FALL NITROGEN FERTILITY OF PEPPERMINT

Alan Mitchell and Charissa Yang

Abstract

Nine rates of nitrogen fertilizer were applied on an established peppermint field after harvest in August 1995, to determine whether nitrogen increases fall vigor and subsequent yield of peppermint. Stems and leaves tested in December 1995 showed no response to nitrogen, but rhizome mass was greater for the 60 and 80 lb/ac treatments. Plant nitrogen concentration and etiolated growth measurements did not differ by treatment. Subsequent dry matter and oil yield (70 lb/ac) were also unaffected by nitrogen treatment. Because of the mild winter of 1996, which permitted good survival of rhizomes, more trials are needed to substantiate whether there is a peppermint yield response to nitrogen applied after harvest.

Introduction

While the extent of nitrate leaching under peppermint is highly dependent on the soil inorganic nitrogen (N) at the end of the growing season prior to the rainy winter season, a 1992 survey of peppermint growers showed a high correlation of fall fertilization to increased yields. If fall N fertilization is shown to increase yield the following year, and more growers adopt the practice, then nitrate leaching may be increased. Thus it is important to find the rates and conditions when fall N fertilization may be profitable.

The objective of this study was to determine whether post-harvest N fertilizer application increased the vigor and yield of peppermint. Measurements were taken in the fall after fertilization, in mid-summer, and at harvest the following August.

Materials and Methods

Nine rates of nitrogen (0, 20, 40, 60, 80, 100, 120, 140, and 160 lb/ac) were applied to 27 plots (6 ft by 15 ft) in 3 replications (Fox, 1973). This experimental design was used earlier on studies of peppermint response to nitrogen in the spring (Mitchell and Farris, 1996). Nitrogen fertilizer was applied on 10 August 1995 as ammonium nitrate.

On 15 December 1995, above- and below-ground peppermint was sampled from 1ft^2 areas within each plot. Samples were washed with water and separated into leaf, stem (above-ground), and rhizome/root (below-ground) components. Dead matter was discarded. Leaf, stem, and rhizome/root sample components were oven-dried at 130 °F. Samples were weighed, ground, and analyzed for total Kjeldahl nitrogen.

On 14 March 1996, rhizomes were sampled from the 0, 80, and 160 lb/ac treatments by taking rhizomes from section approximately 1-ft wide, 2-ft long, and 4-inches deep. Rhizomes were washed, trimmed, weighed, tagged, treated with fungicide, buried in moist vermiculite and placed in a dark room according to the procedure of Mitchell and Rechel (1997). Four to five weeks later, when growth had ceased, rhizomes were weighed again to determine the non-structural biomass (NSB) expended by the plant for regrowth.

On 31 July 1996, above-ground plant samples consisting of 10 single stems per plot were taken for stem and leaf measurements. Stem length was measured from soil surface to tip of topmost leaf. Number of leaves directly attached to the main stem and number of leaves attached to branches were counted separately. Fully-expanded leaves and terminal clusters of leaves (including three or more small leaves) were counted as single leaves. Presence of buds was noted. Numbers of branches and of leafed and non-leafed nodes were recorded. Dry weight measurements of stems and leaves were taken.

Harvest occurred 15 August 1996. Plots were cut with an experimental plot harvester. Samples from a 40-inch by 15-ft strip from the center of each plot were weighed fresh for biomass determination. One 10- to 12-lb subsample from this strip was weighed fresh and reserved in a burlap sack for oil analysis, and a second, approximately 0.5-lb subsample was weighed both fresh and dry for percent dry matter determination. To ensure accurate fresh weight measurements, fresh weights were recorded without delay after sampling. Burlap-sack samples were kept outdoors under shelter and turned periodically to allow dissipation and even distribution of moisture before distillation. Oil was distilled directly from burlap-sack samples using the mini-distillery apparatus at the Hyslop farm, Corvallis, OR.

Results

Stem and leaf mass taken 15 December 1995 did not vary significantly among treatments (Figure 1). Rhizome mass, however, appeared to increase with nitrogen application rate through 80 lb/ac and decline with application rates above that level. Rhizome mass was significantly effected ($P \leq 0.02$) by N according to Tukey's ANOVA test. The highest response was for the the 80 lb/ac N treatment which was significantly greater than five of the other treatment levels, according to Fisher's mean comparison test, $P \leq 0.05$. Stem, leaf, and rhizome nitrogen contents were not different between treatments. Etiolated growth measurements, taken in March, did not differ significantly between treatments, although higher N application was associated with higher non-structural biomass and etiolated growth (Table 1).

The July plant sampling likewise revealed little differences in plant growth. The August harvest produced no differences for N rate, with a mean of 2.32 t/ac dry matter and 70 lb/ac oil yield. The mild winter of 1996 likely had no detrimental effect on winter survival of rhizomes, and this may have produced similar yield for all treatments.

Discussion and Conclusion

More trials over several years are needed in order to make reliable conclusions. More severe winters may profoundly influence the survival rates of peppermint rhizomes with different health. If this study's finding on the fall rhizome response to moderate N is real, then there are unanswered questions. Why did the rhizomes not respond to N above the 80 lb/ac rate? Why was the N content of rhizomes not higher for the 60 and 80 lb/ac levels? And ultimately, will fall nitrogen improve winter survivability of rhizomes.

References

Fox, R.L. 1973. Agronomic investigations using continuous function experimental designs—nitrogen fertilization of sweet corn. Agron. J. 65:454-456

Mitchell, A.R., and N.A. Farris. 1996. Peppermint response to nitrogen fertilizer in an arid climate. J. Plant Nutrition 19:955-967.

Mitchell, A.R., and E.A. Rechel. 1997. Peppermint rhizome studies. (This issue).

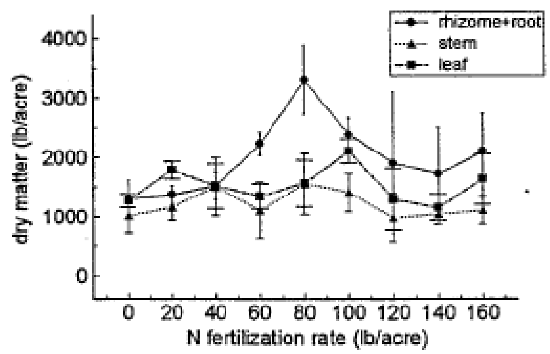

Figure 1. Leaf, stem, and rhizome-and-root dry matter taken 15 December 1995, Madras, OR.

Table 1. Etiolated growth measurements of rhizomes sampled 15 March 1996, Madras, OR.

Treatment	Non-Structural Biomass	Etiolated Growth
(lb/ac fall-applied N)	(g/kg)	(g/kg)
0	656±210*	261±195
80	751±303	344±216
160	846±33	660±232

*arithmetic mean ± standard error