Multi-pest regulation for the compensation of the yield losses due to competition in bananas

A theoretical modelling approach to design sustainable management strategies

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OBJECTIVES

► To understand the interactions between pest regulation and the competition for the resources at the plant scale in multi-species cropping systems
► To test the interest of a theoretical modelling approach:
  ► To quantify the pest regulation service that multi-species cropping systems should provide to compensate for the competition
  ► To design sustainable pest management strategies

PESTS & ASSOCIATED PLANTS INTERACTIONS

Pests and associated plants both have negative impact on the biomass production, through the reduction of light or nitrogen crop potential uptake

Shading and leaf necrosis cause a decrease of intercepted light which in turn cause a decrease of biomass and thus a decrease of N demand. This can lead to a delay in nitrogen stress occurrence or a minor nitrogen stress, paradoxically reducing yield losses

COMBINATIONS OF LEAF AND ROOT PEST REGULATION LEVELS EXPECTED TO REACH A GIVEN YIELD LEVEL

RESULTS

► The most often, leaf and root pest regulations are negatively correlated ➔ possible trade-offs between ecosystem regulation services

In high fertility conditions (C, F and I) or in the case of the highest yield levels (in C, E, F and G), the two pest regulations can become positively correlated ➔ no possible trade-offs, poorly interesting strategies

In A (low mineralization rate, nitrogen competition and no growth reduction by shading), Yref is achievable only at a high cost and higher yield levels are impossible to reach ➔ association with ground plant very costly in terms of pest regulation

To reach a given yield level, the three cropping systems perform differently when considering the strategy of minimizing both pest regulations ➔ N fixing tree is the most efficient (smallest pest regulation levels), followed by Tree and ground plant

N fixing tree is the association the most sensitive to pest regulation levels (smallest pest regulation change to reach upper yield level)

CONCLUSIONS

Our theoretical modelling approach enables:

► To generate knowledge about the generic rules of interaction between associated plant and pest regulation
► To quantify the expected pest regulation service to reach a given yield level

Furthermore, it can help:

► To evaluate the regulation needs remaining at farmer’s expense, if the service is not entirely provided by the cropping system itself
► To determine the most appropriated strategy of multi-pest management reflecting the technical, economical or bio-physical constraints and the targeted yield level