



## **Cultivation of Green Peas Under an Age Series of Poplar (*Populus deltoides* Bartr.) Plantations**

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### **ABSTRACT**

Green pea (*Pisum sativum*) was grown under an age series of poplar (*Populus deltoides*) plantations (clone WSL 39) and the results for intercrop yield and growth attributes, as affected by the presence of trees on the fields, are presented. The age of poplar plantations was 33 months, 45 months, 57 months, 69 months, and 81 months when pea seed was sown and of 35.5 months, 47.5 months, 59.5 months, 71.5 months, and 83.5 months when the experiment was terminated on plucking the green peas. The data recorded for yield and plant attributes grown under poplar trees were also compared with that grown in open conditions and these indicate that the yield of green peas and plant attributes had significant affect when grown under poplar plantations of different ages. There was significantly higher yield of green peas under open and young plantations compared to that in old plantations. There was gradual decrease in pea yield with increase in age and size of trees. The economical analysis indicates positive returns when grown under poplar plantations up to seven years age. Pea being a short duration and nitrogen fixing leguminous crop is economically viable for growing in poplar based agroforestry.

### **Key words:**

Economical analysis, intercrop, pea, poplar based agroforestry,.

### **INTRODUCTION**

Poplar (*Populus deltoides* Bartr.) plantations, in some parts of northern states, have been made for the last four decades and now the tree is also promoted under diversification plan to divert farm land from harmful paddy culture. Cultivation of paddy with poplars affects tree survival, growth and productivity and its cultivation is thus avoided in poplar based agroforestry. Most other winter crops cultivated in the poplar growing region can be successfully integrated with its plantations as the affect of trees on crop growth and productivity is less during winters. Sugarcane is the main intercrop grown in the initial two years and

wheat thereafter till poplar trees are harvested. Agronomical inputs like irrigation, fertilizers and soil working provided to intercrops, are also available to poplar as a result trees grow much better in agroforestry than those planted in pure plantations without integration of crops. In India, major share of poplar is grown on farm land and it therefore has more affinity towards farm land cultivation than that with forestry.

Green pea production is one of the main winter crop grown in Tarai Region of Uttar Pradesh and Uttarakhand. Seed sowing for green pea production is done during the month of October/November and it is harvested during

February/March. Many farmers avoid making fresh poplar plantations in pea grown fields as the intercrop does not favour heavy irrigation during its production and this sometimes adversely affects poplar establishment. Once poplar is established, many farmers routinely grow peas inside its plantations 2<sup>nd</sup> year onward. However, there is hardly any information available on the pea-tree integration in poplar based agroforestry. The present experiment was, therefore, an attempt to evaluate the performance of green pea (*Pisum sativum*) cultivation under poplar plantations of different ages varying from 3 years to 7 years. The paper also provides economical analysis of growing green peas with poplar plantations.

## MATERIALS AND METHODS

Green pea as intercrop was grown under poplar plantations of clone WSL 39 which were established each year during 2004 (T1), 2005 (T2), 2006 (T3), 2007 (T4), and 2008 (T5) at a spacing of 5m X 5m. The experiment was laid out in a randomized block design having six treatments (age of plantations including open field) and four replications. The study was conducted at R & D Centre of Wimco Limited (Wimco Seedlings Division) situated at 28°N latitude, 78°E longitude and at an altitude of 200 above mean sea level. The centre is located in the Tarai Region, Kichha Tehsil of District Udham Singh Nagar, Uttarakhand. This location is known for pea cultivation on a large scale. The soil of experimental site is clay loam. It is rich in organic carbon (1.21%) and medium in available nutrients (17.8 kg ha<sup>-1</sup> P, 242.5 kg ha<sup>-1</sup> K) with a pH of 7.8.

Pea seed (variety- AP 3) @ 125 kg ha<sup>-1</sup> was sown 15 cm apart in 4 to 5 cm deep furrows made with the help of seed drill on 21.10.2010 under a series of poplar plantations (established on the same field during February each year) when trees were 33 months, 45 months, 57 months, 69 months, and 81 months old respectively. This experiment was terminated on 5<sup>th</sup> January 2011 when trees completed 35.5 months, 47.5 months, 59.5 months, 71.5 months, and 83.5 month's age respectively. Pea seed was also sown under open field condition for comparing its yield and other attributes with those grown under poplar

plantations. Fertilizers @ 120 kg N ha<sup>-1</sup>, 60 kg P ha<sup>-1</sup> and 40 kg K ha<sup>-1</sup> were applied through urea, granular single super phosphate and murate of potash, respectively. Pre-emergent herbicide-Pendimethalene 30% EC @ 2.5litre ha<sup>-1</sup> was applied within 24 hours of seed sowing to check the weed population. Green pea yield and plant attributes were recorded during the course of investigation. Height and girth at breast height (GBH) of poplar trees were measured at the time of sowing & harvesting of pea crop. The data obtained during the course of this investigation were analyzed, standard error of means (S. Em.±) was computed and the critical difference (C.D.) at 5 percent probability level was calculated for comparing the treatment means.

## RESULTS AND DISCUSSIONS

### Tree growth

Mean values for tree height, GBH and their increments between the start and termination of experiment are given in Table-1. Trees of older plantations (83.5 months age) were significantly taller in height and thicker in girth when compared to trees of young plantations (below 5 years age). Trees of immediate next age plantation, in a few cases, did not differ significantly in these growth traits. For example, tree height and GBH for both dates i.e., at the start and termination of intercropping trial did not differ significantly between 83.5 months and 71.5 months old plantations. In case of height increments, there were two separate groups within which there were non-significant differences for height growth. The first group for such non-significant differences was of 83.5 months, 71.5 months and 59.5 months and second group was of 47.5 months and 35.5 months old plantations. In case of GBH increment, there were three such groups. For example, trees of 83.5 months and 71.5 months formed first group, trees of 71.5 months, 59.5 months and 47.5 months formed second group, and trees of 59.5 months, 47.5 months and 35.5 months formed third group showing non-significant differences within each group. Tree growth, in clonal plantations like poplars, is a function of age and management interventions and therefore old age trees were having higher mean values for height and diameter

compared to those of young trees (WSD 2009). Young trees retain foliage longer, continue photosynthesis and growth till late before they enter in dormancy during winters. Young trees therefore put on significantly more height growth than older trees.

### Crop yield

The data presented in Table 2 for most of plant attributes and green pea yield had shown significant differences due to age of trees under which the intercrop was grown. Mean values for number of plants/m<sup>2</sup>, pod length, pod weight, number of seed/pod, seed weight/pod and green pea yield/ha (pods) were maximum for plants grown in open fields and these had significant differences with that of plants grown under plantations of different ages including the youngest plantation of 35.5 months age. There was gradual reduction, in most cases significant ones, with increase in age of plantations with minimum values for all these traits recorded for plants grown under 83.5 months old plantation. Some traits like, plant height, number of flowers/plant and pod mid diameter had non-significant differences due to age of trees. There was a gradual and non-significant increase in number of flowers per plant with decrease in age of trees. No specific trend was observed for plant height and pod mid diameter due to age.

Green pea yield/ha under 83.5 months, 71.5 months, 59.5 months, 47.5 months, 35.5 months old plantations was 39.26% (42.2 q/ha), 53.40% (57.4 q/ha), 56.56% (60.8 q/ha), 57.30% (61.6 q/ha), 64.72% (72.8 q/ha) respectively when compared with 107.5 q/ha that was recorded in open fields (Table-4). Poplar trees, depending on age, may divert up to 10% field space from intercropping by their presence on the fields and expand their crown with age to 100% of ground cover by 6<sup>th</sup> year (Dhiman 2009) which affect the yield of intercrops including peas. This study is in line with findings of Puri and Bangarwa (1992) who reported increased adverse affect of trees with increase in their age and size.

### Cost of cultivation

Component-wise cost of cultivation of pea crop under poplar plantations of different ages is given in Table 3 which indicates that the major cost was incurred on seed purchase followed by that on fertilizers and chemicals, field preparation, irrigation, transportation, and labour cost on applying fertilizers and chemicals, and on seed sowing. Over half of the cost was on material (seed & chemicals including fertilizers), around 40% on labour inputs, and 10% on transportation. Green peas were sold as standing crop as per practice in the locality and, therefore, there was no cost

**Table 1:** Height and GBH of different aged (years) poplar trees

Age of plantation (Months)	Height (m)	GBH (cm)	Height (m)	GBH (cm)	Increment	
	As on October 2010		As on January 2011		Height (m)	GBH (cm)
T1 (83.5)	21.70	71.4	21.76	71.8	0.06	0.4
T2 (71.5)	21.74	69.8	21.78	70.6	0.04	0.8
T3 (59.5)	18.20	66.2	18.28	67.6	0.08	1.4
T4 (47.5)	15.34	53.4	15.62	54.8	0.26	1.4
T5 (35.5)	13.28	47.2	13.64	49.4	0.36	2.2
Mean	18.1	61.6	18.2	62.8	0.20	1.2
S.E.m+	0.42	2.14	0.41	2.28	0.07	0.42
C.D. 0.05	0.89	4.54	0.86	4.84	0.16	0.89

**Table 2:** Pea growth and yield traits under different aged (years) poplar plantations

Age of trees (months)	Plant height (cm)	Number of flowers/plant	Plant/m <sup>2</sup> (No.)	Pod No. /m <sup>2</sup>	Pod length (cm)	Pod mid. Diameter (cm)	Pod weight (g)	Seed No./pod	Seed weight /pod (g)	Pod yield (q/ha)
T1 (83.5)	33.68	1.98	37.2	73.2	7.23	1.35	6.00	5.38	2.48	42.2
T2 (71.5)	32.65	2.05	51.7	92.7	7.53	1.30	7.15	5.63	3.05	57.4
T3 (59.5)	32.95	2.18	53.7	99.0	7.53	1.35	7.48	5.88	3.33	60.8
T4 (47.5)	33.00	2.10	55.5	102.5	8.25	1.30	7.63	6.50	3.40	61.6
T5 (35.5)	33.63	2.20	58.7	102.2	8.25	1.33	7.78	6.75	3.43	72.8
(T6)Control	31.40	2.28	67.7	135.0	8.93	1.40	9.60	9.35	4.30	107.5
Mean	32.89	2.13	54.1	100.8	7.89	1.33	7.61	6.58	3.33	67.1
SE Mean	NS	NS	4.04	7.18	0.27	NS	0.42	0.33	0.20	3.46
CD 0.05			8.61	15.31	0.57		0.89	0.69	0.43	7.37

**Table 3:** Component-wise cost incurred on pea production per ha

S. No.	Cost component	Cost	
		Rs.	Percent
1	Cost of seed	5950	36.38
2	Field preparation	3500	21.40
3	Labour cost on sowing	250	1.53
4	Labour cost on applying fertilizers & chemicals	1000	6.11
5	Labour charges on irrigation	1555	9.51
6	Cost of fertilizers and chemicals	2600	15.90
7	Transportation cost	1500	9.17
Total cost of production		16355	100

involved on plucking and selling of green peas and is not included in the cost analysis given in Table 3.

Economic analysis of growing green pea under open conditions and under poplar plantations of different ages is given in Table-4 which indicates that though there is reduction in

returns with increase in age of plantations, yet it provides good returns to the growers. Maximum returns of Rs. 58895/ha were available from the crop when grown under open conditions. Minimum returns were from 83.5 years old poplar plantations which gradually increased with

**Table 4:** Economic analysis of growing peas under poplar plantations of different ages

Age of plantation (Months)	Pod Yield q/ha.	Return/ha Pod sold @ Rs. 900/ql	Cost of cultivation/ ha. (Inclusive of picking cost)	Net profit /ha.	Decline in pea yield from open fields (%)	Decline in profits from open fields (%)
T1 (83.5)	42.2	37980	24795	13185	39.26	77.61
T2 (71.5)	57.4	51660	27835	23825	53.40	59.55
T3 (59.5)	60.8	54720	28515	26205	56.56	55.51
T4 (47.5)	61.6	55440	28675	26765	57.30	54.55
T5 (35.5)	72.8	65520	30915	34605	67.72	41.24
T6 (Open)	107.5	96750	37855	58895	100.0	0.00

decrease in age of trees. Net profits from pea cultivation were declined by 77.61%, 59.55%, 55.51%, 54.55% and 41.24% under 83.5 years, 57.5 years, 59.5 years, 47.5 years and 35.5 years old plantations respectively when compared with pea production in open fields. The decrease in the net return from cultivation of peas under poplar plantations are in line with earlier finding for other intercrops by Dhiman and Gandhi (2007) and Jain and Singh (1999).

Poplar being deciduous during the greater period of pea cultivation favours pea growth and cultivation. Green pea production is weather sensitive crop which provide remunerative returns when it is sown earlier in the month of October when it generally fetches good prices in the market. With setting winter rains, humidity increases and the crop is exposed to powdery mildew disease as a result its prices crash in the market and that usually happens with late sowing of peas. Pea cultivation for seed production is a rare option being practiced by farmers in Tarai region due to its exposure to winter rains. Poplar growing region

practices intensive crop culture with excessive use of fertilizers and chemicals. Peas being a short duration leguminous crop is reported to fix 105 Kg nitrogen per ha (Unkovich et al. 2010). Its regular integration in poplar based agroforestry would therefore certainly improve soil fertility and health. The crop is thus a good substitute for the wheat crop as it provides better returns in short period and trees also get benefit of the cultural inputs provided for the pea as intercrop. A few farmers also try to take another cover crop of mustard/maize crop after peas that could further improve economic viability of poplar based agroforestry. The present study clearly establishes that pea cultivation is a better and economically viable option for poplar based agroforestry.

## REFERENCES

- Dhiman RC 2009 Carbon footprint of planted poplar in India. *ENVIS Forestry Bulletin* **9(2)**: 70-81.
- Dhiman RC and Gandhi JN 2007 Growing of medicinal and aromatic plants in

- agroforestry: WIMCO's experience. *ENVIS Forestry Bulletin* **7(2)**: 34-45.
- Jain SK and Singh P 1999 Performance of intercrops in agroforestry system: the case of poplar (*Populus deltoides*) in Uttar Pradesh (India). *Indian Forester* **125(2)**: 195-205.
- Puri S and Bangarva KS 1992 Effects of trees on the yield of irrigated wheat crop in semi arid regions. *Agroforestry Systems* **20(3)**: 217-227.
- Unkovich M, Baldock J and Peoples M 2010 Prospects and problems of simple linear models for estimating symbiotic N<sub>2</sub> fixation by crop and pasture legumes. *Plant and Soil* **329**: 75-89.
- WSD 2009 *Annual Research Report*. Wimco Seedlings Division, WIMCO Ltd. Rudrapur, Uttarakahnd.