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ECONOMIC ANALYSIS OF *AILANTHUS EXCELSA* BASED AGROFORESTRY SYSTEM

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Abstract– This experiment was carried out at farmer's field to evaluate the performance of different agricultural crops under *Ailanthus excelsa* (mahaneem) based agroforestry system (AFS) at a spacing of 3.6 × 2.1 m during *Rabi* season 2014-15. After 2 years of mahaneem plantation, yield of agricultural crops (potato, onion and wheat) were significantly reduced under mahaneem based AFS as compared to sole crop (devoid of tree). Among all the crops, the maximum yield was recorded in onion (18750 kg ha^{-1}) which was closely followed by potato (15000 kg ha^{-1}) under mahaneem based AFS during the year of experimentation. The highest per cent decrease in yield over control was recorded in potato (33.3%) and it followed the order: onion (21.05%) > wheat (15.0%). On the other hand, among all the crops grown under mahaneem based AFS, the maximum net return were found in wheat crop (Rs. 7525/ha), which was closely followed by onion with the net returns (Rs. 6515/ha) during the study period.

INTRODUCTION

Agroforestry is an important component of the 'evergreen revolution' movement in the country (Puri and Nair, 2004). In the light of combating the challenges of hunger, diseases, climate change and environmental degradation agroforestry, or woody perennial based intercropping systems, has proved itself as a key component of sustainable agriculture (Garrity, 2004).

Tree crop integration results into many types of interactions for solar radiations, soil moisture and plant nutrients, thereby changing microclimate, which affect the productivity of component crop. The large crown of trees produces a striking shade effect. Because of the plant height ratio of tree-crop intercropping is far greater than in pure crops, an entirely new pattern for light utilization is formed (Whiting, 2011). Agroforestry is one of the best options to increase the tree cover outside the forest. The need of agroforestry has been necessitated in many parts of the country, which face several agricultural and ecological problems, predominant of which are soil degradation, large scale deforestation, increasing population pressure of human beings and livestock, and decreasing land: man ratio. Agroforestry is a popular tool to modify the microclimatic under field conditions. Trees mainly modify radiations, relative humidity, carbon dioxide concentration, wind velocity and soil environment to crop (Dhillon *et al.,* 2016).

Ailanthus excelsa Roxb. commonly known as 'Ardu' or 'Mahaneem' is a fast growing tree and is extensively cultivated in many parts of India. Mahaneem plantation on community land, farm boundary, road avenues and in agroforestry system helped in maintaining the ecosystem by slowing down the variations in climatic parameters due to climate change. Foliage of mahaneem is used by small ruminants to meet the green fodder requirement during lean period and it is also sold in the market to earn some income to meet the farmer's expenditure to sustain their livelihood in harsh climate. It has been found to be a suitable species for planting in dry areas with annual rainfall of about 250 - 300 mm. It can grow on a variety of soils but thrives best on porous sandy loams. The tree can be seen growing upto an elevation of 900 metres (Orwa *et al.* 2009). Mahaneem is a large deciduous tree of upto 24 m height with a straight cylindrical bole. Bark is light grey and smooth in young trees with large leaf-scars, rough, granular and grayish brown

in older trees. Leaves are pinnately compound, upto 90 cm long with 8-14 pairs of leaflets. Flowers small, yellowish in panicles and fruits are single seeded samara (Kirtikar and Basu 1995). Due to its fast growing and deciduous nature, agricultural crops can be grown successfully underneath this tree. Different *Ailanthus excelsa* based AFS (Bund/ boundary, scattered trees in the existing farming systems) are practiced by the farmers in dry parts of north-west India. However, modern/improved *Ailanthus excelsa* based agroforestry systems are not popular among the farmers. Therefore, the present study was conducted to address this research gap, suitable agricultural crops intercropped with *Ailanthus excelsa* based AFS compared to sole crop in semi-arid ecosystem of Haryana.

MATERIALS AND METHODS

Experimental site

This study was, therefore, carried out on farmer's field to obtain base line data on agricultural crops under a particular spacing (3.6 × 2.1 m) of mahaneem based AFS. The on farm trail was conducted in Bhiwani district (Haryana) located between 28.19^0 and 29.05^0 north latitudes and 75.26^0 and 76.28^0 east longitudes. The district located in semi-arid climate with hot and dry winds in summer. The maximum temperature sometimes exceeds upto 50^0C in summer. The average annual rainfall is 300-400 mm. About 80-90 % of total rainfall are received from south-west monsoon in the month of July to September while remaining 10-20 % rainfall are received from north-east monsoon in the winter season. The soils are sandy loam in texture and low in available organic carbon (0.39 %), low in available phosphorus (6 kg ha^{-1}) and medium in available potash (121 kg ha^{-1}). Different crops were grown with mahaneem at a particular season to checkout their production and returns.

RESULTS AND DISCUSSION

Yield attribute of different agricultural crops under mahaneem based AFS

The data presented in Figure 1 showed that there was a significant reduction in the yield of crops (potato, onion and wheat) as intercrops in mahaneem based AFS as compared to control (without tree). The highest per cent decrease in yield over control (Figure 2) was recorded in potato (33.3%) which was followed by onion (21.05%) and then wheat (15.0%). Similar finding were also reported by Kumar and Nandal (2004) who evaluated the performance of five test crops viz. wheat, beseem, potato, mustard and lentil under 2.5 years old *Eucalyptus tereticornis* based AFS at a spacing 6 x 2 m. They studied that all the test crops sown in the interspaces of *Eucalyptus tereticornis* showed reduced plant vigour in terms of plant height, stem diameter, number of branches and yield attributes as compared to control (sole crop). Further, they found that the yield of lentil, berseem, wheat, potato and mustard under *Eucalyptus tereticornis* decreased to the tune of 16.3, 52.1, 62.3, 80.8 and 82.4 per cent, respectively. The yield of all the winter crops reduced significantly with the increase in age of *Eucalyptus tereticornis* plantation.

Net return (Profit) Rs./ha

On the other hand, among all the crops grown under mahaneem plantation, the maximum net

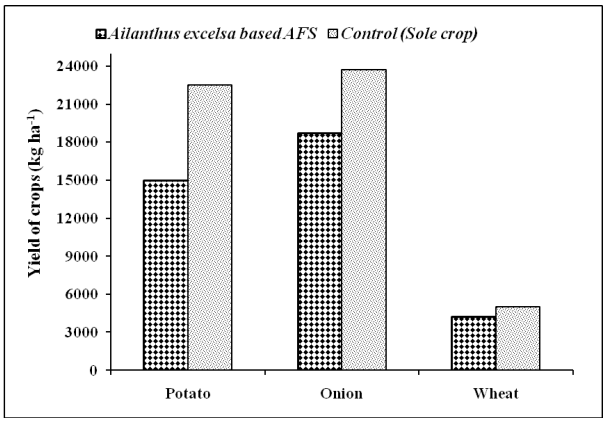

Fig. 1. Effect of *Ailanthus excelsa* based AFS on yield (kg ha^{-1}) of different agricultural crops

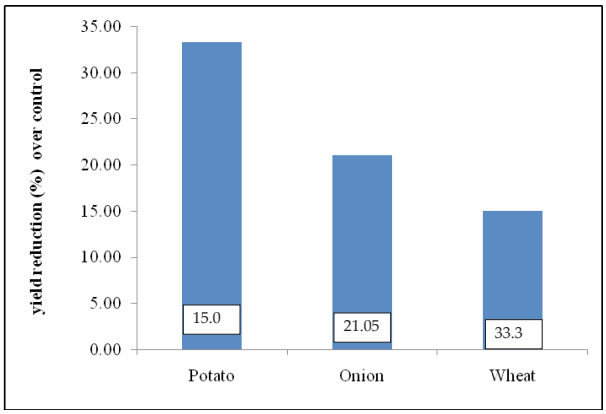

Fig. 2. Effect of *Ailanthus excelsa* based AFS on yield reduction (%) of different crops over control

Table 2. Effect of *Ailanthus excelsa* based AFS on Net Return (profit) in Rs./ha of different crops

Sr. No.	Crops	Net Return (Rs.) With tree	Net Return (Rs.) Without tree	BC Ratio With tree	BC Ratio Without tree
1	Potato	Rs.3993/ha	Rs.57588//ha	1.03	1.57
2	Onion	Rs.6515/ha	Rs.48710//ha	1.04	1.34
3	Wheat	Rs.7525/ha	Rs.25665//ha	1.1	1.38

return were found in wheat crop (Rs. 7525 /ha), which was closely followed by onion with the net returns (Rs. 6515 /ha) and potato (Rs. 3993/ha) during 2012-13 (Table 2).

The results revealed that wheat have maximum benefit cost ratio as compare to other crops under mahaneem based AFS. In sole crop, potato gave a higher net return followed by onion and wheat respectively which influence the benefit cost ratio at a greater extent. Similarly, Rajalingam *et al.* (2016) revealed that the growth and yield of intercrops reduced under intercropping when compared to sole cropping. Among the test crops, tomato was most affected and cluster beans was least affected. However, the benefit cost ratio from the crop was highest in brinjal (2.82) and the lowest with vegetable cowpea due to intercropping.

CONCLUSION

Based on the results, different agricultural crops grown in *Ailanthus excelsa* based AFS suggested that the reduction in potato production was maximum as compared to other agricultural crops. Moreover, the reduction in production of onion and wheat crop was minimum under *Ailanthus excelsa* based AFS. On the basis of the present study, it might be concluded that *Ailanthus excelsa* based AFS was found more suitable for the maximum production of onion and wheat crop in semi-arid region of Haryana.

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