HORTICULTURE BASED AGROFORESTRY SYSTEMS OF DOON VALLEY

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ABSTRACT

A survey was conducted during *rabi,* 1993-94 to study the fruit based agroforestry systems (AFS) existing on farmers' fields in Sahaspur-Vikasnagar blocks of Doon Valley. Based on age group, the AFS were classified into various categories. Among various fruit types, the mango based AFS was most popular (57.8%) followed by litchi (15.6%), guava (11.2%), kinnow (7.8%), peach (4.4%), lemon and olive (1.1%). Wheat was the main groundstorey crop among the fruit types. Mango with wheat was the dominant system prevailing in the area. In case of mango and litchi upto 14 years age with 48.6 per cent and 43.5 per cent canopy cover, the yield reduction of wheat crop was 42.5 per cent and 39.8 per cent, respectively and thereafter the reduction in yield was more than 50 per cent in both the cases. The yield reduction was less in case of guava, kinnow and peach even at fully grownup stage (15-21 years). Appreciable attention was also given by the farmers to incorporate some of the plant species as boundary plantations for their multiple uses.

INTRODUCTION

The Doon Valley is a parallelogram shaped and is bounded in north by lesser Himalaya and in south by Siwaliks, in north by river Yamuna and in south-east by river Ganga. Geographically, it lies between latitudes 29^0 55' and 38^030' N longitudes 77^0 35' and 78^020' E covering an area over 2002.9 sq km. Its elevation ranges from 315 to 2500m. The annual rainfall is 210 cm. The Sahaspur-Vikasnagar blocks in the Dehradun district of Uttar Pradesh are located in sub-humid foothill zone of Western Himalayan region. The major farming constraints are erratic rainfall, frost prone area and biotic interference, which necessitate the judicious selection of tree-crop species and their scientific management for improving the productivity.

Fruit trees are considered as an important component in agroforestry system (AFS) for their multi uses (Arora and Mohan, 1986 and Singh and Singh, 1990). Incorporation of fruit plants in AFS show better prospects not only in term of health and economy but also as an insurance against crop failure during drought years. It also generates better employment opportunities for landless labourers and small/marginal farmers. The present study was, therefore, undertaken to identify the most common system of the locality and to study the tree-crop interactions.

MATERIAL AND METHODS

A field survey was conducted in *rabi* 1993-94 to study the fruit based AFS existing on farmers' fields in Doon Valley. A total of 90 orchards of different fruit types were surveyed from 19 villages of Sahaspur-Vikasnagar blocks in Dehradun district representing most of the sites. Orchards were classified into various categories, based on their age groups and crop combinations. All the tree-crop combinations were studied properly and opinions of orchardists were also taken into consideration for seeking necessary informations. The observations on canopy cover and its shade effect were recorded in north-south and east-west directions from the tree trunk and average values were expressed in percentage. The yield reduction of groundstorey crop under different fruit types and age groups over pure crop was worked out on per unit area basis, grown under the same management practices. Care was taken about variety and plant spacement. The observations on plant species grown as boundary plantations were also recorded.

RESULTS AND DISCUSSION

Agroforestry Systems

Perusal of the data (Table-1) indicate that most of the agroforestry systems were mango based (57.8%) followed by litchi (15.6%), guava (12.2%), kinnow (7.8%), peach (4.4%), lemon and olive (1.1%). There were only two components in general, i.e. single fruit type with single ground storey crop but in some cases two or three fruit types were also observed. In mango based AFS, mango-wheat was the main combination (21.1%) followed by mango-berseem (11.5%), mango-litchi-wheat (9.6%), mango-guava-wheat and mango sugarcane/oat (5.8%). There were some other combinations like mango-mustard/barley (3.8%), mango-potato/ginger/*rabi* maize/groundnut/onion/lentil/methi (1.9%) with single fruit type; mango-kinnow-wheat (3.8%), mango-peach-wheat(1.9%) with double fruit type and mango-litchi-kinnow-wheat (1.9%) with triple fruit types showing a diversity of combinations.

In other fruit types also, wheat was the main component as groundstorey crop. With litchi, the common combinations were litchi-mango-wheat (21.4%) followed by litchi-kinnow-wheat (14.3%) with double fruit types and litchi-sugarcane/berseem (7.14%) with single fruit type while in case of guava, guava-sugarcane (18.2%) followed by guava-berseem/barley (9.1%) were observed. In guava based farming system, no double or triple fruit types were included in any combinations. In kinnow also, the main combination was kinnow-wheat (57.1%) followed by kinnow-berseem (14.3%) with single fruit type, kinnow-peach-wheat(14.3%) with double fruit type and kinnow-peach-papaya-onion (14.2%) with triple fruit type. The trend was similar with peach also. The lemon and olive based AFS were not much prominent.

Canopy Cover and Yield Reduction

The yield reduction pattern of ground crop with a specific variety of fruit and at a spacing under

Table 1. *Major Fruit based agroforestry stsyems*

AFS	Components			
	With single fruit type		With double/triple truit types	
Mango based	Mango-wheat	(21.1)	Mango-Litchi-Wheat	(9.6)
	Mango-Berseem	(11.5)	Mango-Guava-Wheat	(5.8)
	Mango-Oat	(5.8)	Mango-Kinnow-Wheat	(3.8)
	Mango-Sugarcane	(5.8)	Mango-Pomegranate-Wheat	(1.9)
	Mango-Barley	(3.8)	Mango-Peach-Wheat	(1.9)
	Mango-Mustard	(3.8)	Mango-Litchi-Kinnow-Wheat	(1.9)
	Mango-Potato	(1.9)	Mango-Litchi	(5.8)
	Mango-Onion/Garlic	(1.9)	Mango-Peach	(1.9)
	Mango-Lentil/Methi	(1.9)		
	Mango-Ginger	(1.9)		
	Mango-Maize	(1.9)		
	Mango Pure	(5.8)		
Litchi based	Litchi-Wheat	(28.6)	Litchi-Mango-Wheat	(21.4)
	Litchi-Sugarcane	(7.1)	Litchi-Kinnow-Wheat	(14.3)
	Litchi-Berseem	(7.1)		
	Litchi-Peach	(7.1)		
	Litchi-Pure	(14.3)		
Guava based	Guava-Wheat	(54.5)		
	Guava-Sugarcane	(18.2)		
	Guava-Berseem	(9.1)		
	Guava-Barley	(9.1)		
	Guava-Pure	(9.1)		
Kinnow based	Kinnow-Wheat	(57.1)	Kinnow-peach-Papaya-Onion)	(14.3)
	Kinnow-Berseem	(14.3)	Kinnow-Pear-Wheat	(14.3)
Peach based	Peach-Wheat	(75.0)	Peach-Papaya-Wheat	(25.0)
Lemon based			Lemon-Mango-Wheat	(100)
Olive based	Olive-Wheat	(100)		

Figures is parenthesis are percentage value

the same management practices were studied. The data (Table-2) indicate that·initially the shading effect and canopy cover of mango has more but at later stage the effect of litchi was advanced as compared to the mango. This was due to their differential growth habit. At the young age of tree(< 8 years), the yield reduction of wheat crop was not much prominent under both the fruit types. Prasad *et al.* (1983) have also observed that the effect of trees on the crop growth is lower in the initial years and it increases with the age but in general, trees decrease crop growth in their vicinity. At the middle age (8-14 years) under 48.6 per cent canopy cover in mango and 43.5 per cent in litchi, the yield reduction was 42.5 and 39.8 per cent, respectively. At fully grown up stage (15-21 years) with the canopy cover of 61.3 per cent in mango and 68.8 per cent in litchi the yield reduction was 52.8 and 56.5 per cent, respectively. Thereafter, the yield reduction of fruit crop was more drastic under both

Table 2. Canopy cover, shading effect and yield reduction pattern of wheat crop under different fruit types.

Fruit type	Variety	Spacing (m apart)	Canopy cover (%)				Shading effect (m)				Yield reduction(%)			
			<8	8-14	15-21	>21	<8	8-14	15-21	>21	<8	8-14	15-21	>21
Mango	Dashehari	10	5.30	48.6	61.3	80-100	0-2.0	3.3	4.3	5.0	10-18	42.5	52.5	72.0
Litchi	Calcuttia	10	5.25	43.5	68.8	85-100	0-1.5	3.6	4.6	5.0	10-16	39.8	56.5	83.5
Guava	Safeda	7	5-20	32.2	39.5	-	0-1.5	2.5	3.0	-	5-13	25.3	33.4	-
Mandarin	Kinnow	7	0-16	25.5	-	-	0-1.5	2.8	-	-	5-12	23.5	-	-
Peach	Flordasum	7	0-12	22.2	33.6	-	0-1.0	2.3	3.0	-	5-10	19.2	28.7	-
Lemon	Eureka Round	6	-	24.5	-	-	-	2.5	-	-	-	21.6	-	-
Olive	-	7	20.2	-	-	-	0-1.0	-	-	-	18.5	-	-	-

the fruit types. Reduction of wheat yield with increasing age of trees have also been reported
Dhillon *et al.* (1982) with *Acacia nilotica*, Dhillon *et al.* (1984) with *Dalbergia sissoo* and Saxena
al. (1990) in case of mango. Besides wheat, a large number of intercrops under mango were tried
Bhuva *et al.* (1989) and Rajput *et al.* (1989), where they observed good responce in terms of y
and economics without any adverse effect to the main crop. The yield reduction under litchi crop
more than those of mango because of their huge size tree with dense foliage.

At fully grownup age of guava and peach with canopy cover of 39.5 and 33.6 per cent the y
reduction of wheat crop was only 33.4 and 28.7 per cent, respectively. In case of middle age mand
orchard having 33.6 per cent canopy cover, the yield reduction was to the extent of 23.5 per cent o
The trend was almost similar with lemon and olive. Infact, yield reduction of any component
agroforestry system is not only due to shading effect of canopy cover but it is an interaction effe
the system where sharing of important resources like light, moisture, nutrient and space took pl
(Bremner, 1972,; Buck); 1986 and Jackson, 1986). Contrary to this, interactions between neighbo
ing plants need not always produce a competition for resources but may also involve in the actio
biologically active plant exudate (allelopathy), the transfer of microbially fixed nitrogen and proc
concerning other type of organisms such as rhizosphere saprophytes, parasitic micro-organis
nematodes and herbivorous insect-pests (Nair, 1990).

Boundary Plantations

Various plant species were also grown by the farmers as boundary plantations. The b
objectives of boundary plantations were to meet the fuelwood requirement of the family, protec
against biotic interference as well as boundary demarcation. Among the forest species *Eucalyp*
Toona ciliata, Dalbergia sissoo, Morus species, *Populus* species, *Albezia lebbek, Leuca*
leucocephala and *Bauhinia purpurea*; in shrubs/grasses *Carissa carandus, Agave americ*
Lantana camara and *Saccharum munja;* in fruit species *Sizygium cumini, Mangifera indica* (se
lings), *Psidium guajava, Prunus persica and Pyrus communis* were the common plant types use
boundary plantations. Although, the plantations were not systematic but farmer's own wisdom
involved, such as planting fruits towards the side of house building while thorny plant species tov
common road side and side of more biotic interference. Besides this, some farmers also m
trenches in close promixity of boundary plantations to avoid root interference and the same trenc
may be utilised as irrigation channel also.

From the foregoing study, it can be concluded that mango wheat was the common AFS of
locality. However, the area under kinnow fruit is also increasing in recent years. In case of ma
and litchi (10m apart), the economic yields can be obtained upto 14 years with proper managem
Whereas, guava, peach, mandarin etc. did not show much yield reduction even beyond this age li
indicating their better applicability as a fruit based agroforestry component under similar agroclim
condition. With increasing trend of horticulture based agroforestry systems it appears that such e
friendly systems may be an alternate for sustained productivity.

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