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# Fertilizer application and liming practices of small-holder tobacco farmers in Zimbabwe

J. T. Gonese

Kutsaga Research Station, P. O. Box 1909, Harare, Zimbabwe.

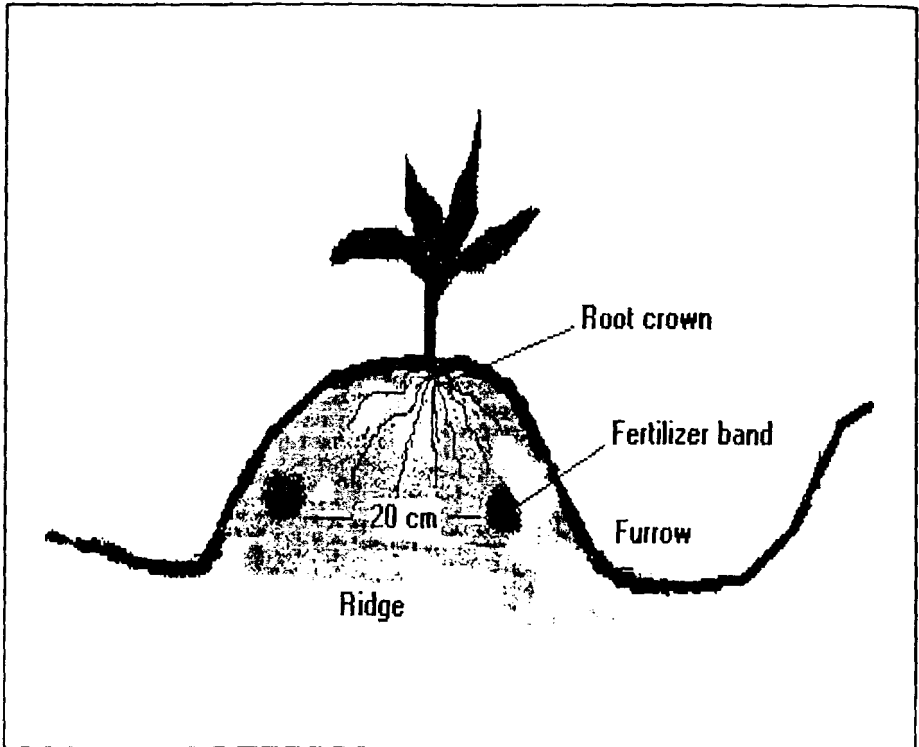
A survey of small-holder tobacco farmers' production practices, featuring the use of fertilisers and lime in their tobacco lands indicated that 21 out of a systematically drawn sample of 43 respondents from an area covering over 95 percent of the total small-holder tobacco area of the country, use the recommended rate of basal fertilizer. None of the 43 had their soils analysed for pH or nutrients before growing tobacco or had ever applied any lime before growing tobacco. Forty two soil samples collected from tobacco lands belonging to another group of 42 farmers, similarly selected from the same population of farmers, showed that more than 80 percent of the farmers may be growing tobacco at pH levels below 5.0, and that only about 6 percent of them may be growing it at levels near its optimum. The latter group was predominantly from the northern regions of the country. Most of the soils sampled fell in the pH range 4.0 to 4.5. This trend may suggest that tobacco productivity on small holder-farms may increasingly be threatened with acidity over time and that the fertilizer levels being applied on small-holder farms may not be cost-effective.

**Keywords:** Small-holder; tobacco production; liming practices; fertilizer placement; soil tests.

## Introduction

Flue-cured tobacco requires fairly high nutrient levels for it to attain profitable yields and good quality leaf. Striving to improve productivity, small-holder farmers (growing less than 10 ha) have, during the past few years, substantially increased their use of inorganic fertilisers in tobacco lands. Many of them apply the blanket fertilizer recommendation of 600 to 700 kg/ha of the tobacco compound consisting of 2-6N:17 P<sub>2</sub>O<sub>5</sub>K: 15 K<sub>2</sub>O. This recommendation is generally in excess of crop requirements to ensure high yields of quality tobacco even on the poorest soils, and the rates may only be decreased if soil test results suggest this (Ryding, 1986).

Equally as important as the amount of fertilizer to the growing tobacco plant is its position of placement in relation to the plant root crown. In Zimbabwe tobacco is mainly grown on ridges (about 20 cm high) and basal fertilizer is placed just below the root crown buried at about half the height of the ridge. Ideally the fertilizer should be applied in a double band of 20 cm apart with the row of tobacco in the middle of the double band (Figure 1).



**Figure 1: Correct placement of a double band of basal fertilizer for tobacco grown on ridges.**

Under large scale (> 10 ha) operations where sophisticated machinery is affordable, the operation is easily carried out with a tractor-mounted applicator at the time the ridges are made and the fertilizer is placed uniformly at the correct height. Tobacco is then transplanted so that its roots are slightly above the fertilizer band. The newly formed roots access this fertilizer within a few days. Placing fertilizer before ridging is not very widely practised under small-holder conditions due to several reasons including that of lack of affordable applicators. Most farmers find it more convenient to apply it soon after planting, using a spade to dig a small hole and then place half the amount of fertilizer with a cup, on either side of the plant. This method is effective only if placement depth is strictly adhered to and the fertilizer is placed within a week of planting.

For inorganic fertilisers to be effective, they have to be balanced with the use of lime to counter the acidity that arises from their repeated applications. In addition, tobacco is said to be a "lime-loving" crop, with the level optimal for its growth being about pH 5.5. Below pH 5.0 its root development tends to be stubby and limited,

while above ground the plant growth may be irregular. Soil acidity affects plant growth directly and indirectly as it interferes with the soil availability of phosphorus, one of the major nutrients essential for plant growth; molybdenum, an essential micro nutrient; as well as that of some toxic elements such as aluminium, iron and manganese (Akehurst, 1981). Under acid soils aluminium, iron and manganese are more soluble and these react or bind the phosphorus, rendering it unavailable for uptake by the plant, consequently lowering both yield and quality of the tobacco produced under these circumstances (Akehurst, 1981). Liming facilitates the precipitation of aluminium, iron and manganese salts out of the soil solution which frees the phosphorus for uptake by plants. Lower pH than ideal also results in decreased microbial activity.

Soil acidity will increase with tobacco cropping at approximately 0,2 to 0,3 pH units per year (Stocks, 1996) so that lime has to be added periodically to maintain it at the level ideal for the crop. In the absence of soil tests, on most tobacco soils on large-scale farms, generally 225 kg/ha lime may be applied for each 0,1 pH unit increase intended (Stocks, 1996). In Zimbabwe the standard rotation recommendation of three years of *Chloris gayana* in between two consecutive tobacco crops makes it necessary to lime only once in three to four years (TRB Handbook of Recommendations, 1960). However, due to land limitations most small-holder tobacco farmers cannot afford this rotation schedule. They may also not be relying on soil tests as a guide to their fertilizer application programme and soil acidity may be limiting the yield and quality of their tobacco crops.

This study is part of a broader survey of small-holder farmer tobacco production practices which sought to establish their fertilizer and lime application practices, determine the extent of awareness among them of the need to lime their tobacco fields as well as to ascertain the acidity status of their tobacco lands.

## Materials and Methods

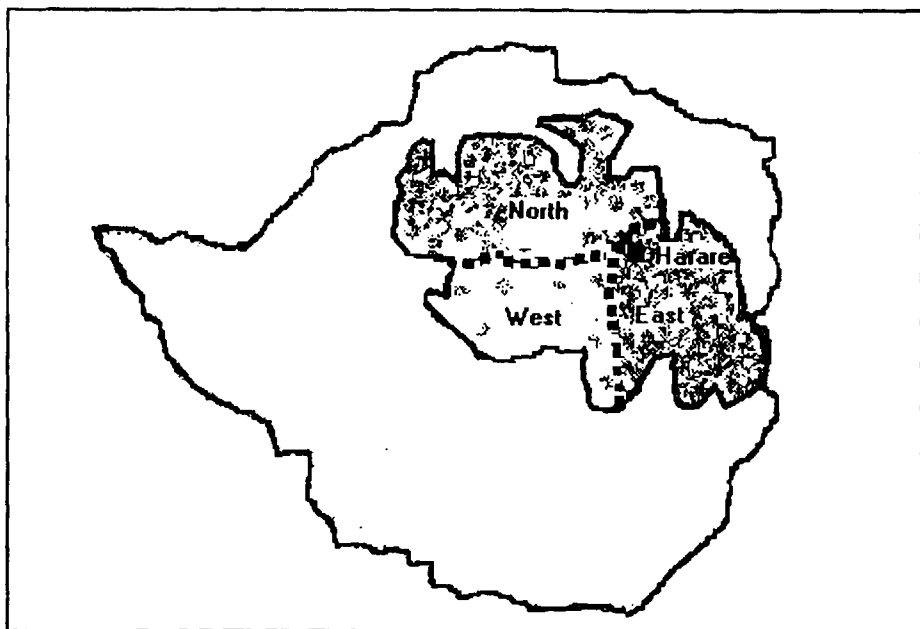
The study consisted of two surveys, done on samples of 43 and 42 farmers, respectively. As small-holder farmers are heterogeneously scattered in the tobacco growing belt of Zimbabwe, for the purpose of sampling, the belt was divided roughly into three main zones: Eastern, Western and Northern (Figure 2).

At the time of the study, it was felt that very few farmers from the Western zone had been growing tobacco for more than a couple years and the zone was therefore excluded from the surveys. The samples were subjectively weighted towards the Eastern zone where the population distribution was denser. Individual farmers were then picked out systematically from the respective zones by their farmer registration number from a list of tobacco farmers registered for the 1995-96 growing season. The distribution of tobacco farmers registered in the year of study is shown in Table 1.

**Table 1: Regional distribution of flue-cured tobacco small-holder farmers who were interviewed for production practices and those whose lands were sampled for soil pH.**

Zone	Farmers					
	*Total No. of Farmers	*Total Crop size (Ha)	No. of farmers interviewed for production practices	% of famers interviewed for production practices	No. of farmers with lands sampled	% of farmers with lands sampled
North	574	1 258	12	2.1	13	2.3
East	942	1 940	31	3.3	29	3.1
West	39	155	0	0	0	0
Total	1 555	3 353	43	2.8	42	2.7

\* Figure obtained from flue-cured Virginia tobacco annual statistical report, 1996. Tobacco Marketing Board, Harare.



**Figure 2: Flue-cured tobacco growing zones of Zimbabwe.**

Legend

**East:** Ruwa/Bromley; Marondera/Wedza; Headlands/Macheke; Rusape/Nyazura/Odzi

**West:** Trelawney/Darwendale; Beatrice/Norton; Chegutu/Selous

**North:** Doma/Chinhoyi; Banket/Ayshire; Centenary/MtDarwin; Mvurwi/Concession Karoi; Tengwe; Bindura/Shamva.

In the first survey, the 43 farmers were interviewed at their farms for their use of fertilisers, lime and soil test guides, as part of a broader survey on their knowledge base and practices on growing tobacco. Only those aspects pertaining to soil tests, fertilizer and lime requirements are dealt with in this paper. The second survey consisted of collecting plough-layer [20 to 40 cm depth] soil samples from tobacco lands belonging to a different sample of 42 farmers, selected in a way similar to the one above, during the winter months of 1996, four to five months before tobacco was to be planted. Soil pH determinations were carried out as recommended (Schofield and Taylor, 1955), on air-dried soil that had been passed through a two mm sieve and were conducted using the calcium chloride scale. From the observed pH, the suggested amount of lime required to bring the pH to that optimal for tobacco growth was calculated for all the soil samples.

## Results

Results of the survey of practice adopted by small-holder tobacco farmers are shown in Table 2 and soil analysis results are given in Figure 3. At least half of the farmers interviewed applied the recommended amount of basal fertilizer and about as many of them also placed it correctly while the rest of them indicated that they were not sure of the recommended placement. None of the 43 farmers had ever sent soil samples for pH or nutrient analysis before growing tobacco. None of them had ever applied any lime in their tobacco lands either and most of them cited the following as reasons for not applying lime:

- limited information on the need to lime and how to apply it;
- poor or haphazard availability of lime in rural trade stores;
- unavailability of an affordable lime spreader or applicator;
- the large volumes to be applied;
- the difficult logistics from their rural farm lands, of organising for soil tests to be done.

Only eight of the 42 sampled lands had a pH above 5.0, considered "reasonable" for efficient tobacco production and only two of these did not need to be limed for tobacco at all. The rest of the lands needed amounts of lime ranging from 0.3 to > 2.5 tonnes per hectare. Only one of the eight lands with pH > 5.0 was from the Eastern zone where also the lowest pH of 3.89 was recorded.

**Table 2: Survey of fertilizer application practices.**

Farmers					
Zone	Interviewed	Requesting soil analysis	Applying correct amount of basal fertilizer	Correctly placing basal fertilizer	Not sure of fertilizer placement
East	30	0	13	16	13
North	13	0	9	8	4
Total	43	0	22	24	17

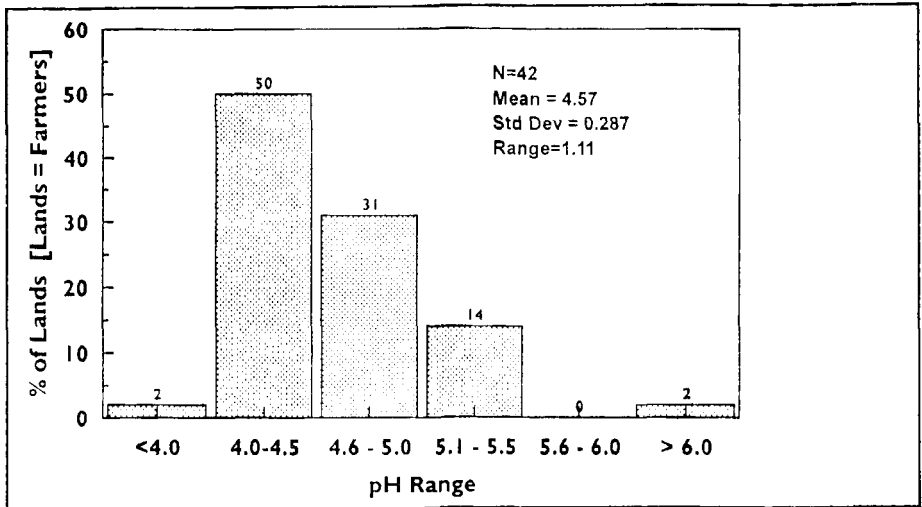


Figure 3: Distribution of soil pH levels on small-holder tobacco lands.

## Discussion

Zimbabwean small-holder farmers of maize have adopted good husbandry practices for maize. Many use cow manure as a supplementary fertilizer in maize production and this helps ameliorate soil acidity (Grant, 1967 and 1981) so that in some cases the need to lime regularly may even be eliminated. With tobacco, in addition to the crop being particularly sensitive to soil acidity, generally higher rates of compound fertilizer are recommended: 600 to 700 kg/ha compared to 300 to 400 kg/ha for maize. Also as tobacco is a high value crop farmers tend to use inorganic fertilisers more often than they would in other crops. Generally the use of animal manure in tobacco is not encouraged as there is only scanty information on the nitrogen release of manure from different sources in relation to the growing tobacco plant's needs. The continuous cultivation of tobacco or the short rotations practised on small-holdings as a result of limited land may compound the soil acidity situation further so that tobacco lands may actually acidify faster than maize lands. Thus for optimal tobacco production on small-holdings there probably is a greater need to lime the tobacco lands more often and probably with more lime per unit area, than on large farms where the rotation of three to four years of a grass ley can be practised.

The survey results suggest that the average initial applications of lime to bring the pH up to levels acceptable to tobacco on most of the lands would be about 1 500 kg/ha. This is equivalent to 30 x 50 kg bags/ha. The high amounts required sound prohibitive. In addition to this, there is currently no affordable lime spreaders appropriate for use on a small farm basis on the market and this is another pertinent



hindrance to the use of lime by small-holder tobacco farmers. Lime is bulky and generally costs less than most fertilisers. It, therefore, offers a lower return per unit volume / mass transported than most fertilisers and many rural traders may not be keen on stocking it.

There was a general lack of awareness on the need to apply lime periodically. The effect of pH on crop growth is often not as visually dramatic as that of fertilisers and is therefore, very difficult to demonstrate to farmers. It is very strongly emphasised in agricultural extension circles to lime only after soil tests suggest this, as the danger of over liming is very difficult to correct. The poor infra-structural development in most small-holder farming areas makes the logistical arrangements for soil sampling and testing difficult to implement.

In view of the logistical difficulties small-holder tobacco farmers face to get soil tests done, the blanket lime rates suggested for large-scale farm conditions in the absence of soil tests (Stocks, 1996), could be used successfully under small-holder conditions, to improve productivity. From all the observations and reasons for not liming cited above, the possibility of small-holder farmers readily accessing soil tests and the lime itself may still be a long way off. The detrimental effect of continuous cultivation with no liming outweighs by far the dangers associated with over-liming as a result of liming with no soil test guides. For most of the small-holder tobacco lands the blanket lime rate recommendation would probably consist of a once-only application of 1 500 kg/ha for every land that has had more than two tobacco crops with no lime applied plus a replacement maintenance of 500 kg/ha lime for every tobacco crop planted. This should maintain the pH by approximately the same units it will go down with a tobacco crop. To make it easier for the farmers, the application exercise could be split into smaller units that are applied to all the crops grown in rotation with tobacco, to spread the bulk and labour required to incorporate it over several years.

## Conclusion

It is evident that the fertilizer rates that are applied by the majority of small-holder tobacco farmers are not cost-effective, even though many of the farmers may be applying more than the recommended rates of it. Agricultural extension agents need to direct more attention towards fertilizer placement and lime application, if productivity is to be improved in the small-holder sector. Whilst farmers should be encouraged to make use of soil tests, as much as possible for more cost-effective fertilizer rates, where these cannot be done farmers should still be encouraged to lime their lands with the blanket rates, to arrest soil acidification. Research also needs to address the nitrogen release patterns of the different manures that are readily available to most small-holder tobacco farmers, in relation to the needs of the growing tobacco plant, for a more integrated approach to the problem of soil fertility and acidity. The use of cow manure in crops grown in rotation with tobacco could also be more aggressively promoted.

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