

Agroecological profile of plants used as production factors and as management components in tropical polyculture systems

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Sustainable production of plant products on poor and acid soils under edaphoclimatic conditions of the Amazonian humid tropics has not been achieved with monocultures like rubber trees, oil palm or cocoa. Two fundamental restrictions led to socioeconomic and ecological disasters, when the first modern wave of colonization swept into Amazonia, using monocultures as an economic agricultural production basis: 1.) the complexity of the interaction of biotic and abiotic compartments of the primary forest was unknown (or not respected by planners), and 2.) the plants used for plantation culture had been selected as high producing clones under high input management conditions. Instability of these systems due to pest and pathogen attack, due to loss of nutrients, and due to unadapted management measures delayed the onset of plant maturity and of the production phase and lowered the amount and the quality of products. The following phase of rural development was characterized by experiments with mixed cultivation systems without a clear design. Ecological adaptability and phenotype flexibility of plants was widely unknown. Knowledge of plant inherent factors, the plants' reaction to environment and the plants' impact on the environment is needed in order to design rational combinations of plants for long term stable polyculture systems

Four projects of the SHIFT-program (ENV 23, 42, 45, 52) aim at the analysis of plant-environment interaction in widest sense. The experimental site and the plant combinations were selected by ENV 23. Plant development, phytopathological aspects, agricultural production and interaction of plants with secondary vegetation are followed by ENV 23.

The chemical and physical impacts of a plant on the site of growth, the mineral and water flow in the soil are studied by project ENV 45, primary production and wood formation in perennials and its limits by nutritional factors are analysed by ENV 42. Mechanisms of nutrient storage and internal cycling within the plant as well as the quotient of mineral to organic biomass are quantified and have been identified to be important features of stable planting systems.

A main factor of plant cover stability is a powerful mineral recycling system which avoids any loss of essential nutrients and which guarantees the redistribution of the mineral elements. The root systems, their spread on and in the soil (ENV 23, 45), the root interaction of different plants and the roots' metabolic capacity is considered as a central feature. Besides the plant/mineral element - relationship the direct biotic interaction plant-plant, plant-microbe (ENV 23), plant-animal as well as the indirect relationships of these biotic compartments are under study (ENV 52).

Development of a descriptor system for multicropping plants, which allows, on a rational background, to combine plants to form ecologically stable, good producing and site adapted polyculture systems with low input needs is on its way, worked out by a multidisciplinary approach.