

SPECIFIC TIME FOR DEBUDDING IN THE TOBACCO VARIETY "COROJO 2006" IN CONTRAMAESTRE'S CONDITIONS

Momento óptimo del desbotone en la variedad de tabaco "Corojo 2006" en las condiciones de Contramaestre

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ABSTRACT. The present work was carried out on a farmer's tobacco Plantation in Baire, municipality of Contramaestre, in Santiago de Cuba province, between November 2015 and February 2016 with the purpose of evaluating the proper moment for eliminating leaf buds from the Corojo 2006 tobacco variety, according to the amount of fully developed leaves in the environment of Contramaestre an experimental design at random blocks was used, with four replicas and four treatments which consisted of 16, 18, 20, and 22 leaves per plants as the proper height for eliminating leaf buds. Data were processed after an Anova/GWBasic. Exe. doble classification variance analysis. Morphologic characteristics as leaves length and width, green and dry mass of stem and leaf were evaluated so as stem height, combustibility, yield and crop quality. An economic analysis was done taking into as count the cost of production the value of production and the cost per each peso invested on the basis of a hectare. When leaf buds were eliminated from 20 leaves per plants. Results were the best regarding morph characteristics of the leaf, yield and quality of the cured leaf, as combustibility as a chemical component of the leaf. It was also determined, that from the economic point of view, this treatment made possible a \$104989,06 profit and a cost of \$0,062 per each peso invested.

Key words: combustion, gain, performance

INTRODUCTION

After a significant decrease in tobacco production in the 80s, the beginning of the 90s and the losses of its traditional markets, the fertile plains of our country

RESUMEN. El presente trabajo se realiz  en  reas de la CCS "Mois s Popa Gonz lez", en condiciones de suelo pardo carbonatado ligeramente alcalino, medianamente profundo y ligeramente ondulado con erosi n media en Contramaestre, provincia Santiago de Cuba. En el per odo comprendido entre los meses de noviembre de 2015 y febrero de 2016 con el objetivo de evaluar el momento  ptimo del desbotonado para la variedad de tabaco Corojo 2006 a partir del n mero de hojas emitidas en las condiciones de Contramaestre. Se utiliz  un dise o experimental de bloques al azar, con cuatro r plicas y cuatro tratamientos, consistentes en 16; 18; 20 y 22 hojas/plantas como altura del desbotonado. Los datos fueron procesados a partir de un an lisis de varianza clasificaci n doble Anova/GWBasic.Exe. Se evaluaron las caracter sticas morfol gicas de longitud y anchura de la hoja, masa verde y seca del tallo y la hoja as  como la altura del tallo, combustibilidad, rendimiento y calidad de la cosecha. Se realiz  un an lisis econ mico a partir del costo de producci n, valor de la producci n y costo por peso, tomando como base de c lculo (ha). Cuando se desboton  a 20 hojas por planta se alcanzaron los mejores resultados en cuanto a caracter sticas morfol gicas, rendimiento y calidad de la hoja curada as  como la combustibilidad como componente qu mico de la hoja. Se determin  adem s que desde el punto de vista econ mico este tratamiento obtuvo una ganancia de \$104989,06 y un costo por peso de \$0,062.

Palabras clave: combusti n, ganancia, rendimiento

currently offer a recovery. The production of this crop in the Contramaestre municipality is managed by the Base Business Unit, which has three Credit and Service Cooperatives (CCS). The unit's revenue in 2014 was \$ 1 946 700 and the expenses of \$ 2 090 700 for a cost per peso of \$ 1.07.

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In studies carried out, it was taken into account that the morphological characteristics are one of the main evaluations carried out in the cultivation of tobacco to estimate the bottling height effectiveness (1).

Therefore, it is necessary to bear in mind the variability in the behavior independently of the adaptability of this crop to the conditions of Cuba, it is understood the need to deepen these elements in a localized way.

Contramaestre municipality is called to become the largest producer of the province because it is planned to plant in the 2016-2017 campaign 115 ha and achieve an average yield of 1.0 t ha⁻¹, using as main form of cultivation the sun stem, giving a rational and adequate use to natural resources: water and soil.

The objective of the work is to evaluate the influence of the debundling on the morphological parameters of the tobacco variety "Corojo 2006" from the emission of leaf numbers after transplantation, determining the influence that this work exerts on qualitative parameters of the leaf as well as the economic valuation of the results.

MATERIALS AND METHODS

LOCATION OF THE EXPERIMENT

The experiment was developed in the period included in the 2015/2016 tobacco harvest because the study included the benefit and cure of the leaf and the economic evaluation of the selected variant in areas of the CCS "Mois s Popa Gonz lez" of the Agroindustrial Company "Am rica libre" in Baire area of Contramaestre municipality.

EXPERIMENTAL DESIGN

A randomized block design with four treatments and four replicates was used (Table 1). The experimental data were subjected to a double classification analysis of variance (Anova/GWBasic.Exe), at a significance level of 5 % error probability.

Table 1. Treatments under study

| | Treatments |
|-------------|--|
| A | Unbuttoned when 16 sheets / plant had been issued = 576000 sheets per ha |
| B (control) | Unbuttoned when 18 sheets / plant had been issued = 648000 sheets per ha |
| C | Unbuttoned when 20 leaves / plant had been issued = 720000 sheets per ha |
| D | Unbuttoned when 22 leaves / plant had been issued = 792000 sheets per ha |

Description of the experimental plot

Each experimental plot had an area of 50 m² (5m long and 10m wide), a sowing frame of 0.35 x 0.50 m (sowing in triangle at a rate of 36000 plants per ha), each plot it had 12 furrows and each furrow with 14 plants for a total of 168 plants per parcel. The first two and the last two rows were despised by the effect of borders, as well as the three plants at the beginning and end of each furrow, evaluating a total of 64 plants per plot.

Indicators to be evaluated to assess the influence exerted by the unbundling on the morphological variables of tobacco cultivation

- ◆ Height of plants (cm). The plants were measured from the neck of the root to the apex with a tape measure.
- ◆ Width of the leaf (cm). Three leaves were taken per plant located in the leaf levels, uno y medio (section directly above the base), centro fino (center of plant with mid-sized leaves), centro gordo (center of plant with thickest leaves) were measured by the widest part with the tape measure and the average was determined per plant.
- ◆ Length of the leaves (cm). Three leaves were taken per plant located in the leaf levels, uno y medio, centro fino y centro gordo. They were measured from the apex until their insertion in the stem and the average was determined per plant.
- ◆ Fresh mass of the leaf (g). Samples of the leaves of the plants were taken by leaf levels; libre de pie (the base), uno y medio (section directly above the base), centro ligero (center of plant with thinnest leaves), centro fino (center of plant with mid-sized leaves), centro gordo (center of plant with thickest leaves) and corona (top of plant or crown) were weighed on digital scales with an accuracy of ± 0.01 g and the average weight per plant was determined.
- ◆ Dry mass of leaves (g). Once the leaves had dried in the curing house, they were taken to the fermentation chamber to complete the process and determine the actual weight of the leaf. Mass of the fresh stem (g). The samples were weighed on a digital scale, the weight of the stem was determined in relation to the leaf.
- ◆ Dry mass of the stem (g). Stem samples were weighed on a digital scale and the mass of the stem was determined in relation to the leaf.

Once the curing phase was finished, the leaves were taken out and taken to the chamber for controlled fermentation according to the methodological specifications to determine the total yield and quality. Studies carried out under production conditions, during four tobacco campaigns, showed that the new genotype "Corojo 2006" surpasses commercial genotypes in high class yields and in total yield; likewise, its good behavior towards diseases and its good organoleptic characteristics has motivated its great acceptance by producers (2).

INFLUENCE EXERTED BY DEBUDDING ON QUALITATIVE PARAMETERS OF THE LEAF

Combustion

The procedure was carried out based on the indications for the evaluation of the combustibility of Cuban tobacco (3).

During the years 1981-1985, the behavior of the combustibility of skewered black tobacco was investigated, in the production under irrigated conditions, harvested in Pinar del Río province, determining that it varied depending on the leaf levels (4).

Concluded the tobacco fermentation process in the curing house where the qualitative parameters of the leaf were taken into account (5), the test samples were taken to determine the evaluation of the combustion taking 5 % of the sheaves, one at each treatment, ten leaves that did not have a content higher than 18 % humidity were chosen. These leaves were ironed and a small hole about a centimeter in diameter was made in the center of one of the bands with the index and thumb fingers, they were subjected to the combustion test using the flame method with a phosphorus underneath and in the center of the hole made.

The evaluation of combustion was carried out on the basis of a score of 12 points measured according to the following scale.

- ◆ 3 points - does not burn, makes flame and forms coal; the combustion does not advance and goes off immediately when the flame is removed.
- ◆ 6 points - combustion progresses little and goes out.
- ◆ 9 points - the combustion takes place and advances through the leaves of irregular shape in all directions.
- ◆ 12 points - the combustion is carried out and advances through the leaves without stopping irregularly or regularly in all directions.

The evaluation of the combustion (Table 2) was carried out taking into account the result of the score of each one of the chosen leaves and with these results the average value was calculated.

Table 2. Evaluation of combustion

| Intervals | Quality of combustion |
|-----------|-----------------------|
| 3,0-4,0 | Very low |
| 4,1-6,0 | Low |
| 6,1-7,0 | Acceptable |
| 7,1-9,0 | Good |
| 9,1-12,0 | Excellent |

It is considered that the lot to be evaluated is combustible when it reaches a score higher than six points.

Yield in kg ha⁻¹

To determine the agricultural yield, four sheaves were taken, one for each treatment. These were classified by upper and lower classes, (make) (not make). Each of the classes was weighed individually to determine the percentage of quality; these were added to determine the agricultural yield in kg ha⁻¹, taking as a reference the hectare as a unit of calculations.

ECONOMIC VALUATION

For the economic analysis, the starting point was the determination of the profits from the incomes and the costs incurred, taking as a unit of calculation the hectare and the value of the product from the current prices of TABACUBA, as well as the unit cost from the formulas that are presented below. Also as an indispensable requirement it was found that the cultivated area was free of pests and diseases for commercialization (6).

The calculation of the expenses incurred in the production of tobacco was made. Income from the sale of the production was calculated. In addition, the cost by weight and the profit margin were calculated. For the calculations, the price approved by TABACUBA was considered for the purchase and sale of tobacco according to the quality obtained.

$$\text{Gain} = \text{Income} - \text{Cost}$$

$$\text{Cost per weight} = \frac{\text{Cost of production}}{\text{Value of the production obtained}}$$

INDICATORS FOR THE ECONOMIC ANALYSIS OF EXPERIMENTAL WORK

- ◆ Cost of production (Cp): is the momentary expression of the expenses incurred in obtaining the product.
- ◆ Value of production (Vp): it is given by the monetary expression of the income that is reached through obtaining products valued at established prices and that have their origin in sales.
- ◆ Gain (G): was determined by subtracting production costs from the production value, through the formula $G = Vp - Cp$.
- ◆ Cost per weight (C / P): relationship established between production costs and income from it. Express what is spent by the weight of production obtained and determine: Cp / Vp .

RESULTS AND DISCUSSION

EFFECT OF THE HEIGHT OF THE BUTTON ON SOME MORPHOLOGICAL CHARACTERISTICS OF THE LEAF

Stem length (cm). The analysis of morphological characteristics is a major evaluation in the cultivation of snuff to estimate the effectiveness of debudding height. It can be observed that the highest values in the length of the stem were reached in the treatments where it was unbundled to 20 and 22 leaves per plant without significant statistical difference between them (Table 3). The lowest value for this morphological parameter was obtained when it was debudded to 16 leaves per plant with 82 cm and a difference of 33 cm in relation to the highest height. Similar results were obtained by ensuring that the length of the stem increases to measures that the release is higher, showing that there was an influence of the number of leaves emitted, in this parameter.

Mass of the fresh stem (g). It can be observed that the highest values for this characteristic were presented in the treatment where it was debudded to 22 leaves per plant with statistically significant difference in relation to the other treatments (Table 3). It was determined that when there was no significant difference when the plant was bottled at 18 and 20 leaves per plant, the lowest value for this morphological parameter was obtained when it was untied to 16 leaves per plant with 151.8 g and a difference of 87.4 g in relation to the of greater value. It is good to point out that physiologically satisfactory results should be expected, since the cumulative processes of substances are favored. The researchers of the work agree with the results obtained in Pinar del R o in the black tobacco, when evaluating the distance between plants and the height of the debudding according to technical instructions of the tobacco cultivation (7).

Dry mass of stem (g). It can be observed that the highest values were reached in the treatment where it was debudded to 22 leaves per plant with 207g and a statistically significant difference in relation to the other variables, also determined that when it was unbolted to 18 and 20 leaves per plant respectively, there were

no significant differences and which in turn significantly exceeded the treatment (A) 16 sheets (Table 3). On the other hand, the lowest value for this morphological parameter was obtained when it was unbundled to 16 leaves per plant with 115 g and a difference of 92 g in relation to the highest value 22 leaves; being similar the data reached in the mass of the dry stem and the one of the green stem, showing a linear relation with the heights of the debudding from 115 to 207 g. Coinciding in this variable with the results obtained according to studies carried out to evaluate this indicator.

Dry leaf mass (g). When performing the analysis of variance to this indicator shows that the highest values correspond to plants unbuttoned to 16 and 18 leaves per plant with significant difference with the rest of the treatments, on the other hand it was found that between treatments C and D, that is, 20 and 22 leaves per plant, there was no significant difference. If we take into account that the reduction of the height of the debudding causes greater accumulation of total dry matter due to the fact that the substances elaborated by the plants are distributed in a smaller amount of leaves, which increases the length, width and thickness of them evidencing in our result

ANALYSIS OF THE INFLUENCE EXERTED BY THE HEIGHT OF THE DEBUDDING IN SOME MORPHOLOGICAL CHARACTERISTICS OF THE TOBACCO LEAF

Length of the leaf (cm). The length of the leaves is one of the main evaluations made to the tobacco to estimate the effectiveness of the height of the debudding in Table 4, it is observed that the highest value is reached in the treatment in which it was untied to 16 leaf with 43.44 cm significantly exceeding and the smallest to 22 leaves per plant with 39.85 cm, while in the cases where it was bottled at 18 and 20 leaves per plant there was no significant difference between them, it was determined that the length of the leaves when harvesting decreased as it is opened higher, increasing the height of the plant (8).

Table 3. Evaluated indicators

| Treatments | Stem length (cm) | Green stem mass (g) | Dry mass of the stem (g) | Dry leaf mass (g) |
|------------|------------------|---------------------|--------------------------|-------------------|
| A | 82 c | 151,8 c | 115 c | 287,5 a |
| B | 100 b | 228,8 b | 126 b | 253,0 b |
| C | 110 a | 232,0 b | 138 b | 230,0 c |
| D | 115 a | 239,2 a | 207 a | 230,0 c |
| C.V. | 6,29 | 21,72 | 3,47 | 6,90 |
| E.S. | 0,032 | 23,1660 | 2,5423 | 0,7801 |

Equal letters do not differ significantly for $P \leq 5\%$

Table 4. Influence of the height of the debudding in some morphological characteristics of the tobacco leaf

| Treatments | Length of the sheet (cm) | Sheet width (cm) | Green leaf mass (g) |
|------------|--------------------------|------------------|---------------------|
| A | 43,44 a | 24,77 a | 474,95 a |
| B | 41,55 c | 22,82 c | 479,80 a |
| C | 40,30 c | 22,60 c | 473,35 a |
| D | 39,85 b | 21,92 b | 472,45 a |
| CV | 2,82 | 5,18 | 2,14 |
| ES | 0,1699 | 0,6025 | 0,3227 |

Equal letters do not differ significantly for $P \leq 5\%$

In studies carried out on tobacco of the type "Oriental", "Havana 2000" and "Corojo 2006" it was concluded that the length of the leaf decreases with the height of the debudding which corroborates the results obtained in the investigation. Evaluating the variety of tobacco "Corojo 2006" in two types of soil in Granma province determined that in addition to the bottling soil and climate conditions influenced the length of the leaves.

Width of the leaf (cm). When evaluating this indicator we realized that there is a direct relationship between the length and the width of the leaf, appreciating that there were significant differences between the evaluated treatments, being the 16-leaf debudding the widest one and the 22-leaf debudding the one with the least, that is to say, it decreases to measures that the work was carried out to a greater number of leaves. This result is based on elements already explained about the influence of the debudding in the processes of physiological development of the lower parts of the floral part. In studies carried out it was shown that as the debudding is higher the width of the leaf and the length of the same decreases.

Fresh mass of the leaf (g). When performing the double classification variance analysis for the 5 % probability of error, it was determined that there was no significant difference, the highest values were reached in treatments 16 and 18 leaves per plant with 479.80 and 474.95 g of fresh mass respectively and the lowest

value in the release to 20 leaves per plant with 472.45 g. These values, despite not being significant, show that with the decrease in the height of the rebound, a greater accumulation of total dry matter is caused due to the fact that the substances elaborated by the plants are distributed in a smaller amount of leaves, which increases their length, width and thickness. These results coincide with those obtained when studying the growth of tobacco at two planting times in fluvial soils of Granma province.

ANALYSIS OF THE INFLUENCE EXERTED BY THE DEBUDDING ON QUALITATIVE PARAMETERS OF THE LEAF

Among the fundamental attributes of this product, combustibility stands out as one of the most important properties of the leaf and the finished product.

The results obtained in this work expressed that the treatment (A) debudded to 16 leaves showed a good combustibility with 8.7 points (Table 5). The treatment (B) debudded to the 18 leaves showed similar result when obtaining a combustibility of 9.0 points. While the treatment (C) debudded to 20 leaves showed superior behavior to the other treatments with an excellent combustibility with 9.9 points, likewise the treatment (D) debudded to 22 leaves showed an excellent combustibility with 9.6 points, showing treatments with better results (C and D) according to the evaluation of the interval scale.

In studies carried out on the varieties "Habana 92" and "Santi Spiritus 96" in Granma province, when evaluating the behavior of the combustibility at different times of the harvest, higher values were obtained when the tobacco was harvested 60 days after the transplant. This result coincides with that of the present investigation when evaluating this variable at 62 days.

For the performance in lower classes, the results show that the highest value was obtained when it was debudding to 16 leaves per plant with 609.41 kg ha⁻¹ and there were significant differences with the rest of the treatments corresponding this with a negative result of the yield.

Table 5. Results of the combustibility at different moments of the debudding

| Treatments | Sheaf number | H1 | H2 | H3 | H4 | H5 | H6 | H7 | H8 | H9 | H10 | Mean |
|------------|--------------|----|----|----|----|----|----|----|----|----|-----|------|
| A | 1 | 9 | 6 | 6 | 12 | 9 | 9 | 9 | 9 | 9 | 9 | 8,7 |
| B | 1 | 9 | 9 | 9 | 9 | 6 | 6 | 9 | 12 | 12 | 9 | 9,0 |
| C | 1 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 12 | 12 | 12 | 9,9 |
| D | 1 | 9 | 9 | 9 | 12 | 12 | 9 | 9 | 9 | 9 | 9 | 9,6 |

**Hn – consecutive analyzed leaves

For this variety of black tobacco the best behaviors were obtained when it was debudded at 18, 20, 22 leaves per plant.

In the analysis of the total yield, the significant differences were observed and the highest value was reached when unbundling at 20 leaves per plant with 2285.30 kg ha⁻¹, the lowest total yield was shown by the treatment of debudding height at 16 and 18 leaves per plant without significant differences between them with 2132.95 kg ha⁻¹ respectively. In studies conducted on black tobacco variety "Cabaigu n 72", it was found that the highest yield was achieved by debidding 20 leaves per plant without sacrificing the quality of the plant and it should be noted that the effects of climate change were taken into account about the crop (9).

It is known that the height of the debudding is a factor of great influence on the yield and quality of tobacco; it is observed (Table 6).

Table 6. Results of the performance and quality of the cured tobacco leaf

| Treatments | Higher classes (kg ha ⁻¹) | Lower classes (kg ha ⁻¹) | Total yield (kg ha ⁻¹) |
|-----------------|---------------------------------------|--------------------------------------|------------------------------------|
| 16 leaves/plant | 1523,53 c | 609,41 a | 2132,94 c |
| 18 leaves/plant | 1675,89 c | 457,06 b | 2132,95 c |
| 20 leaves/plant | 1828,24 a | 457,06 b | 2285,30 a |
| 22 leaves/plant | 1752,06 b | 457,06 b | 2209,12 b |
| E.E.χ | 0,3461 | 0,2539 | 0,2041 |
| C.V. (%) | 0,16 | 0,41 | 0,07 |

When 20 leaves were left per plant when debudding, the highest value of 1828.24 kg ha⁻¹ was reached, with significant differences for the rest of the treatments.

In addition, the low release produces less performance and the quality of the leaves tends to decrease as the height of the debudding is increased, so we must keep in mind the proper performance of the same.

The variety of black tobacco "Corojo 2006" cultivated in the sun reaches greater total yield and in superior class if it is debudded to 20 leaves per plant, showing that the obtained yields are higher with about 2285.30 kg ha⁻¹ and 1828.24 kg ha⁻¹ respectively (10).

Table 7. Valuation of some economic indicators

| Treatments | Production kg ha ⁻¹ | Cost (\$) of production | Cost (\$) of production ha (\$) | Gain ha (\$) | Cost per weight (\$) |
|------------|--------------------------------|-------------------------|---------------------------------|--------------|----------------------|
| A | 2132,95 | 7290,84 | 104514,55 | 97223,71 | 0,069 |
| B | 2132,95 | 7140,84 | 104514,55 | 97373,71 | 0,068 |
| C | 2285,3 | 6990,84 | 111979,70 | 104989,06 | 0,062 |
| D | 2209,12 | 6840,84 | 108246,88 | 101406,04 | 0,063 |

Tobacco cultivation must be adequately treated from the beginning of planting to its maximum development with organic fertilizers, in connection with this, organic fertilizers must meet parameters that ensure improved soil quality, supply of nutrients, facilitate penetration of water, increase moisture retention, and improve soil biological activity (11).

In Cuba, tobacco cultivation is subject to a wide range of adversities, grouped into three categories: climatic, edaphic and biotic, which must be taken into account in order to achieve the expected results (12,13).

RESULT OF THE ECONOMIC VALUATION. *NICOTIANA TABACUM L.*

As a result of the yield per treatment in kg ha the analysis of the experiment was carried out, observing that in all the evaluated treatments the obtained yields have good profitability (Table 7), resulting the treatment (C) debudded to 20 leaves the one with the highest result with a profit of \$ 10,489.06 and a cost by weight of \$0.062 with a difference of \$ 7,765.35 and a cost by weight of \$0.007 in relation to the lowest result (14).

Studies carried out, showed that the best results were achieved when the debudding was performed at a higher height and a distance of 0.50 m between plants, which we corroborated with the results obtained in our research (15).

CONCLUSIONS

- ◆ The biological indexes length, width, fresh mass and dry mass of the leaf of the tobacco plant tend to decrease as the height of the debudding increases.
- ◆ All the treatments showed indices superior to 6 points in the scale of combustibility, being better the treatment of debudding to 20 leaves per plant with 9.9 points reaching the quality of excellent.
- ◆ The variety of black tobacco "Corojo 2006" cultivated in the sun reaches greater total yield and in higher classes if it is debudding to 20 leaves per plant with 2285.30 and 1828.24 kg ha⁻¹ respectively.
- ◆ From the economic point of view, the best behavior was shown in the treatment (C), debudding to 20 leaves per plant in which a profit of \$ 10,489.06 was obtained and a cost by weight of \$.062.

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