IACO ANNUAL MEETINGS

PROCEEDINGS OF THE 5TH AFRICAN SCIENTIFIC COFFEE CONFERENCE, HELD IN LOME, TOGO, 15TH NOVEMBER 2022.

Organisers:

- Inter-African-Coffee Organisation (IACO)/African Coffee Research Network (ACRN)

- Coordinating Committee of the Coffee and Cocoa Sectors (CCFCC) of Togo

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RÉPUBLIQUE TOGOLAISE

IACO
INTERAFRICAN
COFFEE ORGANISATION

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1. Introduction

The coffee industry is the main source of income for more than 12 million households in Africa and a key pillar in the fight against rural poverty. It is a source of income, food and nutritional security, as well as job creation in rural and urban areas. This is in addition to the fact that it is a major source of tax revenue and foreign exchange for the governments of the countries that produce it. However, Africa's potential role in the global coffee value chain has preoccupied industry players for several years. The challenges faced by the development of the sector are amplified by the poor agronomic practices, the lack of new high-yielding varieties, the damage caused by pests and diseases and the effects of climate change, which lead to a decline in quality and productivity in African coffee producing countries.

The African Coffee Research Network (ACRN) under the auspices of the Inter-African Coffee Organization (IACO) was established to facilitate and build the capacity of research institutions, improve human resources and disseminate effectively appropriate technologies or information to coffee stakeholders, in response to these challenges facing the sector. IACO/ACRN organizes a scientific conference on coffee every two years as one of its tools to facilitate the exchange and dissemination of scientific information on coffee among member states. The 5th African Scientific Coffee Conference held in Lomé, Togo on November 15, 2022 was organized in collaboration with the Coordinating committee of the coffee and cocoa value chains of Togo (CCFCC), with the theme "**Connecting Research and Extension for Improved Coffee Productivity and Quality**".

Researchers from different institutes in member states and RECA partners made presentations on different topics in the coffee fields, including:

- Agronomy,
- Breeding,
- Pests and diseases control
- Socio-economy,
- The effects of climate change, and quality improvement

After the presentations and discussions during the conference, the recommendations made are presented in this report.

2. Conference proceedings

The 5th ACRN Scientific Conference took place on November 15, 2022, in the Fazao room of the Hotel 2 -Fevrier, in Lomé, Togo, and was attended by coffee scientists and delegates from IACO members countries. The opening ceremony was marked by the introductory words of Dr. Celestin GATARAYIHA, Director of Research and Development (DRD) of IACO and Coordinator of ACRN; followed by a word of welcome from Mr. Enselme GOUTHON, Secretary General of the Coordination Committee for the Coffee and Cocoa Sectors (CCFCC) of Togo and representative of the Minister of Commerce,

Industry, and Local Consumption, President of IACO and, finally, the opening address of the Secretary General of the IACO, Amb. Solomon RUTEGA.

IACO/ACRN had launched a call for researchers to submit abstracts for the conference. A total of 65 abstracts were received, out of which 34 were selected for presentation by 31 researchers from 15 ACRN member countries.

Of the 34 papers scheduled for presentation, only 23 papers were presented by 20 researchers from 14 countries. Cameroon, Cote d'Ivoire, DR Congo, Ethiopia, Gabon, Kenya, Madagascar, Malawi, Nigeria, Sierra Leone, Tanzania, Togo, Uganda, and Zimbabwe. The table below summarises the number of abstracts received and presented.

	Number of abstracts	Number of countries	Number of researchers
Abstracts received	65	15	46
Abstracts approved	34	15	31
Abstracts presented	23	14	20

These communications were presented in three sessions and covered different topics on genetics, agronomy, pest and disease control, socio-economy and the effects of climate change.

2.1 First session

Moderated by Dr Gichuru Elijah from Kenya, it was furnished with 8 communications, which focused on the sub-theme "***Genetic Improvement and Quality Improvement***".

After presentations and discussions, the following recommendations were made:

i) That research work be more accentuated on certain links in the coffee value chain, in particular processing and consumption (profile of the quality cup);

ii) IACO to find a strategy for exchanging high-performance plant material and technologies between member states in order to make high-performance varieties available to all these countries;

iii) To orient research work on tools or technologies that can increase the added value of African coffee (Agro-industrialization);

iv) Encourage governments of IACO member states to fund more research activities on coffee;

v) Accentuate research on the more oriented socio-economic aspects of the African coffee market;

vi) Multiply meetings between ACRN researchers for more exchanges of research experiences on coffee;

vii) Set up ACRN scientific journal to publish research results and other communications on African coffee

2.2 Second session

The second session was moderated by Prof. Pamphile GUEMA from Gabon with the sub-theme "Agronomy & Socio-Economy". Nine (9) communications were made.

The presentations focused mainly on the state of coffee growing in different IACO member states and its contribution to the gross domestic products (GDP) of these countries. Challenges in terms of climate change and aging of the coffee plantations and other environmental and human factors, in particular the end of the quota system which had a negative impact on the African coffee industry were also discussed.

At the end of the discussions, the following recommendations were made to meet the various challenges identified:

i) Develop improved varieties that are resistant to diseases and insect pests,

ii) Extend extension services, and use Good Agricultural Practices (GAP)

iii) Strengthen the capacities of producers,

iv) Develop agricultural data collection policies,

v) Include coffee in the priorities of the agricultural programs of producing countries to benefit from adequate investments.

2.3 Third session

Moderated by Dr. WEGBE Komlan from Togo, this session had 6 communications covering the field of pest and disease control & climate change, Four (4) of these presentations were made physically and two (02) virtually. During the discussions, it was recommended that research should refer to existing results to better advance and this requires close collaboration between researchers at regional and international level.

In conclusion, clarifications and explanations on these recommendations were made following some concerns raised by the participants. It was thus recommended to ACRN:

i) To develop a strategy to maintain the members who are back,

ii) To develop a policy of exchange and/or sharing experiences,

iii) Encourage the creation of research centers in Member states.

iv) Encourages the sharing of information on research results;

3. Repertory of abstracts

3.1 Plant breeding

Caractérisation de la diversité génétique des caféiers robusta (Coffea canephora) exploités au sud-est du Gabon à travers l'analyse par microsatellites des génotypes

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Abstract

Knowledge of plant material used is one of the most important criteria for selection and varietal improvement, with an absolute regard for respect for the environment. However, coffee accessions have been introduced in Gabon for more than three decades without any specific interest in the identity of the plant genetic resources concerned. The present study aims at the phenotypic and genotypic characterization of the coffee collections in the province of Haut-Ogooué, in the South-East of Gabon, in order to know the diversity of the plant material grown in this producing basin. The collection of plant material on eleven samples of trees (leaves and mature cherries), presenting phenotypic dissimilarities, was carried out in two orchards: Alanga (Okondja) and Kélé (Franceville). A first descriptive approach was carried out for the phenotypic characterization in order to place the samples collected in one of the known groups: Guinean or Congolese. A multivariate analysis of the leaf organs by microsatellites was performed using the software Darwin 6 to assess the genetic distances and identify the genotypes of the coffee trees observed. It appears that the samples of this study cover a large part of the potential diversity of Coffea canephora, apart from the so-called "Guinean" group. This situation is remarkable and relatively rare, therefore interesting, in the same plantation. The study thus contributes to the increase of knowledge on the cultivars of robusta coffee trees exploited in Gabon and it sees good prospects for the establishment of a national program for the improvement of coffee varieties.

Keywords: coffee trees, robusta, genotype, phenotype, characterization, microsatellites

Diversité des espèces de cafiers et utilisation dans la recherche

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Abstract

Among the 139 species of coffee trees listed in the world, Madagascar is the home to 67 wild species of coffee trees, i.e. almost half of the diversity of coffee trees in the world. Caffeine is the main compound of coffee trees except wild coffee trees from Madagascar. In addition to this biochemical variability, Malagasy species are also made up of their morpho-phrenological diversity and their wide geographical distribution. Like any other coffee producing country, Madagascar produces the two species of cultivated and marketed coffee trees which are arabica and robusta. However, robusta dominates (95%) the production and the coffee market in Madagascar. The sensitivity of arabica to rust and to the different pedoclimatic conditions of the island means that the production of the latter is very low (5%). Improvement programs, in order to create new varieties of Arabica adapted to the different pedoclimatic conditions of Madagascar, have been carried out since the 1970s by IFCC researchers and then continued by FOFIFA to this day. Thus, hybrids resulting from the three-way cross obtained from the cross between three species, *Coffea eugenioides, C. canephora* and *C. arabica* at the tetraploid level were obtained. Some of these hybrids have agronomic potential such as grain size, rust resistance and production. Genetic analyzes using some simple sequence repeats (SSRs) markers were also carried out, the result showed that these hybrids are very close genetically to the arabica species. This same way could be used for the improvement of coffee trees grown with Malagasy wild coffee trees according to traits of interest such as adaptation to extreme pedoclimatic conditions or the duration of the fruit flowering-maturation cycle in order to obtain new varieties that perform better in the face of current climate change.
Keywords: Coffea, diversity, improvement, Madagascar, climate change

Evaluation des performances d'une nouvelle variété de caféier arabica au Togo

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Abstract

Coffee is the world's second largest export product, in value, behind oil. It has long been recognized as a good stimulant of the body and brain activity due to the caffeine it contains. Two species of coffee with complementary ecological requirements supply the entire market: *Coffea arabica* L, and *Coffea canephora* Pierre (Robusta). In Togo, the Robusta coffee tree is widely cultivated. In order to diversify coffee cultivation and expand the range of coffee produced in Togo, a new variety of Arabica coffee tree originating from Cameroon has been introduced because of its highly appreciated aroma and taste. The young plants of this variety, obtained by sowing seeds, were planted at the ITRA/CRA-F experimental stations in Tové and Danyi in May 2020 with a spacing of 3m ✕ 3m for the adaptability trial in order to study their agronomic performances under the conditions of Togo. The data collected at the 13th and 19th months after planting focused on precocity, vigor and number of branches of the plants. It appears from the results obtained that the height of the plants, the diameter at the collar and the number of ramifications obtained on the Danyi station (810 m altitude) were significantly higher ($p < 0.05$) than those obtained on the station of Tové (248 m above sea level). Regarding the increase in height, diameter at the collar and number of ramifications between the 13th and 19th month, the results showed that the performances obtained on the Danyi station were significantly higher ($p < 0, 05$) to those of the Tové station. All the results obtained confirm that the Coffea arabica species is adapted to high altitude conditions.
Keywords: Coffea arabica, agronomic performance, high altitude.

Influence du schéma de mise en place sur les performances agronomiques de café arabica (Coffea arabica L.) au Togo

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Abstract

In order to identify the best Arabica coffee installation scheme to popularize in Togo, a planting density trial was set up in May 2020 at the ITRA/CRA-F experimental station in Danyi. The young plants were installed with two planting densities: 3 m x 1.5 m (2222 plants/ha) and 3 m x 3 m (1100 plants/ha). Data were collected at the 13th and 19th months after planting and focused on the precocity, vigor and number of branches of the plants. In addition, the number of glomerules /plant and the number of cherries/glomerule were evaluated at the 19th month after planting. The results showed that for the growth in height, in diameter at the collar and the number of branches of the plants, the best performance ($p < 0.05$) was obtained with the cropping scheme of 3m x 3m both in the 13th month than in the 19th month after planting. However, with regard to the number of clusters/plant and the number of cherries/cluster, the values obtained with the 3 m x 1.5 m scheme (7 clusters/plant and 2 cherries/cluster on average) were significantly higher. ($p < 0.05$) to those obtained with the 3m x 1.5m scheme (3 clusters/plant and 1 cherry/cluster on average). More data are being collected to be able to confirm these results since they were found to be contradictory.

Keywords: Coffea arabica, cropping pattern, agronomic performance, production.

Delineating the population structure of Coffea arabica germplasm conserved ex situ using genome-wide SNP markers.

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Abstract

The global coffee trade is in excess of $466 billion, where only two coffee species are of economic importance; *Coffea arabica* L., and *Coffea canephora* P. accounting for about 65% and 35% of the total coffee trade volume. The *C. arabica* species is characterized by low genetic diversity and hence its susceptibility to common diseases and a major bottleneck in the development resilient varieties. Efforts were put in place to improve the diversity of this gene pool in Africa that involved the collection of several genotypes from different regions while conserving them ex-situ in different research centers, notably, the Food and Agricultural Organization (FAO) of the United Nations in 1964, the Organization de Recherche Scientifique et Technique OutreMers (ORSTOM) in 1966; as well the introduction of genes from the more diverse diploid species. These materials are of little value if their genetic information is not well documented. This study determined the population structure and genetic diversity of *C. arabica* germplasm mainly obtained from the two missions and conserved in Kenya. Genomic DNA was extracted from 173 genotypes using standard CTAB protocols and sequenced by Diversity Arrays Technology. A total of 2965 of good quality SNP markers were obtained that discriminated the genotypes into four subgroups, with heterozygosity of between 2.6 – 37%. Three of the four subgroups accounting for 93% of the population had a heterogeneity of less than 10% while only one subgroup recorded 37% heterogeneity accounting for 7% of the study population. The genotypes with high percentage of heterogeneity were found to be associated with introgressed genes from the diploid coffee species. The study revealed high genetic vulnerability within the *C. arabica* germplasm conserved ex situ with the African continent and further revealed that introgression of genes from the diploid coffee species is a strategic move to improve the genetic diversity within the Arabica coffee genome.
Keywords: Diversity Arrays, accessions, landrace, breeder material, Heterozygosity, variety.

Evaluation of Introduced and Local Arabica Coffee Genotypes on Cherry Yield, Cup Quality, Vegetative Growth and Tolerance to Major Pests and Diseases in Malawi.

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Abstract

Coffee contributes significant income to the economy of Malawi. However, smallholder coffee cherry productivity is below 500 kg/ha, compared to potential yield of above 2500kgs/ha. Cultivars are now more susceptible to pests and diseases due to continued recycling of seed. The Trial is being implemented in partnership between World Coffee Research and Lunyangwa Agricultural Research Station (LARS) in Malawi. Specifically the objectives are to determine variability among coffee genotypes, and identify genotypes with high cherry yield of good cup quality. The trial was established in 2017 at LARS, and it was laid out in a Randomized Complete Block Design in three replicates with 33 genotypes. Genotypes Catimor 129 (Nyika) and Geisha, released varieties in Malawi were included as check varieties. Elite genotypes with potential high yield performance (15066, 15069, and 15077) from previous trials at LARS were also included. Data were collected in 2020 and 2021 on cherry yield (kg/tree), and growth parameters. Data were fit to mixed linear model in R and Genstat statistical packages. Kruskal-Wallis and Wald chi-squared statistics were used to test significance of tests. Genotype IPR103 had the highest cherry yield of 12.3 tons/ha, while Geisha had the lowest yield of 2.4 tons/ha. Very highly significant cherry yield differences were observed among the genotypes (P ≤ 0.001), and Standard error was 0.71. There were very highly significant differences (P ≤ 0.001) among the genotypes on growth parameters. Top performers from the first cupping include: IPR 103, Pacamara, Catimor 129, Oro Azteca, and 15066. Variability observed among the genotypes could be attributed to genotypic and environmental effects. In order to select the best performing varieties, the genotypes will be evaluated and performance verified over multiple years and sites in order to test for GxE effects.

Key words: Genotypes, IPR103, Yield, Cup quality, GxE.

Assessing the Coffea liberica value chain, perceptions, attributes, potential for commercialisation and research in Uganda

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Abstract

Sustainable increase in coffee productivity and production offers a key assurance of improving economic and social development in Uganda. Emerging biotic and abiotic constraints exacerbated by climate change threaten global coffee production as well millions of coffee producing households. Uganda is Africa's largest coffee exporter as well as a centre of origin of *Coffea robusta* that constitutes about 80% of the country's production followed by *Coffea arabica*. Uganda has instituted a number of reforms in its coffee sector including establishing a target of 20 million coffee 60kg bags by 2025 up from 5.2 million bags in 2017/2018. Achieving this target will require the country to devise practical ways of minimizing emerging production challenges that include increasing pest and disease pressure, low soil productivity in addition to the increasing frequencies of prolonged droughts associated with climate change. Due to these challenges, farmers are increasingly adopting a highly resilient *Coffea liberica* species (Liberica coffee). A study involving focus group discussions and structured interviews was therefore conducted by a team from coffee research and the coffee regulatory Authority in Uganda in the emerging major *Coffea liberica* growing districts of Butambala, Kamuli, Kyotera and Luweero in central Uganda and Arua, Moyo and Koboko in the West Nile region of Uganda. It was aimed at exploring the factors underscoring the increasing interest in the species, challenges of its production, its value chains, mapping out its potential in Uganda's coffee sector as well as identifying potential areas for research and intervention. Farmers in the order of importance cited its conducive harvest time in the times of limited alternative income sources, excellent yields (10-200kg of red cherry per tree) as well as high/absolute resistance to pests and diseases especially coffee wilt disease and coffee leaf rust as the major factors driving its preference. Traders majorly alluded to high comparative profit margins and heaviness of its coffee beans for its preference. Mentioned demerits of growing the species included; difficulties in harvesting due to the giant tree sizes and hard to pick cherries, as well as the lower prices offered by traders for the species. Cupping of the species samples was done by a panel of experts in a reputable regulatory agency laboratory (UCDA), samples had a high average cup score of 80% with various special profile notes. Physical bean analysis showed that 59% of the analyzed *Coffea liberica* coffee beans were screen 19, followed by screen 13, only 4 % had a screen size less than 12. The overall average moisture content of the FAQ samples was 11.2%. Overall average percentage FAQ outturn of the liberica coffee samples was 95% with 87.3% as minimum out turn and 98.8% maximum outturn. The study therefore identified the species to have a great potential in diversifying the fortunes of the coffee sector in Uganda and globally amidst climate change constraints, pest and disease

challenges, decreasing soil fertility, low farmer productivity, as well as being a good source of genetic diversity for improved coffee variety selection and development.

Phenotypic Diversity of Wild Sierra Leonean Coffee (Coffea stenophylla) Collected from Kenema and Moyamba Districts for Qualitative Traits Assessment

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Abstract

Coffee is one of the major cash and export crops of Sierra Leone and is mainly cultivated in the tropical rainforest regions in the southern and eastern provinces of the country. Major coffee growing districts of the country include, Kenema, Kailahun, Moyamba, Bo, Pujehun and Kono. Aside these districts, a smaller amount of coffee is also grown in Tonkolili and Koinadugu districts in the northern region. This study looks at the extent of phenotypic diversity of the rare and wild *Coffea stenophylla* in the hills of Kenema and Moyamba districts. The Shannon-Weaver diversity were computed following the IPGRI (1996) list of coffee descriptor. The Shannon-Weaver diversity revealed that large variations exist among the 203 *C. stenophylla* samples for the observed 13 morphological traits which ranges from (H'=0) for both fruit colour and calyx limb persistence to (H'=0.87) for angle of insertion of primary branches on the main stem. Among the 13 qualitative traits assessed, angle of insertion of primary branches on main stem (H' = 0.87), growth habit (H' = 0.78), bean size (H' = 0.75), young leaf colour (H' = 0.66), stem habit (H' = 0.66) and fruit shape (H' = 0.65) exhibited high level of diversity and evenness while seed shape (H' = 0.58), stipulate shape (H' = 0.46), leaf shape (H' = 0.43), seed uniformity (H' = 0.31) and leaf apex shape (H' = 0.06) showed low level of diversity. This is the first report of the phenotypic diversity of *C. stenophylla* in Sierra Leone and the study thus unraveled the existence of diversity among the samples collected. It is recommended thus, that the observed variabilities be exploited in order to come up with better accessions that are high yielding but with the same taste (as proven to have better taste than other coffee varieties). Additionally, it is imperative that the morphological characteristics observed be confirmed through genetic fingerprinting.

Key words: Phenotypic, Diversity, Traits, Stenophylla and Accessions.

3.2 Agronomy & Socio-economy

Analysis of the Profitability and Technical Efficiency of Coffee Production In Kogi State, Nigeria

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Abstract

The study examined the profitability and technical efficiency of coffee production in Kogi state, Nigeria. There have been a lot of studies on efficiency of annual crops with little attention given to perennial crops such as coffee. Therefore, this study examined the profitability and technical efficiency of coffee production, Multi – stage random sampling technique was used to select the respondent for the study. The first stage was the purposive selection of three Local Government Areas (LGAs) from the State. Second stage was the random selection of 15 coffee producing communities from the three selected LGAs (the selection was proportionate to size), while the third stage was the random selection of 400 coffee farming household from the selected communities. Data were collected with the use of structured questionnaire for the literate respondents and an interview schedule for the illiterate respondents. The data collected were analyzed using descriptive statistics, Gross Margin (GM) and Net Revenue (NR) to analyze the profitability of the coffee farmer and Stochastic frontier production function was used to estimate technical efficiency. Results revealed that (24.8 %) of the respondents in the study area have the age of their household heads falling between 60 and 70 years. Majority (77.8%) are male while 22.2% are females. 85% were married; Most of the farmers (65.0 %) in the aggregate were acknowledged to be educated far beyond primary school with 55.5 percent of the farmers having family size of 4 – 7 persons. About 30.5 percent of the farmers had between 21 and 30 years of the farming experience in coffee production. The result showed that production of coffee as a venture is profitable because for every ₦1 invested in the business, it yielded ₦1.39. The results of technical efficiency were obtained using parametric stochastic production frontier (SPF) model. The results indicate that there was efficiency in the production of Coffee in the study area and farmers are efficient for half -normal and truncated normal distribution. The mean distribution of technical efficiency was about 74%. Econometric results obtained from half -normal and truncated –normal frontier model indicate that labour, volume of chemical used and seed quantity has significant level of significance and positive sign. Thus the results suggest that there need to be policies geared towards enhancing production efficiency of farmers so as to enhance their productivity and export-competitiveness of this commodity and study also recommended that government should support expanded production of coffee to other potential areas by taking further research on cost and benefit analysis of increasing coffee production, government and other lending agencies should also do more in assisting the farmers with soft loans in order to reduce the problem of inadequate capital among the farmers. These will enhance connectivity in research and extension for an improved coffee productivity and quality.

Economic Analysis of Small-Scale Coffee Production in Kogi state

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Abstract

Coffee is a crop of great importance in the world market. It is majorly produced in Kogi state Nigeria. In the past, it has brought great gains to farmers improving their income and livelihood. This study assessed the costs and returns of coffee production in Kogi state, Nigeria. Structured questionnaire was used to obtain information from 105 coffee farmers in the study area. Descriptive Statistics, budgetary analysis and ordinary least square (double log model) regression was used in the data analysis. Majority (89%) of the tea farmers are male with a mean age of 68years. Three out of ten farmers have tertiary level of education. Eighty percent of the respondents have farming as their primary occupation with a mean farm size of 4.39hectares. The average total cost per hectare per year and the average gross revenue per hectare per year are ₦9092.83 and ₦64087.95, respectively. The coefficients of labour cost on land clearing, labour cost on planting, labour cost on weeding, labour cost on pruning and labour cost on harvesting are all significant at 1%. The proportion of the net income to the total cost is 6.86%. Hence, 6.86% of the total cost expended on coffee production was generated as profit. This proportion is low and most of the farmers are cutting down their coffee trees because of low market. Government at all levels; stakeholders in the coffee industry should sensitize the farmers on the need to go back to planting coffee and link them to the right markets.
 Keywords: Cost, Coffee production, Returns, Small scale

Yield gap analysis among adopters and non-adopters of improved coffee varieties in the Southern Highlands of Tanzania

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Abstract

Coffee productivity in Tanzania is still low despite having coffee varieties with the potential of producing more yield. This study aimed at understanding factors affecting coffee productivity and causing the yield gap among smallholders in Mbinga and Mbozi Districts of Southern Highlands. The primary data were collected from 122 adopters and 198 non-adopters of improved coffee varieties using a semi-structured questionnaire. The descriptive statistics and SAFERNAC model were used to analyse the coffee yield gap while linear regression (OLS) model was used to determine factors influencing coffee productivity. The findings revealed 38 % of respondent adopted improved coffee varieties and 43 % of the total area under coffee is planted with these varieties. The average fertilizer application for both adopters and non-adopters is below the recommended rate. Fungicide application to control Coffee Berry Diseases (CBD) and Coffee Leaf Rust (CLR) is below the recommended rates. The average coffee productivity attained by adopters is 1250 kg/ha and non-adopters is 512 kg/ha. The descriptive analysis showed that the yield gap for adopters is 750 kg/ha equivalent to 38 % and non-adopters is 488 kg/ha equivalent to 49 % which imply that farmers gain less than the potential yield. Likewise, the farmers actual yield was below the estimated yield with SAFERNAC model. The main factors positively influencing coffee productivity were coffee variety planted ($p < 0.055$), plant population ($p < 0.000$), access to extension services ($p < 0.008$), fertilizer applications ($p < 0.001$), pruning ($p < 0.003$) and amount of fertilizer applied ($p < 0.001$). The study concludes that, the coffee productivity among adopters and non-adopters of improved coffee varieties is affected by lack of proper implementation of good agronomic practices such as use of fertilizer and fungicides at the recommended rate. Therefore, the study recommended that government should strengthen extension services to ensure farmers access to the right information on recommended fertilizers application rates and use of fungicides. Also, farmers should implement recommended agricultural practices as per the type of coffee varieties planted which mean that, farmers are required to know the line of coffee varieties planted because they have different management practices and it could contribute to increase coffee productivity to attain the optimal level and minimize yield gap.

Keywords: Coffee, adopters and non-adopters, coffee varieties, the coffee yield gap

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Effect of credit access on productivity: Case of smallholder coffee sector in Zimbabwe

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Abstract

Case study research was executed based on a random sample of forty-five selected smallholder coffee farmers aimed at determining the relationship of credit access and productivity. After reviewing literature, it was found out that credit access is one of the important resources needed to fight low productivity, hence the need for the study. The process involved cross sectional data collection following structured questionnaires, through telephone interviews and subsequent data analysis. Analysis showed that credit access is a guarantee to higher productivity. It was found out that there were no significant associations between borrower characteristics and amount of credit accessed. Therefore, the null hypotheses were accepted and it was concluded that borrower characteristics and amount credit access are independent or there was no sufficient evidence to reject the null hypotheses. The research will be able to contribute to the body of literature with context specific information and inform government and other stake holders in sound decision making related to credit provision in the smallholder coffee sector. It is recommended that government and other stakeholders should increase credit provision to the smallholder coffee sector. Amount of credit provision should not pursue short approach but rather target productive groups such as the youth and women in line with youth and women empowerment policies and imperatives. Extension efforts should be channeled to organize farmers into working groups as credit should also target those belonging to farmer groups and consider level of education of beneficiary as these variables have been shown to have impact on productivity.
Key words: Credit access, productivity, youth, women

Données pédo-climatiques actualisées des zones de culture des caféiers en Côte d'Ivoire

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Abstract

In the current environment of production of Robusta and Arabusta coffee trees in Côte d'Ivoire, characterized by the decline in soil fertility, the decline and poor distribution of rainfall, most attempts to plant or replant orchards pay off failures. It is clear from this observation that coffee growing and its sustainability are dependent on water control and sustainable soil management. In addition, the pedo-climatic zones have been subject to modifications under the action of climate change with the corollary of a reduction in the zones favorable to coffee growing. Also, these must be refined by soil studies, because the criteria taken separately do not make it possible to objectively define the zones favorable to a given crop. Thus, within the framework of this study, the agro-climatic zoning maps (1985 - 2019) of the Robusta and Arabusta coffee trees were crossed with the soil suitability maps of 1971 at 1/5,000,000 and those of 2021 from soil surveys (Scale: 1/50,000) to determine the pedo-climatic zones favorable to coffee growing. The combination of different maps of soil suitability for cultivation and agro-climatic zoning using GIS has made it possible to define four levels of pedo-climatic zoning (unfavorable, unfavorable, favorable and very favorable) for coffee trees. Robusta and Arabusta. The results obtained show that the areas favorable to coffee growing have evolved. Indeed, the proportion of areas favorable to the cultivation of Robusta has gone from 70% (1971 at 1/5,000,000) to 82% (today at 1/50,000). These cover the mountainous West and the forest South up to the southern limit of the Abengourou and Bongouanou Regions. On the other hand, the area favorable to the cultivation of Arabusta is smaller. In proportion, this has gone from 78% (1971 at 1/5,000,000) to 72% (today at 1/50,000) and is limited only to the Western Mountainous Region. The study carried out made it possible to set up Decision Support Tools (DST), not only for the choice of areas suitable for the cultivation of coffee trees, but also for updating the technical itineraries of new equipment. selected plant.

Keywords: Coffee trees, Robusta, Arabusta, Pedo-climatic zoning, Cartography-GIS, Ivory Coast.

Cartographie agro-climatique actualisée des zones favorables aux caféicultures Robusta et Arabusta en Côte d'Ivoire

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Abstract

Coffee production in Côte d'Ivoire has fallen by two thirds, dropping from 300,000 t in the 1970s to around 80,000 t in 2020. The country has therefore made a priority of reviving the coffee growing. This revival requires the development of regionalized technical itineraries adapted to climate change. To this end, taking into account the updated agro-climatic zoning is essential. This is because the evolution of climatic parameters has revealed a drop in the annual rainfall and a shortening of the length of the growing seasons, generating de facto limiting conditions for the cultivation of coffee trees in certain regions of Côte d'Ivoire. This study was therefore carried out to contribute to the improvement of the productivity of the coffee tree on the basis of updated maps of the agro-climatic zones favorable to the cultivation of coffee trees. To do this, the zoning consisted of crossing the climatic parameters calculated taking into account the climatic requirements of the coffee trees (Robusta and Arabusta), in order to define homogeneous agro-climatic zones, forest and pre-forest zones at the limit of the 8th parallel. North. These data used come from 55 climate data measurement stations spread over all the coffee-growing regions covering the 19 square degrees of all the coffee production areas of Côte d'Ivoire over the period 1985-2019. In addition, crosses of different layers of spatialized information were carried out for the classification of cultivation areas into four (4) zones (very favorable, favorable, less favorable and unfavorable) according to the criteria defined for each coffee crop. The results obtained showed; that despite climate change, there are still areas favorable to the cultivation of the two varieties of cultivated coffee trees (Robusta and Arabusta) in Côte d'Ivoire. The analysis of the climatic requirements of the Robusta coffee tree and the climatic conditions of Côte d'Ivoire made it possible to identify favorable (66.46%) and unfavorable (30.54%) zones. The climatic conditions of most of the forest and pre-forest areas of Côte d'Ivoire are not favorable to the cultivation of the Arabusta coffee tree, with the exception of the mountainous west. Regarding this variety, only 11.39% of all areas were identified as favorable for its cultivation. This study also made it possible to update information on the evolution of the climate in areas favorable to the cultivation of coffee trees. This will make it possible to determine the characteristics of the growing seasons in the production zones.

Keywords: Robusta and Arabusta coffee trees, agro-climatic zoning, GIS-cartography, Ivory Coast.

Conduite régénérative du caféier robusta (Coffea canephlora L.) : Effet du recépage sur la productivité du caféier robusta au Togo

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Abstract

The robusta coffee tree is the most cultivated variety of coffee tree in Togo by more than 17,000 households. Due to its vegetative cycle, the productivity of the robusta coffee tree declines after a few years of production despite regular maintenance. The objective of this study was to evaluate the effect of stumping on the productivity of robusta coffee in Togo. Data were collected over three years from 3,558 households supported by extension services for the cutting of 2222.6 ha of their old robusta coffee plantations (19 ± 4 years) with support in NPK 20 10 10 fertilizer in grant by the PASA project. Data analysis showed that, two years after stumping Robusta coffee plantations, yields increased from 314.89 ± 122.28 kg.ha-1 (year before cutting) to 710.56 ± 174.49 kg.ha-1, i.e. a 126% increase in yields, whereas on the non-stumped control plots, yields decreased by 40% (from 318.78 kg.ha-1 to 192.33 kg.ha-1). Initially, the difference in yields on plots to be stumped and those not coppiced was barely 1%. But two years after cutting, yields on the cut-back plots have improved by 269% compared to the non-cut-back plots. Regenerative management of the Robusta coffee tree by coppicing therefore remains a substantial means of improving and restoring the productivity of the Robusta coffee tree.

Key words: robusta coffee tree, coppicing, productivity

Diagnostic participatif pour l'identification des contraintes actuelles et approches de solutions au développement de la culture du café au Togo

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Abstract

In Togo, coffee cultivation benefited between 1972 and 1992, from major five-year development projects, through the National Society for the Renovation of the Coffee and Cocoa Plantation which, among other things, allowed for better growing conditions and an increase consequent production. However, following the liberalization of the coffee and cocoa sectors in 1996, coffee production fell drastically. In order to identify the main constraints related to coffee production and propose solution approaches that will make it possible to revive coffee growing in Togo in a sustainable way, a survey on the management of orchards was carried out in the main producing areas (Akposso plateau, Akébou, Amou and Danyi). The survey was conducted by a team from the Togolese Institute for Agronomic Research / Center for Agronomic Research in the Forest Zone (ITRA/CRA-F) and the Coffee and Cocoa Technical Unit (UTCC) on 80 coffee growers, with 20 by area. The questionnaires were administered individually to the coffee growers and the data collected focused on access to productive resources, the level of maintenance and phytosanitary protection of the plantations as well as the constraints linked to climatic hazards and human actions. The results show that the area of coffee plantations varies from 0.25 to 5 ha. Three-quarters of the orchards benefit from advisory support services which are limited to only two to three visits per year. The majority of the orchards are conducted under shade composed mainly of a mixture of forest trees, agroforestry trees and fruit trees. Plantation maintenance is limited to one or two manual or chemical weeding per year and pruning twice a year. The fight against insects is done by a single insecticide treatment before harvest. More than half of the coffee growers bring fertilizers once or twice a year. In addition, around 40.3% of the orchards are affected by wildfires which decimate an average of 17.71% of the plantations. Consequently, the orchard is not very productive and the average yield is 309 kg/ha/year. This low productivity of coffee trees is linked, according to coffee growers, to the vagaries of the weather, the high cost of fertilizers, the lack of credit to finance farming operations and the lack of advisory support services.

Keywords: Participatory diagnosis, coffee growing, constraints, low productivity

Assessment of fire engulfed coffee plantation for revitalization and proper future management

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Abstract

Understanding the impact of fire in respect to loss of plantations, alteration in micro ecosystem, destruction of soil microorganisms and loss of soil fertility is very germane. Hence, this study centered on the assessment of coffee germplasm plot engulfed with fire for possible revitalization and recommendations for future management. The coffee plot was divided into burned and unburned sections for soil and coffee leaf samples collection. The soil samples were analyzed for the textural composition, the bacteria and fungi population counts, organic C, pH, N, P, K, Ca, Mg, Na, $Al^{+3}H^+$, ECEC, BS, Mn, Cu, Fe and Zn contents using standard methods. The coffee leaf samples were analyzed for the C, N, P, K, Ca, Mg, Na, Mn, Cu, Fe and Zn contents. Results indicated that fire outbreak resulted to reduced microbial population counts for the burned section. However, the soil pH was slightly acidic for the unburned plot while it was slightly alkaline for the burned plot. The soil organic C, N, K, Ca, Mg, and Na contents of the burned section were higher than values obtained for the unburned section. However, the soil N, P, K, Ca, and Mg contents of the unburned section as well as the N, K and Mg contents of the burned section were all below their corresponding critical levels. Hence, the coffee plot soils were considered low in most of the nutrients. This indicated that sustainable coffee production could only be guaranteed with the rational application of fertilizers. Application of manures at 5tones/ha is recommended to build up the soil organic C, soil microbes and nutrients supply. However, it is advised that planting of improved coffee cultivars to replace the fire damaged stands, a 3-meter perimeter fire tracing and good farm sanitation should be taken into consideration in the plantation revitalization as extension guide to farmers.

Keywords: Coffee production, fire damage, nutrient supply, plot rehabilitation, Soil microbes

3.3 Pests and diseases management & Climate change

Management of Coffee Leaf Rust Using Different Fertilizers and Supplementary Irrigation Application

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Abstract

Coffee leaf rust (CLR) is the major disease significantly affecting coffee production worldwide, and caused by an obligate biotrophic fungi *Hemileia vastatrix* Berk. and Broome. CLR management is mainly depends on the use of contact and systemic fungicides. Considering the economic, environmental and social impact of this control method, it is justified to search alternative management option. In view of this, the study was initiated to evaluate the effect of fertilizer types and supplementary irrigation for management of CLR. There was highly significant variation ($P < 0.001$) observed on disease intensity and coffee yield due to application of different fertilizer treatment and supplementary irrigation. Lesser CLR disease was observed by application of organic fertilizer (Severity 5.81%) than inorganic chemical fertilizer application (Severity 18.01%). Moreover, supplementary irrigation showed significantly lesser disease intensity (Severity 13.78%) than without supplementary irrigation condition (Severity 18.63%) and coffee yield of (992.95kg/ha) than without supplementary irrigation condition (665.5kg/ha). It was possible to notice that organic fertilizer perform better under without supplementary irrigation condition and combination of inorganic and organic fertilizers preformed under supplementary irrigation condition. From the study, it is possible to conclude that soil fertilizer type and supplementary irrigation can significantly influence the intensity of CLR and yield of coffee in Ethiopia. The use of organic fertilizers could be the best practice for smallholder coffee producers under without supplementary irrigation condition to reduces CLR pressure and increasing coffee yield.
Keywords: - incidence, leaf rust, organic fertilizer, severity, supplementary irrigation

Effect of aqueous extracts of Azadirachta indica A. Juss, Jatropha curcas L. and Moringa oleifera Lam. on coffee berry borer (Hypothenemus hampei F.; Coleoptera: Scolytidae) in laboratory

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Abstract

The fruit borer (*Hypothenemus hampei*) is the main pest of coffee growing. This insect develops resistance to a wide range of insecticides. The objective of this study was to evaluate the effect of aqueous extracts of three plants (*Moringa oleifera*, *Jatropha curcas* and *Azadirachta indica*) on *H. hampei* compared to the chemical insecticide Cypercal 50 EC (cypermethrin). Aqueous extracts of leaves and barks of M. oleifera, J. curcas and A. indica were applied at three concentrations (400 mg/ml, 200 mg/ml, 100 mg/ml) on bark beetles reared in insectaries, according to a randomized block design with five repetitions. The results showed that all aqueous extracts based on *M. oleifera* leaves and bark exhibit insecticidal effects on fruit beetles. Mortality rates of 80% and 60% of bark beetles were recorded after application of aqueous extracts of *M. oleifera* leaves and bark, at 400 mg/ml respectively. All three concentrations (400 mg/ml, 200 mg/ml and 100 mg/ml) of aqueous leaf extracts and the 400 mg/ml concentration of *J. curcas* bark resulted in 50% mortality of bark beetles. Only the concentration of 400 mg/ml of aqueous extract of *A. indica* barks and leaves caused 50% mortality of bark beetles for each extract. These aqueous extracts obtained from natural plants in Côte d'Ivoire are a sure alternative to synthetic insecticides which have become ineffective against the coffee berry borer.
Keywords: Moringa oleifera, Jatropha curcas, Azadirachta indica, Hypothenemus hampei and Ivory Coast

Effets du changement climatique sur la zonation agro-climatique dans les zones caféières en Côte d'Ivoire et adaptations

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Abstract

In the context of climate change, the drop in rainfall to low levels below 1000 mm/year considerably reduces the productivity of the coffee orchard. This drop in production is due to the change in rainfall patterns observed after 1970, throughout West Africa. These modifications concern both the change in the frequency of rains during the wet seasons and the severity of the dry seasons. An agro-climatic analysis was carried out to understand this situation and highlight the evolution of rainfall variability in the coffee growing area in Côte d'Ivoire. In view of the difficulty of obtaining climate data for the entire area, our study was limited to five localities (Man, Gagnoa, Divo, Abengourou and La Mé) where the National Center for Agronomic Research (CNRA) has weather stations. Analysis and mapping tools (Instat+v.3.037, Statistica 7 and Qgis 2.18 software) and analysis methods (reduced centered indices) were used to process the soil and rainfall data obtained. Our study data highlighted climate variability over the entire forest zone. This results in rainfall deficits, which have generated significant risks for coffee growing in the area over the decades, the last two decades of which have been marked by a recovery in rainfall, from 2.5 to 8.29% for the decade 2011 - 2018 compared to that of 1971 - 1980. This improves the conditions for growing coffee in the said area. However, the reduction of 1 to 2 decades in the duration of the wet period during the expansion phase of coffee cherries in recent years is likely to cause significant yield losses. To do this, indications for a reasoned planning of agricultural activities must be followed.
Keywords: Coffee cultivation, agro-climatic zones, climatic variability, rainfall, Ivory Coast.

Évaluation des facteurs agro-environnementaux susceptibles d'influencer le développement de la trachéomycose du caféier en République Démocratique du Congo

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Abstract

Epidemiological surveys were conducted in seven provinces of the Democratic Republic of Congo (DR Congo) to assess agro-environmental factors likely to influence the development of coffee tracheomycosis. The results recorded revealed the "age" factor could represent a risk factor, increasing the probability of infection, in particular during successive prunings. The analysis of the plantation system revealed that tracheomycosis was more important in industrial plantations and in semi-plantations. The majority of heavily attacked plantations did not benefit from any maintenance. In the provinces where tracheomycosis was absent, the plant material used consisted of seeds, while in the affected provinces, it consisted of local material. The practice of pruning coffee trees does not seem to have a clear influence on tracheomycosis in view of the results, which show a great disparity with no apparent link with the presence of tracheomycosis. It is not easy to find a connection between the association of crops and tracheomycosis in view of the frequencies of this agricultural practice which do not show particular trends between the provinces attacked and those still unaffected. Other factors such as environmental conditions do not seem to significantly influence the incidence of tracheomycosis. The latter is found in environmental conditions as varied as those of valleys, forest areas, high and low altitude sites. There is reason to think that the factors age, plantation system, maintenance of plantations and type of plant material used would have an influence on the incidence and development of coffee tracheomycosis in the DR Congo. The use of seeds would offer a high variability that could justify the possibility of encountering subjects resistant to tracheomycosis.

Keywords: Tracheomycosis; Impact; development; agro-environmental factors; Democratic Republic of Congo.

Systèmes de production à base de caféiers au Cameroun : caractéristiques et stratégies de régulation des pressions phytosanitaires

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Abstract

Exploited by nearly 400,000 Cameroonian producers, coffee is one of the main export products in Cameroon. Despite the recovery plans for 2010-2015 and 2015-2020, its production continues to decrease considerably. Among the factors behind this reduction, we note the strong influence of phytosanitary pressures and poor regulation strategies. The objective of this study was to determine the systems in place, the phytosanitary pressures they are subjected to, as well as the strategies for their regulation put in place by the producers. Semi-structured comprehensive interviews and observations were carried out with around sixty coffee growers and their plots in the production areas of Melong, Bamendjou and Doumé. The organs of harvested coffee trees were analyzed in the fields and in the laboratory to identify the presence of different pathogens and their symptoms. The results of surveys and observations in coffee plantations showed that insects were the most formidable phytosanitary constraints in Melong and Doumé while in Bamendjou, it was *Colletotrichum kahawae* (agent responsible for anthracnose). Tree species associated with coffee are for the most part fruit species in terms of density and diversity, compared to forest species. Apart from said associated trees, there is also a strong presence of crops which are mostly annual. The application of management practices of the said phytosanitary pressures depended on their incidence, severity and period of appearance or manifestation. Moreover, all the products used were synthetic, however, the producers have a desire to use organic products. In phytosanitary protection programmes, emphasis should therefore be placed on insecticide control. Faced with the increasingly felt effects of climate change and variations, the reintroduction of trees with high economic value in coffee plantations should be optimized and a law on organic/sustainable agriculture should be put in place.

The insect pests of coffee and their management practices in main coffee growing region in Kenya.

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Abstract

Coffee farming in Kenya is a major source of income to over 700,000 households. Globally, the Kenyan coffee is renowned for its high quality. Most of the Kenyan coffee is produced in Mt. Kenya region. Its production faces many challenges that includes infestation by complex of insect pests. Field survey covering eight (8) main coffee growing counties and 485 households in the region was conducted in May 2022. The survey aimed to establish the key insect pests in Mt. Kenya coffee growing region, their distribution and management practices farmers' apply to manage them. The survey established seven (7) insect pests of major importance in the region. These included the Coffee Berry Borer (*Hypothenemus hampei*), Thrips (*Diarthrothrips coffeae*), Leaf miners (*Leucoptera* spp), Yellow Headed Borer (*Dirphya nigricornis*), White Borer (*Anthores leuconotus*), Green scales (*Coccus alpinus*) and Kenya Meallybugs (*Planococcus kenyae*). Their occurrence ranged from 13 to 63.4%. The *C. alpinus* (63.4%) occurred in all the surveyed counties, Agro Ecological Zones (AEZs) and coffee farms' households. The *D. nigricornis* (54.8%)* was the second most common insect pest. The *C. alpinus, D. nigricornis, Leucoptera* spp and *H. hampei* dominated the "Lower" coffee zone and were less dominant in Upper Midland 1(UM 1). Farmers used insecticides, plant concoctions, physical, mechanical, cultural and field sanitation approaches to control the pests. Insecticides use was the most common practice that ranged from 54.5 to 94.4 % of the farm households. This study and its findings is key to Agricultural extension services in providing focused technical advisory services to coffee farmers based on specific insect pests per County and the Agro Ecological Zones.