

Effects of tree spacing and species composition in cacao plantations

Dr Shahla Hosseini Bai¹, Associate Professor Stephen Trueman¹, Tio Nevenimo², Godfrey Hannel Hannel², Mathew Poienou², Professor Helen M. Wallace¹

¹University Of The Sunshine Coast, ²National Agriculture Research Institute

Cacao (*Theobroma cacao*) is an important cash crop in the tropics and is a newly established but growing industry in Australia. Cacao yield increases under shade and hence cacao is planted under different trees to provide shade. However, different tree spacings and species compositions may affect nutrient cycling in cacao plantations. This study aimed to investigate the effects of tree spacing and tree species composition on soil and plant nutrient cycling 8 years after plantation establishment. Two cacao plantations were established in 2007 in New East Britain, Papua New Guinea, with cacao planted with a non-legume tree (*Canarium indicum*) and a legume tree (*Gliciridia* sp.). The tree spacings included 8 m × 16 m and 8 m × 8 m in the cacao-canarium plantation and only 8 m × 8 m in the cacao-gliciridia plantation. The cacao spacings 4 m × 4 m were in all plantations. We assessed nutrient availability in the soil, plant and cocoa beans as well as nut quality in *Canarium indicum*. Soil labile carbon and nitrogen (except inorganic nitrogen) were influenced by tree spacing and species composition. In general, soil labile carbon and nitrogen were higher in cacao-canarium 8 m × 16 m and cacao-gliciridia 8 m × 8 m than in cacao-canarium 8 m × 8 m. Foliar N of *T. cacao* (ranged between 1.78% and 2.15%) was higher than critical levels in all plantations whereas foliar phosphorus (varied between 0.11% and 0.15%) was under critical levels regardless of the plantations. Our study indicates that tree spacing and species composition are two factors that influence soil-plant systems in cacao plantations.