



## Assessment of soil quality and wheat yield under open and poplar based farming system in *Tarai* region of Uttarakhand

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### ABSTRACT

The present investigation was organized during the *rabi* season of 2013-14 at GBPUA&T, Pantnagar to evaluate the effect of poplar based agroforestry system and open system (without poplar) on yield and yield attributing characters of different wheat varieties and soil properties. The experiment was laid out in RBD having three replications with 4 treatments under both the growing conditions. Wheat varieties *viz* UP-2572, PBW-550, DBW-711 and PBW-373 were taken as four different treatments. Open farming system achieved highest grain yield of all the wheat varieties. Highest grain yield of wheat was attained with UP-2572 under open farming system. The maximum per cent reduction in grain yield of wheat under one year poplar plantation was observed with PBW 373 and minimum with PBW 550. Agroforestry is proven land use system for vertically enhancing soil health against unsuitable weather condition. The distribution of soil properties was detected from the depth 0-15 cm in poplar based agroforestry system and as well as in open system. During the experiment it was found that agroforestry added more nutrients to the soil compared to open system.

**Key words:** Agroforestry, Nutrient, Poplar, Varieties, Yield.

### INTRODUCTION

Agroforestry is considered as a panacea for maladies of intensive agriculture. It not only prevents land degradation but also improves site productivity through interaction among trees, soil and crops and thus restores soil fertility (Kumar, 2006). Hence, now the farmers have long recognized the value of planting trees on their fields for better soil condition and additional income from trees. Agroforestry is also playing an important role in tree-based rehabilitation of degraded lands and watersheds, climate change adaptation and mitigation, agroforestry contribution to a multifunctional agriculture and combining productivity with environmental sustainability. In India, fast growing exotic tree species have been introduced on-farm in order to obtain maximum monetary gains from a given land unit in a short period of time. Poplar (*Populus deltoides* Bartr.), a winter deciduous tree, has proved itself to be the most promising tree in irrigated agro-ecosystems of *Tarai* region of the country and is being raised either as block plantation or along field boundaries/windbreaks. *Populus deltoides* based agroforestry system is one of the viable alternate land use systems to prevent further degradation, obtain biological production on sustainable basis and ameliorate the environment. The past three decades have witnessed the rapid increase in poplar based agroforestry as an alternate land use practice throughout the irrigated agro-ecosystem. It is a general

practice to combine agricultural crops with poplar plantations. Poplar being deciduous in nature, a winter crop, predominantly wheat, is intercropped throughout rotations but needs the quantification at different ages of poplar plantations.

The present study was an attempt to quantify system productivity along with nutrient accumulation in soil. However, concerted efforts are required to quantify yield with nutrient management under short rotation tree species along with agricultural crop.

### MATERIALS AND METHODS

**Experimental Site:** The field experiment was conducted during winter season of 2012-13 at experimental site of Agroforestry Research Centre (old site) near Horticulture Research Centre, Patharchatta of G.B. Pant University of Agriculture and Technology, Pantnagar, Distt. Udham Singh Nagar, Uttarakhand. The Centre at Pantnagar is located between 28° 58' N to 29° 1' N Latitude and 79° 24' E to 79° 31' E longitudes and at an altitude of 243.84 meters above the mean sea level, which lies in the foothills of the Shivalik range of the Himalayas in the narrow strip called '*Tarai*'.

**Experimental design and details:** The experiment was laid out in randomized block design with three replications. Four treatments were made up with different wheat varieties *viz.*, UP-2572, PBW-550, DBW-711 and PBW-373 and were

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planted in open condition and with one year poplar trees. The effect of both of the farming systems was estimated in terms of growth, wheat yield and soil nutrient status. The clones of *Populus deltoides* viz., PH 7 and PH 8 were taken at 3.0×7.0 m<sup>2</sup> spacing during 2012. The wheat (*Triticum aestivum* L.), varieties was raised on October 26<sup>th</sup>, 2013 with the recommended cultural practices. The effect of poplar clone and open condition on wheat crop was estimated in terms of yield (straw and grain). Grain and straw yield (q/ha) was determined on the net plot (3.0 m<sup>2</sup>) area basis. Soil samples were collected after harvesting of the wheat crop from net plots at 0-15cm depth for the study of nutrient status and physico-chemical properties viz., available nitrogen (by kjeldahl method using alkaline potassium permanganate), potassium (by flame photometer) and phosphorus (by Olsen's method), organic carbon (Walkley and Black's method), pH and EC was determined by following standard procedures (Jackson, 1967). Data obtained during the course of this investigation, was analyzed by using analysis of variance (ANOVA) technique "STPR".

## RESULTS AND DISCUSSION

**Growth parameters:** All the growth parameters viz., plant height (cm), dry matter accumulation of plant (g/plant) and root length (cm) at 90 days after sowing (DAS) except plant root length under poplar based agroforestry system were significantly affected by the treatments under both of the growing conditions (Table 1). In open system, highest plant height recorded in UP-2572 (83.5 cm) which was at par with PBW 550 and PBW 373 whereas in poplar system the same was achieved with PBW 373 (85.3 cm) that was at par with UP 2572 and PBW 550. Patil *et al.* (2011) also observed that plant height was reduced by 5 per cent in agroforestry system as compared to sole cropping systems. Maximum dry weight under open system was recorded in UP 2572 (52.1 g/plant) which was significantly superior to rest of the wheat varieties while in poplar system it was highest in PBW 373 (42.9 g/plant) which was at par with DBW 711. Sharma *et al.* (2012) reported that the dry matter accumulation of wheat

declined considerably due to presence of poplar tree line during all the growth stages as compared to pure crop. Under open system, longest root length (15.8 cm) was recorded with PBW 373 that was significantly superior to rest of the varieties while in poplar system root length was not influenced significantly. There is about 2.2 percent reduction in total length of wheat varieties under poplar plantation as compared to open system. Alam and Singh (2011) observed that the root length of soybean gradually declined with increasing shade over it.

**Grain yield:** Grain yield (q/ha) of wheat varieties was significantly influenced by both the growing systems (Table 1). Maximum grain yield of wheat was obtained under open system as compared to poplar system. Sarvade *et al.* (2014) also reported the same result. Highest grain yield of wheat was recorded with UP-2572 while minimum was attained with PBW-373 under both farming systems. As compared to open farming system maximum grain yield reduction (8.99 %) was recorded with the variety PBW-373 and it was minimum with PBW-550 (5.26 %) (Fig: 1). Reduction in grain yield is due to the competition between the tree and crop for light, moisture, nutrients, etc. and the modification of micro environmental conditions. The reduced grain yields in the agroforestry treatments relative to sole wheat demonstrate the existence of competition, as reported by Sarvade *et al.* (2014).

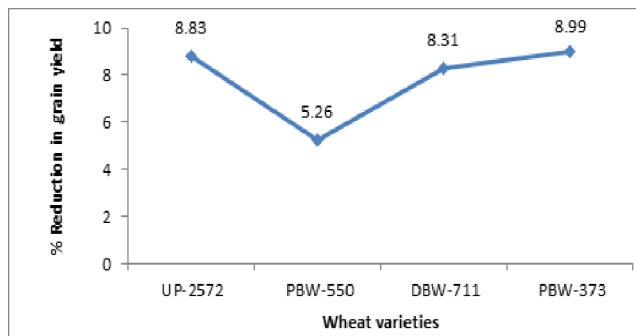
**Soil nutrients:** Poplar system achieved slightly higher amount of nutrient as compared to open system. Soil N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O were not significantly affected by both the systems at 0-15 cm soil depth as the plantation of poplar was only one year old. Lodhiyal *et al.* (2002) reported that the total amount of nutrient return to the soil through litter increased with increase in plantation age because of higher litter accumulation. For both the systems maximum N and P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and minimum N and P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O were recorded with the treatments UP-2572 and PBW-550 respectively. The intercropping of trees with crops that are able to biologically fix nitrogen is common in tropical agroforestry systems. Non-

**Table 1:** Wheat growth parameters, yield and soil nutrients status under open and poplar based agroforestry system.

Parameters	System	Treatments				SEm±	CD (%)	
		UP-2572	PBW-550	DBW-711	PBW-373			
At 90 DAS	Plant height (cm)	Open	83.5	82.5	74.2	82.3	1.8	6.1
		poplar	83.9	81.2	70.7	85.3	2.3	7.9
	Dry matter accumulation (g/plnat)	Open	52.1	47.3	40.0	37.8	0.6	1.9
		poplar	28.9	34.1	40.8	42.9	1.1	3.6
	Root length (cm)	Open	13.2	13.9	12.2	15.8	0.4	1.3
		poplar	11.7	13.8	13.5	14.9	0.9	NS
At harvest	Grain yield (q/ha)	Open	45.3	38.0	31.3	26.7	1.9	6.4
		poplar	41.3	36.0	28.7	24.3	0.9	3.2
	Available N (kg/ha)	Open	249.4	250.5	250.5	250.1	0.8	NS
		Poplar	253.5	252.3	253.1	252.9	0.66	NS
	Available P <sub>2</sub> O <sub>5</sub> (kg/ha)	Open	21.1	19.9	20.4	20.3	0.42	NS
		Poplar	22.3	21.9	22.7	22.5	0.36	NS
	Available K <sub>2</sub> O (kg/ha)	Open	207.6	207.0	208.2	207.3	1.06	NS
		Poplar	219.6	219.4	220.1	219.6	0.66	NS

N-fixing trees can also enhance soil physical, chemical and biological properties by adding significant amount of organic

matter, releasing and recycling nutrients in agroforestry systems (Sarvade *et al* 2014) (Table 1).



**Fig-1:** Per cent reduction in grain yield of wheat under poplar compared to open

## CONCLUSION

To conclude from the above study it can be stated that maximum plant height and dry matter accumulation of plants under open and poplar system was achieved with UP-2572 and PBW-373, respectively. Whereas, the highest root length under both the systems was attained with the wheat variety PBW 373. The wheat yield was higher under open system than poplar based system. Wheat variety UP 2572 and PBW 550 recorded higher yield with minimum reduction in PBW 550 under poplar based system. Soil nutrient status was higher under poplar varying non-significantly than open system.

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