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The experimental design selected Castillo and Caturra varieties, allowing the evaluation of 40% of plants and monitoring of the variables, using own scales with categories that increase from 1 to 4; the recording and analysis of information used the Excel platform, applying statistical methods of distribution and measures of central tendency, as well as significant evaluation.

This is how the statistical process shows favorable results for the Caturra variety with higher percentage of lustiness (90% L1) and flowering (40% L2), but a smaller difference in production (30% L1) compared to Castillo (37% L4).

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I. INTRODUCTION

Coffee is considered one of the main economic and social products offered by the country thanks to its quality [1], but this is also determined by the different conditions of the agro-ecosystems that are formed coffee, it is clear that the cultivation of coffee is grown in about 80 tropical and subtropical countries around the world and its main distribution is found in small and medium-sized farms of around 10 Ha [2] directed by coffee growers that promote family subsistence; However, despite the fact that coffee is considered a core productive bet within the Internal Agenda of Productivity and Competitiveness of the Department of Cauca, it has been identified that one of the greatest challenges to which this nucleus is exposed is that producers have access to the different certification programs required by international markets

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[3], thus, many of the challenges for strengthening the production and marketing of certified regional coffees have been somewhat delayed [4].

At the local level, the Cauca coffee is among one of the main departments in the production of high quality special coffees with denomination of origin, accompanied by Santander, Huila and Nariño; its production is 100% smooth Arabica and its processing is linked to methodologies and protocols determined by the National Federation of Coffee Growers, transferred to the producers by its group of rural extension agents, as well as the Cauca coffee with its Cauca Denomination of Origin, and where it is recognized by characteristics such as: "a coffee with fragrance and aroma very strong and caramelized, which in cup presents high acidity, medium body, balanced global impression, clean, soft with some sweet and floral notes" [5] seeks to contribute day a day to achieve standardization in production and processing, since its levels of consistency and homogeneity is what has made this coffee to be evaluated by the markets and the most demanding palates.

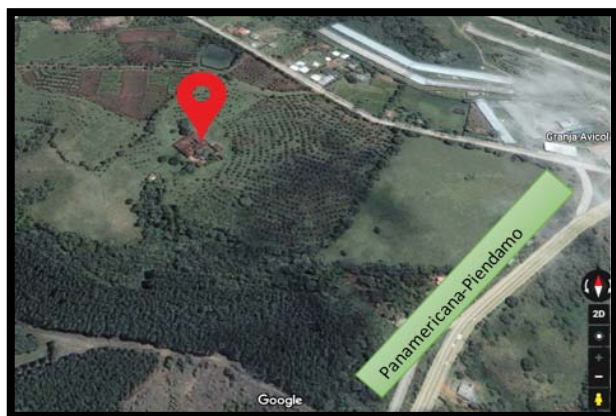
It should be noted that all the characteristics and attributes acquired by coffee as a final product are linked to the interaction of several components within a system; where its complexity depends on the number of related factors; their study is general but their interrelations tend to serve the same purpose; as for example in the present study we have two types of production systems; the first a production system with semi-shade and the second a production system with free solar exposure; both include within their system other subsystems such as weeds, climate, soil and coffee plants and others; this means that the study of all these interactions contributes to the final characteristics of the product [6].

It is here where the National Federation of Coffee Growers and Coffee Research Centers have determined that coffee growers have become the main players in this chain and where research and work in coffee production systems under the different production units and The environment formed between each of them are key to achieve recognition,

strengthening, competitiveness and high levels of quality. Therefore, the present research study evaluated the incidence of agro forestry systems with coffee and production systems for free solar exposure in two varieties of Castillo and Caturra coffee, thus identifying the agronomic aspects that influence the production of coffee as the lustiness, production and flowering periods; study that contributes to the coffee chain with baseline information for agronomic studies of variety behavior and its response to a variety of agro-ecological and micro-climatic conditions offered by the Popayán Plateau.

II. MATERIALS AND METHODS

Study area: The research area was carried out at Hacienda los Naranjos, owned by SUPRACAFE, located in the village of La Venta, Cajibío Cauca municipality, geographically positioned at coordinates N2 35,086 W76 32,959 (Figure 1), and located approximately at 1862 masl, on the banks of the Purace volcano on volcanic soils, with a distance of 28 km from the city of Popayán, with characteristics of flat topography, arboreal vegetation to its surroundings, and where its focus has been determined in the production of coffee, with its own farms converted into technological validation stations, where in conjunction with various entities and universities, more than 200 varieties of Arabica coffee are being validated and micro-lots of high quality and traceability for international markets are being produced.



Source: Authors edited by Google Maps, 2017

Fig. 1: Research Area Location

Methodological Design: For the research, a selection of 4 lots was made, two for each variety and production system, characterizing 50 continuous plants for each batch, with a distance of 1.5 m between rows and 1.3 m between plants; in the lots 40% of the 50 plants corresponding to 20 plants per lot were evaluated with a signaling criterion called Five of golds [7], which covers a marking of 4 plants for each of its corners and 4 plants allowing so perform a systematic evaluation of the lot. In addition, for each of the plants for monitoring, two

branches were taken in different parts of the plant [8], whether primary or branched, superior, inferior or intermediate; this in order to identify the aspects to be evaluated throughout the plant.

Registration of Information: The information was consolidated in data recording formats taking into account some time intervals depending on the format to be evaluated, and the value of the variable was determined on scales of value from 1 to 4, with 1 being the lowest and 4 the largest, and indicating a scale number for each of the variables evaluated as shown below:

Flowering: Evaluating in each of the selected plants the branches that have been marked initially and determining in what stage of flowering it is (E1, E2, E3, E4,) adapted by [8]. **Production:** In which the amount of grains produced in each of the branches marked by each plant under evaluation is monitored. **Phytosanitary control:** Format that allows to determine the status of plants with respect to lustiness, the incidence of pests or diseases and well-marked deficiencies of nutrients. **Climatic conditions:** A record of climatic conditions is made, for example: Relative Humidity, Ambient Temperature; which allow to determine some variations within the research area and with it to be able to determine its influence with the agronomic behavior of the plants under study.

Analysis of the Information: The information registered for the variables was tabulated and developed by means of analysis of significant differences from the evaluation of the variables and their behavioral tendencies, in addition to the correlation of the parameters of development of the plant with respect to agroecological tensors.

III. RESULTS AND DISCUSSION

Characteristics of the Lots: Information was obtained on the characterization of each of the lots under investigation; corresponds to the identity of each lot and which are the variables that act directly on them as shown in the following table:

Table 1: Characteristics of the Lots in Research

| # Lots in Research | 1 | 2 | 3 | 4 (3N) |
|--------------------|---------------|------------|------------|-----------------|
| Variety | Caturra | Caturra | Castillo | Castillo |
| Production System | Partial Shade | Sun | Sun | Partial Shade |
| D.S Grove | 1,5 m | 1,5 m | 1,5 m | 1,5 m |
| D.S Plant | 1,3 m | 1,3 m | 1,3 m | 1,3 m |
| Sowing Date | 1-Jan-2009 | 1-Feb-2009 | 1-Mar-2009 | 1-Apr-2009 |
| Last Fertilization | Oct – 2016 | Oct – 2016 | Oct – 2016 | Oct – 2016 |
| Renovación | Bandola | Bandola | Calavera | Without Renewal |
| Last Flowering | 12-09-2016 | 12-09-2016 | 12-09-2016 | 12-09-2016 |

Source: Authors

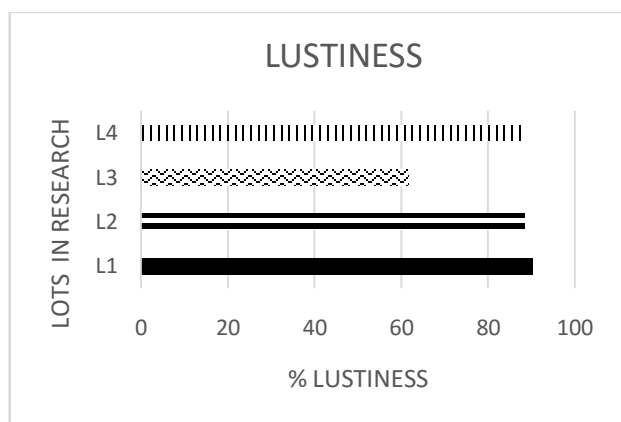
The results shown below are a collection of data enclosed in a tabulation of scales where the behavior of the variables is expressed with the most representative scale, that is, the one that allows to identify the optimal values in the variables under study, in which An analysis is made of each of the variables such as lustiness, flowering and production in the plots.

Table 2: Behavior of Lots in Research Variables (%)

| Lots | Lustiness | Flowering |
|------|-----------|-----------|
| L1 | 90 | 35 |
| L2 | 88,3 | 40 |
| L3 | 61,6 | 10 |
| L4 | 88,3 | 5 |

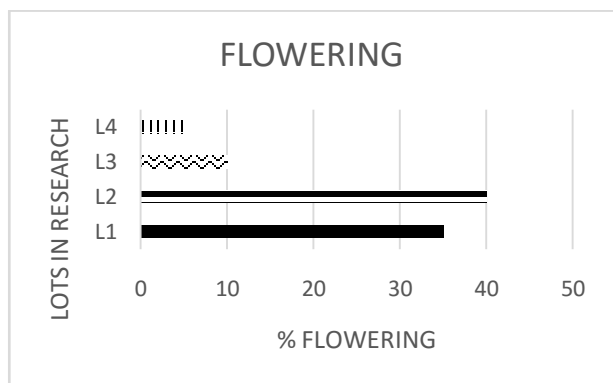
Source: Authors

Lustiness: Aspect of great importance that allows to identify in a visual way the state of the plant; evidencing the response of the same to different environmental factors and to the production systems to which they are exposed.



Graph 1: Major Scale Lustiness Variable

Flowering: In the cultivation of coffee a series of periodic biological changes occur, but there are some more important than others, for example, flowering, reproductive formation of coffee that acts as indicators of reproduction and productivity phases [9].



Graph 2: Variable of Flowering in Greater Scale

Production: Stage of great interest for coffee farmers, the period of post harvest that is made to this production is one of the most important determinants for coffee quality; then, in table 3, the production ratio per plant and its weight is shown.

Table 3: Production Ratio

| Lote | % Pn | # Grains | P. Prom. Grains | Pn*Grs L.sample |
|------|--------|----------|-----------------|-----------------|
| 1 | 15,9 % | 1399 | 1,93 gr | 2,7 kg |
| 2 | 30,2 % | 2657 | 2,27gr | 5,8 kg |
| 3 | 16,5 % | 1452 | 1,77gr | 2,5 kg |
| 4 | 37,2 % | 3271 | 2,41gr | 7,8 kg |

Source: Authors

IV. DISCUSSION

Lustiness: As can be seen in graph 1, the behavior of the lustiness variable (Scale 4) in the plots under evaluation corresponding to larger leaves of dark green color, brightness in its beam, firm, healthy, without affectations and healthy fruits showed its greater percentages of better lustiness in lot 1 (shade - Caturra) with 90%, followed by lots 2 (sol - Caturra) and 4 (shade - Castillo) with similar percentages of 88.3% and finally the lower lot Strength percentage in scale 4 was lot 3 (sun - Castillo) with a percentage of 61.6%, identification determined from an analysis of percentage averages.



In conclusion in the batch of the system of partial shade production that presented better percentages of lustiness where the characteristics of the shadow act hand in hand with the direct influence of the micro climatic and agroecological conditions that has favored the behavior of the variable lustiness previously mentioned, where it is attributed to what contributes to the disposal of organic matter, the assimilation of nutrients, soil protection, the action as a filter against solar radiation, root protection, harvest quality, among others; [10] and [11]; and the lower lustiness in the batches of the production system with direct exposure to the sun, which, despite being varieties developed to adapt to solar exposure conditions, are affected to a minimum by these conditions. On the other hand, the quality of coffee to free solar exposure is preferred by many consumers due to the quality and taste of the drink, and there are even researchers who in their processes have indicated that for some variables such

as production the system to free solar exposure it can be favored in productivity increases [12].

Other researchers such as [13] have conducted similar research to the identification of lustiness levels, but a study was conducted on 8 varieties of Arabica coffee in two provinces Quevedo and Gualea (Ecuador) from which, through the evaluation of the agronomic behavior of the varieties showed lustiness averages in scale 4 corresponding to the characteristic of plants with very good lustiness; situation similar to the present one that in most of them were presented in scale of lustiness 4.



Flowering: As shown in graph 2, the distribution of the flowering period was most marked in batch 2 with 40%, followed by 1 with 35% and finally the batches with the lowest representation were batch 3 and 4 with 10 and 5% in its corresponding order; it is clear that the stage of greatest representation was the E1 in all the lots, which justifies its representation in the graph; in the variable of variety the period of flowering (E1) was observed with greater representation in the caturra variety, and the values in the castle variety were less representative; and between production systems the direct sun exposure showed better results between the data obtained for each of the varieties under study.

It must be borne in mind that the flowering period is a periodic change directly associated with the productive stage of coffee cultivation [14], however, the evaluated flowering stage is not considered the main one; This corresponds to the evaluation carried out in the productive stage of the first semester of the year, which is responsible for the production distributions that are evident in the second semester as normally happens in the southern region of the country, specifically in the department of Cauca for this research thanks to the environmental and climatic conditions provided by the area [8].

The process of identification of flowering stages for the different batches evaluated showed scattered distributions in the lots and during the registration period (6 Months); the appearance of flower buds starts in lots 1 and 2; and in the middle of the follow-up process, buttons start to be identified in lot 4 and finally appearances of flower buds in lot 3; these sporadic distributions of little magnitude continue their development of coffee beans for productions of the second period that occurred at the end of the year in the southern region, as has been demonstrated by several investigations by the National Center for Coffee Research; besides the temperature conditions play a

very important role in the flowering processes since they can inhibit or promote the flower inductions; for this specific investigation we have an average temperature of 25 ° C and 26 ° C and are close to those defined by [15] as the appropriate temperature to promote flower initiation.

Production: As can be seen in graph 3, the production percentages were represented as follows: with the highest percentage of production by number of grains in lot 4 (Castillo-sombra) with 37.2%, followed by lot 2 (Caturra-sol) with 30.2% and lot 3 (Castillo-sol) and 1 (Caturra-sombra) with 16.5% and 15.9% in their corresponding order; this level of production in the varieties had greater representation in the Castillo variety with a percentage of 53.7% unlike the Caturra variety with 46.2%; these values confirm what was stated by Cenicafe 2011 where it determines that the castle variety is a variety composed of low size, slightly larger than caturra of long branches, large leaves, lustiness, large grain, excellent cup quality, and production superior to that of the Caturra variety.



However, studies have been reported that show that the differences between the Castillo and Caturra variety are not as significant; it is the particular case of the research called: "Comparison of the quality of Nariño coffees according to variety"; which was disclosed at the Symposium of the American Specialty Coffee Association (SCAA) in Seattle, Washington, and indicating that coffees of these varieties grown and processed in similar conditions have very similar sensory characteristics, indicate that the castle can reach equal quality levels a caturra, however the difference that if taken into account is the resistance diseases where the caturra variety has presented resistance weaknesses against these characteristics [16].

Similar situation occurs in the productive quantity between the production systems, where the coffee agroforestry system presents a production of 53.1% and the system for free solar exposure presents percentages of 46.8%, thus considering again the benefits of coffee agroforestry systems with sustainable characteristics and contributing to the care of the environment; it must be taken into account that this can be determined by the agronomic management that is given to the crop, related to cultural work, density of planting, application of nutrients among others, since in different occasions and studies many varieties of free-ranging arabica solar have shown excellent productive results.

V. CONCLUSIONS

It concludes that the castle variety has a higher growth rate than the Caturra variety; however, this difference is not very significant; These conditions make it possible to verify what was stated in similar investigations where this characteristic had already been determined; and the behavior of the lustiness was better represented in the Caturra variety and between production systems the best lustiness is the production system under shade. That in relation to the flowering variable in productive stage this was presented in a dispersed manner during the monitoring period and its representation was more reflected in the Caturra variety in the two production systems corresponding to batch 1 and 2. In the process of production initially have better results in the Castillo variety and in the shade production system. It was found that lot 1 and 3 behave similarly to the standard behavior in cherry coffee production; now, batch 2 and 4 although they belong to a SP and different variety show an increase in production both in number and weight of grains. And in general, after making the relation between the number of grains and their weight, it was determined that they are directly proportional.

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