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# **DEFENSE DES CULTURES**

# L'IMPACT DES CONNAISSANCES EN ÉPIDÉMIOLOGIE POUR UN MEILLEUR CONTRÔLE DES MALADIES DU CAFÉIER : EXEMPLES DU COFFEE BERRY DISEASE (CBD) ET DU COFFEE WILT DISEASE (CWD)

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## Résumé

L'épidémiologie végétale a pour principal objectif de comprendre le développement des maladies dans les populations végétales cultivées dans la perspective de mieux gérer les épidémies et donc de réduire au maximum les dégâts occasionnés. Dans le cas du caféier, qui est une plante pérenne et tropicale, cet objectif est particulièrement important, car les épidémies peuvent se développer sur plusieurs années et occasionner d'importants dégâts. Par ailleurs, certaines maladies n'étant présentes que sur certains continents, il est primordial de bien comprendre les mécanismes épidémiques pour limiter la propagation et l'extension des maladies les plus dommageables. Pour illustrer notre propos, nous nous focaliserons sur deux grandes maladies qui ne sont présentes sur le caféier qu'en Afrique : le Coffee Berry Disease (CBD), et le Coffee Wilt Disease (CWD). La première, le CBD, s'attaque aux fruits du caféier et provoque des pertes de production importantes. Les résultats que nous présentons indiquent que cette maladie repart chaque année à partir des mêmes foyers, et ces foyers sont identifiables durant la phase exponentielle d'expansion de la maladie. Après cette phase exponentielle, la maladie est présente sur toute la superficie des parcelles observées. Par ailleurs, l'incidence de la maladie est réduite chez les caféiers situés à l'ombre d'arbres fruitiers ou forestiers, et plusieurs expérimentations ont permis d'identifier les mécanismes en cause. L'adoption de systèmes agroforestiers pour réduire l'incidence de la maladie est proposée. Cette mesure, accompagnée d'une sélection de variétés moins sensibles, devrait permettre de réduire de façon importante les dégâts occasionnés par le CBD. La deuxième maladie (CWD), s'attaque à l'appareil végétatif aérien des caféiers et provoque la mort des arbres à plus ou moins brève échéance. Cette maladie se propage également en foyer, et des systèmes agroforestiers sont également proposés pour constituer des barrières et ralentir ainsi la propagation de la maladie. La sélection de matériel végétal moins sensible pourrait également permettre de mieux contrôler l'expansion de cette maladie. Pour les pays d'Amérique latine ou d'Asie, où ces maladies ne sont pas présentes, il serait particulièrement judicieux de tester les variétés actuellement cultivées pour connaître leur réaction vis-à-vis de ces deux maladies importantes. Les systèmes agroforestiers, utiles pour améliorer la qualité du café et pour l'environnement, devraient être développés et adaptés en fonction des contraintes sanitaires qui pèsent sur les caféicultures.

**Mots clés :** épidémiologie, distribution spatiale, agroforesterie système, contrôle des maladies

# EVALUATION OF RELEASED ARABICA COFFEE VARIETIES FOR THEIR TOLERANCE TO BACTERIAL BLIGHT OF COFFEE (BBC) AT SIDAMA AND GEDEO ZONES, SOUTHERN ETHIOPIA.

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## Abstract

Bacterial blight of coffee also known as Elgon or Solai dieback, caused by *Pseudomonas syringae* pv *garcae* van Hall, is reported as a serious disease of Arabica coffee in Kenya and Brazil. Outbreak of bacterial blight of coffee was reported in three districts in southern Ethiopia where the famous Sidama specialty coffees is produced. The results of three years data showed that the disease syndrome on young, mature and older coffee plants were similar with bacterial blight of coffee documented elsewhere. The disease invariably attacks coffee leaves, branches and shoots with characteristic blight symptoms. The infected branches and shoots start die-back from the point of infection towards the tip while coffee berries on infected braches are also completely destroyed leading to total crop failure. Currently the spread of the disease was reported at Gedeo, Sidama, Wolita and Kembata-Tembaro Zone of SNNP regional state. To update the current status of the disease and evaluate the reaction of released Arabica coffee cultivars survey was under taken in six and three districts of Sidama and Gedeo Zones respectively. Nine coffee cultivars were evaluated for their tolerance to bacterial blight of coffee under field condition. The current survey result revealed the disease is observed in all released coffee cultivars at different locations at various levels of disease severities. The highest disease severity value of 12% was observed on Angefa at Aletawondo. Less than 3% disease severity was observed at Sidama Zone on coffee cultivars 74110, 74112 and 74158. On the other hand, at Gedeo Zone severity value of 10.8, 15 and 15.6 % was observed on coffee cultivars of Odicha, Koti and Angefa. Conversely coffee bacterial blight infection was not observed or negligible on compact released cultivars (74110, 741140). On local coffee land race disease severity varied between 12-42 and 12-25 % for Sidama and Gedeo respectively. In general, low infection was also observed on well managed coffee plantations. Farmer's preference increased to use coffee cultivars 74110 and 74112 due to moderately tolerance against bacterial blight of coffee. Further screening commercial coffee cultivars in laboratory is recommended to have reliable information's on their resistance level. Moreover, it is recommended to conduct successive year's field observations to look for the dynamics of the disease in the areas in order to understand and factors associated which favors the disease epidemics.

**Key words:** *Coffea arabica*, released coffee cultivars, Bacterial blight of coffee.

# MICROSATELLITE MARKERS SCREENING FOR COFFEE BERRY DISEASE (COLLETOTRICHUM KAHAWAE) RESISTANCE IN PROGENIES OF KP423 GENOTYPE AND ETHIOPIAN COFFEE ARABICA ACCESSIONS

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## Abstract

Coffee berry disease (CBD), caused by *Colletotrichum kahawae*, is a major constraint for Arabica coffee cultivation in Africa. Several previous studies have revealed molecular markers associated with its resistance. CBD is a disease that attacks berries at different developmental stages. The current study was aimed at using of these markers to screen for resistance to the disease on genotypes and progenies developed from the Tanzanian commercial variety and Ethiopian accessions at seedling stage. Eleven Ethiopian genotypes were crossed to a variety KP423, F1 progenies plus their parental genotypes were used in the study. Physiological screening was applied on the hypocotyls of parental genotypes and F1 progenies using the procedure developed by Van der Vossen in 1976. Marker screening was applied on the DNA extracted from their young tender leaves using gene specific markers Sat 235 and Sat 207. The genotypes containing the resistance gene were expected to show phenotypic resistance to CBD and banding patterns similar to the resistance donors on marker screening while those lacking the genes were expected to show phenotypic susceptibility and banding pattern similar to susceptible commercial variety KP423. The presence of the coffee berry disease resistance genes was revealed in the studied coffee genotypes amplified by SSR marker Sat 235 and Sat 207. This was confirmed by production of bands similar to the progenitors of CBD resistance. This finding implied that marker screening can be used in coffee berry disease resistant genotypes selection at early stages of growth hence reducing the time of selection cycle.

**Key words:** Microsatellite markers, coffee berry disease.

# STATUS OF MAJOR COFFEE (*COFFEA ARABICA* L.) DISEASES IN MAJOR COFFEE GROWING AREAS OF EASTERN ETHIOPIA

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## Abstract

Ethiopia coffee is among the best quality coffee which is vital to the economy of Ethiopia, providing a major source by fetching good foreign currency earnings. However; its production and productivity has been decreasing due to limiting factors include major diseases, such as coffee leaf rust (CLR), coffee berry disease (CBD, branch dieback (BDB) and coffee wilt disease (CWD). Therefore, in order to establish the effective management of the diseases, there was a need to ascertain their current incidence and spread in Eastern Oromia coffee growing areas. The survey was conducted in four major coffee producing districts of West (D/Labu, Habro & Boke) and East (Beden) Hararghe zones. And then presence or absence and prevalence or volume of the diseases was determined as incidence and severity, respectively. The results reveal that CBD, CLR and BDB were highly affecting the coffee tree followed by BDB. However, CWD incidence was only observed in Daro Labu and Bedeno district at very low level to less than 3% with overall average of 0.92%. The mean severity of CBD was 29% with range of 0-89 and its highest (45%) severity in Bedeno followed by Boke (26%) district, while average CLR severity was 6.3% with the range of 0-19. Also, the mean severity of BDB is 25% with the range of 0-74 and highest (40%) in Boke followed by Habro (25%) district. The disease occurrence was very high across all study areas with an average incidence of 66%, 33% and 47% for CBD, CLR and BDB, respectively. Currently, in these study areas CBD, CLR and BDB are economically important diseases which cause sever loss of yield. Generally, from the results of the study, there was the major shift in the status of coffee diseases in the Hararghe. Therefore, the diseases in region should get due attention immediately.

Keywords: Major diseases, Hararghe coffee, incidence, severity

# STATUS OF MAJOR COFFEE INSECT PESTS IN MAJOR COFFEE GROWING AREAS OF EASTERN ETHIOPIA

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## Abstract

The yield and quality of coffee in the country had been significantly reduced by biotic factors (diseases, insects, weeds etc.) and abiotic factors (temperature, drought, and rain pattern). Harerge coffee is among the spatiality coffee which is vital to the economy of Ethiopia, providing a major source by fetching good foreign currency earnings. However; its production and productivity has been decreasing due to limiting factors include major insect pest, such as antestia bug (AnB), bloch leaf miner (BLM) and green scale (GrS). Therefore in order to establish the effective management of the insect pest, there was a need to ascertain their current infestation and spread in Eastern Oromia coffee growing areas. The extensive biological survey was conducted in August 2015. The study covered representative sites where truly known as high producing high cup quality Hararghe coffee brand from the Daro Labu, Habro, Boke and Bedeno districts of Hararghe zones. The assessment was done on coffee insect pests like Antestia bug, blotch leaf miner and green scale. And then presence or absence and prevalence or volume of the insect pest was determined as infestation and severity, respectively. The result showed that, the infestation Antestia bug was highly observed in all lowland PAs of all districts in which up to 15 Antestia bug per tree were recorded. This indicates that, highly severe infestation for coffee in the areas than before which required attention. The highest infestation of blotch leaf miner (18%) in D/labu and green scale insect (36%) in Boke and antestia bug (27%) in Habro were identified as the major pests of coffee which are becoming a big threat for coffee production in the areas. Green leaf scale was severe on berry (19.48%) in Boke while high antestia bug severity (2.22%) was observed in Habro districts. However, the severity of BLM in all studied areas was very low (0.81%). The outbreak of these pests might be due to the current climate change. Generally, from the results of the study, there was the major shift in the status of coffee insect pests in the Hararghe, therefore, the insect pests in region should get attention immediately,

**Key words:** Insect pests; Infestation; Severity

# ELABORATION D'UNE LUTTE INTÉGRÉE CONTRE LE SCOLYTE DES BAIES DU CAFÉIER DANS LES HAUTS PLATEAUX DE TOBA (NORD DE SUMATRA)

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## Résumé

Le scolyte des baies du caféier *Hypothenemus hampei* (Ferrari) est le ravageur du café le plus répandu au monde. Il est aussi le plus destructeur, car il attaque les baies tout au long de la fructification, et les dégâts produits sur les grains causent d'importantes pertes de récolte. Influencé par un climat de type équatorial, le caféier Arabica, cultivé sur les hauts plateaux de la région de Toba (Nord de Sumatra), se caractérise par une production florale étalée au cours de l'année et une fructification continue sur laquelle le scolyte se développe jusqu'à la fin des deux récoltes annuelles. Depuis 2012, le CIRAD et IndoCafCo s'intéressent à la lutte contre le scolyte dans cette région, et les premiers résultats d'étude permettent aujourd'hui de proposer un schéma de lutte intégrée excluant toute composante chimique, simple à mettre en œuvre, accessible à tous les revenus et d'une haute efficacité permettant d'abaisser les infestations à des niveaux économiquement acceptables.

Parmi les composantes les plus importantes, la récolte sanitaire, appliquée au sol et sur les branches, permet d'éliminer une grande partie des baies infestées, quel que soit leur stade de maturation, à la fin de chaque récolte et moins de trois mois après les deux principales floraisons. L'usage permanent du piège BROCAP© permet de réduire de moitié les infestations de scolytes, et plus encore lorsque les plantations sont protégées des parcelles voisines par des pièges installés sur la ligne de bordure. Par ailleurs, les aires de dépulpage et de séchage du café, contrôlées en permanence par des pièges, sont autant de sites d'émergence où le retour des scolytes vers les plantations est stoppé. Enfin, la taille périodique des caféiers permet de stimuler les fructifications et d'accroître la production tout en réduisant les taux d'infestation.

D'autres composantes peuvent s'ajouter à ce modèle de lutte, tels que le désherbage et le nettoyage régulier des parcelles qui facilitent notamment la récolte sanitaire. Des suspensions aqueuses de spores de *Beauveria bassiana* régulièrement pulvérisées dans les plantations, contribuent également à la lutte, mais avec une efficacité variable. Enfin, pour évaluer à tout moment les niveaux d'infestation, il convient d'effectuer des échantillonnages de baies dans les plantations.

**Mots clés** : scolyte des baies, lutte intégrée, *Beauveria bassiana*, *Hypothenemus hampei*, BROCAP©



# **AGRONOMIE**

# **DETERMINING THE IMPACT OF MULCHING PRACTICE ON THE EARLY SURVIVAL AND SUBSEQUENT GROWTH PERFORMANCE OF NEWLY TRANSPLANTED COFFEE SEEDLINGS**

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## **Abstract**

The global temperature has been increasing over the years due to recurrent climate change and variability, which directly or indirectly affects the agriculture sector. This has made the necessary for the farmer to get the best out of the varying rainfall amount and distribution. Experiments were conducted with the objectives of identifying effective mulching materials and their optimum application thickness for newly transplanted coffee seedlings at Mechara Agricultural Research Center (MARC) on-station and Sakina on-farm during 2015 and 2016. Coffee seedlings of Mechara-1 variety and organic mulching materials of maize Stover and vetiver grass at 5cm and 10cm mulching depth were compared with farmers' practices of using soil as mulching material and no-mulch bare soils. The experiment was laid out in RCBD with three replications. Data were analyzed for seedling survival rate, soil moisture content, moisture stress score, weed density and subsequent early growth performance of the seedlings under different mulching treatments. The result showed that there are statistically a significant difference ( $p < 0.05$ ) among the treatment for most parameters studied at both locations and seasons. The highest seedling survival rate, soil moisture content and different growth parameters, and the minimum moisture stress score were recorded for coffee seedling treated with maize stover and vetiver grass mulches compared to the no-mulch bare soils and farmers' practices of using soil as a mulching material. However, vetiver grass mulches applied at 5 cm mulching thickness resulted in the highest combined over location and season percentage of coffee seedling survival rate (94.6%), soil moisture content (16.5%), the lowest moisture stress score (1.5) and the highest mean values of the different early growth measurement of coffee seedlings. Weed species and their densities were lowest of all under coffee seedlings treated by maize stover mulches at 10cm mulching depth. Therefore, from these results mulching newly transplanted coffee seedlings with vetiver grass at 5cm mulching depth can be the recommended to farmers in Daro-Labu district and similar moisture stress areas of Hararghe as this practice conserved soil moisture resulting in better seedlings survival through increasing their tolerance to moisture deficits..

**Key words:** Vetiver grass; maize stover; survival rate; soil moisture; moisture stress; coffee seedlings

# COFFEE PEABERRY AS A SEED SOURCE FOR PRODUCTION

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## Abstract

Coffee peaberry is a unique feature of coffee seed as the result of the berry producing a single bean instead of the normal two during fertilization at the field. This might happen by three major factors i.e. failure in one of the two ovules in the ovary to be fertilized and set seed, failure in the further development of the endosperm and incompatibility of the two parents during pollination.

Different coffee seed source type and stage were evaluated as compare to peaberries for growth and development at nursery and for peaberry up to potential yield at field level. For most Ethiopian coffee varieties, occurrence of peaberry % also studied for two seasons at Jimma agricultural research center.

Peaberry like the other normal bean can germinate, emerge and grow as good seedlings, and also the transplanted pea berry seedlings gave a potential yield as of the normal beans perform. On the other hand, the coffee varieties producing peaberry proportion (%) vary from variety to variety which accounts mean value of 7% for pure line and up to 16% for hybrid variety. The hybrid coffee showed two-fold higher pea berry than the pure line coffee. Peaberry may not be predominantly a heritable character, because seeds produced from coffee trees raised from peaberries will not develop all in to peaberries.

**Key words:** coffee, pea berry, growth, Yield

## RESPONSE FUNCTIONS OF TALL *COFFEA ARABICA* VARIETIES TO N, P, K NUTRIENTS IN TANZANIA

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### Abstract

In the past years the Tanzanian coffee farmers used to grow traditional tall coffee varieties N39, KP162, KP- 423 and H.66. These are susceptible to coffee berry disease (CBD) and coffee leaf rust (CLR) which are mainly managed by chemical means as well as host plant resistance. But the use of inorganic fungicides is very expensive especially to smallholder resource-poor farmers and is also not environmentally friendly. As an effort to overcome the use of fungicides TaCRI has developed improved Tall coffee varieties with high yielding potential and resistance to CBD and CLR. The aim of this study was to assess the response of Tall *Coffea arabica* to Nitrogen, Phosphorus and Potassium nutrients. The experiment was established in December 2012 at Lyamungu, following a randomized complete block design with split plots and three replications. Five coffee varieties were treated as main factor (N39-8, N39-9, N39-11, N39-12 and KP- 423) and 4 fertilizer rates as sub factor (75 g of NPK 20:10:10 (recommended/tree, 112.5g of the same, 150g of the same and 37.5g + 10Kg of FYM) each rate applied three times per year with exception of FYM which is applied after every two years. Data collected included stem girth, number of bearing primaries, plant height, berry clusters and yields. The accruing data were exposed to ANOVA using STATISTICA V7 software. The means were separated using Fisher LSD method at 0.05 significance level. KP-423 variety resulted into significantly ( $p<0.05$ ) wider canopy width and higher number of berry cluster than N39-8, N39-9 and N39-11 varieties. On the other hand, N39-8 variety resulted into significantly ( $p<0.05$ ) higher number of branches, strong stem girth and higher tree height. Similarly N39-8 variety resulted into higher yield (1894c Kg clean coffee ha<sup>-1</sup>) which was significantly different ( $p<0.05$ ) from other varieties; N39-9 (1606ab Kg clean coffee ha<sup>-1</sup>), N39-11(1454a Kg clean coffee ha<sup>-1</sup> and N39-12 (1630ab Kg clean coffee ha<sup>-1</sup> ). Interaction between N39-8 variety and 37.5g + FYM resulted into significantly ( $p<0.05$ ) higher yield (2436 Kg clean coffee ha<sup>-1</sup>). Despite the significant difference the lowest yield obtained among the tested parameter was 1300 Kg clean coffee ha<sup>-1</sup>. It is tentatively recommended that 37.5g of NPK (20:10:10) + (10Kg of FYM applied after every two years) or 75g of NPK (20:10:10) if applied tree times per year is enough for N39-8, N39-9, N39-11 and N39-12 varieties under the age of four years.

**Key words:** NPK nutrients, *Coffea arabica*, Tanzania

## TOWARDS EXPANSION OF *COFFEA CANEPHORA* PRODUCTION IN TANZANIA: THE LAND SUITABILITY PERSPECTIVE

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### Abstract

As an effort to generate information that can be used to expand the Robusta coffee production in Tanzania, a study was conducted in six potential districts (Geita, Sengerema, Kibondo/Kakonko, Kasulu/Buhigwe, Uvinza and Mpanda) and two reference districts in Kagera (Muleba and Karagwe/Kyerwa) to assess the quality of land in general and soil fertility in particular. A total of 354 soil samples were taken from 118 survey sites across the study districts and were analyzed for routine soil fertility parameters. Land evaluation (qualitative, parametric method) was done, with climatic data adopted as proxy from nearby weather stations while other land characteristics (slope, drainage and soil depth) taken from the field. In fertility assessment, soil pH was used to establish the correction factors for available N, P and K (fN, fP and fK). Then relationships were empirically worked out between the correction factors, OC and the amount of total N, available P and exchangeable K to get the total available forms of each in kg ha<sup>-1</sup> which were divided by 1, 0.175 and 0.875 respectively and summed up. Then the percentages of total number of sites in each district with natural fertility levels of 400 kE/ha and above were descriptively assessed. Geita and Sengerema compared fairly well with the reference districts in land suitability for Robusta. In the soil's point of view, they showed to be even more fertile than the reference districts. We recommend the two districts to be considered priority areas in Robusta expansion (with the Robusta type of choice being Nganda which appears to be specific to the lacustrine influence). The other four districts could constitute phase two of the expansion and because they are farther away from Lake Victoria, investors can adopt the Erecta type which appears to be better adapted to a diversity of agro-ecosystems.

**Key words:** *Coffea canephora*, Land suitability, soil fertility

# CARACTÉRISTIQUES DES CLONES DE CAFÉIERS CULTIVÉS ET VULGARISÉS AU TOGO

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## Résumé

Au Togo, deux espèces de caféiers sont cultivées : *Coffea arabica* L. et *Coffea canephora* var Robusta. Le matériel végétal utilisé au Togo, provient des introductions de la Côte d'Ivoire, du Cameroun, de l'Angola et de la République Centre Africaine. Ce matériel est distribué aux producteurs sous forme de boutures racinées ou de petits plants produits dans les centres de bouturage du Centre de Recherche Agronomique de la zone Forêt (CRA-F) et de l'Unité Technique Café Cacao. Le *Coffea canephora* var robusta est majoritairement cultivé sous la forme de clones hauts producteurs. Elles sont distribuées en mélange de clones. Cette étude a pour objectif de faire une synthèse bibliographique sur les caractéristiques des clones de caféiers cultivés au Togo. Les clones vulgarisés ont une production moyenne de 2 600 kg/ha de café marchand en station de recherche tandis qu'en milieu paysan, leur rendement moyen est de 800 kg/ha. Huit (8) clones hauts producteurs ont été sélectionnés mais 6 sont vulgarisés. Leurs caractéristiques se présentent comme suit. Le clone 149 a une production moyenne avec de bonnes caractéristiques technologiques ; sa production est irrégulière avec une maturation tardive échelonnée ; son rendement est de 2860 kg/ha. Le clone 181 a une production moyenne avec un rendement de 2780 kg/ha ; il réagit favorable au recepage et a un port géant à caule dure ; il est difficile à récolter. Le clone 182 a un rendement 2500 kg/ha avec une production moyenne et régulière ; il a un port géant à caule dure et est difficile à récolter. Le clone 197 a un rendement 4420 kg/ha ; sa production est bonne et régulière ; il s'adapte à toutes les zones ; par contre, il est sensible à la rouille et a une faible résistance à la sécheresse. Le clone 375 : il a une bonne production et réagit favorablement au recepage ; son rendement est de 2600 kg de café marchand à l'hectare. Le clone 461 a un rendement de 2350 kg de café marchand à l'hectare.

**Mots clés** : café, clone, caractéristiques, vulgarisés, Togo

# EFFECTS OF CUTTING POSITION ALONG MOTHER PLANTS ON ROOTING OF HYBRID COFFEE VARIETIES

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## Abstract

The study was conducted on-station at Tanzania Coffee Research Institute (TaCRI) from December 2013 to March 2014 to evaluate the effect of stem cuttings position along the mother plants on rooting of hybrid coffee varieties. Stem cuttings of coffee varieties were assessed in a rooting medium of forest soil and sand at a ratio of 2:1 by volume under semi-controlled environment. A split-plot experiment in a randomized complete block design (RCBD) with four replications was used. The main factor was five improved hybrid Arabica coffee varieties (N39-1, N39-2, N39-4, KP423-1 and KP423-2) and the sub-factor consisted of four types of positions (stem cuttings collected from the base, middle, apex and conventional treatment used was the mixture of the above cuttings applied as the control). Four months after planting, stem cuttings were evaluated for root growth characteristics. Data collected were subjected to analysis of variance (ANOVA) using CoStat software version 6.311 and treatment means were separated based on Tukey's test at ( $P \leq 0.05$ ). Results obtained indicated that the positions of stem cuttings along the mother plant had a significant effect ( $P = 0.04$ ) on rooting of coffee varieties whereas rooting was highly significant ( $P = 0.00$ ) affected by varieties. Further, interaction between varieties and position of stem cuttings significantly ( $P = 0.04$ ) affected the rooting percentage and number of lateral roots at ( $P = 0.01$ ). This study also indicated that clonal multiplication of coffee stems cuttings differed with varieties and position along the mother plant with stem cuttings taken from basal and middle positions having the highest rooting percentage. It is recommended that, stem cuttings from basal and middle position of mother plants be selected for massive production of varieties N39-1, KP423-1 and KP423-2.

**Key words:** Basal cuttings, Clonal propagation, Multiplication, Stem cuttings, Vegetative

# **EFFET DE DIFFÉRENTS SUBSTRATS SUR LA CROISSANCE ET LE DÉVELOPPEMENT DE BOUTURE DE CAFÉ (COFFEA CANEPHORA VAR ROBUSTA) EN PÉPINIÈRE À L'IRAD BAROMBI-KANG (CAMEROUN)**

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## **Résumé**

La disponibilité de matériel végétal reste une contrainte majeure pour booster la production caféière. Les pertes enregistrées lors de la mise en disposition des boutures racinées aux caféiculteurs restent élevées. Pour remédier à cela, la production des plants de caféier Robusta par bouturage direct sous tunnel a été vulgarisée. Dans le but de proposer aux caféiculteurs un meilleur substrat pouvant favoriser la production rapide des plants en pépinière, cette étude a été menée en pépinière à la Station de Recherche Polyvalente Barombi-kang / Kumba d'Avril à Septembre 2016. Il s'agissait d'évaluer l'effet de différents substrats sur la croissance et le développement des boutures. Les boutures appartenaient au clone M5 de café Robusta et elles ont été récoltées sur des tiges âgées entre 5 à 7 mois

Le dispositif expérimental était celui d'un bloc complet randomisé à quatre répétitions constitués de sept traitements : terre humifère (T0), sable fin de rivière (T1), sciure de bois décomposée ((T2), parche à café (T3), 2/3 : 1/3 mélanges de: terre humifère / sable fin de rivière (T4), terre humifère / sciure de bois décomposée (T5), terre humifère / parche à café (T6).

L'évaluation du pourcentage des repousses a été effectuée à intervalles réguliers d'une semaine après le bourgeonnement des premières boutures avec comme paramètres mesurés: le temps nécessaire pour l'apparition des premières repousses sur différents substrats; les repousses hebdomadaires au niveau des différents traitements et par répétition; le nombre totale de bourgeons par traitement. A la fin du 90ème jour après la plantation, les paramètres mesurés étaient : le nombre de tiges par plant, le nombre d'entre-nœuds par tige, nombre moyen de feuilles par tige, longueur moyenne des tiges par plant en cm, nombre moyen de racines par plant; la taille de la plus longue racine en cm; poids total de la matière fraîche végétale en grammes et le poids total de la matière sèche en grammes. Les données sur les paramètres de croissance et de développement ont été collectées et analysées à l'aide du logiciel R version 3.0. Les résultats obtenus montrent que tous les paramètres mesurés étaient significativement influencés par différents substrats. En conséquence, on pourrait conclure que les substrats T0, T3, T4 et T5 sont indiqués pour la production de plants de caféier Robusta viables et pourraient être recommandés comme bons substrats pour un meilleur enracinement et bourgeonnement tandis que T6 a présenté un taux de mortalité élevé et enfin T2 présentait des performances relativement médiocres pour les paramètres de croissance mesurés.

**Mots-clés :** Boutures Café Robusta ; Clone M5; substrat; production de café; Pépinières



# RÉDUCTION DES EFFETS DE L'ALLONGEMENT DE LA SAISON SÈCHE SUR LA PRODUCTION DU CAFÉ ROBUSTA

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## Résumé

Le caféier est une plante tropicale qui se cultive dans les zones où la saison sèche n'excède pas trois mois. Or au Togo, ces dernières décennies sont marquées par un changement climatique évident, exprimé par l'allongement de la saison sèche, préjudiciable à la floraison, à la nouaison et à la production du caféier. Ce qui réduit la quantité de café marchand et les recettes d'exportation des pays producteurs. Cette situation a imposé la recherche de mesures qui visaient à réduire les effets per vers de ce phénomène climatique. C'est dans ce contexte que, de 1995 à 2018, un essai d'association de quatre légumineuses agroforestières à la culture de caféier robusta a été mis en place en station. Ce sont : *Albizzia adianthifolia*, *Samanea saman*, *Erythrophleum guineensis* et *Albizzia lebeck*. Les premiers résultats ont été obtenus en 2001. Les observations se sont poursuivies de 2003 à 2018 en station sur le diamètre du houppier des espèces agroforestières et le rendement en café marchand. En milieu paysan *Albizzia adianthifolia* et *Erythrophleum guineensis* sont associées à deux densités, 118 plants/ha et 59 plants/ha, au café robusta dans un essai en 2000. Les observations ont porté sur le rendement en café marchand. En station à Tové, *Albizzia adianthifolia* a un recouvrement de 86 m<sup>2</sup> à 5 ans, 217 m<sup>2</sup> à 10 ans, 226 m<sup>2</sup> à 15 ans, et 235 m<sup>2</sup> à 20 ans. *Erythrophleum guineensis* croît de la façon suivante : la vitesse de recouvrement au sol est 44 m<sup>2</sup> à 5 ans, à 132 m<sup>2</sup> à 9 ans, à 175 m<sup>2</sup> à 15 ans et 216 m<sup>2</sup> à 20 ans. *Samanea saman* croît lentement la première année, après il grandit rapidement les 3 premières années. Au Togo le développement horizontal de cette espèce exprimé par le recouvrement au sol est de 126 m<sup>2</sup> à 5 ans, 254 m<sup>2</sup> à 9 ans, il atteint 290 m<sup>2</sup> à 15 ans et 327 m<sup>2</sup> à 20 ans. *Albizzia lebeck* couvre le sol sur 139 m<sup>2</sup> à l'âge de 5 ans, à 9 ans il atteint 197 m<sup>2</sup>. Les rendements en café marchand sous les légumineuses forestières sont : *Albizzia adianthifolia* 851 kg/ha *Samanea saman*, 1024 kg/ha *Erythrophleum guineensis* 1068 kg et *Albizzia lebeck* 1492 kg/ha NPK 20.10.10 à 400 kg/ha, 1336 kg/ha, Témoin 986 kg/ En milieu paysan, et à trois ans, les rendements sont de : *Albizzia adianthifolia* 563 kg/ha, *Erythrophleum guineensis* 527 kg/ha, NPK 281 kg/ha et Témoin 195 kg/ha.

**Mots clés :** caféier robusta, allongement, saison sèche, Légumineuses agroforestières.

# **GENETIQUE/SELECTION**

# CHARACTER ASSOCIATION AND PATH COEFFICIENT ANALYSIS AMONG YIELD AND YIELD RELATED TRAITS IN COFFEE (*COFFEA ARABICA* L.) IN ETHIOPIA

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## Abstract

Coffee is the world's most widely traded agricultural commodity surpassed only by oil and it is the back bone to the Ethiopian economy and it contributes 25-30 % export revenue and more than 20- 25 million people depends on coffee for their livelihoods. The coffee bean yield is a complex character that can be determined by several components which reflect positive or negative effects upon this trait. In view of this, the present investigation was carried out at Agaro, Southwest Ethiopia, to determine the extent of correlation among 26 coffee yield and yield related traits of 49 Limmu coffee accessions and to assess the direct and indirect effects of yield components on coffee yield. The result revealed that significant ( $P < 0.05$ ) differences among the coffee germplasm accessions for all traits except for percent of bearing primary branches, leaf area, bean thickness and rust incidence and in general, the genotypic correlation coefficient was higher in magnitude than its corresponding phenotypic correlation. Morphological traits that exhibited positive and significant ( $P < 0.05$ ) correlation with coffee bean yield, namely, average inter node length on stem, stem diameter, angle of primary branches, fruit length, fruit width and fruit thickness, are important components to improve coffee yield. The positive and significant correlation between coffee yield and other morphological traits indicates that these highly associated traits are controlled by one major gene. Thus, improving one leads to simultaneous improvement of the others. Besides, path coefficient analysis showed that average-inter nodes length on main stem, stem diameter, angle of primary branches, fruit length and thickness, having positive direct effects, exhibited positive and significant genotypic correlation with coffee yield per tree. Therefore, in the current study, average inter node length of main stem, stem diameter, angle of primary branches, fruit length and thickness can be used as indirect selection criteria to improve coffee yield per tree.

**Key words:** Coffee accessions, Correlation, Direct effect, Path coefficient, Primary branch

# DIVERSIFICATION ET IDENTIFICATION DES AGROFORETS A BASE DE CAFEIERS ARABICA (*COFFEA ARABICA* L.) DANS LES HAUTS PLATEAUX DE L'OUEST DU CAMEROUN

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## Résumé

Cette étude vise à identifier les agroforêts à base de caféiers arabica au vu de l'analyse de la diversité floristique. En 2004, les espèces agricoles et pérennes ont été recensées dans 100 caféières arabica réparties à des niveaux d'altitudes suivants : basse (< 1200 m), moyenne inférieure (1200-1450 m), moyenne (1450-1700 m) et haute altitudes ( $\geq$  1700 m). Les résultats montrent que *Cola* spp., *Dacryodes edulis*, *Eucalyptus robusta*, *Mangifera indica*, *Persea americana*, *Raphia mabilensis* et *Spathodea campanulata* représentent 26,8 % des effectifs en basse, 72,2 % en altitude moyenne inférieure, 71,4 % en moyenne et 77 % en haute. Le test de Fisher révèle une influence significative de la variable altitudinale sur l'indice de Shannon. Les caféières d'altitude moyenne inférieure sont les mieux réparties (Equitabilité de Piélou de 0,87) et diversifiées (3,49 bits). Sur la base du taux de perte en caféiers et du test de comparaison SNK, la régression caféière observée dans cette région met non seulement en exergue des systèmes de types restreint (20,3-31,5 % de perte en caféiers) et modéré (7-12,7 % de perte), respectivement en altitudes inférieure et supérieure, mais aussi, des systèmes caféiers sous légumineuses arborées non contrôlées et ceux peu enrichis en basse altitude, en altitude moyenne inférieure, ceux sous *Musa* spp. – fruitiers, et, ceux sous fruitiers et sous *R. mabilensis* respectivement en moyenne et hautes altitudes.

**Mots clés :** Diversification, caféiers arabica, altitude, indices, systèmes.

## SEED AND *IN VIVO* CUTTING MUTAGENESIS FOR BROADENING GENETIC VARIABILITY IN *COFFEA ARABICA*

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### Abstract

Coffee, after crude oil, is the second most valuable commodity exported by developing countries and supports the livelihood of more than 75 million people. Coffee markets have a preference for established cultivars making improvements via conventional breeding difficult. Moreover, the long juvenile period of the coffee tree means that conventional breeding takes many years to produce a new cultivar. Arabica coffee production is based almost entirely on coffee cultivars developed decades ago with a narrow genetic base (Davis, 2006), leaving the crop vulnerable to new threats of diseases and pests emanated from climate change effects. Mutation breeding has proven to be effective in broadening genetic variability in plant species therefore has great potential in improvement of tree crop specie such as *Coffea* spp (Bado et al., 2017). Prior to starting a mutation breeding programme, radio-sensitivity tests need to be performed to determine the optimal dose treatment for mutation induction. The susceptibility of seeds and in vivo cuttings of three selected *Coffea arabica* cultivars Kents, Mundo-novo and Geisha to Gamma irradiation was determined. A wide range of irradiation doses between 0 and 300 Gy for seed mutagenesis and between 0 and 25 Gy for in vivo cuttings were used. Subsequently germination percentage, success takes percentage and seedling vigour was used as a measure of radio-sensitivity. This study corroborated the high sensitivity of vegetative cutting compared to seed. Results showed that genotype and dosage of irradiation significantly influenced response to irradiation treatments ( $p < 0.05$ ). As for seeds, the effect of the irradiation on treated cultivars was inversely proportional to the emergence of the radicle, hypocotyls which were less affected while all treated seeds developed hypocotyls. The optimal mutation induction dose for seeds (LD50) ranged from 105 to 150 Gy for the Gamma irradiation, while the optimal mutation treatment (GR50) of cuttings was in the range of 12 Gy in all the treated Arabica varieties. Germination percentage, success takes, plant height, root length, number of roots and number of leaves were all affected. The optimal mutation treatment (GR50) of cuttings was in the range of 12 Gy in all the treated Arabica varieties. This study presents a pioneer work of *Coffea* spp. mutation breeding and provides first data on suitable irradiation doses for mutation induction in seeds and in vivo cuttings. The work is part of the FAO/IAEA Co-ordinated Research Project on 'Efficient Screening Techniques to Identify Mutants with Disease Resistance for Coffee and Banana (D22005).

# DEVELOPMENTAL VARIATION AMONG IMPROVED COFFEE HYBRIDS PROPAGATED THROUGH SOMATIC EMBRYOGENESIS

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## Abstract

Arabica is one of the most important crop in the World. TaCRI developed 15 improved tall and four (4) compact Arabica varieties combining high yield, good cup quality and resistant to coffee berry disease (CBD) and coffee leaf rust (CLR). Increasing demand for the improved coffee seedlings calls for exploration of somatic embryogenesis as a complementary technique on top of clonal and grafting techniques. A study was conducted to assess the response of improved coffee varieties to somatic embryogenesis and identify varieties that can be included in multiplication programme. Six varieties (N39-1, N39-5, KP423-1, KP423-3, CVT1-1 and CV2-1) were used in this study. Young fully expanded leaves from genotypes were surface sterilized 20 minutes in a solution of calcium hypochlorite ( $\text{CaCl}_2\text{O}_2$ ) at  $40 \text{ g l}^{-1}$  and rinsed thrice in sterile water. Small explants were cut and placed on callus induction semi-solid T1 medium containing 6-benzylaminopurine (BA) hormone, 1/4 strength macro salts and half strength micro salts of MS medium, B5 vitamins supplemented with  $1.0 \text{ mg l}^{-1}$  BA,  $30 \text{ g l}^{-1}$  sucrose and  $8.0 \text{ g l}^{-1}$  agar. The explants were incubated in darkness at  $25 \text{ }^\circ\text{C}$ . Subculture was done at the interval of 1 to 2 months on T2 medium and exposed to the same conditions. Six to ten months later, yellowish friable primary calli were selected and further multiplied in liquid media, 0.10 g FW of friable calli were transferred into 10 ml of liquid medium in RITA system or in semi-solid medium in Magenta jars. Each variety had 5 magenta jars, each one having 7 explants. Data were recorded one month after initiation on explant reactivity on embryogenic callus development time and amount, and plantlet development. Calli were weighed per jar and results expressed as percentage of the established average weight of calli per genotype. Data were statistically analyzed using GenStat statistical software 14<sup>th</sup> Edition. Variations were observed at the early stage of culturing. The study observed a significant difference among the genotype tested at  $P < 0.05$ . The highest percentage of callus development was observed from explants obtained from variety KP423-3 (86.25%), KP423-1 (83.73%) followed by N39-3 (63.75%) and CVT1-2 (61.25%), while the least performers were N39-1 (46.25%) and CVT2-1 (43.75%). The use of somatic embryogenesis is an effective means of mass production of the improved coffee hybrid varieties in Tanzania, and the first two varieties are to be preferred for expedited production of more seedlings.

Keywords: *Coffee hybrids, propagation, somatic embryogenesis*

## **AGROECONOMIE ET AUTRES**

# **LES FILIÈRES AGRICOLES COMME MOTEURS DE POLES DE COMPÉTITIVITÉ : CAS DE LA FILIÈRE CAFE EN COTE D'IVOIRE.**

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## **Résumé**

La filière café Ivoirienne a connu de nombreux soubresauts, consécutivement aux crises politiques et sociales, ainsi qu'aux chutes des cours mondiaux. Ces crises ont occasionné une chute sévère de la production, et un ralentissement dans la mise en œuvre des politiques d'intensification de la production et de transformation locale. La présente étude se veut une contribution à l'organisation du sous-secteur café ivoirien, par le développement de l'attractivité des chaînes de valeurs et de démontrer que ce dernier peut constituer un véritable levier de développement, aussi bien au niveau régional qu'au niveau national. Cette étude propose une analyse de la filière café, par les chaînes de valeurs, et envisage de donner une meilleure compréhension des facteurs de succès d'un pôle de compétitivité basé sur le café. Les résultats partiels des recherches, menées entre juin 2016 et août 2018, ont permis d'identifier les parties-prenantes du sous-secteur café, avec les interactions qu'ils ont, ou peuvent avoir, aussi bien au niveau régional qu'au niveau national ; ils permettent aussi de mieux comprendre l'organisation du sous-secteur, la performance des acteurs au niveau local, notamment les organisations de producteurs et les industriels. Les travaux se poursuivent et permettront de promouvoir des liens entre les acteurs (le café peut-il construire un réseau autour de lui ?), susceptibles de les aider à améliorer leurs pratiques et leurs performances.

**Mots clés :** Côte d'Ivoire, café, filières agricoles, pôle de compétitivité, chaînes de valeurs



## COFFEE QUALITY RESEARCH IN ETHIOPIA

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Coffee is the first most traded Agricultural commodity in world market. Arabica coffee contributes more than 65% of world's coffee supply. Ethiopia is center of origin and diversity of Arabica coffee. About 20-25 million Ethiopian people directly and indirectly depend on coffee for their livelihood. Vast agro-ecology and genetic variability in Ethiopia creates opportunity to have different distinct coffee quality characters. Despite the vast majority of coffee quality has not been improved as expected. Besides, though Jimma Agricultural Research Center (JARC) has been conducting coffee quality research for the last five decades, the results were not compiled in a way that can be used by different users. Therefore, these review papers were aimed at compiling the results of coffee quality research by JARC. From the coffee quality research conducted for the last five decades by JARC, appropriate method and optimum time coffee fermentation, use of shade during coffee fermentation, depth and expositor time of parchment coffee during drying and some coffee quality profile mapping for some coffee growing areas were the major output. Therefore, coffee growers in Ethiopia should use these improved coffee quality management options to improve their coffee quality. However, as the demand of coffee buyers is growing from time to time, coffee quality research should focus on advanced coffee processing and postharvest handling methods.

**Key words:** Coffee quality, drying, fermentation, profile map, processing

# **SOCIO-ECONOMIC APPRAISAL OF THE COFFEE REHABILITATION PROGRAMME IN GHANA**

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## **Abstract**

Coffee production increased to its highest level in 1999/2000 due to the good price incentives enjoyed by farmers at the time. However, between 2001 and 2004, the price of the crop on the international market suffered major decline that seriously affected the internal coffee trade. Consequently, farmers in Ghana diverted from coffee farming to other cash crop farming, especially, cocoa. Since 2010, the government of Ghana through the Ghana Cocoa Board (COCOBOD) implemented a four-year Coffee Rehabilitation Programme (CRP) in order to promote the production of coffee with a target of 10,000 metric tonnes of coffee within the four-year period, enhance productivity and to attract more farmers to cultivate coffee for export. The main strategy to achieve this was to support and motivate farmers with inputs including extension to rehabilitate and maintain their abandoned farms and to attract new farmers to establish new coffee farms. The support programme was even extended for one more year. Having run the programme for over four years, the question is whether the objectives set were achieved? Are farmers motivated to sustain coffee cultivating in Ghana now? This socio-economic study was initiated to assess the programme in respect of these questions, gains made and to track any other unintended outcomes that may have arisen. A total of 448 coffee farmers were interviewed from 36 communities in all coffee growing regions in Ghana between July and September 2018 using pre-tested and structured questionnaires. Results are highlighted in this paper.

**Key words:** socio-economics, farmers, coffee, rehabilitation, production

# PERCEPTIONS DES CHANGEMENTS CLIMATIQUES ET STRATÉGIES ENDOGÈNES D'ADAPTATION DES PRODUCTEURS DE CAFÉ AU TOGO

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## Résumé

Les changements climatiques ont été reconnus comme une menace pour l'agriculture africaine, car plus vulnérable en raison de ses faibles capacités d'adaptation. Cette étude examine les possibilités d'adaptation de la production caféière au Togo face aux changements climatiques. Elle s'est fixée pour objectif général de contribuer à l'accroissement de la résilience de la production caféière aux effets des changements climatiques. Spécifiquement, il s'agit de connaître les impressions des producteurs de café sur les changements climatiques dans leur milieu et de recenser les mesures endogènes utilisées pour l'adaptation. Pour ce faire, des données ont été collectées à travers une enquête par questionnaire dans l'Ouest de la Région des Plateaux. Un échantillonnage stratifié à deux degrés a permis de retenir 182 producteurs de café, auxquels le questionnaire a été administré. Les principaux résultats montrent que les producteurs sont conscients dans 98% de cas des changements climatiques dans leur milieu. Ils affirment des mutations des éléments du climat liés à la pluviométrie et à la température. Tous les producteurs enquêtés indiquent une réduction de la pluviométrie moyenne annuelle et une hausse de la température moyenne annuelle. Ces affirmations sont confirmées par l'analyse des données météorologiques de la zone d'étude. Les producteurs de café évoquent le démarrage tardif de la saison pluvieuse (90%), l'arrêt précoce de la saison de pluies (85%), les poches de sécheresses (80%) et les vagues de chaleur en saison sèche (45%). Les mesures endogènes d'adaptation aux changements climatiques utilisées par les producteurs de café contribuent à la conservation de l'humidité au profit des plants de caféiers. Ces mesures sont la construction d'ombrières ou l'installation des pépinières sous l'ombrage d'arbres (100%), le déplacement de la période d'installation des plants de caféiers (100%), le remplacement les plants morts (100%), le renforcement l'ombrage dans les plantations par l'association des arbres fruitiers (100%), la conservation des essences agroforestières (*Albizzia*) dans leurs plantations (85%), le paillage des ronds autour des jeunes plants (74%), installation les pépinières à proximité des rivières (60%) et la conservation de l'humidité du sol par le non-labour en saison sèche (56%). Néanmoins, les mesures recensées sont très limitées par rapport aux impacts des changements climatiques sur la production caféière. Les actions à entreprendre pour l'accroissement de la résilience de la production caféière au Togo doivent tenir compte des mesures endogènes d'adaptation identifiées dans cette étude.

**Mots clés :** Changements climatiques, production caféière, perceptions, mesures endogènes d'adaptation, Togo

# **DOES COFFEE CULTIVATION HAVE A FUTURE IN GHANA IN THE FACE OF CURRENT GHANAIAN FARMERS' OUTLOOK, ATTITUDE AND MARKETING CONSTRAINTS: EVIDENCE FROM PRIMARY DATA.**

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## **Abstract**

Although coffee was introduced in Ghana around the same time in the 18th century as cocoa by the early missionaries, its cultivation has lagged behind cocoa for many years since it has not received the much-needed attention as cocoa. However, coffee cultivation received a major boost in 1991 when the Government of Ghana embarked on the Agricultural Diversification Project to revamp the coffee industry (Oppong *et al.* 2009). Efforts included improved pricing, liberalized markets and intensification of research as well as enhanced extension services for farmers. CRIG, a subsidiary of the Ghana Cocoa Board continues to research on coffee planting materials, and on other important aspects of the crop. In 2016, a Coffee cultivation Manual was developed by CRIG (CRIG, 2016). The recent coffee rehabilitation programme in Ghana, between 2011 and 2015, also, yielded some results. However, in the face of current marketing regulations, policies and constraints facing farmers, what future does coffee cultivation have? Could coffee cultivation be a crop of choice and livelihood option for the rural poor in Ghana based on the growing evidence of health benefits and economic potential to reducing poverty? This paper shares some insight into Ghanaian farmers' views, perceptions, attitudes and constraints.

**Key words:** coffee outlook, coffee production, farmer attitude, marketing, constraints