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Research Article

STUDY ON YIELD OF *KHARIF* VEGETABLE CROPS UNDER POPLAR BASED AGROFORESTRY SYSTEM IN SUBTROPICS OF JAMMU, JAMMU AND KASHMIR

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Abstract: Two years trial was conducted to study the performance of different vegetables under poplar based agroforestry system in subtropics of Jammu, Jammu and Kashmir at Agroforestry Research Farm, Chatha of Sher-e-Kashmir University of agricultural sciences and technology of Jammu. Trial was conducted under 5 year's old plantation of poplar, to find out the growth and yield of tomato, brinjal, okra in *kharif*. All the vegetables were grown in open as well as under shade of poplar trees with five treatments T_1: RDF of NPK, T_2: 50%N+50%N through FYM, T_3: 100% N through FYM, T4: 50%N+50%N through VC, T_5: 100% N through VC. Significant affect of shade and fertilizer treatments was recorded on the growth and yield of all the vegetables under poplar. The yields of all the crops were reduced under shade of poplar in comparison to open. Highest growth and yield were recorded in treatment T_1 (Recommended dose of NPK).

Keywords: *Poplar based Agroforestry system, Vegetables crops, Subtropical areas*

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Introduction

The term, agroforestry is internationally used as an umbrella term for all the multiple land use system. In particular, in India it includes the use of trees grown on farms, community forestry and a variety of local forest management and ethno-forestry practices [1]. This system characterized by the integration of the tree, crop and vegetable on the same area of land is a promising production system for maximizing yield and maintaining friendly environment [2]. Growing of crops in layer by layer is called multilayered/ multistoried cropping system and it is diffused in Indian states as well as in the world. It may be two; three or four layers which may be consist of forest tree, horticultural or agronomical crops, spices and medicinal plants in same land.

Agroforestry plays a key role in the Indian economy by way of tangible and intangible benefits. It can simultaneously satisfy three important objectives *viz*., protecting the ecosystems; producing a high-level output of economic goods; and increasing income and basic needs of rural population besides maintaining the resource base. In general, it helps in enhancing overall productivity in the rainfed areas and in the arid and semi-arid regions.

Populus ciliata which is a well-known agroforestry species is grown to a noticeable extent in plantation programmes in the North India. It is planted on boundary and in blocks near villages in mixture with other hardwood species and plantation. These plants are valuable for non-timber uses such as soil stabilizers, ornamental plantings, visual screens and windbreaks. Many cereals, pulses, medicinal plants and vegetables crops have been tried as intercrops under poplar all over the world, but the literature on growing of vegetables as intercrop with poplar is not available for subtropics of Jammu and Kashmir.

Present study was attempted to explore the possibilities of growing vegetable crops *viz*. Tomato, Brinjal, Okra as intercrop under poplar plantation with the following objectives to evaluate the effect of light intensity and integrated nutrient application on growth, physiology and yield of intercrop.

Material and methods

The present trial was carried out at Agroforestry Experimental Farm Chatha, Sher-e-Kashmir University of Agricultural Sciences & Technology (SKUAST) Jammu. It is located at an altitude of 325m above mean sea level, between 32°73' N latitude and 74°87' E longitude. The average rainfall of the experimental field was about 1000-1200 mm, of which 75-80% is received during July to September and rest 20- 25% during winter months in December to February. The maximum temperature remained upto 45°C during May to June and minimum falls to 1°C during December- January. The study consisted of two structural components *viz*. Poplar (*Populus deltoides*) tree as woody perennial and vegetable crops as intercrop in two seasons. In addition, effect of NPK, Farmyard Manure (FYM) and Vermi-compost (VC) was studied with and without Poplar trees. Two experiments with same treatments were laid separately (i) in open and (ii) under poplar plantation in 2017 and 2018 in Factorial Randomized Block Design (FRBD) design with different treatments *viz*. T1-Recommended dose of NPK/control; T2- 50% N+ 50%N through FYM + (Recommended P and K); T3- 100% N through FYM+ (Recommended P and K); T4- 50% N+ 50%N through VC+ (Recommended P and K); T5- 100%N through VC+ (Recommended P and K). Different growth and yield parameters of intercrops were recorded to get the growth of plants under open and shade of trees. Total numbers of fruits per plant were counted and the mean number of the fruits was reported. Average fruits weight in gram per plant was taken by weighing all the fruits on a plant, dividing that by the total number of fruits per plant. Total crop yield per hectare presented here was calculated by multiplying the average yield of single plants with total number of plants in one-hectare area. The yield per hectare was expressed in quintals per hectare.

Results and Discussion

Intercropping and integrated nutrient application showed significant variation in plant height, number of fruits per plant, average fruit weight and yield per hectare due to different doses of inorganic and fertilizer.

Table-1 *Effect of intercropping and integrated nutrient application on yield (q) per hectare of tomato*

	2017			2018		
Treatments	Sole	Intercrop	Mean	Sole	Intercrop	Mean
T_1- 100% NPK (RDF)	90.55	39.48	65.02	96.61	42.06	69.34
T_2- 50% N & 50% FYM	72.88	32.00	52.44	77.67	34.77	56.22
T_3- 100% FYM	63.40	28.59	46.00	66.36	29.97	48.17
T_4- 50% N & 50% VC	69.74	31.11	50.43	73.74	33.79	53.76
T_5- 100% VC	50.89	27.56	39.22	52.91	30.03	41.47
Mean	69.49	31.75		73.46	34.13	
	Intercrop	Fertilizer	I x F	Intercrop	Fertilizer	I x F
SEm±	0.71	1.13	1.60	0.77	1.21	1.72
CD (5%)	2.13	3.36	4.76	2.28	3.61	5.11

Table-2 *Effect of intercropping and integrated nutrient application on yield (q) per hectare of brinjal*

	2017			2018		
Treatments	Sole	Intercrop	Mean	Sole	Intercrop	Mean
T_1- 100% NPK (RDF)	108.36	40.86	74.61	121.22	49.66	85.44
T_2- 50% N & 50% FYM	94.28	34.61	64.45	105.67	41.15	73.41
T_3- 100% FYM	81.46	26.92	54.19	90.25	33.73	61.99
T_4- 50% N & 50% VC	92.33	31.13	61.73	104.30	38.26	71.28
T_5- 100% VC	64.65	25.96	45.31	73.59	32.24	52.91
Mean	88.22	31.90		99.01	39.01	
	Intercrop	Fertilizer	I x F	Intercrop	Fertilizer	I x F
SEm±	1.17	1.85	2.61	1.06	1.68	2.38
CD (5%)	3.47	5.49	7.77	3.16	5.00	7.07

Table-3 *Effect of intercropping and integrated nutrient application on yield (q) per hectare of okra*

	2017			2018		
Treatments	Sole	Intercrop	Mean	Sole	Intercrop	Mean
T_1- 100% NPK (RDF)	36.62	18.97	27.79	39.10	20.12	29.61
T_2- 50% N & 50% FYM	34.05	16.06	25.06	34.93	17.44	26.19
T_3- 100% FYM	27.63	13.75	20.69	29.55	15.01	22.28
T_4- 50% N & 50% VC	31.44	14.95	23.20	33.66	16.26	24.96
T_5- 100% VC	23.65	13.15	18.40	25.33	14.32	19.83
Mean	30.68	15.38		32.51	16.63	
	Intercrop	Fertilizer	I x F	Intercrop	Fertilizer	I x F
SEm±	0.33	0.53	0.75	0.35	0.55	0.78
CD (5%)	1.01	1.59	2.25	1.04	1.64	2.33

Effect of intercropping and integrated nutrient application on growth and yield parameters is described below:

total crop yield per hectare was calculated by multiplying the average yield of single plants with total number of plants and represented in quintal per hectare.

A perusal of the data in [Table-1], indicate that per hectare yield of tomato in all the 5 treatments differed significantly in both the years under sole crop and intercrop. When tomato was grown in open condition, T1 showed the maximum yield (90.55 q) followed by T2 (72.88 q) and T4 (69.74 q) in *kharif* 2017. Also, in *kharif* 2018 T1 (96.61 q) recorded the maximum yield, followed by T2 (77.67 q) and T4 (73.74 q). The lowest yield was recorded in T5 (50.89 q and 52.91 q) for the year 2017 and 2018 respectively under sole crop. Under the shade the maximum yield was attained in treatment T1 (39.48 q) followed by T2 (32.00 q) and T4 (31.11 q) in 2017. In year 2018, maximum yield was also recorded in treatment combination T1 (42.06 q) followed by T2 (34.77 q) and T4 (33.79 q). T5 showed the minimum yield of 27.56q and 30.03q in 2017 and 2018 respectively.

As for data presented in [Table-2], per hectare yield of brinjal differed significantly in all the 5 treatments in both the years under sole crop. In T1 the maximum yield was recorded (108.36 q) followed by T2 (94.28 q) and T4 (92.33 q) in 2017. In 2018, T1 (121.22 q) recorded the highest yield, followed by T2 (105.67 q) and T4 (104.30 q). The lowest yield was recorded in T5 (64.65 q and 73.59 q) for 2017 and 2018 respectively. However, the yield varied significantly and maximum yield was attained in T1 (40.86 q) followed by T2 (34.61 q) and T4 (31.13 q) in. In 2018, maximum yield was also recorded in treatment combination T1 (49.66 q) followed by T2 (41.15 q) and T4 (38.26 q). T5 treatment with minimum yield of 25.96 q and 32.24 q in 2017 and 2018 respectively was lowest under the tree canopy.

Per hectare yield of okra significantly differed in different nutrients in both the years under sole crop [Table-3]. Treatment T1 showed the maximum yield (36.62 q) which was followed by T2 (34.05 q) and T4 (31.44 q) in *kharif* 2017. Whereas in *kharif* 2018 T1 (39.10 q) recorded the maximum yield again, followed by T2 (34.93 q) and T4 (33.66 q). The yield was recorded lowest in T5 (23.65 q and 25.33 q) for 2017 and 2018 respectively. The yield varied significantly and maximum yield was attained in T1 (18.97 q) followed by T2 (16.06 q) and T4 (14.95 q) in 2017. In 2018, maximum yield was also recorded in treatment combination T1 (20.12 q) followed by T2 (17.44 q) and T4 (16.26 q). T5 showed the minimum yield of 13.15 q and 14.32 q in 2017 and 2018 respectively under the tree canopy.

Per hectare yield significantly reduced when tomato, brinjal, okra were grown under the tree canopy. It may be due to less availability of photo active radiation (PAR) under the tree shade. Photo active radiation is required for photosynthesis in plants which generates energy in form of glucose. Around 56% reduction in tomato, 62% reduction in brinjal and 48% reduction in okra was recorded in *kharif* 2017. In 2018, the yield reduction in tomato was around 56%, in brinjal 55% and in okra was 55%. Increase in yield, in second year may be due to soil work and availability of more nutrients provided during trial, as the soil operations were not carried out after the plantation.

Similar reduction in yield of intercrops under trees in comparison to sole cropping was observed by Makinde *et al.* (2016) [3], Ravi *et al.* (2009) [4] under Ailanthus excels based agro forestry system and by Rishi *et al.*, (2011) [5] under *Populus deltoids* and *Melia composita* based agro forestry systems. Naik (1994) [6], Balle Gowda (2000) [7], Miah (2000) [8], Jagadeesh (2002) [9], Mallikarjunaiah (2009) [10] and Rajalingam *et al.* (2016) [11] also reported reduction in yield under tree shade. Adeleye *et al.* (2010) [12]; Adeoye and Agboola (1985) [13] and Ogunwale (2003) [14] reported that the more readily nutrients are available to a crop; the growth performance of the crop will be higher.

Conclusion: The vegetables can be growing easily under the shade of poplar; thus, their yield reduces due to less availability of photo active radiation (PAR). Among kharif vegetables brinjal can be a good crop to be planted under the tree canopy.

Application of research: The findings of the research can be applied on the fields under tree plantation. Presently farmers grow wheat in rabi only. But in kharif, growing of vegetables under plantation can help farmers to increase their income.

Research Category: Agroforestry

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