

SLOW RELEASE N FOR IRRIGATED MINT

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ABSTRACT

Five field trials were conducted in southwest Idaho (1978-81) to evaluate potential slow release alternatives for improving applied N effectiveness for furrow irrigated peppermint and sprinkler irrigated spearmint. Sulfur coated urea and urea applied with N-Serve were evaluated as slow release treatments and other N sources included urea or ammonium sulfate. N sources were evaluated at variable N rates in most trials. Effectiveness of treatments was evaluated using stem nitrates, hay and oil production, N uptake, plant height, residual nitrates after harvest, or mint regrowth. Stem nitrates were typically lower for SCU and N uptake, hay and oil yield were lower in some trials than for other N sources similarly applied. SCU did not generally release N at rates that met the N requirements of rapidly growing mint. Early season urea knifed with N-Serve was more effective than SCU and in some cases urea alone.

INTRODUCTION

Nitrogen management for peppermint, a perennial, is challenging for a number of reasons. There is little opportunity for mechanical incorporation of fertilizers for fear of reducing the mint stand. Fertilizer N is generally topdressed so there is potential for ammonia volatilization from ammoniacal N. The amount of N that can be safely applied to the foliage is limited due to the potential for foliar burn. Since foliar burn can be an issue when there is leaf surface, N is frequently applied early in the season before appreciable mint growth. The early applied N also takes advantage of greater rainfall in late winter/early spring to help incorporate the N applied. But early applied N is also more subject to leaching in furrow irrigated systems and/or movement to bed centers with repeated irrigation (1,2).

Studies have been conducted with furrow irrigated mint to evaluate split applied N in the irrigation water in order to overcome the problems associated with early season applied N. Nelson (5) found no advantage to split applied N using NH₄OH in the irrigation water.

Management of N for mint is simplified with sprinkler irrigation as the overhead watering provides the opportunity for movement of N into soil. Injected N can also be applied periodically more in concert with the needs of the plant without risking foliar burn. Slow release N in the form of Polyon coated urea was evaluated by Mitchell (3,4) in sprinkler irrigated peppermint in Oregon. While the Polyon coated urea was useful under excessive sprinkler irrigation, at more optimum irrigation amounts the Polyon material did not provide an advantage in hay or oil production.

Slow release N sources had not been evaluated for furrow irrigated mint. Therefore the objective of these studies was to evaluate sulfur coated urea (SCU) and urea with N-ServeTM (UNS) for peppermint and spearmint.

METHODS

A series of field experiments with peppermint or spearmint were conducted from 1978 to 1981 as described below. All knifed treatments were applied using a belt applicator. Topdressed treatments were spread by hand. All tissue samples were oven dried at 65° C for 24-48 hours and ground in a Wiley Mill to pass a 40 mesh screen. Stem nitrates were analyzed with a

specific ion electrode. Total N was determined by Kjeldahl. Oil content of hay was determined in most trials using an experimental mint still. The dried hay was packed into 16 qt pressure cookers and steam introduced from the bottom. Steam was condensed and the oil separated from the distillate in a separatory funnel fabricated with a graduated cylinder at the top for measuring the volume of oil captured. All data from the trials below were analyzed using analyses of variance procedures available in SAS.

1978 Parma

An experiment was established at the University of Idaho Parma Research and Extension Center in 1st year peppermint. Nitrate in the 1st and 2nd foot averaged 6.6 and 9.1 ppm, respectively. Urea (UR) and SCU-30 (37% N) were knifed 3-4" deep on April 18 into bed shoulders (8" to the side of the furrow center). The SCU-30 was obtained from the National Fertilizer Development Center and had a reported release rate of 30% in the first week. The UR with the nitrification inhibitor N-Serve™ (UNS) was knifed April 25 into bed shoulders. Knifed treatments were applied using a belt applicator. Significant rainfall (1.4") occurred intermittently over the next three days. Over a month later ammonium sulfate (AS) was topdressed May 25 with no incorporation. All fertilizers were applied at three N rates (50, 100, and 200 lb N/A). Treatments were arranged in a randomized complete block with six replications. Individual plots were four beds wide (128") and 40 feet long.

Topdressed AS caused some foliar burn. By May 30 visual differences were evident among the N treatments with top-dressed AS the lightest in color and appearing to have the least growth. The field was sprayed with Orthene June 6 (0.5 ai/A) to control the cabbage looper.

Stem tissues (25 from each plot) were collected June 13, July 3, and July 25. Plant heights were recorded June 26. The peppermint was harvested beginning August 7 and finished the following day. Fresh weight from the two center beds of each plot (5.33') was measured for a distance of 30' (160 ft²). Three sub samples of weighed fresh weight were collected into burlap bags and placed into frozen storage for later drying, and oil distillation.

Soil samples were collected from the 0-12" and 12-24" depth of bed centers on August 17. Samples from each rep were composited for each treatment. Soil samples were air-dried and ground and the nitrates determined at the Analytical Service Lab in Moscow using Cadmium Reduction. The field was subsequently irrigated to support peppermint re-growth.

1979 Apple Valley

Knifed N treatments (UR, SCU, and UNS) were evaluated at three rates (50, 100, and 200 lb N/A) in established peppermint at Apple Valley north of Parma. Treatments were arranged in a randomized complete block with four replications. Initial N measured less than 20 lb/A to a depth of two feet. Treatments were knifed May 4 and 5 into bed shoulders. Beds were 32" wide and were reformed using a rotary corrugator after the treatments were applied. Individual plots were 6 beds wide and 60' long. Peppermint stem samples were collected June 19, July 3, July 18, and July 31. Fresh weight was measured from a 3' swath using a Lawn Genie for a distance of 57' (171 ft²). Fresh weight subsamples were collected for later distillation, dry matter and N content determinations.

1980 Parma

Knifed N treatments (UR, SCU, and AS) were evaluated at four rates (50, 100, 200, and 400 lb N/A) in established peppermint at the Parma R & E Center. Treatments were arranged in

a randomized complete block with six replications. Individual plots were three beds (32" beds) wide for a distance of 40 feet. Treatments were knifed May 2 into bed shoulders. Peppermint stem samples were collected May 21, June 3, June 18, July 1, July 14, and July 28. Peppermint fresh weight from a 3' Lawn Genie swath for a distance of 37" was measured August 5 and 6. Fresh weight subsamples were collected for subsequent oil distillation, dry matter, and N content determinations. Plant regrowth was measured October 26.

1980 Greenleaf

SCU and AS were topdressed to established sprinkler irrigated spearmint in Greenleaf at three N rates (50, 100, and 200 lb/A) on May 8-9. Residual nitrate-N measured less than 16 lb/A to a depth of 24". Treatments were arranged in a randomized complete block with four replications. Individual plots were 10' by 60'. Stem samples were collected May 22, June 6, and June 20. Spearmint was harvested July 3 from 120 ft² and fresh hay subsamples saved for subsequent dry matter and total N content.

1981 Parma

Treatments for established peppermint of UR or SCU knifed into bed shoulders at the 120 or 240 lb N/A rate on May 27 were arranged in a randomized complete block with six replications. Individual plots measured 15' wide and 40' long. Mint was furrow irrigated as needed. Peppermint stem samples were collected June 8, July 6, July 20, and August 3, 1981. Fresh biomass yield was measured from 80 ft². Two burlap bags of fresh cut hay were filled from the total fresh weight, weighed, and stored in the greenhouse for later distillation. Fresh hay samples were also taken for a dry matter and total N determination.

RESULTS

1978 Parma 1st year Peppermint

Knifing of treatments uprooted some plants and covered adjoining plants. Significant leaf burn occurred from the delayed topdress of AS. Plant heights were lower on June 26 with topdressed AS (39.7") than with the earlier knifed UR (41.7") or SCU (42.5") but did not differ from the UNS (40.9"). Heights were unaffected by N rates. Stem nitrates increased with higher N rates on each sampling date and declined with each sampling as the plants matured. Nitrate concentrations were consistently lower with the delayed topdress of AS than with the earlier knifed treatments. Stem nitrates for UNS averaged higher than for SCU on the last two samplings and higher than for UR on the last sampling date. Peppermint fresh weight at harvest increased with the two highest N rates. Fresh weight was greatest with UR and lowest with both topdressed AS and knifed UNS. SCU did not differ in hay yield from the other N treatments. Bed center nitrates in mid August were apparently increased with applied N and averaged higher for UR than for the other treatments. Hay and oil production, as well as stem nitrates, were low in this trial even for first year mint. It is not clear why the mint was not more responsive.

1979 Apple Valley established Peppermint

Stem nitrates increased with added N and declined with each successive sampling. Stem nitrates were highest in mid June with UR, but by early July stem nitrates for UR were lower than with other N sources. From mid to late July, stem nitrates were highest with UNS. Fresh and dry hay production increased with increasing N but did not differ among N sources. Hay oil content on a dry matter basis averaged low for this site (0.61 %) in part due to contamination of

the fresh weight with soil picked up during the flail chop harvest. Oil yield was not significantly affected by N rates or sources. Nitrogen uptake more than doubled with applied N, was lowest for urea and highest for UNS. Peppermint re-growth by October was greatest with the highest N rate and significantly less for UR than for slow release treatments.

1980 Parma established Peppermint

Nitrogen increased N uptake, hay and oil yield, and stem nitrates. Stem nitrates were highest for knifed AS and lowest for SCU from mid May through mid July, but N uptake and oil yield did not differ among N sources.

1980 Greenleaf established Spearmint

Spearmint hay yields, N uptake, and stem nitrates were increased with increasing N rates. Spearmint fresh weight and N uptake were significantly lower for topdressed SCU than for AS. Stem nitrates also were consistently lower for SCU.

1981 Parma established Peppermint

The SCU resulted in significantly lower fresh weight, oil yield, and N uptake at harvest than knifed urea in 1981. Stem nitrates also were consistently lower with SCU.

SUMMARY

SCU knifed on bed shoulders of furrow irrigated mint or topdressed under sprinkler irrigation generally resulted in lower stem nitrates than for UR and in some cases significantly less hay, N uptake, and oil production. SCU also resulted in lower residual nitrates in soils after harvest but promoted better fall regrowth than UR. The results suggest that the SCU materials used in these studies did not release N sufficiently to meet the requirements of rapidly growing peppermint or spearmint under these conditions. Knifed UNS resulted in higher stem nitrates than knifed SCU or UR. N-ServeTM is not labeled for mint but the results indicate that when combined with urea in the band, it was the better of the two delayed release N treatments. The AS was only more effective than SCU when knifed.

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Table 1. First year peppermint response to N sources and rates. Parma, 1978.

	Fresh	Dry	Oil	June	Stem Nitrates			Bed ¹
	Weight	Matter	Yield	Height	June 13	July 3	July 25	Nitrates
	T/A	T/A	lb/A	in	-----ppm-----			ppm
<u>N Rate</u>								
50	5.9	1.03	22	16.5	2907	1809	1072	26
100	6.7	1.10	22	16.2	2895	1925	1176	35
200	<u>6.9</u>	<u>1.09</u>	<u>22</u>	<u>15.9</u>	<u>3119</u>	<u>2316</u>	<u>1750</u>	<u>62</u>
LSD _{.10}	0.8	0.11	3	1.9	190	227	208	--
<u>N Source</u>								
UR	7.2	1.20	23	16.4	3081	2256	1435	62
SCU-30	6.4	1.07	23	16.7	3031	2021	1218	27
UNS	6.4	1.03	21	16.1	3161	2353	1705	32
AS	<u>6.0</u>	<u>1.01</u>	<u>21</u>	<u>15.6</u>	<u>2620</u>	<u>1435</u>	<u>970</u>	<u>42</u>
LSD _{.10}	0.9	0.13	4	1.7	220	262	240	--

¹Soil nitrates (0-24") in bed centers after harvest. Treatments composited across reps

Table 2. Peppermint response to knifed N rates sources and rates. Apple Valley, 1979.

	Fresh	Dry	Oil	N	Stem Nitrates				Height
	Weight	Matter	Yield	Uptake	6/19	7/3	7/18	7/31	
	T/A	T/A	lb/A	lb/A	-----ppm-----				cm
<u>N Rate</u>									
50	9.98	2.49	46.2	50.1	1809	511	370	278	7.7
100	11.37	2.84	51.8	72.4	4160	1360	546	263	9.2
200	<u>13.33</u>	<u>3.33</u>	<u>47.6</u>	<u>109.2</u>	<u>9393</u>	<u>4139</u>	<u>2412</u>	<u>1850</u>	<u>12.7</u>
LSD _{.10}	4.2	0.58	10.1	12.9	945	445	452	172	1.5
<u>N Source</u>									
Urea	11.2	2.79	50.0	63.8	6151	1637	811	452	8.5
SCU-30	11.7	2.94	48.9	78.1	4920	2102	917	568	11.0
Urea/NSV	<u>11.8</u>	<u>2.92</u>	<u>46.7</u>	<u>89.8</u>	<u>4290</u>	<u>2270</u>	<u>1599</u>	<u>1372</u>	<u>10.2</u>
LSD _{.10}	3.6	0.58	10.1	12.9	945	445	452	172	1.5

Table 3. Peppermint response to knifed N rates and sources and rates. Parma, 1980.

	Fresh	Dry	Oil	N	Stem Nitrates					
	Weight	Matter	Yield	Uptake	5/21	6/3	6/18	7/1	7/14	7/28
	T/A	T/A	lb/A	lb/A	-----ppm-----					
<u>N Rate</u>										
50	6.7	1.59	25.0	26.6	5244	2531	518	216	244	154
100	9.6	2.18	28.8	45.1	7592	5490	1923	522	310	204
200	11.9	2.37	40.7	58.8	8976	8090	5180	2751	1251	572
400	<u>14.3</u>	<u>2.84</u>	<u>50.0</u>	<u>91.9</u>	<u>9746</u>	<u>9864</u>	<u>7743</u>	<u>5761</u>	<u>3500</u>	<u>1848</u>
LSD _{.10}	0.8	0.20	6.4	6.0	702	500	499	569	545	361
<u>N Source</u>										
Urea	11.2	2.35	35.1	47.5	8995	6551	4318	2448	1443	709
SCU-30	9.8	2.03	34.6	58.1	5364	4432	2359	1510	933	508
AS	10.9	<u>2.36</u>	<u>38.7</u>	<u>61.2</u>	<u>9310</u>	<u>8499</u>	<u>4845</u>	<u>2979</u>	<u>1576</u>	<u>867</u>
LSD _{.10}	0.7	0.18	5.6	5.2	608	433	432	493	472	313

Table 4. Spearmint response to topdressed N rates and sources. Greenleaf, 1980.

	Fresh	Dry	N	Stem Nitrates			
	Weight	Weight	Uptake	May 22	June 6	June 20	July 1
	T/A	T/A	lb/A	-----ppm-----			
<u>N Rate</u>							
50	9.8	1.77	53.0	2962	3142	913	738
100	13.1	2.19	80.3	3154	6071	3055	3300
200	<u>14.0</u>	<u>2.23</u>	<u>101.2</u>	<u>3651</u>	<u>8116</u>	<u>6446</u>	<u>5967</u>
LSD _{.10}	0.9	0.32	13.4	907	978	734	843
<u>Source</u>							
AS	13.0	2.08	85.7	3862	7487	4318	3896
SCU	<u>11.5</u>	<u>2.05</u>	<u>70.6</u>	<u>2649</u>	<u>4065</u>	<u>2625</u>	<u>2774</u>
LSD _{.10}	0.4	0.26	11.0	740	799	599	688

Table 5. Peppermint response to knifed N rates and sources. Parma, 1981.

N Source	N Rate	Fresh	Dry	Oil	N	Stem Nitrates			
	lb/A)	Weight	Weight	Yield	Uptake	6/15	6/23	7/6	7/20
	T/A	-----lb/A-----			-----ppm-----				
Urea	120	10.4	4244	56.9	69.3	7483	13933	7783	1791
Urea	240	13.6	5343	75.5	107.8	7500	14150	9750	5033
SCU	240	<u>11.2</u>	<u>4528</u>	<u>65.6</u>	<u>83.2</u>	<u>6075</u>	<u>12600</u>	<u>6300</u>	<u>2783</u>
LSD _{.10}		1.9	2665	9.5	21.5	1381	1075	1024	1109