Development and production of cupuaçu-plants on degraded areas: Implications of water relations

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The high market value of the fruit pulp and the potential use of the seeds for the production of chocolate-like wares make the cultivation of cupuaçu-trees *(Theobroma grandiflorum)* very attractive. Our question was, which factors influence the development of this economically attractive plant if it is used as a crop-plant in agroforestry systems designed for the recultivation of degraded areas.

We studied the development of 750 cupuaçu-plants grown in a monoculture and three mixed cultivation systems on a degraded area, a former terra firme rain forest site near Manaus. Topographic features of the position of each plant have also been taken into consideration. In addition, measurements of water uptake and stomatal resistance of particular plants have been conducted.

It became very evident that all mixed cultivation systems provide better conditions for the development and productivity of cupuaçu-trees than the monoculture. Between the mixed cultivation systems we observed, that the development and productivity after the first 3 years was more advanced in the system with the highest planting density. Neither different fertilization treatments (30% and 100% of recommended dose) nor the topographic relief were significantly related to the development of cupuaçu-plants.

But we observed an evident influence of the adjacent forest on the development and productivity of cupuaçu-plants. After the first 3 years the development of cupuaçu-plants was advanced towards the border of the experimental site. This influence of the adjacent forest became also very obvious through the "El niño"-phenomenon in the 5th year. We observed a gradient of fruit productivity declining from the border to the central part of the plantation. The positive influence of the forest's neighborhood was effective up to a distance of about 40m. Climatic measurements revealed an evident gradient in the same spatial range concerning the potential evaporation, water vapor deficit and air temperature as a function of the distance to the primary forest. Thus, we assume that the observed effect on plant development and productivity bases on a positive influence of the forest's microclimate on the water balance of the cupuaçu-plants.

A drought experiment showed, that the zone of water uptake of a 6 years old cupuaçu-tree is almost completely restricted to the upper 10 cm of the top soil. Parallel measurements of the stomatal resistance showed evidently reduced transpiration if the volumetric water content of the upper soil approximates 20 to 15 % - a soil draught which can frequently be exceeded during the dry season.

We conclude that - despite the vast precipitation in Central Amazonia - water supply is a limiting factor for the cultivation of cupuaçu-trees. Plants grown solitary on degraded areas suffer frequently from draught. Thus, designs of plantations for the recultivation of degraded areas must consider the water balance of the system. Species composition and planting densities should lead to storied structures of the plant community. Such structures reduce the vertical mass transfer and consequently counteract the water loss of the planting system, thus, preventing a retardation of the development of cupuaçu-plants by draught.