Tree-Crop Interface in Agroforestry Systems

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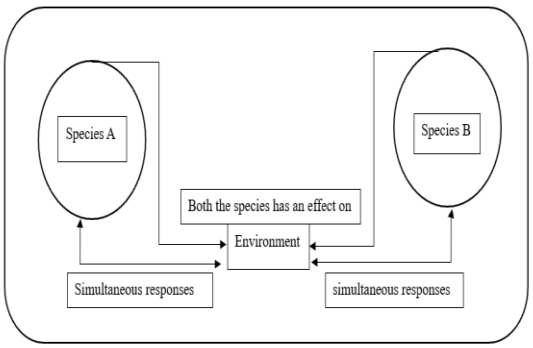
ABSTRACT

Agroforestry systems are not just systems where trees and crops/animals produce products useful to farmers, but rather systems where trees and crops/animals interact. Thus, there is concern that the presence of a plant can change the environment of neighbouring lands, creating a favorable balance between negative and positive plant interactions that increases total yield, reduces yield variability, and conserves resources. Interaction simply means the effect of one component on the growth and functioning of other components. In agroforestry systems, trees are grown close to crops and pastures, and their efficiency depends largely on the ability to share different growth resources under certain environmental conditions. There are various interactions between the woody component and herbaceous plants (crops or pastures), called the tree-crop interface, which can be both below and above ground. These interactions occur through the medium of soil and microclimate factors that can have beneficial or detrimental effects on yield and vice-versa. Interaction studies help to understand how the components of agroforestry use and share environmental resources and how the growth pattern of one component affects the growth pattern of another component. Agroforestry places great emphasis on interactions, which are often overlooked but remain relevant.

INTRODUCTION

Agroforestry is a multidisciplinary approach to land use systems that includes ecological, social and economic factors (Sinclair, 1992). Although agroforestry systems are altered or disturbed environments and cannot be described as natural, they represent a new approach of artificial monoculture systems that emphasize species diversity and conservation of natural resources. The interaction between species is mediated by the environment through the principle of Response and Effect (Goldberg and Werner, 1983), which means that the plant and its corresponding environment shape each other. The environment causes a reaction in the activity of the plant by changing its yield and growth, and the plant affects the environment by changing one or more of its factors (Clements, 1928; Goldberg and Werner, 1983). The environment affects the phenotypic and genotypic changes of plants, which can also prompt other organisms to modify their surroundings.



Complex interactions, including radiation exchange, water balance, and nutrients, occur both underground and above ground. When crops are intercropped with woody perennials, the interaction leads to a no. of results that can be positive, negative or neutral (a neutral interaction is only possible if the niches are very far from each other). Five types of interactions are mainly defined in the ecological literature (Schoener, 1988). The nature of interactions can be defined as the net effect of one element of a system on another. A key principle in determining the nature of interactions is that it depends on the ability of the various elements to capture and effectively use limited essential growth resources. The ability to capture limiting resources (i.e. light, water, nutrients) depends on how abundant, how widespread and how efficient individual elements are in the canopy/root system of the species/species combination in question. In an agroforestry system, components A and B help each other in creating a favorable growth environment, that is, they complement each other in their growth phase. In a complementary interaction, two components interact in such a way that the growth and performance of one component exceeds that of the other component without affecting the growth and performance of the other component. While in a competitive interaction, both components interact in such a way that one component leads to a decrease in the performance of the other component. Competition can be seen as mutual prevention (The actual performance of each species is less than expected), mutual cooperation (The performance of each species is higher than expected), and Environment Species A Species B Both the species has an effect on Simultaneous responses simultaneous responses compensation (one species gives less and the other more than expected). The main effects of positive interactions in agroforestry systems are increased productivity, improved soil fertility, nutrient cycling, soil conservation, water conservation, weed control and microclimate improvement. Also, the effects of negative interactions include competition for light, competition for nutrients, competition for water, pests and diseases, and allelopathy. However, these interactive processes are interdependent, and environmental conditions influence the manifestation of their effects. The relative

importance of each effect depends on both types of agroforestry systems and site factors.

POSITIVE EFFECTS OF AGROFORESTRY INTERACTION

- Increased productivity
- Improved soil fertility
- Nutrient cycling
- Soil conservation
- Water conservation
- Weed control
- Microclimate improvement

NEGATIVE EFFECTS OF AGROFORESTRY INTERACTION

- Competition for light
- Overall decrease in the yield
- Competition for nutrients
- Competition for water
- Microclimatic modification for pests/diseases
- Allelopathic interaction

CONCLUSION

The success of agroforestry depends heavily on exploiting the interactions between the components. In an optimal relationship, the production of trees and crops or grasses combined could be equivalent to their performance alone. However, agroforestry would be even more beneficial if the production of related components was increased due to the influence of trees. Trees can improve soil productivity in many ways, many trees are known to symbiotically fix nitrogen. However, there are also instances of crop inhibition associated with trees. These are common due to shade effect and competition for below-ground resources such as nutrients, water, etc. In some cases, inhibitory effects may be caused by allelochemicals released by certain tree species.

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