Production potential of agri-horticulture system in temperate Himalaya: an experimental trial in North-Kashmir, India

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ABSTRACT

The present study was conducted to analyze the production potential of Agri-horticulture system in a temperate region of Himalaya, *viz.*, district Kupwara of Northern-Kashmir, situated at 1650 m amsl. Plum (*Santa Rosa*), a Horticulture tree species, was under taken to test the influence of its shade on the performance of growth and yield parameters of pea (*Pisum sativum*) under different spacing's and directions from tree trunk. The results revealed that maximum yield and growth was observed under T_6 (open: sole cropping) which was at par with T_5 (2.5 m) and minimum was observed in T_1 (0.5 m) distance. The north direction from tree truck also resulted maximum production than south direction. The study concluded that the monetary return from Agri-horticulture system is higher than the sole cropping pattern.

Key words: Agri-horticulture, pea, plum, intercropping, productivity.

INTRODUCTION

Agroforestry systems are biologically more complex than other means of using land either through arable farming, fruit cultivation or forest farming. A common hypothesis is strongly implied to the agroforestry systems that integration of trees with annual crop increases the overall productivity of system. However, some studies have shown reduction in crop yield when grown with the tree plantation (1, 2). In temperate agroforestry systems, cereals, pulses and vegetable crops are intercropped with fruits, fodder, fuel wood yielding trees. The need of time is to identify and assess the productivity potential of the existing agroforestry system by diagnosing the constraints to alleviate the production level in short time period through necessary recommendations and their timely application. It has been generally observed that trees and crops both compete strongly for light and nutrients, where the shade of tree crown detrimentally influence the productivity potential of annual crops. Despite great efforts by the researchers through out the world to test the production potential of tree crop interaction, there still is no such information available for the temperate region. This study, therefore, is an effort to analyze the shade impact of plum (*Santa rosa*) on the growth and yield attributes of pea (*Pisum sativum*) in temperate Himalaya.

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MATERIALS AND METHODS

The present study was conducted in district Kupwara of North Kashmir lies between 33^0-22' and 37°-06'N and 72°-30' and 77°-33'E and situated at 1650m amsl. The experiment involved the intercropping of pea with plum tree laid under Randomized Block Design (RBD) replicated thrice with six treatments and in two directions. The orientations of plum trees were in rows down from east to west direction in 5 cm^2 pattern. The 4.90 x 4.90 m plot size was taken for the study with one tree per plot. The details of tree crown characteristics are given in Table 1. The pea crop was sown in alleys between the plum trees with different distances always from tree trunk, *viz.*, 0.5 m (T_1), 1.0 m (T_2), 1.5 m (T_3), 2.0 m (T_4), 2.5 m (T_5) along with open, *i.e.,* no tree (T_6). All those treatments were observed along the north (D_1) and south (D_2) directions of tree trunk. All the necessary agro-techniques were adopted for pea and plant management measures. The growth and yield parameters of pea in 1 m^2 sampling plot were used with 7.5 cm spacing between plants in 1 m row. Growth and yield attributes of pea, *viz.*, plant height, number of branches plant[-1], number of flowers plant[-1], leaf area, pod length, number of pods plant[-1], weight of pods plant[-1], number of grains pod[-1], thousand grain weights and productivity index were recorded. The cost benefit ratio was calculated on per hectare basis of cropping including cultivation cost and returns for one growing season.

RESULTS AND DISCUSSION

The results of growth performance in pea at different distances and directions from tree base are present in Table 2. The growth parameters, *viz.*, plant height, number of branches per plant and leaf area significantly varied at different distances and directions. The maximum plant height (60.10 cm), number of branches per plant (16.50) and leaf area (5.60 cm^2) was recorded under T_6 (open), closely followed by T_5 (2.5 m distance from tree base). The results of yield performance in pea at different distances and directions from tree base are present in Table 3. The yield parameters, *viz.*, number of pods per plant, weight of pods per plant and productivity index showed statistically significant difference among different treatment combinations. However, the pod length, number of grains per pod and thousand grain weights showed non-significant differences among different treatment combinations. The maximum number of pods per plant (16.24), weight of pods/plant (106.50 g) and productivity index (42.14) was obtained under T_6, followed by the maximum distance from tree base, *i.e.*, T_5. While as the minimum values were recorded at 0.5 m distance from tree trunk (T_1) for all the parameters. As far as the direction of plot was concerned, the growth and yield attributes were recorded higher in north direction (D_1) as compared to south direction (D_2). The present study shows that crop distance from tree base effects the growth and yield of inter crop significantly. Pea yield was lower near the trees and is increased with increasing the crop distance or decreasing the canopy spread. The reduction in yield near tree reflects higher level of competition between tree and crop for soil resources and light intensities. The present study has also been supported by earlier findings of many workers more closely by Sharma *et al.* (3), Dhillon *et al.* (4) and Umeshwar *et al.* (5).

The monetary value (Rs. ha^{-1}) of agri-horticulture system and sole crop (open condition) is presented in Table 4. The data revealed that T_5 gives maximum net return (Rs. 85,811.00 per ha/year), followed by T_4 (Rs. 79,955.00 per ha/year), T_3 (73,391.00 per ha/year), T_2 (64,211.00 per ha/year) and T_1 (56,830.00 per ha/year), respectively. While as, the minimum return was observed under T_4 (sole cropping: Rs, 48,182.00 per ha/year). The higher net return under agri-horticulture system was due to additional income from plum fruit under the system. These results are in line with the finding of Majumdar (6) and Kumar (7) who have reported higher return from agrihorticulture system over sole cropping pattern.

Table 1. Average growth attributes of plum in one growing season of agri-horticulture system in North Kashmir.

Months	Crown spread (m)				Height (m)	Diameter (cm)	Fruit yield/ tree (kg)	Age (year)
	North	*South*	*East*	*West*				
March 2003	1.50	1.53	1.49	1.53	4.54	40.98	-	10.0
July 2003	1.52	1.53	1.53	1.54	4.55	40.98	20	10.4

Table 2. Influence of tree crop combination at different distances (T) and directions (D) on pea growth parameters.

Distance	Plant height (cm)			Number of branches/plant			Number of flowers/plant			Leaf area (cm^2)		
	D_1	D_2	*Mean*	D_1	D_2	*Mean*	D_1	D_2	*Mean*	D_1	D_2	*Mean*
T_1 (0.5 m)	44.90	44.10	44.50	8.67	8.50	8.58	13.50	13001	13.25	3.21	3.06	3.13
T_2 (1.0 m)	45.10	44.40	44.75	9.30	8.80	9.05	13.80	13.50	13.65	3.45	3.32	3.38
T_3 (1.5 m)	45.59	44.86	45.22	11.00	10.17	10.58	14.90	14.20	14.55	3.60	3.50	3.55
T_4 (2.0 m)	54.03	52.10	53.06	12.10	11.09	11.59	15.30	14.90	15.10	4.06	3.90	3.98
T_5 (2.5 m)	59.50	59.10	59.30	15.40	15.32	15.36	18.60	18.01	18.30	5.50	5.48	5.49
T_6 (open)	60.10	60.10	60.10	16.50	16.50	16.50	19.75	19.75	19.75	5.60	5.60	5.60
Mean	51.47	50.76		11.99	11.76		15.97	15.56		4.17	4.07	
CD$_{0.05}$												
T		0.57			0.62			0.45			0.16	
D		0.33			0.29			0.26			0.13	
TxD		0.89			0.86			NS			0.15	

Abbreviations used: D_1: North direction; D_2: South direction

Table 3. Effect of tree crop interaction at different distances (T) and directions (D) on pea yield.

Tree crop distance	Yield Pod length (cm)			Number of pods /plant			Weight of pods/ plant (g)			Number of grains/pod			Grain weight (#1000)			Productivity index		
	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean
T_1 (0.5 m)	6.15	5.80	5.97	8.32	7.60	7.96	50.10	49.60	49.85	4.90	4.37	4.63	250.42	236.17	243.29	20.25	17.32	18.78
T_2 (1.0 m)	7.10	6.90	7.00	11.86	10.53	11.19	60.35	58.20	59.27	5.09	4.80	4.94	280.50	270.13	275.31	27.57	23.33	25.45
T_3 (1.5 m)	7.82	7.52	7.67	12.67	12.61	12.64	73.65	72.36	73.00	5.15	5.03	5.09	325.10	301.36	313.23	25.75	23.86	24.80
T_4 (2.0 m)	8.01	7.92	7.96	14.70	14.10	14.40	93.13	91.80	72.46	5.83	5.55	5.69	345.21	332.67	338.94	35.00	31.54	33.27
T_5 (2.5 m)	8.52	8.50	8.51	15.33	15.31	15.32	100.36	100.20	100.28	6.30	6.10	6.20	398.20	390.70	394.45	41.85	41.72	41.78
T_1 (open)	8.58	8.58	8.58	16.24	16.24	16.24	106.05	106.05	106.50	6.80	6.80	6.80	410.00	410.00	410.00	42.14	42.14	42.14
Mean	7.69	7.53		13.18	12.73		80.60	79.70		5.67	5.44		334.90	323.50		32.09	29.96	
$CD_{0.05}$																		
T	0.22			0.35			4.46			0.29			15.04			0.01		
D	0.15			0.25			0.43			NS			NS			0.42		
TxD	NS			1.06			7.10			NS			NS			1.06		

Abbreviations used: D_1: North direction; D_2: South direction

Table 4. Monetary value (Rs ha^{-1}) of agri-horticulture system and sole crop (open condition).

Components	Agriculture					Sole crop
	T_1	T_2	T_3	T_4	T_5	T_6
Pea(green pods)	36,072.00	43,452.00	52,632	59,196.00	65,052.00	77,112.00
Plum (fruits)	60,000.00	60,000.00	60,000.00	60,000.00	60,000.00	60,000.00
Total	96,072.00	1,03,452.00	1,12,632.00	1,19,196.00	1,25,052.00	77,112.00
Net returns						
Gross return (Rs. ha^{-1})	96,072.00	1,03,452.00	1,12,632.00	1,19,196.00	1,25,052.00	77,112.00
Cultivation costs (Rs. ha^{-1})	39,241.00	39,241.00	39,241.00	39,241.00	39,241.00	28,930.00
Net return (Rs. ha^{-1})	56,831.00	64,211.00	73,391.00	79,955.00	85,811.00	48,182.00

On the basis of present study, it is concluded that plum pea combination is economically profitable over sole cropping. However, a distance of 2.5 m from tree base should be adopted for inter cropping in agri-horticulture system. The overall approach will be helpful in socio-economic upliftment of the farmers in temperate Himalaya.

REFERENCES

1. Dagar, J.C., Singh, G. and Singh, N.T. 1995. Evaluation of crops in agroforestry with teak (*Tectona grandis*), Maharukh (*Dilanthus excelsa*) and tamarind (*Tamarindus indica*) on reclaimed salt affected soils. *J. Trop. For. Sci.* **7**: 623-24.

2. Singh, G., Singh, H., Dagar, J.C., Singh, N.T. and Sharma, V.P. 1997. Evaluation of agriculture, forestry and agroforestry practices in terms of productivity, sustainability and economics in moderately alkali soil. *Agrof. Sys.* **37**: 279-95.

3. Sharma, K.K., Khanna, P. and Gulati, A. 1996. The growth and yield of wheat and paddy as influenced by *Dalbergia sissoo* Roxb. Boundary plantation. *Indian Forester,* **122**: 1114-26.

4. Dhillon, G.P.S., Dhanda, R.S. and Dhillon, M.S. 1998. Performance of wheat under scattered trees of kikar (*Acacia nilotica*) under rainfed conditions in Punjab (India). *Indian Forester,* **124**: 48-53.

5. Umeshwar, S.S. Gupta, D.K. and Nangariya, M.N. 2004. Performance of C*eiba pentandra* under different planting density and their effect on productivity of wheat in agrisilvicultural system, in: *Symposium on Agroforestry in 21st Century*, Ludhiana, 2004, pp. 79-82.

6. Majumdar, H.K. 1991. *Biomass productivity and nutrient budgeting in different agroforestry system*, Ph.D. Thesis, UHF, Nauni-Solan (H.P.), 192 p.

7. Kumar, M. 1996. *Bio-economic appraisal of agroforestry land use system*. M.Sc. Thesis, UHF, Nauni-Solan, H.P., 162 p.