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PLANT GENETICS AND BREEDING (1 JDL)

Lars Hein, Franz Gatzweiler, The economic value of coffee (Coffea arabica) genetic resources,
Ecological Economics, Volume 60, Issue 1, 1 November 2006, Pages 176-185, ISSN 0921-8009, DOI: 10.1016/j.ecolecon.2005.11.022.
(http://www.sciencedirect.com/science/article/B6VDY-4J2W0JJ-1/2/0da1ec62271517591c598355cfb6bc20)

Abstract:
Whereas the economic value of genetic diversity is widely recognized there are, to date, relatively few experiences with the actual valuation of genetic resources. This paper presents an analysis of the economic value of Coffea arabica genetic resources contained in Ethiopian highland forests. The valuation is based on an assessment of the potential benefits and costs of the use of C. arabica genetic information in breeding programs for enhanced coffee cultivars. The study considers the breeding for three types of enhanced cultivars: increased pest and disease resistance, low caffeine contents and increased yields. Costs and benefits are compared for a 30 years discounting period, and result in a net present value of coffee genetic resources of 1458 and 420 million US$, at discount rates of 5% and 10%, respectively. The value estimate is prone to considerable uncertainty, with major sources of uncertainty being the length of breeding programs required to transfer valuable genetic information into new coffee cultivars, and the potential adoption rate of such enhanced cultivars. Nevertheless, the study demonstrates the high economic value of genetic resources, and it underlines the need for urgent action to halt the currently ongoing, rapid deforestation of Ethiopian highland forests.

Keywords: Genetic resources; Coffee; Coffea arabica; Damage costs; Economic value; Ethiopia

PLANT PHYSIOLOGY AND BIOCHEMISTRY (1 JDL)

Jason W. Johnston, Stephane Dussert, Samantha Gale, Jayanthi Nadarajan, Keith Harding, Erica E. Benson, Optimisation of the azinobis-3-ethyl-benzothiazoline-6-sulphonic acid radical scavenging assay for physiological studies of total antioxidant activity in woody plant germplasm,
Plant Physiology and Biochemistry, Volume 44, Issue 4, April 2006, Pages 193-201, ISSN 0981-9428, DOI: 10.1016/j.plaphy.2006.04.005.

(http://www.sciencedirect.com/science/article/B6VRD-4JXRHW5-1/2/e117f60e94a92546d5e5ddc4c6e3e6bd)

Abstract:

A robust spectroscopic method for determining total antioxidant activity in aqueous extractions has been applied to tissues from diverse woody plant species, including seeds of Coffea arabica and in vitro shoots from Ribes nigrum, Picea sitchensis and Shorea leprosula. The assay involves scavenging of an ABTS [2,2'-azinobis-(3-ethyl-benzothiazoline-6-sulphonic acid)] radical generated by the reaction of potassium persulphate with ABTS to produce an ABTS[filled circle]+ chromophore ([lambda] = 734 nm). Antioxidants reduce ABTS[filled circle]+ back to ABTS with a concomitant decrease in absorbance. Aqueous extractions from C. arabica and S. leprosula had considerably higher (110-205 [mu]mol Trolox eq. g-1 FW) total antioxidant activities than P. sitchensis and R. nigrum (6-11 [mu]mol Trolox eq. g-1 FW). Further studies in two of these species showed that the inclusion of water-insoluble polyvinylpyrrolidone during aqueous tissue extraction enabled the combined phenolic and alkaloid antioxidant activity to be determined. These fractions accounted for 85% and 60% of total antioxidant activity for C. arabica seeds and R. nigrum shoots, respectively. The ABTS radical scavenging assay is presented herein as a robust method for determining total antioxidant activity in germplasm from diverse woody plant tissues and species. Its applicability to study oxidative stress in tissue cultures and germplasm employed in plant biotechnology, breeding and stress physiology programmes is discussed.

Keywords: Oxidative stress; Antioxidant; Free radical; Scavenging assay

PLANT PHYSIOLOGY-NUTRITION (3 JDL)

Hiroshi Ashihara, Hiroshi Sano, Alan Crozier, Caffeine and related purine alkaloids: Biosynthesis, catabolism, function and genetic engineering,

Phytochemistry, Volume 69, Issue 4, February 2008, Pages 841-856, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2007.10.029.

(http://www.sciencedirect.com/science/article/B6TH7-4RCW7WP-1/2/48370b6c2717b11c86549153c7678352)

Abstract:

Details of the recently elucidated biosynthetic pathways of caffeine and related purine alkaloids are reviewed. The main caffeine biosynthetic pathway is a sequence consisting of xanthosine --> 7-methylxanthosine --> 7-methylxanthine --> theobromine --> caffeine. Genes encoding N-methyltransferases involved in three of these four reactions have been isolated and the molecular structure of N-methyltransferases investigated. Pathways for the catabolism of caffeine have also been studied, although there are currently no reports of enzymatic and genetic studies having been successfully carried out. Metabolism of purine alkaloids in species including Camellia, Coffea, Theobroma and Ilex plants is summarised, and evidence for the involvement of

caffeine in chemical defense and allelopathy is discussed. Finally, information is presented on metabolic engineering that has produced coffee seedlings with reduced caffeine content, and transgenic caffeine-producing tobacco plants with enhanced disease resistance.

Keywords: Camellia sinensis; Theaceae; Coffea sp.; Rubiaceae; Theobroma cacao; Sterculiaceae; Review; Metabolism; Caffeine

Tadesse Woldemariam Gole, Thomas Borsch, Manfred Denich, Demel Teketay, Floristic composition and environmental factors characterizing coffee forests in southwest Ethiopia,

Forest Ecology and Management, Volume 255, Issue 7, Large-scale experimentation and oak regeneration, 20 April 2008, Pages 2138-2150, ISSN 0378-1127, DOI: 10.1016/j.foreco.2007.12.028.
(http://www.sciencedirect.com/science/article/B6T6X-4S0HBYC-1/2/6b111a3c6c94f1fd12590b975fed00a6)

Abstract:

Afromontane rainforest stands in Ethiopia with a high frequency of wild populations of Coffea arabica are commonly known as `coffee forests'. These forests are important for the conservation of the genetic diversity of wild Arabica coffee, and for subsistence coffee production. This study analyses the floristic composition and environmental factors of such coffee forests, using the Yayu forest as a case. Fifty-eight plots of 20 m x 20 m were assessed, and a total of 220 plant species, representing 73 families, were recorded, of which 71 were trees, 28 shrubs, 27 climbers and 94 herbs. A cluster analysis, coupled with indicator species analysis, revealed three plant community types, which can designated as C. arabica-Cassipourea malosana, Argomuellera macrophylla-Celtis africana and Dracaena fragrans-Teclea noblis communities. The C. arabica-C. malosana and D. fragrans-T. noblis communities occur at relatively higher altitudes (1450 and 1435 m on average) on gentle and steep slopes, respectively, while the A. macrophylla-C. africana community occurs on steep slopes at lower altitudes (1380 m on average). C. arabica is one of the most frequent species in the Yayu forest, and its abundance is strongly negatively correlated with slope. These habitat differences, together with the predominance of Coffea in the understorey, support the floristic circumscription of a coffee forest. Forests commonly known as 'coffee forests' have, therefore, to be viewed as a complex mosaic of different plant communities, which needs to be taken into consideration in the designation of conservation areas and differential management planning.

The plant species composition of Yayu forest is predominantly Afromontane rainforest type, with several dry peripheral semi-deciduous Guineo-Congolian forest type species. Hence, Yayu forest can best be described as transitional between these lowland and montane forest types.

Keywords: Afromontane rainforest; Coffea arabica; Guineo-Congolian rainforest; Indicator species; In situ conservation

Diriba Muleta, Fassil Assefa, Sileshi Nemomissa, Ulf Granhall, Composition of coffee shade tree species and density of indigenous arbuscular mycorrhizal fungi (AMF) spores in Bonga natural coffee forest, southwestern Ethiopia,
Forest Ecology and Management, Volume 241, Issues 1-3, 30 March 2007, Pages 145-154, ISSN 0378-1127, DOI: 10.1016/j.foreco.2007.01.021.
(http://www.sciencedirect.com/science/article/B6T6X-4N14D5W-1/2/9e50546e0505bfb6a2510026f8c9cfc2)

Abstract:

The composition of coffee shade tree species and density of arbuscular mycorrhizal fungi (AMF) spores in Bonga natural coffee forest of southwestern Ethiopia were investigated. This study is the first report on AMF populations of Ethiopian natural coffee forests. The main purposes were to systematically identify the dominant coffee shade tree species, evaluate their densities and quantify and characterize populations of arbuscular mycorrhizal fungi particularly in the rhizosphere of coffee plants. Sample plots of 400 m2 with coffee plants and dominant shade tree species were selected. Sampling of soil was carried out at a depth of 0-15 cm from the rooting areas of shaded and unshaded coffee plants for analysis of some soil parameters and quantification of AMF spores. Nineteen dominant shade tree species belonging to 14 plant families were identified in considered 10 quadrates. In terms of their stand dominance, Millettia ferruginea (Hochst.) Baker had the highest frequency of occurrence (22.3%) followed by O. welwitschii Friis & P.S. Green (15.5%). High density (503 stems/ha) and/or percentage (66%) of Coffea arabica L. were recorded. All soil samples yielded AMF spores and the counts ranged from 4 to 67 spores 100 g-1 of dry soil. Notably higher mean counts of AMF spores were found under leguminous shade trees compared to non-leguminous ones. AMF spore counts were significantly positively correlated with coffee counts and available soil P content. Five genera of AMF were identified based on spore morphology. Glomus dominated members of Glomeromycota. The other genera found were Gigaspora, Acaulospora, Entrophospora and Scutellospora in order of occurrence. The present investigation has documented species richness among dominant coffee shade tree species along with a fair distribution of relevant numbers and types (genera) of AMF to stimulate coffee growth. Thus, Bonga natural coffee forest seems to be an ideal focal forest for in situ coffee genetic resources conservation and promotion of organic coffee production.

Keywords: Arbuscular mycorrhizal fungi spore density; Bonga natural coffee forest; Coffee shade tree species