3-1990

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AGRONOMY NOTES

Vol. 23, No. 3, March 1990

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Relatively large amounts (1500 to 3000 lbs per acre) of inorganic fertilizers are commonly broadcast preplant in the production of burley tobacco. Such high rates of fertilizer increase both the salt content of the soil solution and soil acidity, often causing reduced stands, manganese toxicity, plant molybdenum and calcium deficiencies, delayed growth and maturity, and reduced yield and quality of cured leaf. Manganese toxicity alone is thought to cost growers 30-40 million dollars each year from yield loss and the costs associated with growing extra acreage the following year to make up their quota. Improved fertilizer management systems are needed to increase early plant growth and fertilizer use efficiency. The objective of this study was to determine the effect of banding fertilizer 10 to 12 inches to the side of the row, as compared to preplant broadcast applications, on concentration of manganese and growth of burley tobacco during the early season.

Experimental Procedures

A field experiment was conducted at Lexington during two years (different sites) on Maury silt loam soil (Typic Paleudalf). Initial surface soil chemical characteristics each year were pH, 6.1 and 6.3; Bray 1 P, >336 lbs per acre (very high) at both sites; and exchangeable K 481 (very high) and 300 (high) lbs per acre, respectively. The experimental areas had been in tobacco and grass-clover sod prior to plowing.

Treatments consisted of four rates of a complete fertilizer totaling 775, 1550, 2325, or 3100 lbs per acre and three

placement treatments: (1) broadcast, (2) drill-bands located 8 inches to each side of the row, and (3) drill-bands located 16 inches to each side of the row. The fertilizer was formulated from a mixed fertilizer (grade 5-10-15) supplemented with NH_4NO_3 and K_2SO_4 to produce a 2:1:2 ratio of $N:P_2O_5:K_2O$ at each rate. Amounts of N were equivalent to 100, 200, 300 and 400 lbs per acre; rates of P_2O_5 were equivalent to 50, 100,150 and 200 lbs per acre; and rates of K_2O were equivalent to 100, 200 300, and 400 lbs per acre. The broadcast treatments were disked into the soil surface each year 10 days prior to transplanting burley tobacco (KY 14) and the band treatments were made with a tractor-mounted applicator two weeks after transplanting. Plant samples were taken at 35 days after transplanting for growth and manganese measurements.

Results and Discussion

Effect of Fertilizer Rate and Placement on Manganese Content

Concentration of manganese at 35 days after transplanting increased nearly 4 fold in broadcast treatments as rate of fertilizer increased from 775 to 3100 lbs per acre (Table 1). In contrast, manganese concentration was unaffected by rate of fertilizer in the 16 inch band treatment. The effect of rate on manganese concentration in the 8 inch band treatment was intermediate to that of broadcast and the 16 inch band treatment. When the fertilizer was broadcast, a positive linear relationship existed between plant manganese content and rate of fertilizer (Fig. 1). However, with band treatment, manganese content did not increase with rate of fertilizer.

Effect of Fertilizer Rate and Placement on Growth

Dry weight of tobacco plants at 35 days in plots with the fertilizer bands placed at 16 inches from the row was highest of all method treatments and essentially unaffected by rates of fertilizer (Fig. 2). Plant weight was somewhat reduced at the lowest rate (775) and the highest rate (3100) when fertilizer was broadcast. In contrast, when fertilizer was applied in the 8 inch band, plant dry weight was greatly reduced by rates greater than 775 lbs per acre. Reasons for the decreased weight in the 8

inch band treatment with increasing fertilizer rate are unknown but may have been due to the greater amounts of fertilizer salt and soil manganese near the row in this treatment. Previous work showed the salt content and manganese concentration of the soil solution in the center of the fertilizer bands to be higher than in broadcast treatments. Also, some difficulty was encountered with the tractor mounted application equipment in keeping the band exactly 8 inches from the row during treatment; hence some of the fertilizer in this band could have been closer to the row than 8 inches.

Effect of Fertilizer Rate and Placement on Occurrence of Manganese Toxicity Symptoms

Visual symptoms of manganese toxicity occurred only in leaves of plants growing in plots receiving the two highest rates of broadcast fertilizer. And, although plant dry weight was lowered in the 8 inch band treatment, the concentration of manganese in this treatment (220 to 260 ppm) was considerably below the 400 to 600 ppm concentration that commonly results in visual symptoms of toxicity. However, it is not necessary for visual symptoms to be present in order for dry weight to be reduced. In previous field studies, plants of tobacco with 250 ppm manganese at 40 days after transplanting were 17% smaller than plants containing 150 ppm manganese. In that study, visual symptoms of toxicity occurred only in tissue containing greater than 350 ppm manganese.

SUMMARY

Previous work has shown that many of the problems occurring during early growth of tobacco can be eliminated by properly liming soils to pH 6.4 to 6.6 one to two years prior to growing the crop. The data of this study, together with previous work, suggests that banding high rates of fertilizer at least 10 to 12 inches from the row should also alleviate many of the early growth problems attributed to manganese toxicity. Since nitrogen fertilizers (particularly ammonium forms) contribute greatly to fertilizer induced soil acidity, the banding effects on Mn toxicity in the current study were primarily the result of moving

nitrogen away from the plant. Hence, we recommend that 75-80% of the nitrogen fertilizer be banded 10 to 12 inches to the side of the row after transplanting for lowest plant manganese and improved growth.

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Table 1. Effect of rate and method of fertilizer application on plant manganese concentration after 35 days growth.

Rate of Fertilizer	Application Method			Mean
	Broadcast	Band at 8"	Band at 16"	
Lbs/Acre		Plant Manganese, ppm		
775	110	176	167	151
1550	229	256	182	222
2523	288	261	185	245
3100	423	222	176	274
Mean	263	229	178	

Total lbs/A of N-P-K fertilizer.

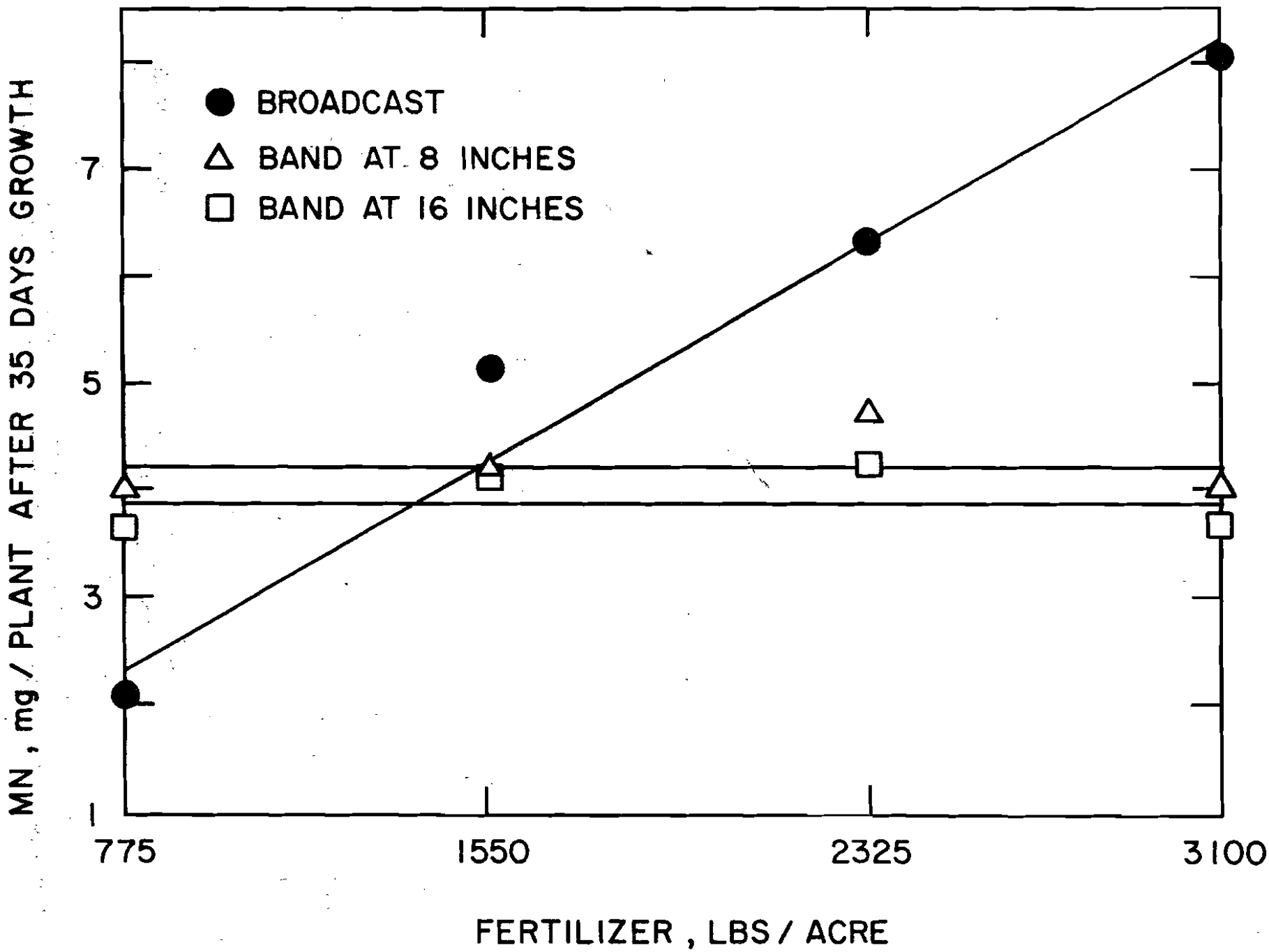

Figure 1. Effect of Fertilizer Rate and Placement on Mn Content of Burley 35 Days After Transplanting.

Figure 2. Effect of Fertilizer Rate and Placement on Weight of Burley 35 Days After Transplanting