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# Effect of Bottom Leaf Removal and Fertilizer Rates on the Yield and Quality of Flue Cured Tobacco in Zimbabwe

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***Abstract*— The leaf position on a tobacco stalk determines leaf quality. Leaf quality is lowest for the bottom prime and lug grades, and is highest for the leaf and tip grades at the upper part of the plant. Experiments on removal of lower leaves to eliminate prime (P) and lug (X) grades date back to the nineties; and results then indicated that there was no merit in this agronomic practice. Recently, there were changes in market preferences, and merchants began demanding more of the upper leaves and paying a premium for these. This necessitated the re-initiation of leaf priming studies using two new higher yielding varieties at two sites for two planting dates (September and October). In these experiments, up to 10 bottom leaves were removed, and topping was done to reduce the number of remaining leaves to 14 against the standard of 18 leaves. In some treatments, additional fertilizers were applied to improve yield and quality of the remaining leaves. The highest value gain (~US$2 839) was obtained when six bottom leaves were pruned. However, an additional 400 kg/ha of high analysis fertiliser was applied at pruning, resulting in a yield increase of 1 104 kg/ha compared to the standard (no priming, no additional fertiliser). The same trend was obtained in the previous season (2014/15), where 421 kg/ha yield increase was observed when six leaves were pruned with similar fertiliser adjustments. The implications of these results will be discussed in this paper.**

***Index Terms*— Leaf Quality, Yield, Priming Leaves, Varieties, Net Profit.**

## I. INTRODUCTION

Tobacco is one of the few crops entering the world trade entirely on dry leaf basis and is the most widely grown commercial non-food plant in the world used in the manufacture of cigarettes, cigars, biddies among other products [3]. Due to increased prices of fuel, labour and other inputs, the cost of producing quality flue-cured tobacco has risen. Farmers therefore need to be efficient in their production practices to attain higher yields of superior quality for maximum profits. Adoption of best management practices (BMPs) is therefore imperative for tobacco farmers to realize the highest profits. The physical and chemical properties of leaf tobacco are influenced by genetics, agricultural practices, soil type and nutrients, weather conditions, plant disease, stalk position, harvesting and curing procedures [1]. A change in any of these factors can markedly alter the chemical composition of leaf and thus affect smoking quality [2].

Bottom leaves on a tobacco plant are generally of lower quality, and are of low nicotine. Also, because of their proximity to the ground, these leaves often come in contact with soil and consequently, must be cleaned before they can be processed. There are reports that some farmers are removing these primings soon after applying first ammonium nitrate side dressing in order to achieve better yields and grades [4]. The leaf position on a tobacco stalk determines leaf quality. Leaf quality is lowest for the bottom prime grades and is highest for the tip grades at the topmost part of the plant. Experiments on removal of lower leaves to eliminate prime (P), lug (X) and sometimes cutter (C) grades date back to the nineties; and results then indicated that there was no merit in this practice. Recently, there have been changes in market preferences, and merchants are demanding more of the upper leaves and paying a premium for these. This necessitated the re-initiation of leaf priming studies. Some studies were conducted in the USA to evaluate removing either the bottom four or eight leaves from each plant as a way to reduce production of priming grades. In another study by Edwards [5] removal of lower leaves at the early flowering stage with the assumption that weight would be shifted to higher stalk positions to moderate potential yield loss proved to be false. The author also found out that removing four leaves resulted in a nine percent yield and an eleven percent value per hectare loss compared to a 23% yield and 22% value per hectare loss when removing eight leaves. Studies currently underway at the Tobacco Research Board showed that the removal of priming leaves from the tobacco plants in the field could improve the yield and quality of the harvested tobacco leaves especially those of the first reaping. It is however not clear on the exact number of priming leaves to be removed for improved yield and quality and whether additional fertilisers would further improve these parameters.

## II. MATERIALS AND METHODS

### *A. Description of site*

The study was done at Kutsaga Research Station during the 2013-2016 tobacco growing seasons. The research station is in Natural Region II and it receives an average rainfall of around 800 mm to 1000 mm per annum. The rainfall usually occurs during a single rainy season from November to April. The site receives a mean annual temperature of 21°C with insignificant frost occurrence in the months of June and July. The experiment was carried out in an open field where the soils are sandy loams derived from granite.

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### B. Field operations

The land was ploughed to a depth of 38 cm using a tractor drawn plough. Liming was done at the recommended rate after soil analysis. Ridges were made around mid August each year. Basal fertilizer, high C (6N: 28P2O: 23K2O), was applied as recommended by soil analyses. The seedlings were transplanted in September (irrigated trial) and October (dry land trial) each experimental year. Herbicides and pesticides to control weeds and insect pests were also applied as recommended.

### C. Treatments and trial design

A Split-split plot design with three replications was used. Each block had a total of 12 treatments. A plot was made up of 3 rows of 32 plants each. Two topping heights (14 and 18 leaves) were the main plot factors, fertiliser rates (Standard and the adjusted rate) as the sub-plot factor and priming levels (0, 6 and 10 leaves) as the sub-sub plot factors. Two tobacco varieties (KRK 26 and T 71) were used (one experiment for each variety). Leaf pruning was done at around six weeks after planting, when the crop would have attained 12 leaves. Blocking was done against varying soil texture and fertility. The standard fertiliser programme involved applying 500 kg/ha high analysis at planting and 150 kg/ha of Ammonium nitrate at four weeks after planting. The other fertiliser treatment involved application of 500 kg/ha of compound fertiliser and 150 kg/ha Ammonium nitrate at planting plus additional 400 kg/ha at pruning (6 WAP).

### D. Measurements and data analysis

The parameters measured included leaf expansion after topping, yield, quality and leaf chemistry. Data was subjected to Analysis of Variance (ANOVA) and mean separation was done using the Least Significance Differences (LSD).

## III. RESULTS

### A. Irrigated crop (K RK26 variety)

The variety K RK26 positively responded to the priming treatments and there were significant differences (p=0.044) in yield due to the main priming effects. In the irrigated trial, average yield increased from 3 193 kg/ha in the non-primed treatment to 3 650 kg/ha in treatments where six leaves were primed, but there was a yield drop to 3 056 kg/ha in the 10-leaf priming treatment. Significant differences (p=0.045) were also noted among the interaction of fertilizer and priming levels. The highest yield of 4 238 kg/ha was obtained when six priming leaves were removed, topping done at 18 leaves and when an adjustment to the fertiliser programme was done. Although the 14-leaf topping height treatment appeared good in the field, the difference in number of leaves from the standard topping height could not be compensated for.

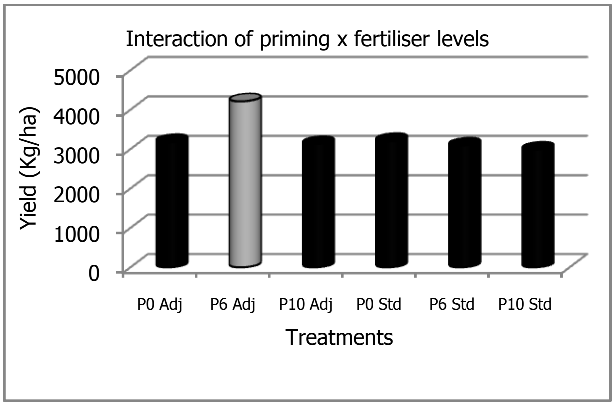


**Fig 1: Priming and fertiliser interaction effects**

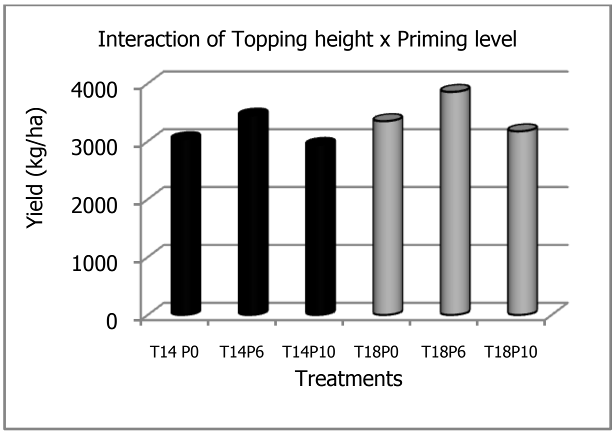


**Fig 2: Topping height and Priming interaction effects**

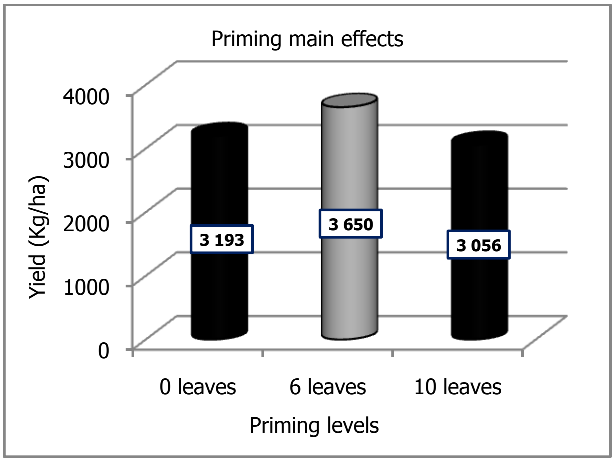


**Fig 3: Priming main effects**

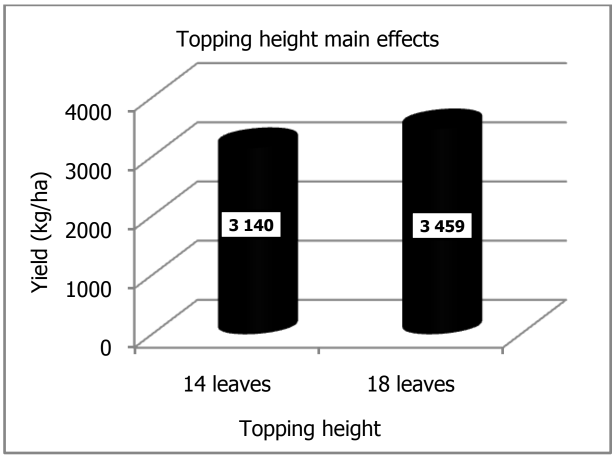


**Fig 4: Topping height main effects**

*B. Irrigated crop (T71 variety)*

The variety T71 responded differently from K RK26 and no significant differences (p>0.05) were found in yield due to the main priming effects. Generally increasing leaf pruning to 10 leaves resulted in yield loss. The highest yield of 3 711 kg/ha was obtained when six priming leaves were removed, topping done at 18 leaves and when standard fertiliser programme was followed. The lowest yield was obtained in the treatment where 10 priming leaves were removed, topping done at 14 leaves and standard fertilizer followed. There were significant differences (p=0.05) in the quality (Grade index) of the cured leaf due to the priming main effects, with the best quality leaf obtained from the treatment where 10 priming leaves were removed. There were also significant differences (p=0.002) in quality due to topping height treatments with the standard (18 leaves) having better quality leaf than the 14 leaf topping height.

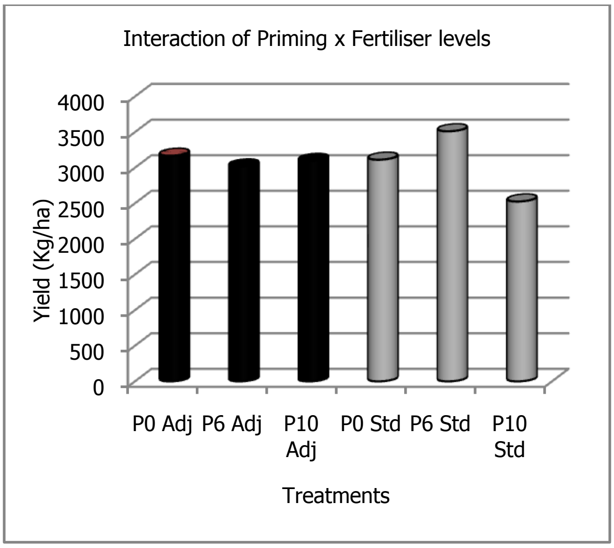


**Fig 5: Priming and fertiliser interaction effects**

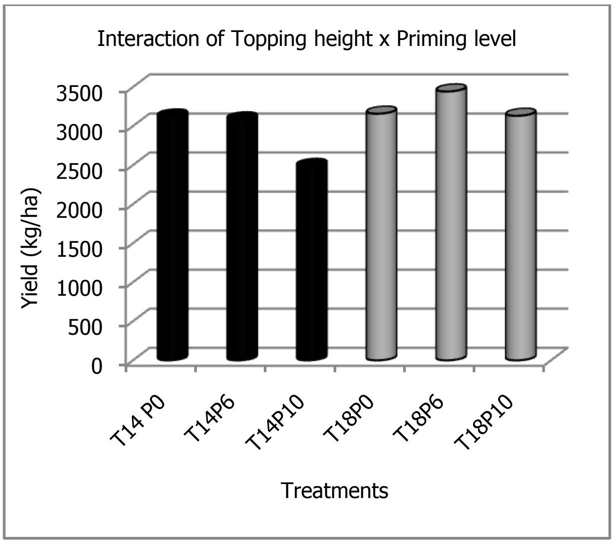


**Fig 6: Topping height and Priming interaction effects**

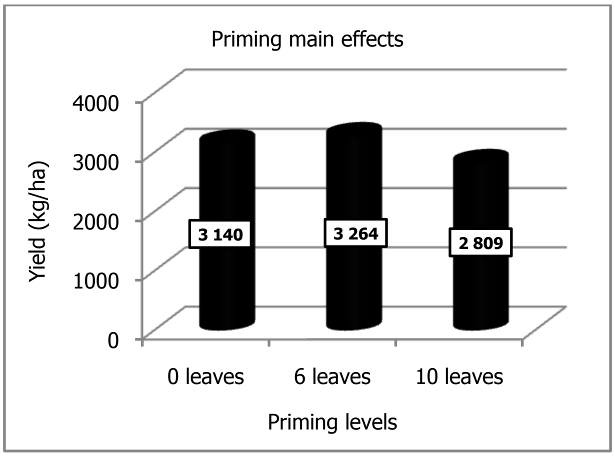


**Fig 7: Priming main effects**

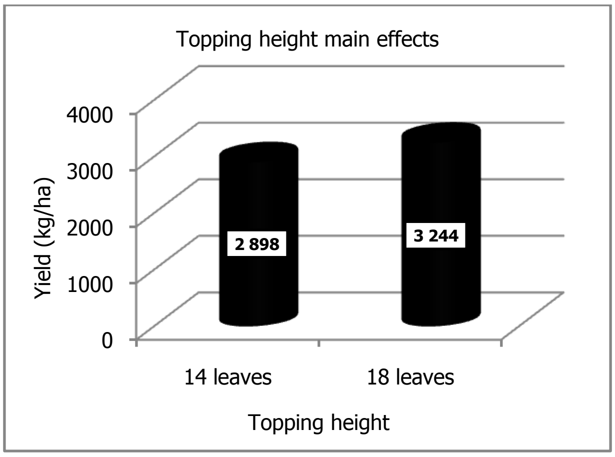


**Fig 8: Topping height main effects**

*C. Dry land crop*

For the K RK26 dry land trial no significant differences (p>0.05) were found among the main priming effects in yield. The highest yield (2 934 kg/ha) was obtained in the treatment where no priming leaves were removed, standard topping height (18 leaves) and where additional 400 kg/ha high C fertilizer was applied. The lowest yield of 2 446 kg/ha was obtained when 10 priming leaves were removed, topping done at 14 leaves and where fertilizer adjustment was done. The other variety, T71, responded negatively to the priming treatments with the highest yield (3 555 kg/ha) obtained in the standard treatment where no priming leaves were removed, standard topping height (18 leaves) followed and with the standard fertilizer programme. The lowest yield of 1 920 kg/ha was obtained when six priming leaves were removed, topping done at 14 leaves and when fertilizer adjustment was done.

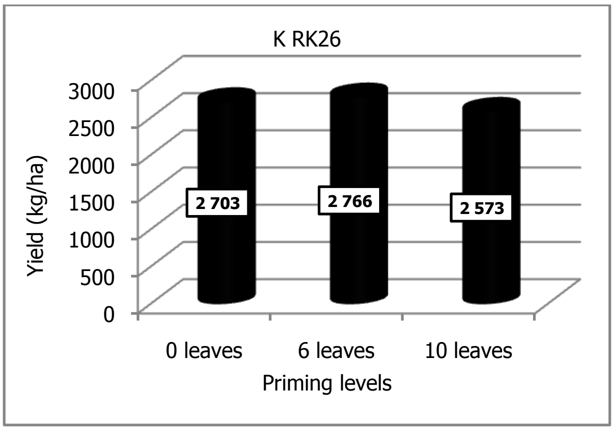


**Fig 9: Priming main effects (K RK26)**

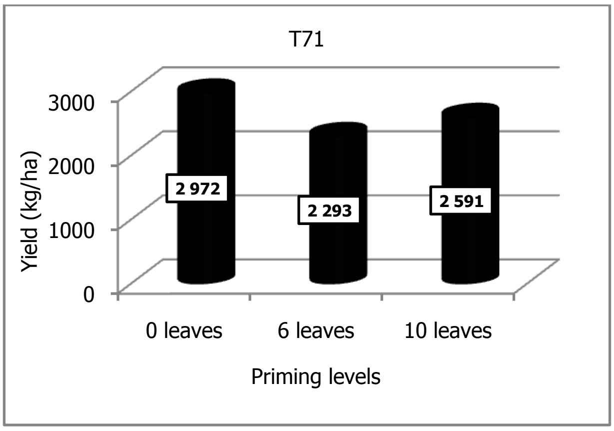


**Fig 10: Priming main effects (T71)**

## IV. GENERAL OBSERVATIONS

The cost-benefit analysis (attached) of bottom leaf removal exercise generally resulted in economic merits in the irrigated trials, more so with the K RK26 variety, where a yield increase of up to 1 104 kg/ha was obtained. The same trend was observed in the previous season (2014/15) where 421 kg/ha yield increase was observed when six leaves were pruned with additional application of 400 kg/ha high C fertiliser. The other variety (T71) marginally responded to the priming treatments in the irrigated trial but showed no advantages in the dry land crop. The same trend was also experienced in the previous season (2014/15) where yield losses were evident due to the priming exercise.

## RECOMMENDATIONS

It has been noted that the effects of priming removal are variety dependent, and based on the results of this study, the exercise can be applied to the variety K RK26 that responded more positively to priming removal than T71. The time of planting also influenced varietal response with more positive results obtained from early planted irrigated trials compared to the rainfed (dry land) crop. Lower priming rates are ideal for late planted crop as increased pruning resulted in yield losses. It has also been noted that fertilizer adjustments can be necessary to compensate for nutrients lost during pruning. Generally, the standard topping height (18 leaves) resulted in higher yields than topping at 14 leaves. therefore, recommendations on the priming removal should not be generalized and must be treated with caution as the response is influenced by many factors including variety, topping height, nutrition, time of planting and timing of pruning.

## ACKNOWLEDGMENT

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