The plants receiving the treatments were in a randomized block design and grew under natural photoperiod although the greenhouse was fairly heavily shaded and without artificial cooling. At harvest, October 15, the roots were examined for blister and other symptoms, cured 1 wk at 85°F and stored at 55–60°F until April 24, 1964, when final observations for blister symptoms were made. Treatments that resulted in the development of blister in the stored roots were used as variables in 3 field experiments.

Two experiments were conducted in different fields at the Central Crops Research Station, Clayton, North Carolina, in 1964 and 1966. The check treatment consisted of 80 lb N, 26 lb P, and 133 lb K per acre. Calcium, Mg, B, and the other elements were superimposed on the check treatment. These were held constant except where a particular element was varied. All P, Ca, Mg, and microelements and half of the N and K were applied under the row prior to setting with 'Nugget' plants. The remaining N and K were side-placed at the last cultivation. The dosages of the elements, used as variables, are presented with the data in Table 1.

In 1967 an experiment was conducted on a private farm with a history of blister and where commercial fertilizer containing 30 lb N, 26 lb P, and 25 lb K per acre was applied mechanically as rows were prepared for planting 'Nugget'. Prior to that operation, in open rows, we applied 50 lb N per acre to high N plots, 100 lb K per acre to high K plots, and Ca, Mg, lime, and B to plots dictated by treatment. The remaining N and K were sideplaced at the last cultivation to complete the treatments described in Table 1.

Plots were cultivated often enough to control weeds and to maintain and increase the bedded row. For 1964 and 1966 each plot consisted of 4 rows, 42 inches apart and 20 ft long; and in 1967 the plots consisted of 2 rows,

Table 1. Elements applied to establish differential nutritional treatments for sweet potato blister studies. Values are lb/A.

Treatment code	N	P	K	Ca	Mg	B
A. Central Crops Research Station 1964 and 1966						
Low N[a]	40	26	133	—	—	—
High N	160	26	133	—	—	—
High K	80	26	266	—	—	—
High Ca	80	26	133	400	—	—
High Mg	80	26	133	—	120	—
Lime	80	26	133	200	120	—
High B	80	26	133	—	—	1.1
Mn-Zn-Cu[b]	80	26	133	—	—	—
Check	80	26	133	—	—	—
B. Commercial farm 1967						
High N	259	26	60	—	—	—
High K	107	26	248	—	—	—
High Ca	107	26	60	400	—	—
High Mg	107	26	60	—	120	—
Lime	107	26	60	200	120	—
High B	107	26	60	—	—	1.1
Check	107	26	60	—	—	—

[a]Commercial fertilizer applied by farmer while establishing experiment made low N treatment impossible in 1967.
[b]6.2 lb Mn, 1.9 lb Zn, and 4.8 lb Cu added in 1964 and 1966. Insufficient area allocated by farmer to include this treatment in 1967.

30 ft long, separated by a border row of 'Centennial'. Roots were harvested from the central 2 rows in October, cured at 85°F and high relative humidity for 1 wk and stored in a room with a thermostat setting of 55°F. Roots were examined for blister symptoms at monthly intervals from mid-December till mid-April.

Results and Discussion

None of the roots from the greenhouse experiment had blister symptoms when harvested. Plants that received no microelements, however, produced roots with cortical and internal necrosis similar to that described by Nusbaum (2) as boron deficiency. These roots deteriorated in storage. All other treatments received the microelements at a level thought to be sufficient for good growth; i.e., Zn, .25, B .2, Mn .05, Cu .02, and Fe 5.0 ppm respectively. Blister symptoms developed in roots from plants that received high and low N, high K, Ca, and Mg; and no symptoms developed in roots from plants that received the microelements at 3 times the concentrations given above.

The development of blister in the stored roots from field-grown plants that received the various treatments was associated with the nutrients given (Table 2). The application of B was the only treatment that prevented the development of blister. The 0.2% recorded in 1967 for this treatment represents 1 root in 393 examined from the 4 replications. Vines of 'Nugget' may exceed 10–12 ft in length, and this root may have formed on such a vine from a plant in an adjoining plot.

Table 2. Relationship of mineral nutrition of the growing plant to development of blister symptoms in stored sweet potato roots produced in 3 field experiments.

Treatment code[a]	Central Crops Research Station		Commercial farm
	1964	1966	1967
	% of roots with blister		
Low N[b]	3.1	21.8	—
High N	10.2	29.8	33.9
High K	20.1	22.2	35.0
High Ca	2.0	10.8	11.6
High Mg	22.4	15.8	17.5
Lime	26.9	38.4	14.4
High B	0.0	0.0	0.2
Mn-Zn-Cu[c]	0.6	30.5	—
Check	8.6	25.4	19.8
LSD .05	9.2	11.4	15.4

[a]See Table 1 for differential nutrient applications.
[b]Commercial fertilizer applied by farmer while establishing experiment made low N treatment impossible in 1967.
[c]Insufficient area allocated by farmer to include this treatment in 1967.

Roots from plants that received high N, K, and Mg developed more blister each year than those from B-treated plants. In 2 of the field experiments, the most blister developed in roots from the dolomitic lime treatment. The results from the high Mg treatment suggest that the high incidence of blister from dolomitic lime was probably associated with the Mg content rather than the Ca content of the lime as the incidence of blister in roots from the Ca treatment did not exceed, statistically, that from the B treatment.

The check treatment consisted of the N, P, and K applied to the plots as given above for the 2 locations. The relative incidence of blister in roots from this treatment for the 3 years was possibly related to the residual elements in the different soils from earlier applications of fertilizers which resulted in an imbalance as was created with the N, K, and Mg treatments. The addition of B to the check treatment essentially prevented the development of the disease.

These data indicate that blister of sweet potatoes is associated with an imbalance of nutrients in the fertilizer that can be antidoted by supplementing the fertilizer with B.

Literature Cited

1. Nielsen, L. W. 1965. Blister, a new disease of sweet potato. *Plant Dis. Rep.* 49:97–101.
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