Photo 2. Types of off-grade spears characteristic of asparagus harvest during the summer months.

treatment 2. This was not surprising since the vigor and growth of these plants was suggested by the progressive increase in yield with each harvest season (table 1, 2). The low yields and vigor ratings for plants harvested during the summer months indicate that the ability of these plants to produce spears was greatly reduced.

A harvest period in June and July of 60 days limits the growth period of the fern to three months before harvest and approximately three and a half months after harvest in Riverside. This total growth time appears to be sufficient to prevent the loss of stand but not adequate for good growth and plant vigor.

Harvests made later in the summer (treatments 6 and 7) permitted a longer growth period for the fern before the harvest but stored sugars would be utilized on the production of harvested spears and on growth of fern after the cutting season ends.

Since no harvest was made beginning in October and continuing until soil temperature inhibited the production of spears, it is difficult to project the yield for this period. However, the data suggest that a fall harvest may be feasible providing it begins late in the season and continues until the plant becomes dormant, thereby preventing stored sugars from being lost in fern production after the harvest season.

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A research brief . . .

POTASSIUM ROLE found essential IN STOMATAL FUNCTIONING for plant life

RECENT EXPERIMENTS have shed new light on two age-old and seemingly unrelated questions: why potassium is essential for plant growth; and how the stomata on leaves open and close.

Stomata, the microscopic pores formed by paired guard cells in the leaf epidermis, act as valves that simultaneously regulate water loss by transpiration and the entry of CO_2 from the air into the leaf for photosynthesis. It is known that stomata open when guard cells are inflated by the absorption of water. The inflation results osmotically from the build-up of solutes in guard cells. What had not been resolved in more than a half of a century of research is what the solutes are and how they build up to cause the stomata to open.

Solutes

In a series of papers evidence has been presented that solutes are built up to cause to stomata to open through the uptake of potassium by guard cells in osmotic amounts. Potassium is specifically required for opening brought about by light; no other physiological ion can substitute for potassium in this crucial role.

The first important step in this work in the Department of Water Science and Engineering at Davis began when strips of epidermis were obtained from leaves of broadbeans (*Vicia faba*) with their guard cells still functioning as in intact leaves. Such strips eliminated complications caused by other parts of the leaf in studies of stomata. The effects of ions and other chemicals were tested by floating the strips on solutions. When solutions of various ions at dilute and physiological concentrations were used, only potassium (and rubidium) permitted the stomata to open fully in light. Ions such as sodium, ammonium, magnesium, and calcium permitted little or no opening. Radioactive isotopes were used to determine the amount of potassium taken up during the opening process. From these data it was calculated that a sufficient amount of potassium was absorbed to act osmotically to produce the opening. Evidence was also obtained showing that the energy for potassium uptake came from light, probably via the process called cyclic photophosphorylation.

Reverse process

Closing of stomata in the dark is apparently brought about by the reverse process—a loss of potassium from the guard cells, followed by loss of water and deflation. We have demonstrated that potassium concentrations in epidermal strips and guard cells drop in the dark when stomata close.

The discovery of the role of potassium in stomatal function provides one of the long-missing links in understanding the operation of these important valves in leaves. This work also identifies for the first time a detailed physiological process in which potassium is absolutely necessary and cannot be replaced by other ions normally found in plants. It is now clear why potassium deficiency in plants is known to reduce stomatal opening and, therefore, transpiration and photosynthesis.—*G. D. Humble, R. A. Fischer, T. C. Hsiao, Department of Water Science and Engineering, University of California, Davis.*