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Biodiversity Interactions under Agroforestry Cropping System

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Abstract: In order to assess the effect of agroforestry of some field crops with citrus trees as an approach to establish biodiversity in fruit tree plantations three field crops i.e., maize, soybean and sunflower were inter-planted with seedless orange trees (4*4 m) or were planted as solid plantings. The results for the trees indicated a larger fruit yield when soybean and sunflowers were interplant with citrus. Statistically significant effects ($P<0.05$) were found for maize grain and biological yields, with increased yields when grown as solid planting. There were no differences in the yields of soya bean and sunflower where the yields were very similar between the two cropping systems. It could be concluded that agroforestry is an efficient concept to increase biodiversity through the interaction of trees with the interplant field crop species. Maize, unlike the other crops, was more sensitive to shade conditions under agroforestry practice and not preferred in biodiversity system.

Key words: Biodiversity · Faba bean · Prickly oil lettuce · Mungbean · Triticale

INTRODUCTION

Agroforestry (AF) means combining the management of trees with productive agricultural activities. The ultimate aim. of using agroforestry is achieving sustainability of production and resource use [1]. However, despite the demonstration that such systems can dramatically reduce soil losses and improve soil physical properties, the beneficial effects on crop yield are often unpredictable and insufficient to attract widespread adoption. In semiarid areas, crop yield increases are rare in alley cropping because fertility and microclimate improvements do not offset the large competitive effect of trees with crops for water and nutrients [2].

It is also assumed that agroforestry might be a practical way to mimic the structure and function of natural ecosystems, since components of the latter result from natural selection towards sustainability and the ability to adjust to perturbations [3]. Very few concern in evaluating field crops under agroforestry AF systems [4-7], Therefore, the aim of this work is to study the interactions among some field crops and citrus trees as an approach to establish biodiversity in through agroforestry system.

MATERIALS AND METHODS

Three field crops i.e., maize, soybean and sunflower were inter-planted with seedless orange trees(4*4 m) or were planted as solid planting. The yields of citrus fruit were assessed on each plot and the number of fruit per tree and fruit weight were recorded and production was determined. During the two crop cycles the crops were routinely inspected for diseases, pests and weed control. At crop maturity, the growth characteristics and yield components were assessed. The individual plant measurements included plant height and weight, number of branches per plant as well as number, weight of fruiting organs (pods, seeds). The conventional assessment practices were followed to provide mean individual plot performance as well as biological, straw and grain or seed yield fed^{-1}. The yields of interplant and solid planted crops were determined and statistically analysed with t test using MSTAT-C Computer Software [8].

RESULTS

Table 1 also provides an overall summary of the fruit production and this shows that the yields are relatively.

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Table 1: Yield of Citrus in Agroforestry system

Statistic	No of trees per plot	Mean fruit weight (g)	Mean No. of fruit per tree	Mean yield per tree (kg)	Yield (t/fd)
Mean	47	92	133.5	12.91	3.38
Minimum	12	50	54.8	4.93	1.29
Maximum	89	125	226.8	25.00	6.54

Table 2: Comparison of Crop Yields under Inter-Cropped and Sole crops Production

		Yield (t/fd)			
Crop	Yield parameter	Inter-cropped	Solid planting	Significance	Probability
Maize	Grain	0.998	1.764	*	0.0262
	Stover	6.709	10.415	ns	0.0557
	Total	7.687	12.180	*	0.0245
Soya bean	Grain	1.168	1.128	ns	0.8067
	Straw	4.439	3.991	ns	0.2266
	Total	5.600	5.119	ns	0.2849
Sunflower	Grain	1.146	1.128	ns	0.8755
	Straw	7.235	7.198	ns	0.9033
	Total	8.396	8.345	ns	0.919

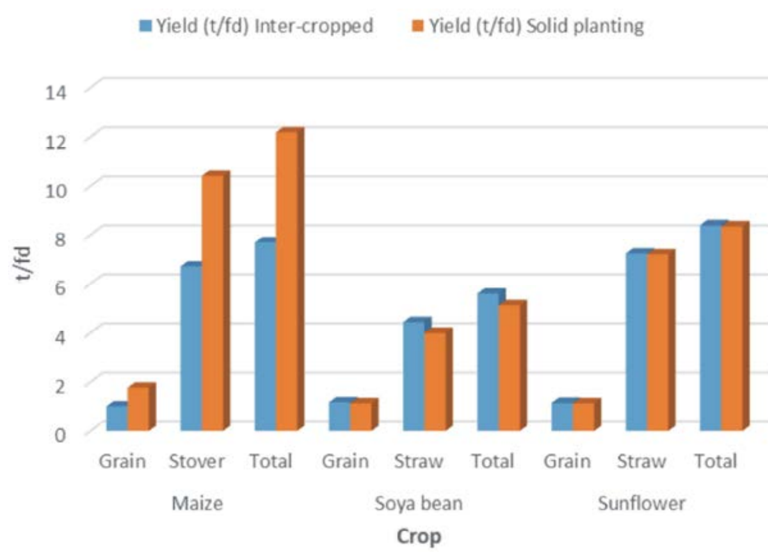

Fig. 1: Effect of Crop Yields under Agroforestry and Sole crops Cropping systems

Statistically significant effects (P<0.05) were found for maize grain and biological yields, with increased yields when grown in the sole crops (Table 2) and Fig. 1. Maize stover yields were also increased and this almost achieved significance (P = 0.056). There were no differences in the yields of soya bean and sunflower where the yields were very similar between the two areas. Maize, unlike the other crops, is a C4 plant and can utilize high light intensity more efficiently and is thus more sensitive to shade conditions when inter-cropped.

The potential of agroforestry to improve or increase biodiversity is efficient as the understorey crops are usually C4 species and the overstorey trees are invariably C3 species in agroforestry. Improvement in interplant species is most likely if the understorey crop is a C3 species, which are usually light saturated in the open and partial shade may have little effect on assimilation or by concurrent reduction in transpiration.

Zea mays, is sun-adapted plants; they are generally considered specialists for open environments and, as such, comparisons involving only sun-plants may not show the full range of acclimation that could be seen in a true generalist species. Also, there is substantial evidence that C4 plants have inherent constraints that prevent them from acclimating to environmental change as well as C3 species and this may have consequences for the range of life forms and landscapes where C4 photosynthesis can occur [9, 10]. Moreover microclimate adaptation is an advantage of AF where Planted in alignment or in hedges, the trees can influence the components of microclimate at different scales. Trees play on two essential elements: radiation and air flow. They contribute to decrease daily amplitude of air (2.5 to 8°C) [11] and of soil temperature (5°C) [12] and to play a role of windbreak. Wind may stimulate photosynthesis and increase yields in crop plants, while in different circumstances it retards growths or occasions physical damage. It seems therefore relevant to screen the crop genetic diversity under different situations of wind and temperature.

CONCLUSION

It could be concluded that agroforestry is an efficient concept to increase biodiversity through the interaction of trees with the interplant field crop species. Some field crops could be employed successfully like soybean or sunflowers while others like maize are sensitive to incorporate in agroforestry system.

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