PEPPERMINT RHIZOME HEALTH AS MEASURED BY ETIOLATED GROWTH

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Abstract

Etiolated growth of peppermint *(Mentha piperita)* rhizomes was investigated as a means to determine vigor. A procedure was developed for measuring etiolated growth and non-structural biomass (NSB). NSB declined from 467 g/kg in April to 314 g/kg in August. Rhizome mass, measured at regular intervals throughout the season on separate plots, showed a gradual increase until harvest in August.

Introduction

Etiolated growth is the growth of plants in the dark, and it can be used as a measure of regrowth. The amount of reserves a plant has available for regrowth is called non-structural biomass (NSB), and can be used to infer the vigor, or health, of the rhizomes. Etiolated growth has been used to characterize alfalfa regrowth potential (Rechel, 1993) and sod reserves (Burton, 1995). This method is being developed in order to measure the efficacy of fall cultural practices on the health of peppermint plants in the fall. It may also have use for comparing rhizome vigor that is diseased or pest-infested. The objective of this study was to develop the etiolated growth method estimating NSB for peppermint. Peppermint rhizome growth was also measured monthly from seperate field[plots.

Methods

On April 13, 1995, four 3 ft. x 30 ft plots at the Central Oregon Agricultural Research Center (COARC) in Madras, were chosen from an established field of peppermint 'Murray Mitcham'. The field was planted in March 1994 and had never been harvested. Plots were selected by visual inspection for uniform stand density.

Samples were taken from randomly selected areas of each of four replications. Samples were dug from 1 x 2.5 ft rectangles to a depth of 4 inches that included rhizomes at least 10 inches in length. Soil was washed from the samples, then eight rhizomes of at least 30-cm length were chosen from the sample Four additional rhizomes (5 to 15 cm long) were also taken from the sample and freeze-dried for fructan analysis. Three additional rhizomes (15 to 23 cm long) were also taken for determination of moisture content. Fine roots and green stems were removed from all rhizomes. From each of the first eight rhizomes chosen, a 23-cm segment was removed. A 3-cm segment was cut from each of these, and fresh and oven-dry weight was determined. Fresh weight were determined for the remaining 20-cm segment that was to be tested for etiolated growth. The 3- and 20-cm segments were tagged with the same plot and plant number for future reference and calculations.
The 20-cm segments were treated with PCNB, pentachloronitrobenzene, to prevent fungal

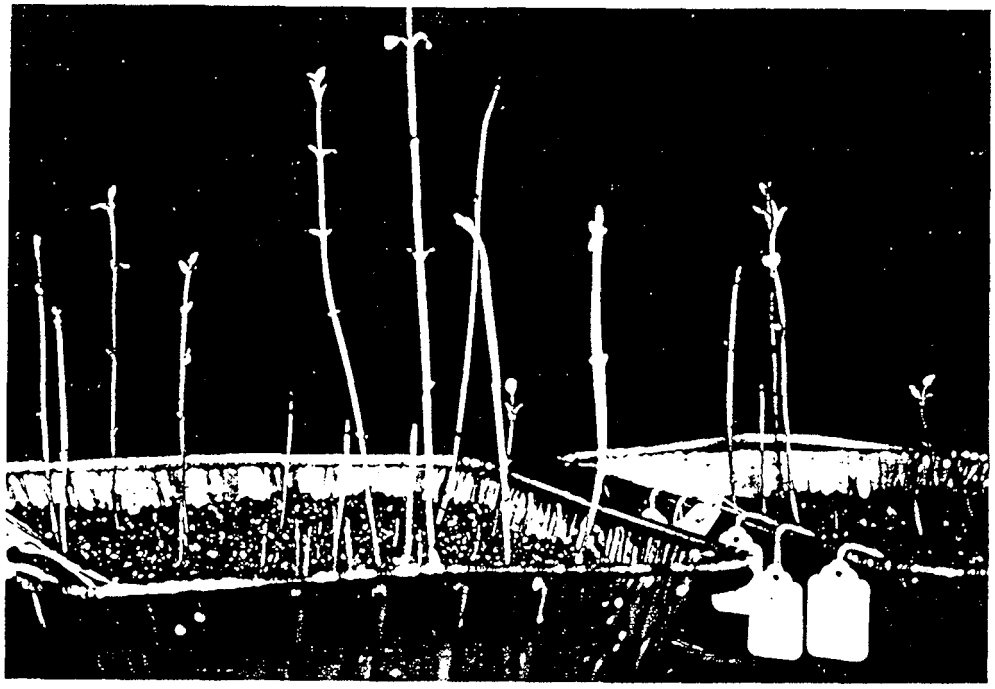

Figure 1. Etiolated growth of peppermint, Madras, Oregon, 1995.

growth during the experiment. Rhizomes were placed in a 1-liter beaker with 6.0 g/1 PCNB and distilled water for five minutes while stirring slowly. The 20-cm segments were then placed 1 cm deep in moist vermiculite located in the dark at room temperature. From the 3 rhizomes selected for determining percent moisture, a segment no greater than 23 cm was removed. A 3-cm segment was cut from this and fresh and oven dry weight determined for this and the remaining segment. The length of the long segment was also recorded.

Etiolated rhizomes were observed periodically until growth ceased. The endpoint was usually manifest by blackening of the tip of the etiolated stern, and usually took four to five weeks. The plants were then separated into either rhizomes or etiolated growth, and the NSB was calculated as the difference between the initial and final dry matter divided by the final dry matter. Visual estimates of black decay on the rhizome were noted. The etiolated growth is shown in Figure 1.

Sampling was repeated in like manner on May 25, June 20, July 20, and on Aug 14, the day after harvest. Sampling also occurred on Sep 14, during post-harvest regrowth, and on October 12. Periodic sampling occurred throughout the season in order to include the variation in NSB in the rhizomes and to validate the method.

Etiolated growth will be compared to other methods of estimating NSB, such as analyzing for fructans or sugars. Earlier, thin layer chromatography (TLC) analysis was used to verify fructan as the major storage carbohydrate. Freeze-dried rhizomes from each of the sampling dates and replicates will be used for sugar analysis. Unfortunately, this data is not available at the time of this report.

For the data on peppermint growth, samples were taken at 14-day intervals from 0.093-m^2 areas

of field 16 at COARC. Components were separated into rhizomes, dead rhizomes, stem-plus-leaves, and fallen leaves.

Results

The NSB declined from 467 g/kg in April to 314 g/kg in August in an approximately linear fashion (Figure 2). Each of the four sampling areas, or replications, is plotted to show the variation between locations. The declining NSB can be attributed to the plant directing more NSB to plant growth as the season progresses. We could anticipate an increase in NSB sometime in the late fall or winter as the plant redirects NSB for survival.

The coefficient of variation (CV) is a measure of the variability of the samples, and is equal to the _ standard deviation divided by the mean. The CV for each replication varied between 10 and 33 percent, and was usually 15 to 20 percent. This means that the method contains some inherent error, but that error can be minimized so that treatment differences may be distinguishable.

The etiolated growth (Figure 3) also declines during the growing season, but takes an upward turn for the August 14 sampling. We have no explanation for this at this time.

Peppermint growth, including rhizome mass, is shown in Figure 4 for a tilled field It the COARC. Because the field was tilled during the winter, the rhizomes mass at about 300 g/m is lower than an established field. The rhizome mass increased before harvest, possibly in response to shorter day lengths and flowering. Then rhizome mass decreased after harvest, and recovered by September.

In conclusion, the etiolated growth appears promising for measuring the NSB and vigor of rhizomes. More measurements are planned to refine the method and test its usefulness in other applications.

References

Burton, G.W. 1995. An efficient method for measuring sod reserves for greenhouse and field studies. Crop Sci. 35:579-580.

Rechel, E.A. 1993. Etiolated growth as a measure of non-structural biomass in lucerne taproots. Ann. Botany 72:103.

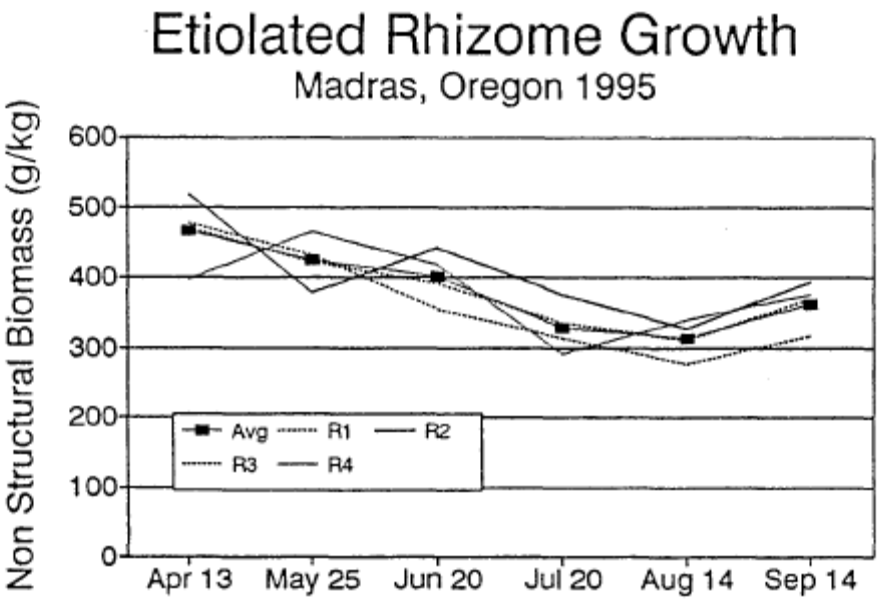

Figure 2. Non-structural biomass of peppermint rhizomes, Madras, Oregon, 1995.

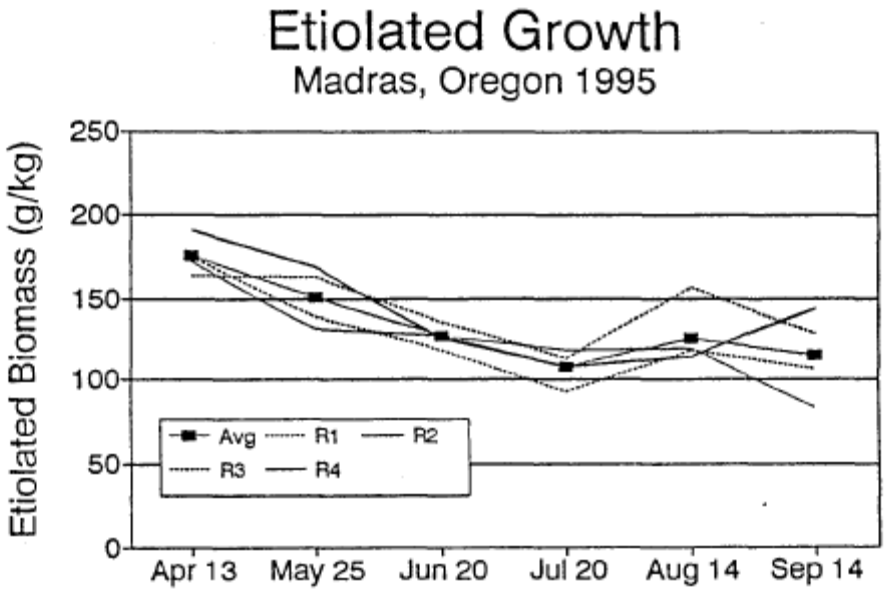

Figure 3. Etiolated biomass of peppermint rhizomes, Madras, Oregon, 1995.

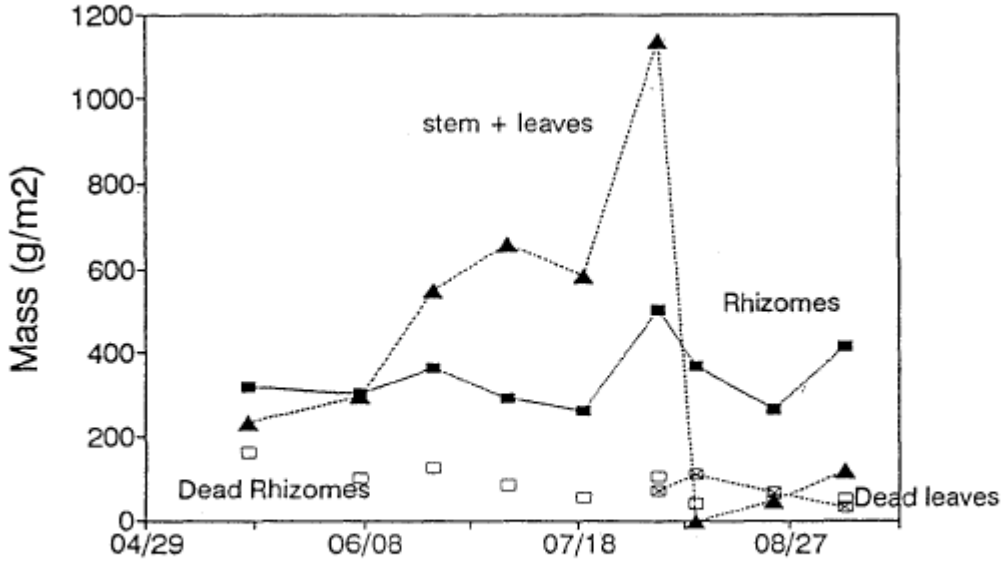

Figure 4. Peppermint growth by rhizomes, stems-and-leaves, dead rhizomes, and dead leaves, Murray Mitcham field 16, Madras, Oregon, 1995.