



PRODUCTIVITY AND PROFITABILITY OF MAIZE VARIETIES IN AGROFORESTRY ALLEY CROPPING WITH GLIRICIDIA SEPIUM ON THE COLOMBIAN PACIFIC COAST

Romeo Angulo Góngora¹
William Enrique Ballesteros Possu²
Jose Julian Apraez Muñoz^{*3}

ABSTRACT

Objectives: The objective of this research was to evaluate the agronomic and economic performance of improved and regional varieties of maize (*Zea mays* L.) in agroforestry systems with mousetrap (*Gliricidia sepium*) in the municipality of Tumaco, Nariño.

Theoretical Framework: The study is based on the importance of maize as a strategic crop for food security in Colombia, where the country still relies on imports for 46% of its production, and on the need for sustainable production alternatives in the Pacific region.

Method: A randomized complete block experimental design was used with four treatments (three improved varieties and one regional variety) and three replications, evaluating agronomic, production, and profitability variables under alley cropping systems.

Results and discussion: The results showed significant differences between varieties, with ICA V-109 standing out with a yield of 2,138 kg/ha and a profitability of \$1,259,719 COP, compared to the poor performance of the regional variety (678 kg/ha and a loss of \$589,011 COP). The association with *G. sepium* contributed biomass to the soil, helping to improve fertility and demonstrating the potential of agroforestry systems as an environmentally friendly practice.

Research implications: The findings show that alley corn cultivation with legume species can constitute a productive and sustainable alternative for local farmers, reducing the expansion of illicit crops and strengthening food security.

Originality/Value: The originality of this study lies in its being one of the first studies on the evaluation of improved maize varieties in agroforestry systems in Tumaco, providing scientific and practical evidence for agricultural diversification in areas of high socioeconomic vulnerability.

Keywords: Agricultural Productivity, Profitability, Nitrogen-Fixing Legumes, Rural Sustainability, Diversification.

PRODUTIVIDADE E LUCRATIVIDADE DE VARIEDADES DE MILHO EM PLANTAÇÕES AGRÍCOLAS COM GLIRICIDIA SEPIUM NA COSTA DO PACÍFICO DA COLÔMBIA.

RESUMO

Objetivos: O objetivo desta pesquisa foi avaliar o desempenho agrônomo e econômico de variedades melhoradas e regionais de milho (*Zea mays* L.) em sistemas agroflorestais com ratoeira (*Gliricidia sepium*) no município de Tumaco, Nariño.

¹ Universidad de Nariño, Facultad de Ciencias Agrícolas. Programa de Ingeniería Agroforestal Tumaco-Nariño, Colombia. theeder@hotmail.com, romeroangulo92@gmail.com

² Universidad de Nariño, Facultad de Ciencias Agrícolas. Programa de Ingeniería Agroforestal Tumaco-Nariño, Colombia. Correo electrónico: wballesterosp@gmail.com

³ Universidad de Nariño, Facultad de Ciencias Agrícolas. Programa de Ingeniería Agroforestal Tumaco-Nariño, Colombia. *autor de correspondencia Correo electrónico: apraez.julian@gmail.com



Referencial Teórico: O estudo baseia-se na importância do milho como cultura estratégica para a segurança alimentar na Colômbia, onde o país ainda depende de importações para 46% de sua produção, e na necessidade de alternativas de produção sustentáveis na região do Pacífico.

Método: O delineamento experimental utilizado foi o de blocos casualizados completos com quatro tratamentos (três variedades melhoradas e uma variedade regional) e três repetições, avaliando variáveis agrônômicas, de produção e de rentabilidade em sistemas de cultivo em aléias.

Resultados e discussão: Os resultados mostraram diferenças significativas entre as variedades, com destaque para a ICA V-109, com produtividade de 2.138 kg/ha e rentabilidade de COP 1.259.719, em comparação com o baixo desempenho da variedade regional (678 kg/ha e prejuízo de COP 589.011). A associação com *G. sepium* contribuiu com biomassa para o solo, contribuindo para a melhoria da fertilidade e demonstrando o potencial dos sistemas agroflorestais como uma prática ecologicamente correta.

Implicações da pesquisa: Os resultados demonstram que o cultivo de milho em alamedas com espécies leguminosas pode constituir uma alternativa produtiva e sustentável para os agricultores locais, reduzindo a expansão de cultivos ilícitos e fortalecendo a segurança alimentar.

Originalidade/Valor: A originalidade deste estudo reside em ser um dos primeiros estudos sobre a avaliação de variedades melhoradas de milho em sistemas agroflorestais em Tumaco, fornecendo evidências científicas e práticas para a diversificação agrícola em áreas de alta vulnerabilidade socioeconômica.

Palavras-chave: Produtividade Agrícola, Rentabilidade, Leguminosas Fixadoras de Nitrogênio, Sustentabilidade Rural, Diversificação.

PRODUCTIVIDAD Y RENTABILIDAD DE VARIEDADES DE MAÍZ EN ARREGLOS AGROFORESTALES CON GLIRICIDIA SEPIUM EN LA COSTA PACÍFICA COLOMBIA

RESUMEN

Objetivos: El objetivo de esta investigación fue evaluar el comportamiento agronómico y económico de variedades mejoradas y regionales de maíz (*Zea mays L.*) en arreglos agroforestales con matarratón (*Gliricidia sepium*) en el municipio de Tumaco, Nariño.

Marco teórico: El estudio se fundamenta en la importancia del maíz como cultivo estratégico para la seguridad alimentaria de Colombia, donde el país aún depende en un 46% de las importaciones, y en la necesidad de alternativas productivas sostenibles en la región Pacífica.

Método: Se utilizó un diseño experimental de bloques completos al azar con cuatro tratamientos (tres variedades mejoradas y una regional) y tres repeticiones, evaluando variables agronómicas, productivas y de rentabilidad bajo sistemas de cultivo en callejones.

Resultados y discusión: Los resultados mostraron diferencias significativas entre variedades, destacándose la ICA V-109 con un rendimiento de 2.138 kg/ha y una rentabilidad de \$1.259.719 COP, frente al bajo desempeño de la variedad regional (678 kg/ha y pérdida de \$589.011 COP). La asociación con *G. sepium* aportó biomasa al suelo, contribuyendo a mejorar la fertilidad y mostrando el potencial de los sistemas agroforestales como una práctica ambientalmente favorable.

Implicaciones de la investigación: Los hallazgos evidencian que el cultivo de maíz en callejones con especies leguminosas puede constituir una alternativa productiva y sostenible para agricultores locales, reduciendo la expansión de cultivos ilícitos y fortaleciendo la seguridad alimentaria.

Originalidad/Valor: La originalidad de este estudio radica en ser uno de los primeros antecedentes sobre la evaluación de variedades mejoradas de maíz en sistemas agroforestales en Tumaco, aportando evidencia científica y práctica para la diversificación agrícola en zonas de alta vulnerabilidad socioeconómica

Palabras Clave: Productividad Agrícola, Rentabilidad, Leguminosas Fijadoras de Nitrógeno, Sostenibilidad Rural, Diversificación.



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1 INTRODUCTION

Maize (*Zea Mays L*), in Colombia is a fundamental product within the family basket and as a crop there are planted about 390 thousand hectares, however this planting is only in 21 of the 32 departments of Colombia, being the largest producers the departments of Córdoba, Meta, Huila, Sucre and Tolima, on the other hand, in the Pacific Coast of Nariño do not have exact figures of the planted area, since this is not seen as a source of income and is rather considered as a crop of bread to take, although maize is the third crop with more planted area; paradoxically, it also holds the first place in imports, as reported by the International Center Maize and Wheat Improvement – CIMMYT (2019) and International Center for Tropical Agriculture – CIAT (2019).

On the Pacific coast of Nariño, Agriculture, fisheries, trade and tourism are the most important sectors of the economy, with respect to the former, it is developed mostly by producers with few areas of land (2 – 4 ha) and in a state of extreme poverty that added to the high prices of inputs, cultivation is not seen as a source of economic income and therefore there are no clear initiatives on serious processes of becoming a production system (Mayor of Tumaco, 2017). That is why in the municipality of Tumaco, currently maize is not a potential crop; therefore, there are no statistics about its planted area, management methods, planting systems, extension and training, because of these factors there is no proper management of the crop in the area and this ignorance of the socio-economic potential of it, does not allow in the advance of the establishment of the crop as an alternative source of income to traditional agriculture, mitigation of the expansion of the area planted in illicit crops and food source focused on the sovereignty and food security of the department.

There are studies on the behavior of *Z. maize* associated with *G. sepium* of which it can be highlighted; the study of Navia, (2001) in which the behavior of these two species was evaluated under an alley arrangement in a life zone (bs-T), in this it was determined yields of *Z. maize* going from 3.1 to 6 t/ha; in fact, Makumba *et al.* (2006) with the application of pruning of *Glycidia* to a maize crop, where it increased three times the production of traditional maize (monoculture) passing 1.1 to 3.8 ton/ha of dry maize. Also, Beedy *et al.* (2010) in an



intercropped crop of *G. sepium* and *Z. maize* had a significant and positive effect on organic matter and mineral contents compared to monoculture.

Meanwhile, Zambrano (2010) found that the average yields of cotton, maize and sorghum associated with *G. sepium* were 812, 1,457 and 1,377 kg/ha respectively, which were lower in monoculture reaching only 623, 1,014 and 807 kg/ha, respectively. They also indicated that in the third year after planting *G. sepium*, the organic carbon and total nitrogen contents of the soil increased by 5%.

In the municipality of Tumaco very few studies have been carried out on the behavior of the improved maize, only reference is made to the cultivation of traditional maize, which, although very rustic, has very low yield. According to the above, the research focused on evaluating the agronomic behavior of varieties of improved yellow maize varieties, thus promoting scientific sources for the implementation and development of the crop as an alternative in the municipality of Tumaco.

2 MATERIALS AND METHODS

Location. The research was carried out in the village of San Luis Robles, municipality of Tumaco, with coordinates 1°11'26.90" LN and 78° 31'11.78"LW. with 50 masl, 26.2°C average temperature, 2.843 mm/year average precipitation, 1.023 mm/year potential evapotranspiration, tropical rainforest - bh-T (IDEAM, 2021).

System Description. The experimental plot was established in an area of 1532 m², in which 12 units (experimental units) were built which have an area of 10 (m²) where 400 maize plants were planted. In the same one were established furrows of matarraton (*G. sepium*) at a distance of 12 meters between rows, with spaced cuttings at a meter (1m) for a total of 150 plants of matarraton.

Plant material. The *Z. mays* varieties used in this research were: ICA-V109, ICA-V305, ICA-V156 and a control corresponding to Creole maize collected in the area. The varieties were planted between the alleys leaving a distance of one meter next to and next to the row of *G. sepium*. The distance between maize grooves was 1 m, while the distance between plants corresponded to 0.25 m.

Experimental design. A completely randomized block design was used, with 4 treatments (3 commercial varieties and a control) and 3 replicates for a total of 12 experimental units.

Variables assessed



Biomass production per matarraton (*G. sepium*) – BMM: After 6 months of planting the *G. sepium* was cut the total biomass and weighed with a graduated scale. Samples were then taken and placed in the oven at 70 °C until the samples reached constant weight. The amount of nitrogen was estimated taking into account the laboratory results (23% protein). Taking into account that 16% of the protein is nitrogen, it was multiplied by the factor 6.25 (Sader *et al.* 2004).

The variables studied in maize were taken from the methodology proposed by the CIAT (2019); used by (Ortega *et al.* 2010).

Height of the plant – PA (cm): 20 maize plants were randomly selected from the central part of each experimental unit, each plant was measured with a wooden ruler of 4 meters in height, graduated in centimeters, from the base of the stem (point of the junction of the root and the stem) to the base of the male inflorescence.

Days to flowering – DF: At the time of flowering, follow-ups were performed every three days.

Ear length – LM (cm): The sampled cobs were measured from the base of their insertion in the peduncle to their apex, using a king-foot gages.

Ear diameter – DM (cm): The diameter of each of the sample cobs was measured in the cross-section, from the crown of a grain to the crown of a diametrically opposite grain, using a caliper.

Ear weight – PM (g): The sampled cobs were weighed on each plot, using a digital scale and this value was divided by the total number of cobs to establish the average.

Number of grains per ear – NGM: The sampled cobs were stripped and the number of grains of each was counted to determine the average amount per ear.

Yield – RTO: Determined after shelling all the cobs of the sample by treatment. subsequently, the moisture content of the grain was measured to adjust the yield up to 14 % of the moisture content of the grain.

Statistical analysis: The field information of each variable was systematized with Microsoft Excel software. The data were analyzed by means of an Analysis of *Variances to detect differences between treatments when these were detected with the test of comparison of means the respective separation was made, using a significance of 5%, with the Software of Infostat* (Di Rienzo *et al.* 2011).

Profitability Analysis: All labor and input costs used for a crop cycle for each treatment separately were recorded, as well as income from the sale of maize and savings from the application of biomass of the matarraton as bio-fertilizer. The respective calculations were



performed using the modified methodology of CIMMYT (Perrin *et al.* 1976). The average national sales price of \$1,425,500 per ton of dry corn was taken (Minagra, 2021).

3 RESULTS AND DISCUSSION

Biomass contribution of *G. sepium*: 292 kg of matarraton biomass was harvested in the experimental plot, which is equivalent to 21.12 kg of total nitrogen - NT. These values are low because the plants are in their state of establishment and were planted at a low density (150 plants). Barreto, *et al.* (2012) indicate that with 3, 4 and 6 prunings per year of *G. sepium* seines produced 4 to 6 ton/ha of biomass. Gómez *et al.* (1990) affirm that *G. sepium* planted at densities of 40 and 10000 plants/ha (50 x 50 cm and 100 x 100 cm) with four cuts per year, starting at 270 days can produce from 60 to 125 ton/ha/year of biomass. The same authors also confirm the high protein production potential of *G. sepium*, where selecting the best ecotypes and increasing tree density.

The production of green fodder during the first cut fluctuated between 4.8 and 9.8 kg/tree/year values that are similar to those reported by Gómez *et al.* (1990) who obtained yields equivalent to 1.8, 2.5, 5.3 and 7.8 kg/tree/ha/year for high and low densities, respectively. Baggio (1982), on the other hand, in live fences with distance between trees of 2 m and harvested at 6 months, yields of 2.73 kg of green leaf and 2.21 kg of firewood/tree were obtained, which is equivalent to approximately 10 kg of biomass/tree/year. On the other hand, in a plantation of 6 months of age with a density of 6670 plants/ha and pruning regime of 24 weeks, Melchor and Marroquín (2005) obtained 272 kg/ha/year finding that pruning *G. sepium* twice a year increased maize production by 50% in relation to the average yield obtained by the traditional cultivation system, this increase was attributed to the improvement of soil fertility and water retention by the aerial biomass incorporated into the soil, thus demonstrating that *G. sepium* increases the yield of agricultural crops under agroforestry systems in this tropical region. Sanginga *et al.* (1991) found that with an adequate pruning regime *G. sepium* produces 10-20 ton of dry matter/ha/year, up to 130 kg N/ha/year. Similarly, Akonde *et al.* (1986) observed a 35 to 50 % increase in maize yield in Cameroon, attributing it to both organic matter and N incorporated into the soil, several studies have shown that biomass production in N-fixing legumes could be influenced by the frequency and height of pruning Duguma *et al.* (1988); Sanginga *et al.* (1994). Duguma *et al.* (1988), in a trial of *G. sepium* established in Niger, found that the aerial biomass harvested increased from 7.6 to 9.2 tons of dry matter/ha as pruning height increased from 0.5 to 1.0 m, and from 0.5 to 5.4 tons of dry matter when



pruning frequency decreased from 4 to 24 weeks. Kaba and Abunyew (2021), studying 5- and 10-year-old *G. sepium* trees, indicate that adult trees can produce up to 67.15 kg/tree pruned every 8 months, while young trees produce up to 49.37 kg/tree. Similarly, N concentration decreased with pruning time. They conclude that pruning should be scheduled according to the age of the trees, for young trees every four months while for adults every 8 months to produce between 58 and 80 kg N/ha. Dávila and Navia (2007), found that in the alley cultivation system there was fixation and release of nutrients, concluding that *G. sepium* besides providing nitrogen, activates the absorption and recirculation of phosphorus, potassium, calcium and magnesium, among others. With the exception of potassium K, which decreases in some cases possibly due to leaching from rainfall that causes nutrients to be deposited in deeper layers, or to increased demand by trees. In addition, nitrogen inputs by leaf litter are low compared to what is extracted annually.

Plant height – AP. significant statistical differences were found among the studied varieties. The variety that reached the highest height was the regional one with 2.96 m, while the height of the improved varieties ranged between 1.45 and 1.74 m (Image 1). The regional variety is a traditionally managed species, combined with different species in the traditional farms of farmers. Contrary to this, the improved varieties presented an average height of 1.60 m, which facilitates their handling and harvesting. Gordón *et al.* (2006) define adaptability as the ability of genotypes to take advantage of environmental stimuli *as stability refers to the ability of genotypes to show highly predictable behavior depending on the environmental stimulus*. According to FENALCE, (2010), ideal temperatures favor the development and growth of plants and that in addition the increase of nitrogen availability increases the growth and vigor of the plant and therefore, slow mineralization makes the availability provide the necessary elements during the life cycle.

Ear length – LM. significant statistical differences were found between ICA V-109 and ICA V-156 varieties, with longer ears at 16.22 and 16.00 cm, respectively, while the regional variety had the shortest ear length at 9 cm (image 4). The length of the ear is influenced by environmental conditions (climate, soil), nutrient availability the maximum length of the ear will depend on the soil moisture Cantero y Martinez, (2002). Vargas *et al.* (2010), affirm that ear length depends on variety, climatic conditions and ear length of maize is determined by edaphoclimatic factors and influenced management. As evidenced in the cultivars planted where the biomass incorporated helped in the agronomic processes of the treatments. Zambrano, (2010) mentions that the extract from the leaves of matarratón has allelopathic effects, so it influences the germination and growth of some plants.



Days to Flowering – DF. In the variable days to flowering, significant statistical differences were found between the treatments evaluated. The treatment with the regional variety presented the highest number of days (95) or lower precocity to flower 50% of plants, the other varieties did not show differences between them (image 2)., the flowering of the crop depends on the fertilization processes especially nitrogen, phosphorus, potassium accumulation, as well as an adequate water level, variables that are directly conditioned by the management of the crop (Yanez *et al.* 2013)., that is why within the processes of genetic improvement the crop factors such as varieties and stages of development are fundamental at the time of selecting new seeds for planting, all the breeding processes focus on the development of precocity in the plant material is related to its lower soil and climate requirements and focused on increased production as stated by Allen *et al.* 2006, and proof of this are the results obtained in this variable in which Creole maize presented very different and late values at the beginning of flowering in relation to varieties that have gone through genetic improvement processes and were evaluated in this study.

Ear diameter – DM (cm). Significant statistical differences were found among the studied varieties. The introduced varieties reached the largest ear diameter (3.9 cm), while the regional variety had the lowest value with 3.13 cm (image 4). The diameter of the ear is determined by the photosynthetic activity and great absorption of water and nutrients, if this is adverse will affect the size of the ear in formation and consequently will obtain smaller ear diameter, which will ultimately impact on low yields (Saldaña and Calero, 1991). According to Lehman *et al.* (2014), ear diameter is part of the reproductive phase, if the mentioned events are adverse, the size of the spike in formation is affected, and consequently smaller diameter is obtained, which affects low yields. The diameter of the ear is one of the most important components in maize yield and is conditioned by the soil and climate conditions (climate and soil), and nutrient availability (Adetiloye *et al.* 1984).

Ear weight – PM (g): significant statistical differences were found among the studied varieties. The varieties that reached the highest weight were ICA V-109 and ICA V-156 with 89.88 and 81.85 g respectively (Image 5). The weight of the ear is dependent on the planting distance between plant and between row, which determines the number of plants per hectare, although the planting distance is not a dependent factor in this study, the results show that the improved varieties have a better behavior as it was presented in the variable days to flowering, which allows to determine that the genetic improvement processes through which these cultivars have gone have as a priority the increase of production and the efficient use of the nutrients contributed to the soil, mainly nitrogen (Alvarado & Calderon, 2012).



Number of grains per ear – NGM: The varieties with the highest number of grains were ICA V-109 and ICA V-156 with 452.32 and 462.1 grains respectively (image 6). In relation to the effects that pollinators trigger on plants, multiple studies show that seed and fruit production is increased with the presence of these organisms, due to the existence of a positive correlation between their diversity and pollen deposition, as well as by a number of factors such as the population dynamics of the species, their pollinator efficiency, intra- and interspecific competitiveness, the distance between flower patches, the *availability of resources or the management systems used* (Chautá-Mellizo, et al. 2012). Otherwise, the wind direction favors the transit of pollen from the emitter crop to the female flowers of the recipient plants. evaluated are increased in the sense of prevailing winds; at distances below 97 m direct effects on wind pollination were found (Sauthier and Castaño, 2019).

Yield per hectare: there were significant differences between the varieties studied in which the improved varieties presented the highest yields with 2138.6, 2024.19 and 1974.73 kg of dry grain/ha, ICA V-109, ICA V-156 and ICA V-305, respectively (Image 7). The national average yield for technified yellow maize of 5.81 ton/ha and the traditional yield of 1.83 ton/ha (Fenalce, 2020). The yields found are close to the traditional, this indicates that in Tumaco there is a technological gap for what can affect higher yields and profits for this activity for farmers. The reason for this superiority can be explained since the legume has the ability to fix nitrogen biologically and provide it to the soil, added to its low C/N ratio makes its mineralization faster and therefore nitrogen is quickly available to the plant; Sauthier and Castaño, 2019, these authors claim that the mineralization process is determined by factors such as the quality of the waste, soil type, temperature, humidity, among others. In legume residues, the C/N ratio is low, therefore N release is rapid and immediately available for absorption by the next crop. However, the efficiency in the transfer of N to the crop is determined by the synchrony between the release of the N provided and the absorption of N by the crop, the latter being the possible response to a better yield. Kaba and Abunyewa (2021) reported high yields using improved varieties when compared to traditional varieties (5.52 vs 1.48 t/ha respectively).

Analysis of profitability of treatments: The variety with the highest profitability was ICAV-109, while the regional variety presented a negative profitability as evidenced in Table 2. The results suggest that, in Tumaco, high-yield maize varieties should be established to encourage their promotion and *generate income for producers*. The management that producers give to traditional corn, it is evident that this is a subsidiary activity of other production systems such as in the case of cocoa with sombrío, where plantains are planted, corn is irrigated under volley and the bushes and trees are toppled. In this case, maize does not undergo specific



fertilizations or cleaning, so the costs are minimal. The maize system in alleys with high-yield varieties is a viable alternative, since the yields are very similar to the national registers for traditional maize. On the other hand, the application of *G. sepium* biomass is a very good alternative. Beedy *et al.* (2010) affirm that the intercropping of *G. sepium*/ corn had a significant and positive effect on the fractions of soil organic matter (SOM), SOM and nitrogen were 12% and 86% higher in the intercropping of *G. sepium* compared to corn coarse soils. Makumba *et al.* (2006) reports that the application of *Gliricidia* pruning tripled maize yield compared to maize cultivation without any soil amendment (3.8 and 1.1 ton/ha, respectively). Maize yield decreased with time under the monoculture system with and without N source fertilizer; likewise, the application of inorganic fertilizer (46 kg N/ha) in agroforestry systems increased maize yield by 29%. The findings of this research and the results of the different investigations of the crop in alleys of *G. sepium* and maize confirm the increase of maize yield and the improvement of nutrients in the soil in the short term. These results obtained in the municipality of Tumaco become a productive option for farmers, who depend on the cultivation of cocoa, African palm, timber and banana for self-consumption and the generation of economic income and do not have the resources to fertilize with inorganic sources.

Significant statistical differences were presented in the agronomic behavior of the different maize varieties, The improved varieties presented higher values in the variables related to yield, such as length, diameter, weight, number of grains and yield, however the regional variety presented the highest values in the variable plant height, which shows that the improved varieties have a certain height, which is a source of established breeding processes, which is manifested by the no i have significant variability between them, it should be noted that the arrangements established with *G. sepium* generate a contribution of 574 kg of biomass per hectare to the arrangements when they are established, these gains of plant material incorporated into the soil, are fundamental in the processes of accumulation of nutrients by degradation of organic matter.

The improved varieties presented the highest yield and profitability, with ICAV-109 being the most outstanding variety, while the regional variety presented the lowest yield and a negative profitability.

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CONFLICT OF INTEREST

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ANNEXES

Image 1

Average height of the varieties evaluated in this research.

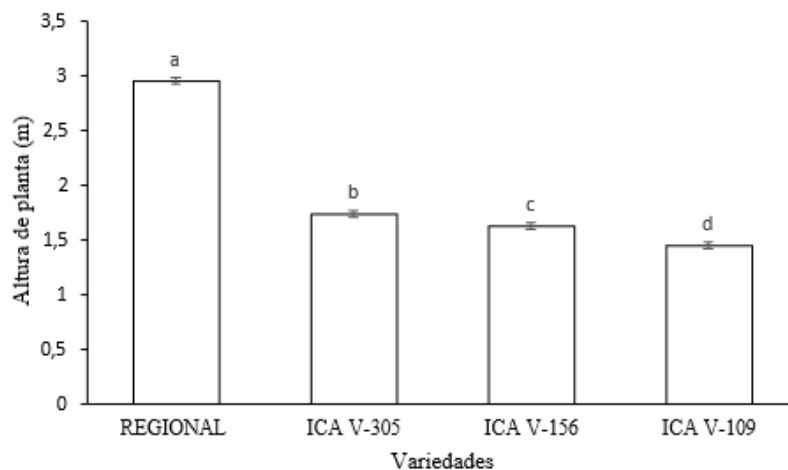


Image 2

Response of the variable days to flowering.

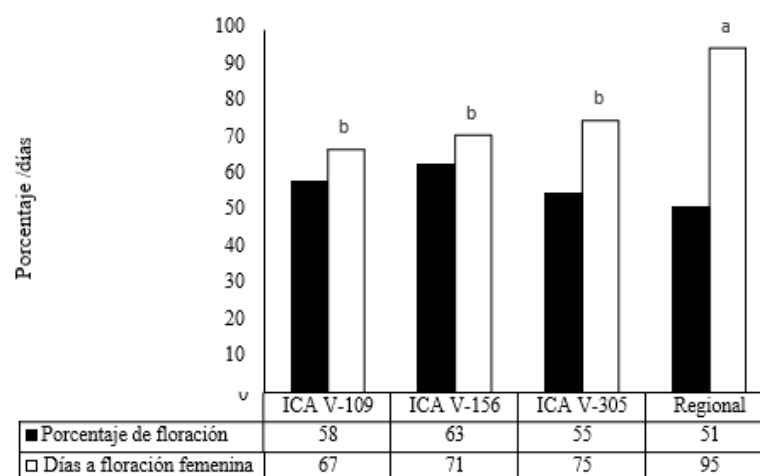




Image 3

Response of ear length variable in the different treatments evaluated.

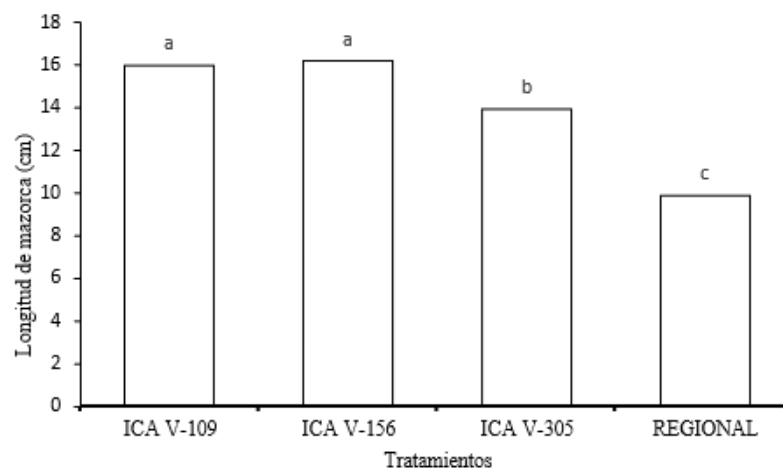


Image 4

Response of the variable ear weight.

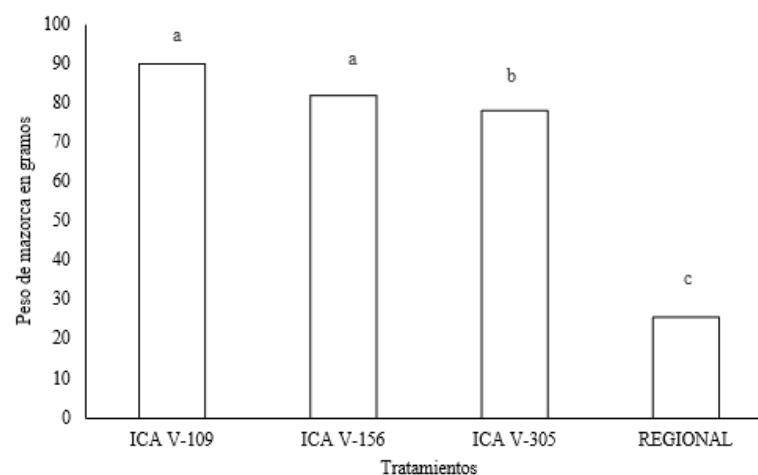




Image 5

Response of the variable Performance.

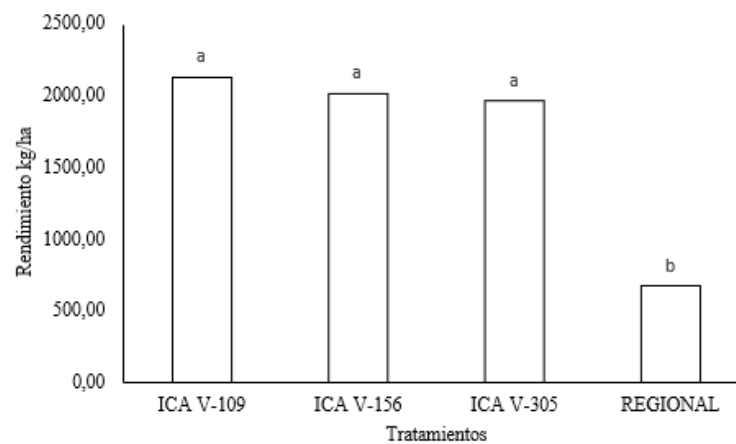


Table 1

Profitability analysis obtained with agroforestry systems in maize cultivation.

<i>Detail</i>	<i>ICAV-109</i>	<i>ICAV-156</i>	<i>ICAV-305</i>	<i>Regional</i>
<i>Yield (ton/ha)</i>	2.138	2.024	1.974	0.678
<i>Sales price</i>	1 425 500	1 425 500	1 425 500	1 425 500
<i>Revenue</i>	3 047 719	2 885 212	2 813 937	966 489
<i>Costs</i>	1 788 000	1 788 000	1 788 000	1 555 500
<i>Utility</i>	1 259 719	1 097 212	1 025 937	-589,011