

Original Research Article

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A Study on Performance of *Lycopersicon esculentum* under Poplar Based Agroforestry System in Subtropics of Jammu (J&K)

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ABSTRACT

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A two years trial was conducted to study the performance of *Lycopersicon esculentum* under poplar based agroforestry system in subtropics of Jammu (J&K) 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 (*Lycopersicon esculentum*). Tomato was grown in open as well as under shade of poplar trees with five treatments T₁: RDF of NPK, T₂: 50%N+50%N through FYM, T₃: 100% N through FYM, T₄: 50%N+50%N through VC, T₅: 100% N through VC. Significant affect of shade and fertilizer treatments was recorded on the growth and yield of Tomato under poplar. The tomato yield was reduced under shade of poplar in comparison to open. Highest growth and yield was recorded in treatment T₁ (Recommended dose of NPK).

Introduction

Agroforestry plays a key role in the Indian economy by way of tangible and intangible benefits. Agroforestry 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 increasing overall productivity in the rainfed areas and in the arid and semi-arid regions in particular. Changing priorities in avenues like optimization of farm productivity, carbon sequestration, green energy and employment

generation are now being focused through agroforestry. Among indigenous species, only *Populus ciliata* is grown to a noticeable extent in plantation programmes in the Himalayan region of North India by State Forest Departments (SFD) near villages in mixture with other hardwood species and plantation around orchards. Poplars are valuable for non-timber uses such as ornamental plantings, windbreaks, visual screens, and soil stabilizers. Many cereals viz. wheat, 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. Tomato (*Lycopersicon esculentum* L.) is a well known and very popular vegetable grown successfully throughout the India. This vegetable contains 1.98g protein, 320 IU vitamin-A, 1.8 mg iron and 31 mg vitamin-C in 100 g edible tomato (Bose and Som, 1986) and is popular for its nutritional value and diversified use like salad, juice, sauce etc.

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

Materials and Methods

The present study was carried out at experimental farm Chatha, Division of Agroforestry, 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 location was about 1000-1200 mm, of which 75-80 per cent is received during July to September and rest 20- 25 per cent 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 tomato crop as intercrops 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 out separately (i) in open and (ii) under poplar plantation in 2017 and 2018. The trial was laid in Factorial Randomized Block Design (FRBD) design with following treatments:

Recommended dose of NPK/ control	T₁
50% N+ 50%N through FYM + (Recommended P and K)	T₂
100% N through FYM+ (Recommended P and K)	T₃
50% N+ 50%N through VC+ (Recommended P and K)	T₄
100%N through VC+ (Recommended P and K)	T₅

Plant height of intercrops were recorded from base to tip of the main leading shoot using meter scale and reported as mean in centimeters. Total numbers of fruits per plant were counted and the mean number of the fruits was reported. 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 was calculated by multiplying the average yield of single plants with total number of plants in one hectare area. The yield was expressed in quintals per

hectare. Bio economics of the system was estimated by calculating the cost of cultivation, gross and net returns per hectare. All these parameters were calculated on the basis of prevailing market price of inputs and output (produce) at the time of termination of the experiment.

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.

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

Plant height (cm)

The plant height of intercrop was governed by different treatments compared. Data presented in table 1 indicated that the plant height of tomato was significantly differed in all the five treatments in both the years under sole crop. Amongst the nutrient combinations, T₁ showed the maximum plant height (63.02 cm) followed by T₂ (61.90 cm) and T₄ (61.62 cm) in kharif 2017. Whereas in 2018 again T₁ (65.14 cm) recorded the maximum plant height, followed by T₂ (64.02 cm) and T₄ (63.74 cm).

The lowest plant height was recorded in T₅ (58.63 cm and 60.74 cm) for 2017 and 2018 respectively. However, under the tree canopy the plant height varied significantly and maximum plant height was attained in T₁ (61.30 cm) followed by T₂ (60.66 cm) and T₄ (60.41 cm) in 2017. In year 2018, in treatment combination T₁ (63.23 cm) recorded maximum plant height followed by T₂ (62.59 cm) and T₄ (62.34 cm). T₅ observed the minimum height of 59.72 cm and 59.77 cm in 2017 and 2018 respectively.

The values were significantly reduced when tomato was grown in the shade of poplar trees. Significant difference was recorded in interaction effect of intercrop and fertilizer application in year 2017 & 2018.

The result shows the importance of nitrogen for the proper growth of the plant, which is in agreement with the publication of Tisdale *et al.*, (2003). The finding in the experiment is also corroborated with the results of Makinde *et al.*, (2016) which obtained that application of RDF of NPK attains the maximum height in growth. This kind of reduction in height in

agricultural crops was already recorded under *Simarouba glauca* by Mohanraj (2004) and in sorghum under *Ailanthus excelsa* based agro forestry system by Divya *et al.*, (2005).

Number of fruits per plant

Table 2, revealed that the number of fruits per plant of tomato differed significantly due to fertilizer treatments in both the years under sole crop. Control was significantly superior over all the treatments. Amongst the nutrient combinations, T₁ showed the maximum number of fruits (9.53) followed by T₂ (8.60) and T₄ (8.54) in 2017. Also in 2018 again T₁ (9.73) recorded the maximum number of fruits, followed by T₂ (8.78) and T₄ (8.63).

The lowest number of fruits were recorded in T₅ (6.69 and 6.83) for the year 2017 and 2018 respectively. Under the tree canopy the number of fruits varied significantly and maximum number of fruits were attained in T₁ (5.73) followed by T₂ (5.18) and T₄ (5.11) in 2017.

In year 2018, maximum number of fruits were also recorded in treatment combination T₁ (5.85) followed by T₂ (5.39) and T₄ (5.33). T₅ showed the minimum number of fruits of 4.76 and 4.97 in 2017 and 2018 respectively. Shade significantly affected the number of fruits in tomato.

Intercrop and fertilizer application made significant affect on number of fruits per plant in 2017 & 2018. The lower number of fruits per plant under shaded condition was probably due to poor photosynthetic capacity of plants.

Treatments affected the fruit set in plants, as nitrogen promotes the fruit set. Similar results of NPK dose was reported by Nnabude *et al.*, (2015) also.

Table.1 Effect of intercropping and integrated nutrient application on plant height (cm) of tomato

Treatments	2017			2018		
	Sole	Intercrop	Mean	Sole	Intercrop	Mean
T₁- 100% NPK (RDF)	63.02	61.30	62.16	65.14	63.23	64.18
T₂- 50% N & 50% FYM	61.90	60.66	61.28	64.02	62.59	63.30
T₃- 100% FYM	59.38	58.42	58.90	61.50	60.35	60.92
T₄- 50% N & 50% VC	61.62	60.41	61.01	63.74	62.34	63.04
T₅- 100% VC	58.63	57.84	58.23	60.74	59.77	60.26
Mean	60.91	59.72		63.03	61.65	
	Intercrop	Fertilizer	I x F	Intercrop	Fertilizer	I x F
SEm±	0.06	0.10	0.14	0.06	0.10	0.14
CD (5%)	0.19	0.30	0.42	0.19	0.30	0.42

Table.2 Effect of intercropping and integrated nutrient application on number of fruits per plant of tomato

Treatments	2017			2018		
	Sole	Intercrop	Mean	Sole	Intercrop	Mean
T₁- 100% NPK (RDF)	9.53	5.73	7.63	9.73	5.85	7.79
T₂- 50% N & 50% FYM	8.60	5.18	6.89	8.78	5.39	7.08
T₃- 100% FYM	7.78	4.86	6.32	7.82	4.88	6.35
T₄- 50% N & 50% VC	8.54	5.11	6.83	8.63	5.33	6.98
T₅- 100% VC	6.69	4.76	5.72	6.83	4.97	5.90
Mean	8.23	5.13		8.36	5.28	
	Intercrop	Fertilizer	I x F	Intercrop	Fertilizer	I x F
SEm±	0.09	0.15	0.22	0.09	0.15	0.21
CD (5%)	0.29	0.46	0.65	0.28	0.45	0.64

Table.3 Effect of intercropping and integrated nutrient application on average fruit weight (g) of tomato

Treatments	2017			2018		
	Sole	Intercrop	Mean	Sole	Intercrop	Mean
T₁- 100% NPK (RDF)	25.67	18.59	22.13	26.80	19.41	23.11
T₂- 50% N & 50% FYM	22.88	16.66	19.77	23.90	17.39	20.64
T₃- 100% FYM	21.99	15.89	18.94	22.93	16.60	19.76
T₄- 50% N & 50% VC	22.06	16.43	19.24	23.07	17.16	20.11
T₅- 100% VC	20.55	15.59	18.07	20.93	16.28	18.60
Mean	22.63	16.63		23.53	17.37	
	Intercrop	Fertilizer	I x F	Intercrop	Fertilizer	I x F
SEm±	0.10	0.15	0.22	0.11	0.17	0.24
CD (5%)	0.30	0.47	0.67	0.32	0.51	0.73

Table.4 Effect of intercropping and integrated nutrient application on yield (q) per plant of tomato

Treatments	2017			2018		
	Sole	Intercrop	Mean	Sole	Intercrop	Mean
T₁- 100% NPK (RDF)	90.55	39.48	65.02	96.61	42.06	69.34
T₂- 50% N & 50% FYM	72.88	32.00	52.44	77.67	34.77	56.22
T₃- 100% FYM	63.40	28.59	46.00	66.36	29.97	48.17
T₄- 50% N & 50% VC	69.74	31.11	50.43	73.74	33.79	53.76
T₅- 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

Average fruit weight (g) per plant

The average fruit weight per plant of tomato significantly differed in both the years under sole crop in response to fertilizer (Table 3). When tomato was grown in open condition T₁ showed the maximum average fruit weight (25.67 g) followed by T₂ (22.88 g) and T₄ (22.06 g) in kharif 2017. In kharif 2018 again T₁ (26.80 g) recorded the maximum average fruit weight, followed by T₂ (23.90 g) and T₄ (23.07 g). The lowest average fruit weight was recorded in T₅ (20.55 g and 20.93 g) for the year 2017 and 2018 respectively. The average fruit weight varied significantly under the shade and maximum average fruit weight was recorded in T₁ (18.59 g) followed by T₂ (16.66 g) and T₄ (16.43 g) in 2017. In year 2018, maximum average fruit weight was also recorded in treatment combination T₁ (19.41 g) followed by T₂ (17.39 g) and T₄ (17.16 g). T₅ showed the minimum average fruit weight of 15.59 g and 16.28 g in 2017 and 2018 respectively under the tree canopy. The average fruit weight was significantly reduced when compared across the systems i.e. sole and under shade in both the years. Significant difference was recorded in interaction effect of intercrop and fertilizer application in year 2017 & 2018. The reduction in fruit weight may be due to lower photosynthetic rate. Similar results were also reported by Miah (2000).

Yield (q) per hectare

A perusal of the data in table 4 indicated that per hectare yield of tomato in all the five 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 27.56 q and 30.03 q in 2017 and 2018 respectively. Per hectare yield significantly reduced when tomato was grown under the tree canopy. The interaction effect of intercrop and fertilizer application was significant in year 2017 & 2018. Adeleye *et al.*, (2010); Adeoye and Agboola (1985) and Ogunwale (2003) reported that the more readily nutrients are available to a crop, the higher the performance of the crop and *vice versa*. Similar reduction in yield of intercrops under trees than sole cropping was observed by Makinde *et al.*, (2016), Ravi *et al.*, (2009) under *Ailanthus excelsa* based agro forestry system and by Rishi *et al.*, (2011) under *Populus deltoids* and *Melia composita* based agro forestry systems.

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