



Performance of Hedgerows of Elm (*Ulmus Wallichiana*) along with Potato-Garlic in an Agri-silviculture System for Sloping Lands of Kashmir

KN Qaisar, PA Khan, TA Rather and FA Shah Khan

Faculty of Forestry, SKUAST-K, camp Wadura-193 201(J&K)

ABSTRACT

In a long term trial on alley cropping on 30% rainfed hill slope, hedgerows intercropping systems comprising hedgerow of Elm (*Ulmus wallichiana*) planted at 1.0, 1.5 and 2.0 m and potato as *kharif* and garlic as *rabi* crop in alleys of 6x4 m was evaluated with respect to growth and bio-economic productivity. The trees in the alley were pruned at 3 m height to reduce the light competition. The dbh (Diameter at breast height) of pollarded trees in 2 m spacing in hedgerows was observed maximum 8.12 and 8.42 cm at the age of 15 and 16 years. The crop yield of potato and garlic was also recorded maximum, 49.50 and 29.84 q/ha respectively, in hedgerows of elm planted at 2 m spacing in first and second year of experiment. However, the yield obtained in control plots was significantly higher during both the years. The 1.0 m spacing resulted in the maximum reduction of crop yield. The reduction in Potato and garlic yield was 91 and 35 % and garlic 154 and 46%, during both years, respectively. The green fodder and fuelwood yield was recorded maximum from hedgerow of elm planted at 1.0 m spacing on the basis of acreage; 43.69 and 45.00 q/ha fodder and 12.35 and 16.30 q/ha fuelwood respectively in first and second year, whereas on the basis of yield per tree hedgerow of 2.0 m spacing resulted in maximum yield of green fodder (2.26 and 2.44 kg/tree) and fuelwood (1.42 and 1.04 kg/tree) in first and second year of experiment, respectively. The bio-economic productivity analysis revealed that 2.0 m spacing of trees in hedgerows fetched Rs. 80466 and Rs.64516 /ha/yr during first and second year, respectively with potato-garlic rotation.

Keywords:

Agrisilviculture system, elm, *Ulmus wallichiana*, hedgerow, potato-garlic rotation.

INTRODUCTION

Hedgerow intercropping is an important practice of Agrisilviculture system and fulfills the criteria of good agroforestry design for productivity, sustainability and adoptability. Hedgerow intercropping has several advantages. It is effective in controlling erosion and particularly suitable for sloping lands (Tewari 1995). In Kashmir nearly 30-40% of land is under *kandi*

area having slopes and these areas have low soil moisture as compared to other valley areas. To overcome the hazards of sloping lands, a trial of hedgerow intercropping was initiated at 30% of hill slope. The tree species chosen for hedgerow was Elm, one among the most preferred tree species by farmers of Kashmir besides willow and poplars. The over exploitation of this species for fodder and fuelwood have brought this species under the

category of endangered trees species (FAO 1986). The fodder is preferred by cattles, sheep and goats. Timber is suitable for light construction, packing case, furniture, handles for agriculture tools and bark for fibre used for making ropes and sandals (Gamble 1922; Pearson and Brown 1981 and Anon 1976). The use of Elm as hedgerow species is very judicious as leaf is used as fodder, twigs as firewood and timber for light construction etc.

MATERIALS AND METHODS

In a long term trial on alley cropping, an experiment was conducted during the year 2003 and 2004 at an experimental hedgerow plantation of Division of Forestry, SKUAST-K, Shalimar Srinagar (J&K) at an elevation of 1650 msl on 30% of hill slope. The mean annual temperature and rainfall is 13.3 and 662 mm respectively. The trial was initially laid during 1988 and number of crops have been rotated with the hedgerow and presently two year data of DBH, crop yield, fodder and fuelwood yield is reported. Three tree spacings (1.0, 1.5 and 2.0 m) of Elm (*Ulmus wallichiana*) in hedgerow were evaluated alongwith potato as *kharif* and garlic as *rabi* crop in alleys of 6x4 m with respect to growth and bio-economic productivity. The trees were pruned at 3.0 m height to reduce the light competition and loppings were taken as green fodder and fuelwood twice in a year in the month of June and October. The experiment was conducted in a Randomized Block Design with six replications along with control at Shalimar. Data was analyzed using R-software.

The bio-economic productivity of the system was also worked out. The input cost included were seed, fertilizer, mandays for soil working, maintenance and harvesting, whereas the output cost was calculated on yield of various components of the system *viz*: Garlic @ Rs 30/kg, Potato @ Rs 7/kg, Leaf fodder @ Rs 0.50/kg, and fuelwood @ Rs 0.90/kg (The land rental, establishment cost and discount factor have not been included).

RESULTS AND DISCUSSION

The data pertaining to yield of crops in hedgerows of Elm with potato and garlic is presented in Table 1. The growth of trees in terms of dbh (Diameter at breast height) did not vary significantly in the years 2003, however it varied significantly during 2004 between spacing of trees in hedgerows. The 2.0 m of tree spacing observed maximum dbh of 8.12 and 8.42 cm during 2003 and 2004, respectively (Tree age 15 and 16 years).

The crop yield of *kharif* and *rabi* varied significantly among the treatments during the period of two years. The crop yield of potato and garlic were recorded maximum with 2.0 m spacing of trees 49.50 and 29.84 q/ha, respectively in the year 2003 and similar trends were observed during 2004. However, the yields obtained in control plots of potato and garlic were significantly higher during both the years. The 1.0 m spacing (2500 trees/ha) of trees in hedgerows resulted in maximum reduction of crop yields. Potato (91 and 35%) and garlic (154 and 46%) recorded reduced yield as compared to control in both the years. Since there are no reports about allelopathic effects of Elm, therefore, the yield reduction is mainly attributed to the density. Several other studies also support the reduction in yield of agriculture crop in the presence of tree component (Khybri et al. 1988; Dagar et al. 1992; Verma et al. 2004 and Qaiser et al. 2005)

The yields of green fodder and fuelwood was recorded maximum with 1.0 m spacing on the basis of acreage: 43.69 and 45.0 q/ha green fodder and 12.35 and 16.3 q/ha fuelwood respectively in 2003 and 2004. In a similar study with *Proposis* sp. 2x2 m spacing gave maximum lopped biomass on acreage basis 64.70 q/ha as compared to 14.50q/ha at 4x4 m spacing (Singh et al. 1989), whereas on the basis of yield per tree 2.0m spacing resulted in maximum yield of green fodder (2.26 and 2.24 kg/tree) and fuelwood (1.42 and 1.04 kg/tree) in 2003 and 2004 respectively (Table 1)

Table 1: Yield of crops in Hedgerows of Elm (*Ulmus wallichiana*) with Potato-Garlic (Tree age 15 &16 years)

Treatment Spacing (m)	Mean DBH (cm)		Mean Crop yield q/ha				Green Fodder q/ha		Fuelwood q/ha.	
	2003	2004	Kharif-Potato 2003 2004		Rabi-Garlic 2003 2004		2003	2004	2003	2004
T ₁ (1.0 X 4)	7.24	7.51	31.67(91)	61.0(35)	16.8(35) 16.79(46)		43.69[1.74]	45.0[1.8]	12.35[0.49]	16.3[0.65]
T ₂ (1.5 X 4)	7.97	8.25	45.81(32)	64.08(28)	27.2(52) 17.62(39)		37.9[2.27]	38.5[2.31]	10.76[0.64]	14.7[0.88]
T ₃ (2.0 X 4)	8.12	8.42	49.5(22)	70.2(17)	29.84(39) 19.5(26)		28.37[2.26]	30.5[2.44]	7.81[1.42]	13.07[1.04]
Control (sole crop)	-	-	60.70	82.50	41.5	24.58	-	-	-	-
LSD	NS	0.39	4.05	4.02	2.73	1.89	4.15	4.57	1.98	NS
S.E.D	0.33	0.17	1.9	1.89	1.28	0.89	1.86	2.05	0.89	1.54

Values in (Paranthesis are) Per cent reduction in yield over control ; Values in [] Kg/tree

The bio-economic productivity of the system, calculated on the basis of input cost in terms of seed, fertilizers, land preparation, sowing, weeding, harvesting, lopping etc., for *kharif* and *rabi* was calculated to Rs. 45825/ha (estimated). Among the spacings tried in hedgerows, the 2.0 m spacing resulted in maximum estimated profit of Rs 80466/ha/yr and Rs. 64516/ha/yr during 2003 and 2004 respectively with potato and garlic rotation (Table 2). These exaggerated profits have been worked out without discount factor and land rental and tree establishment costs. Anon. (2001)

reported bio-economic productivity of *Populus deltoides* with wheat-paddy rotation of irrigated plantation (7 year) from upper Gangetic plain region, the expenditure cost was Rs. 82296/ha and benefit was Rs. 190241/ha resulting in 2.31 benefit cost ratio and from Western Himalayas, *Prunus persica* with rainfed maize and soyabean Rs. 57144/ha is the expenditure and Rs 12039/ha net benefit. So, the 2.0 m spacing of Elm in hedgerows (4.0 m apart) is recommended for sloping land for meeting the farmer's subsistence needs of food, fodder and fuelwood.

Table 2: Estimated income from Agrisilviculture system (Elm+Potato-Garlic)

Treatment (spacing in m)	Estimated income Rs./ha/yr		Estimated Profit Rs./ha/yr	
	2003	2004	2003	2004
1.0	75865	96787	30039	50961
1.5	116530	100964	70705	55139
2.0	126291	110341	80466	64516
Control (sole crop)	166990	131490	126990	85665

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