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Soil Test Potassium As An Indicator of Tobacco Response to Band Application of Fertilizer

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During the past 10 years, several studies have been conducted at Lexington on the University of Kentucky Experiment Farm to compare the effect of banding fertilizer 10 to 12 inches to each side of the row with preplant broadcast applications on growth and yield of burley tobacco. Generally, banding most of the nitrogen and potassium has led to fewer problems with salt and manganese toxicity and to improved growth during the early season. However, as compared to broadcast application, banding has had varying effects on cured leaf yields. In some experiments banding resulted in higher yields, in other experiments in lower yields, and in still other experiments no difference in yields. Additional experiments on farmer fields were conducted to identify soil chemical factors related to yield response to banding.

Experimental Procedures

Experiments using varying soils, rates of N-P-K fertilizer, starter fertilizer, and placement methods, were conducted on farmer fields in Kentucky during 1980 to 1986. Initial plow layer soil test phosphorus at all locations was Bray-1 P greater than 50 lbs per acre (high-medium to very high), and ammonium acetate extractable potassium was 115 to 360 lbs per acre (low to high). Amounts of nitrogen fertilizer added ranged from 100 to

400 lbs N per acre, phosphorus from 115 to 460 lbs P_2O_5 per acre, and potassium from 80 to 480 lbs K_2O per acre. All fertilizer was either broadcast 10 days to 2 weeks prior to transplanting or banded 12 inches either side of the row 1 to 2 weeks after transplanting.

Results and Discussion

The locations, treatment characteristics, and results of the experiments are shown in Table 1. The effect of method of application varied widely as indicated by the column of data for yield difference (band treatment yield - broadcast treatment yield). Contrasted to broadcast treatments, yields for band treatments were higher in some experiments, lower in some experiments, and equal in some experiments. This was similar to results of research conducted earlier.

To help explain the variable responses for placement methods, linear regressions of differences in cured leaf yield on initial soil test phosphorus or potassium, and on added fertilizer nitrogen, phosphorus, or potassium were made using data from the on-farm tests and from earlier experiments. From among the above variables, only the relationship of yield difference and soil test potassium was statistically significant ($r = 0.47^{**}$). Including initial soil test phosphorus or added nitrogen, phosphorus, and/or potassium fertilizer together with initial soil test potassium values in multiple regression models did not improve the prediction of yield difference.

A linear plateau regression model was fitted to the data for yield difference versus soil test potassium and the data plotted in Fig. 1. The data points of Fig. 1 represent values for various rates of N-P-K fertilizer added in each year and are averages of three or more replicates. Hence, more than one pair of observations occurs at a given location.

A positive, linear relationship existed for the regression of difference in cured leaf yield on ammonium acetate extractable soil potassium in the range of 113 to 270 lbs potassium per acre ($r^2 = 0.40^{**}$). The data suggest that placement of N-P-K fertilizer in two bands located 12 inches to each side of the row

reduced yield compared to broadcasting when soil test potassium was less than 225 lbs per acre but increased yield when soil potassium was greater than 225 lbs per acre. These data are in sharp contrast to those commonly reported for corn which show that responses to banding phosphorus or potassium are more likely on soils testing low with respect to the nutrient.

Reasons for the relationship of yield difference and soil test potassium (Fig. 1) are not known but are the subject of continued research. Perhaps at low soil potassium levels, an insufficient number of roots may have been fertilized in band treatments to meet the potassium needs of the plant, as contrasted to broadcast treatments. At high soil test potassium levels, greater growth and yields may have resulted from a reduction in toxic manganese levels and fertilizer salt injury, and to a more favorable balance between potassium and other nutrients in band treatments. The linear regression revealed that yields from band and broadcast treatments were equal when initial soil test potassium equalled 225 lbs per acre.

These data suggest that with additional research, fertilizer recommendations for tobacco may include not only the rate of fertilizer to apply but also the best method of application. Currently, we suggest that 75-80% of the nitrogen be banded 10 to 12 inches to the side of the row after transplanting while most of the potassium and all of the phosphorus be broadcast preplant or placed near the row.

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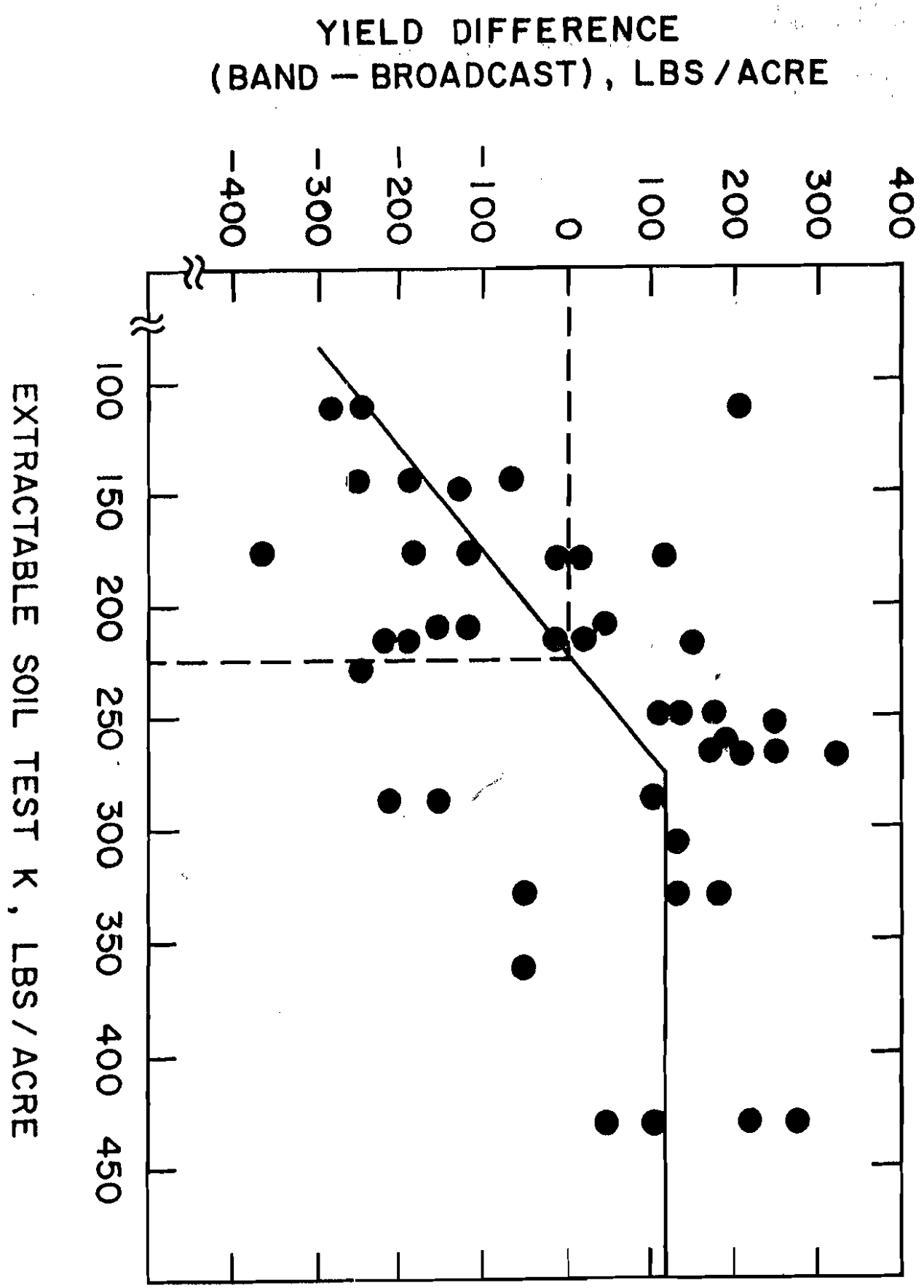
Table 1. Experimental site characteristics, cultivar, yield, and yield differences for band and broadcast fertilizer treatments.

County location	Soil series	Extractable K	Added K	Cultivar	Leaf yield		Yield difference (Band-Broadcast)
					Band	Broadcast	
		Lbs/Acre	Lbs/Acre		Lbs/Acre		Lbs/Acre
Mason	Lowell	113	200	MS Burley 21 x KY 10	2911	3185	-274*
Mason	Lowell	113	300	MS Burley 21 x KY 10	2698	2940	-242*
Mason	Lowell	113	400	MS Burley 21 x KY 10	2881	2681	200+
Fayette	Maury	179	300	KY 14	1841	1955	-114 NS
Fayette	Maury	179	65	KY 14	2499	2481	18 NS
Fayette	Maury	179	130	KY 14	2676	2548	128 NS
Fayette	Maury	179	260	KY 14	2737	2917	-180 NS
Fayette	Maury	180	190	KY 14	2569	2573	- 4 NS
Anderson	Elk	180	250	R-711	3809	4174	-365**
Anderson	Mercer	212	150	MS Burley 21 x KY 10	2532	2695	-163 NS
Anderson	Mercer	212	225	MS Burley 21 x KY 10	2654	2777	-123 NS
Anderson	Mercer	212	300	MS Burley 21 x KY 10	2858	2777	81 NS
Fayette	Maury	215	300	KY 14	3346	3321	25 NS
Anderson	Elk	229	250	R-711	3161	3400	-239*
Calloway	Grenada	250	65	Madole	2491	2367	124 NS
Calloway	Grenada	250	130	Madole	2538	2354	184 NS
Calloway	Grenada	250	260	Madole	2462	2334	128 NS
Franklin	Maury	254	300	KY 14	2963	2724	239*
Anderson	Mercer	265	150	MS Burley 21 x KY 10	3815	3633	182*
Anderson	Mercer	265	225	MS Burley 21 x KY 10	3766	3583	183*
Fayette	Maury	306	300	KY 14	3257	3128	129 NS
Calloway	Grenada	330	200	Madole	2729	2598	131+
Calloway	Grenada	330	200	Madole	2708	2540	168*
Calloway	Grenada	332	200	Madole	1775	1834	- 59 NS
Fayette	Maury	362	200	KY 14	2885	2932	- 47 NS

**, *, and + Significant at P≥ 0.01, 0.05, and 0.10 probability levels. NS = Nonsignificant.


YIELD DIFFERENCE
(BAND — BROADCAST), LBS/ACRE
-400
-300
-200
-100
0
100
200
300
400
EXTRACTABLE SOIL TEST K, LBS/ACRE
100
150
200
250
300
350
400
450