PEPPERMINT RESPONSE TO NITROGEN FERTILIZER IN CENTRAL OREGON[1]

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Abstract

A nitrogen-fertilizer rate study was conducted for two-years to determine optimum response of peppermint (Mentha piperita L.) cv 'Murray' at Madras. The first year, 1993, had a wetter-than-normal spring, while the second, 1994, had above-average temperature. Optimum dry matter yield occurred in the range of 200 to 240 lb/a, while optimum oil yield was 240 to 280 lb/a. These results agree with previous studies on peppermint at various locations.

Introduction

Recent concern with nitrate contamination to groundwater has encouraged the study of crop yield response to nitrogen (N) fertilization. This work was part of a larger research objective to develop new tools for plant-response nitrogen testing containing several N treatments. 'Murray' peppermint (Mentha piperita L.) was used because it is currently grown more prominately now than 'Black Mitcham'. The objective of this trial was to measure the optimal rate of N fertilization for peppermint, while using the N gradient in the field to test instruments that measure the N status of the plant. The results of the instruments will be addressed in a companion report.

Methods

'Murray' was planted in March, 1991 at the Central Oregon Agricultural Research Center on a Madras loam (fine-loamy, mixed, mesic Xerollic Durargid). The field was tilled to a 3-inch depth in February, 1992, to increase plant density. In 1991 and 1992, the years prior to the experiments, the field received 150 lb N/a in 1991 and 250 lb N/a of urea fertilizer, respectively. and were fertilized according to soil sample results in 1993 and 1994. Soil samples taken prior to spring fertilization showed an average of 5 lb N/a in 1993 and 9 lb N/a of inorganic N in the top 12 inches, which N was small relative to the amount of fertilizer applied in the studies.

A complete block design modified by Fox (1973) was used to conserve space while providing information on incremental N rates from 0 to 480 lb/a. In 1993, twenty-five 20-1b/a increments were used beginning with 0, but these were condensed to thirteen 40-1b/a increments in 1994 to insure adequate area for harvest sampling. Plots measured 15 ft by 3.33 ft in 1993, when the entire plot was harvested (50 ft^2), and 15 ft by 6 ft in 1994 with the same amount harvested (50 ft^2). Three replications were used in 1993 and two in 1994.

Urea fertilizer was applied at three times during the season for two reasons. First, we wished to avoid salinity effects of high fertilizer applications, because salinity has been shown to reduce peppermint yields at moderate levels. Second, we also wanted to protect against potential spring rainfall events that could leach the soil N. Hence, N applications were limited to 100 lb N/a for

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the first application, and 150 lb N/a for the second application, as shown in Table 1. Urea fertilizer was applied on April 14, May 26, and July 26, 1993, and on April 13, May 20, and July 11, 1994.

Table 1. Nitrogen rates for three applications

Total	April	June	July
	lb N/a ----------------		
0	0	0	0
20	6.7	6.7	6.7
40	13.3	13.3	13.3
60	20	20	20
80	26.6	26.6	26.6
100	33.3	33.3	33.3
120	40	40	40
140	46.6	46.6	46.6
160	53.3	53.3	53.3
180	60	60	60
200	66.7	66.7	66.7
220	73.3	73.3	73.3
240	80	80	80
260	86.6	86.6	86.6
280	93.3	93.3	93.3
300	100	100	100
320	100	110	110
340	100	120	120
360	100	130	130
380	100	140	140
400	100	150	150
420	100	150	170
440	100	150	190
460	100	150	210
480	100	150	230

Plots were harvested on August 9, 1993, and August 4, 1994. The entire sample was bagged and weighed fresh, a subsample was used for moisture determination, and the remainder was air-dried in burlap bags to await distillation. Distillation occurred at a research distillery at the Central Oregon Agricultural Research Center in Madras, Oregon.

Results

Nitrogen resulting in highly significant effects on dry matter and oil yields, as shown in Figures 1 and 2, respectively. The dry matter yield increased with N to 240 lb/a in 1993, and 200 lb/a in 1994 (Fig. 1). Beyond those levels, no significant yield increase was found. The oil yield response (Fig. 2) also increased with N to 240 lb/a in 1993, which was identical to the dry matter rate, and to 280 lb/a in 1994, which rate was higher than the dry matter rate. The least significant differences, $LSD_{0.05}$, between treatments were 6.1 and 8.2 lbs oil per acre and 543 and 417 lbs dry matter per acre, for 1993 and 1994 respectively.

The similarities in yield response occurred during two contrasting weather scenarios of wetter (1993) and hotter (1994) than the 30-year mean (Taylor). The year 1993 had 6.46 inches of precipitation from March to July, which was 181 percent of the 30-year mean of 3.56 inches. Mean temperatures for 1993 were near the 30-year mean, including a warm May that was 5.7 F above average, but a July that was 6.1 F below average. In contrast, the 1994 growing season was much warmer, being 3.2 F greater than the 30-year mean, including 7.1 greater in July. Precipitation for the 1994 season was merely 10 percent over the average.

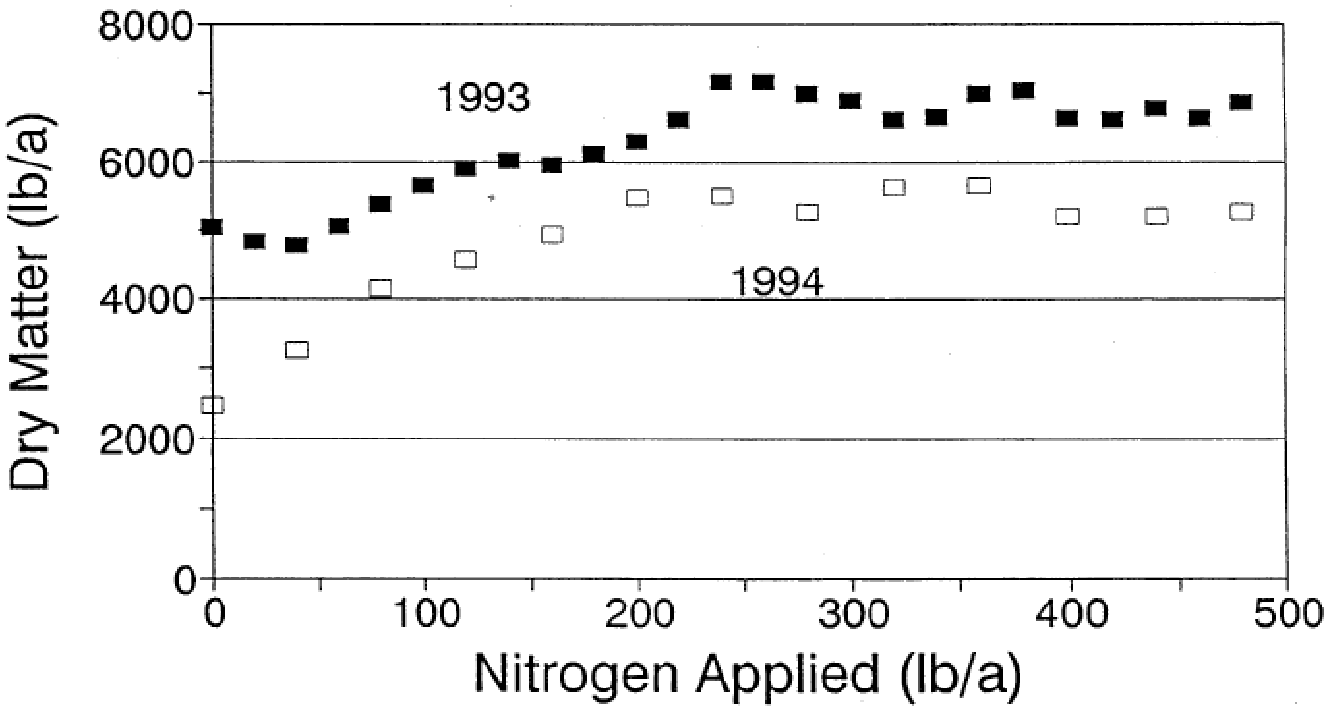

Figure 1. Dry matter response to nitrogen fertilizer, 1993 and 1994, Madras, Oregon

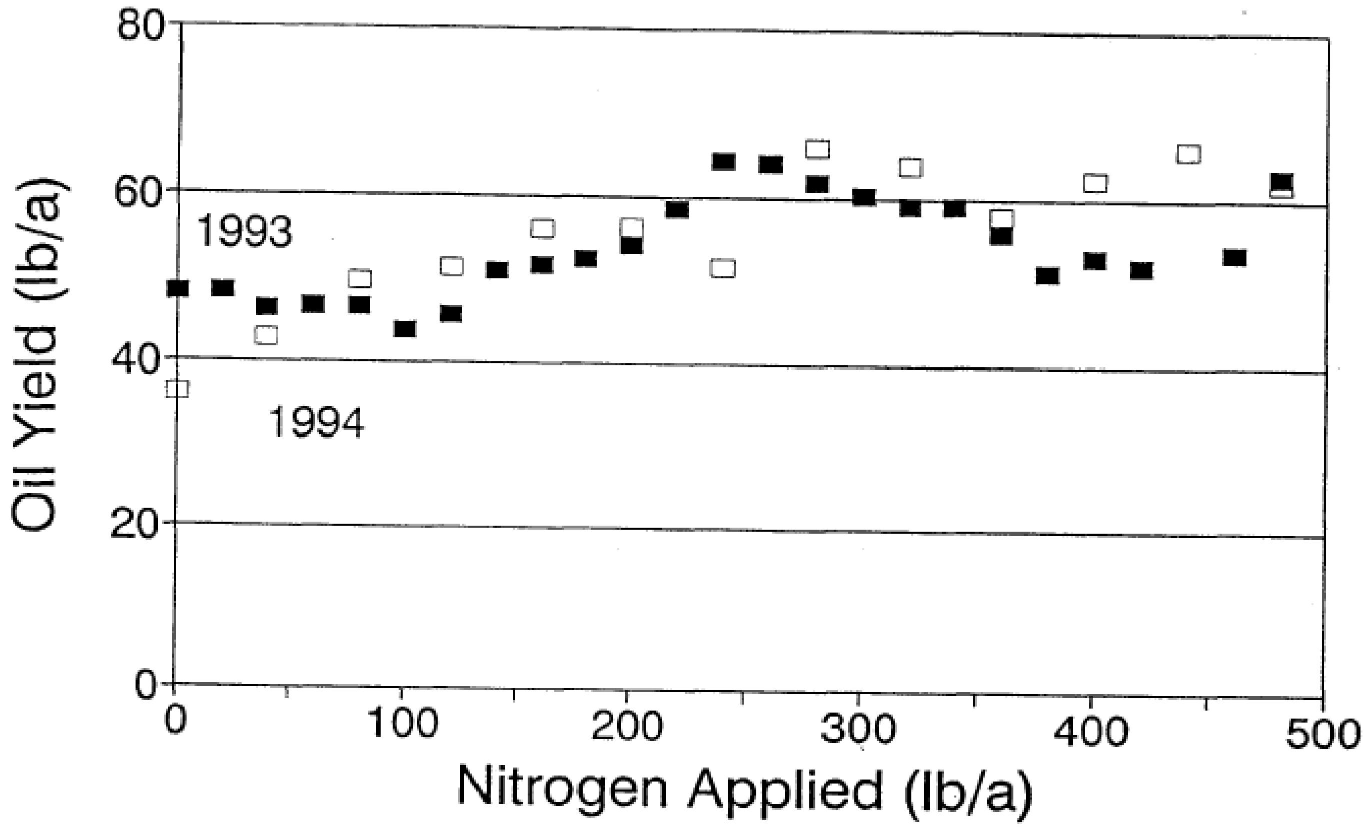

Figure 2. Peppermint oil response to nitrogen fertilizer, 1993 and 1994, Madras, Oregon

Discussion

A previous N-response experiment was conducted in central Oregon by Hee (1974), who concluded that 250 to 300 lb N/a was an optimum range for the 'Black Mitcham' cultivar. The 'Murray' cultivar is thought to be less aggressive, but is now grown because of its resistance to verticillium wilt. Our data suggest that there was little difference in yield response of the two cultivars in central Oregon, and that 250 to 280 lb/a was sufficient for optimum yield.

A separate irrigation-N-fertility experiment by the author, in the same field as this experiment, tested rates of 0, 50, 150, 250, and 350 lb/a of N (Mitchell et al., 1994). There was high variability in 1992, possibly due to high winter carry-over of soil N, and the 50-lb/a treatment resulted in the highest yield. In 1993, 250 lb/a was found to produce the highest oil yield. In 1994, the best-yielding treatment was the 250 lb/a rate applied at three times in the spring

Investigations of N-fertility in other locations in the Pacific Northwest have arrived at nearly the same conclusion. Heuttig (1969) tested five farms in western Oregon for rates from 0 to 450 lb/a, and concluded that 200 lb/a was optimum. Brown (1982) found considerable yield variability in tests in Parma, Idaho, but the largest (nonsignificant) yields were at 400 lb/a in 1980 and 240 lb/a in 1981. Nelson et al. (1971) at Prosser, Washington, found no significant yield difference for N rates between 100 and 600 lb/a when applied as aqua ammonia. Nelson (1971) did find top yields ranging between 200 and 300 lb/a of N for his cultural practice experiment.

In Tasmania, Clark and Menary (1980) found optimum rates at 224 and 336 lb/a. More recently, Wescott et al., (1993) reported the yield for Black Mitchum' to be between 250 and 350 lb/a in Montana during an extremely wet year. All of these studies agree that there is no significant difference in oil yield between 250 lb/a and higher rates. In summary, 250 lb/a should be adequate for yearly spring N-fertilization of peppermint in central Oregon.

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