

## Effect of different levels of inorganic fertilizers on growth and yield of Beetroot under Poplar based Agroforestry System

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### ABSTRACT

Agroforestry is crucial for satisfying the need for industrial round wood and reaching the national aim of bringing one-third of total country's land under forest/tree cover. The risk of losing money on crops due to poor monsoon conditions is mitigated, and farmers receive a steady stream of additional income as a result. Furthermore, it could make a significant impact on the national initiative to double farmers' income. Present experiment was laid out to assess the effect of different levels of inorganic fertilizers on growth and yield of Beetroot under Poplar based Agroforestry in Randomized Block Design (RBD) with ten treatments and three replications viz. T<sub>0</sub> – (70:110:70 kg NPK / ha), T<sub>1</sub> – (100:110:70 kg NPK / ha), T<sub>2</sub> – (130:110:70 kg NPK / ha), T<sub>3</sub> – (160:110:70 kg NPK / ha), T<sub>4</sub> – (70:130:70 kg NPK / ha), T<sub>5</sub> – (70:150:70 kg NPK / ha), T<sub>6</sub> – (70:180:70 kg NPK / ha), T<sub>7</sub> – (70:110:80 kg NPK / ha), T<sub>8</sub> – (70:110:90 kg NPK/ha), T<sub>9</sub> – (70:110:100 kg NPK / ha). Findings of experiment show that fertilizer Treatment has a significant influence on the growth and yield of Beetroot. The yield parameters of beetroot were significantly affected due to different inorganic nutrient management and comparatively higher tuber yield (307.67 q/ha) was recorded in Treatment T<sub>6</sub> (70:180:70kg NPK/ha).

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Comment [TR16]: 1.INTRODUCTION

**Keywords:** Poplar, Beetroot, agroforestry, growth and yield attributes and nutrition level etc.

### INTRODUCTION

In recent years, agroforestry has emerged as a promising field with the potential to provide substantial value and new employment possibilities in rural India, while also improving our country's trade balance and aiding our efforts to achieve its climate and sustainability goals. In recent years, plantations of fast-growing tree species have emerged as an emerging possibility as solutions to address the increasing demand for biomass as a source of renewable energy in global markets. India has experienced remarkable economic growth over the past few decades, and as a result, the country's demand for wood and products made of wood has increased. Because they reduce land competition for biomass and food production while also providing

forest benefits like industrial raw material supply, agroforestry plantations, which include fast-growing tree species, could be an attractive option. Agroforestry is defined as a land use system which integrates trees and shrubs on farmlands and rural landscapes to enhance productivity, profitability, diversity and ecosystem sustainability. It is a dynamic, ecologically based, natural resource management system that, through integration of woody perennials on farms and in the agricultural landscape, diversifies and sustains production and builds social institutions. Poplar (*Populus deltoides*) belongs to the family Salicaceae. There are basically three main species of poplar which are describes as follows. Indigenous poplar species are not new to India. These species merit wider recognition, systematic survey, collection and evaluation of desirable geographical races and development of suitable clones. Exotic poplar species considering the importance of exotic poplar clones for their fast growth and ability to provide substantial production of wood on a short rotation, a major programme of introduction to select suitable species and their hybrids/clones/cultivates for varying agro climatic conditions in India was initiated at the Forest Research Institute (FRI), Dehradun as early as 1950. Beetroot is also known as Table beet, Garden beet and Red beet, and its roots are eaten raw in salads or cooked as a vegetable. It is also a rich source of potent antioxidants and nutrients, including magnesium, sodium, potassium and vitamin C, and betaine, which is important for cardiovascular health. It is the taproot portion of a beet plant, usually known in North America as beets while the vegetable is referred to as beetroot in British English, and also known as the table beet, garden beet, red beet, dinner beet or golden beet. It is one of several cultivated varieties of *Beta vulgaris* grown for their edible taproots and leaves. Beets are rich in folate (vitamin B9) which helps cells grow and function. Folate plays a key role in controlling damage to blood vessels, which can reduce the risk of heart disease and stroke. Present study helps to know the suitability of cultivation and analyzing the growth and yield, quality of the beetroot under Poplar based agroforestry system with different inorganic nutrient management.

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## **MATERIALS & METHODOLOGY**

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Present experiment was laid out to assess the effect of different levels of inorganic fertilizers on growth and yield of Beetroot under Poplar based Agroforestry in Randomized Block Design (RBD) with thirteen treatments and three replications during Rabi season of 2022-23 in the crop research farm of Department of Silviculture and Agroforestry, Naini Agricultural Institute,

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Prayagraj, India. The area is situated on the south of Prayagraj the right side of the river Yamuna on the South of Rewa road at a distance of about 6 km from Allahabad city. It is situated at 25024'23" N latitude, 81050'38" E longitude and at the altitude of 98 meter above the sea level (MSL).

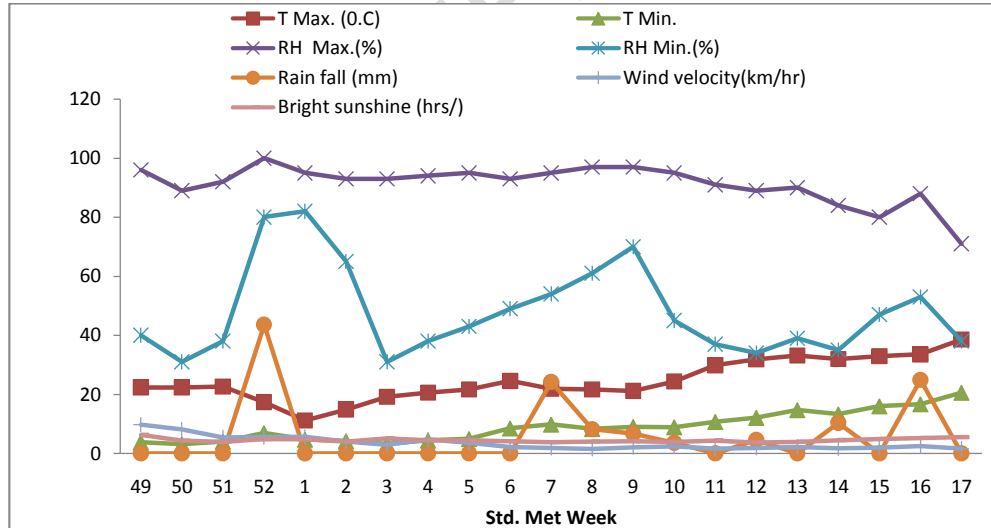
### Climate and weather condition

The meteorological data including the weekly average of maximum and minimum temperature, relative humidity, and rainfall recorded at the Department of Meteorology, School of agricultural sciences. It is endowed with severe winters and mild summers, which remains covered with snow generally from November to March and sometime even upto mid of May. Winter rainfall received in this zone is very low (about 250 mm) and the temperature remains low throughout the growing periods of the crop. Mean weekly meteorological data recorded during the crop seasons (2021-23) have been given.

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**Fig 1. Meteorological data recorded during experimental period (December 2022 to March 2023)**



The climatic condition of terai zone is characterized by high rainfall, high relative humidity, moderate temperature, prolonged winter with high residual soil moisture. The temperature range

of this area varies from minimum of 7-8<sup>0</sup>C to maximum of 24-33.2<sup>0</sup>C. The average rainfall of this zone ranges between 210 cm to 330 cm. The crop growing season of this zone are broadly classified as pre *kharif* (dry and warm) starting from March to May, *kharif* (wet and warm) starting from June to October and *rabi* (dry and cool) starting from November to February. The meteorological data pertaining to the study period are presented in figure 1.

### Statistical Analysis

The data recorded for different characteristics were subjected to statistical analysis by adopting the method of analysis of variance (ANOVA) as described by Gomez and Gomez (1984). The significance of comparison was tested. The significant difference values were computed for 5 percent probability of error. Wherever the variance ratio (F value) was found significant, critical difference (CD) values were computed for the comparison among the treatment means.

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## RESULTS & DISCUSSION

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### Plantheight(cm)

The data as regards to plant height was recorded at 30, 40, 50 and 60 DAS presented in Table 1 showed that the effect of different inorganic nutrients sources on plant height was found to be significant. At 30 DAS, significantly maximum plant height (6.27 cm) was recorded in treatment T<sub>6</sub>, which was at par with treatment T<sub>5</sub> (6.24 cm), T<sub>3</sub>(6.22cm) and T<sub>2</sub>(6.21cm) and significantly superior over remaining treatments. The minimum plant height was recorded in T<sub>0</sub>(6.13cm). At 40 DAS, significantly maximum plant height (12.08 cm) was recorded in treatment T<sub>6</sub> which was at par with treatment T<sub>4</sub> (12.06 cm), T<sub>3</sub>(12.04cm) and T<sub>8</sub>(11.99cm) and significantly superior over remaining treatments. The minimum plant height was recorded in T<sub>0</sub>(11.9 cm). At 50 DAS, significantly maximum plant height (20.96 cm) was recorded in treatment T<sub>6</sub>, which was at par with treatment T<sub>5</sub> (20.30 cm), T<sub>3</sub> and T<sub>8</sub>(20.10cm) and T<sub>3</sub>(20.80cm) and significantly superior over remaining treatments. The minimum plant height was recorded in T<sub>0</sub>(16.76cm). At 60 DAS, the significantly maximum plant height (27.35) cm was recorded in treatment T<sub>6</sub> which was at par with treatment T<sub>4</sub>(27.20cm), T<sub>3</sub> (27.00 cm), T<sub>5</sub>(26.20 cm) and T<sub>2</sub>(26.10 cm) and was significantly superior other the remaining treatments. The minimum was recorded in T<sub>0</sub>(21.19cm) with control treatment.

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**Table 1** Average plant height (cm) of Beetroot as influences by treatment of inorganic nutrient sources

Treatment		Plant height (cm)			
		30 DAS	40 DAS	50 DAS	At Harvest
T <sub>0</sub>	70:110:70Kg NPK/ha	6.13	11.9	16.76	21.19
T <sub>1</sub>	100:110:70kg NPK/ha	6.18	11.72	19.82	21.66
T <sub>2</sub>	130:110:70kg NPK/ha	6.20	11.92	20.08	26.10
T <sub>3</sub>	160:110:70 kg NPK/ha	6.21	12.04	20.10	27.00
T <sub>4</sub>	70:130:70kg NPK/ha	6.22	12.06	20.10	27.18
T <sub>5</sub>	70:150:70kg NPK/ha	6.24	12.06	20.30	26.20
T <sub>6</sub>	70:180:70kg NPK/ha	6.27	12.08	20.96	27.35
T <sub>7</sub>	70:110:80kg NPK/ha	6.15	11.88	19.82	21.66
T <sub>8</sub>	70:110:90kg NPK/kg	6.17	11.99	20.10	24.08
T <sub>9</sub>	70:110:100kg NPK/ha	6.19	12.04	20.10	26.10
'F' test		S	S	S	S
SE(m)±		0.91	1.59	1.61	1.98
CD at 5%		2.69	4.72	4.77	3.25

**Comment [TR32]:** Effect of inorganic nutrient sources on plant height of beetroot

## Leavesperplant

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The data as regard to number of leaves per plant, recorded at 30, 40, 50 and 60 DAS are presented in Table 2 showed that the effect of different inorganic nutrient sources on number of leaves was found to be statistically significant. The maximum number of leaves per plant (7.73) was observed in treatment T<sub>6</sub> i.e. 70:180:70kg NPK/ha, which was significantly superior over rest of the treatments. At 30 DAS, all the treatment was find the same value such like 2.40. At 40 DAS, maximum number of leaves per plant (5.67) was observed in treatment T<sub>6</sub> i.e. 70:180:70kg NPK/ha, which was at par with treatment T<sub>4</sub>, T<sub>5</sub> (5.42), and T<sub>9</sub> (5.42) significant superior over remaining treatments. The minimum number of leaves per plant was observed in control T<sub>0</sub> (4.73). At 50 DAS, maximum number of leaves per plant (7.80) were observed in treatment T<sub>6</sub>, which was at par with treatment T<sub>5</sub> (7.40), T<sub>4</sub> and T<sub>8</sub> (7.20) significant superior over remaining treatments. The minimum number of leaves per plant was observed in control T<sub>0</sub> (6.00). At 60 DAS, maximum number of leaves per plant (7.73) were observed in treatment T<sub>6</sub> which

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was at par with treatment T<sub>4</sub>(7.67), T<sub>5</sub>, T<sub>9</sub> (7.67) significant superior over remaining treatments. The minimum number of leaves per plant was observed in control T<sub>0</sub> (7.47). Probable reasons for enhanced more number of leaves, maybe due to promoted effect of macro and micro nutrients on vegetative growth which ultimately lead to more photosynthetic activities. The beneficial effect of inorganic fertilizer was evident in response of the plant when remarkable increase in relative growth rate with the different treatment. Above finding are in agreement with Jagadeesh (2015) in beetroot.

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**Table 2. The average number of Beetroot leaves per plant as influences by treatment of inorganic nutrient sources**

Comment [TR45]: Effect of inorganic nutrient sources on no. of leaves per plant in beetroot

Treatment		Number of leaves per plant			
		30 DAS	40 DAS	50 DAS	60 DAS
T <sub>0</sub>	70:110:70kg NPK/ha	2.40	4.73	6.00	7.47
T <sub>1</sub>	100:110:70kg NPK/ha	2.40	5.13	6.20	7.53
T <sub>2</sub>	130:110:70kg NPK/ha	2.40	5.27	6.20	7.60
T <sub>3</sub>	160:110:70 kg NPK/ha	2.40	5.40	7.00	7.60
T <sub>4</sub>	70:130:70kg NPK/ha	2.40	5.47	7.20	7.67
T <sub>5</sub>	70:150:70kg NPK/ha	2.40	5.47	7.40	7.67
T <sub>6</sub>	70:180:70kg NPK/ha	2.40	5.67	7.80	7.73
T <sub>7</sub>	70:110:80kg NPK/ha	2.40	5.20	6.20	7.53
T <sub>8</sub>	70:110:90kg NPK/kg	2.40	5.40	7.20	7.60
T <sub>9</sub>	70:110:100kg NPK/ha	2.40	5.47	7.40	7.67
'F' test		S	S	S	S
SE(m)±		0.26	0.45	0.69	0.76
CD at 5%		0.76	1.33	2.04	2.21

### Root Diameter

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The data as pertaining to root diameter is presented in Table 3 showed that the effect of different inorganic nutrient sources on root diameter found to be statistically significant. The significantly maximum root diameter (6.27cm) was recorded in treatment T<sub>6</sub>, which was at par with T<sub>9</sub> (6.13 cm), T<sub>5</sub> (6.06) and T<sub>4</sub>(5.73 cm), showed significant superiority over all other remaining treatments. The lowest root diameter was recorded in

T<sub>0</sub>(4.93). This might be due to the availability of the nutrients in readily available form and the C:N ratio was high over control.

**Table 3. The average root diameters of Beetroot as influenced by treatment of inorganic nutrient sources**

Treatment	Root diameter in (cm)	
To	70:110:70kg NPK/ha	4.93
T1	100:110:70kg NPK/ha	5.33
T2	130:110:70kg NPK/ha	5.54
T3	160:110:70 kg NPK/ha	5.60
T4	70:130:70kg NPK/ha	5.73
T5	70:150:70kg NPK/ha	6.06
T6	70:180:70kg NPK/ha	6.27
T7	70:110:80kg NPK/ha	5.20
T8	70:110:90kg NPK/kg	5.23
T9	70:110:100kg NPK/ha	6.13
'F' test		S
SE(m)±		0.62
CD at 5%		1.843

**Comment [TR48]:** Effect of inorganic nutrient sources on root diameter of beetroot

### Root tuber Yield (q/ha)

The data as regards to root yield ha<sup>-1</sup> (q), is presented in Table 4 showed that the effect of different organic nutrient sources on root yield hectare<sup>-1</sup> was found to be statistically significant. The highest root tuber yield ha<sup>-1</sup> was recorded in (307.67 q/ha) with the application of treatment T<sub>6</sub>, which was significantly superior over all other treatments. The lowest root yield per ha was recorded by T<sub>0</sub> (219.00q/ha). Probable reason for increased marketable root yield plot<sup>-1</sup> and root yield hectare<sup>-1</sup> is due to accumulation of humus substances could have mobilized the reserve food material to the sink through increased activity of hydrolyzing and oxidizing enzymes. The higher root yield might be due to increase in plant height, number of leaves which attributes increase in root length and diameter of root, fresh weight of root. This might be due to the availability of the nutrients in readily available form and the C:N ratio was high over control.

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**Table 4. The Yield of Beetroot as influences by treatment of inorganic nutrient sources**

**Comment [TR53]:** Effect of inorganic nutrient sources on Root tuber yield of beetroot

Treatments		Root yield per ha (q/ha)
T <sub>0</sub>	70:110:70Kg NPK/ha	219.00
T <sub>1</sub>	100:110:70kg NPK/ha	246.83
T <sub>2</sub>	130:110:70kg NPK/ha	253.58
T <sub>3</sub>	160:110:70 kg NPK/ha	277.17
T <sub>4</sub>	70:130:70kg NPK/ha	281.42
T <sub>5</sub>	70:150:70kg NPK/ha	296.92
T <sub>6</sub>	70:180:70kg NPK/ha	307.67
T <sub>7</sub>	70:110:80kg NPK/ha	249.67
T <sub>8</sub>	70:110:90kg NPK/kg	244.58
T <sub>9</sub>	70:110:100kg NPK/ha	261.58
'F' test		S
SE(m)±		2.702
CD at 5%		8.09

## CONCLUSION

The findings of present study concludes that different levels of inorganic nutrients sources viz., N, P and K to beetroot under poplar based agroforestry significantly influences growth parameters viz., plant height, leaves per plant, leaf length and leaf breadth and yield attributing characters i.e. root diameter, root length, root weight and root yield per hectare were also significantly increased with alleviated dose of inorganic nutrients sources of NPK as soil treatment. The combination of 70:180:70kg NPK/ha (T<sub>6</sub>) found superior over other treatments for increasing growth, yield and economic in beetroot over all other treatments followed by T<sub>5</sub> (70: 150: 70kg NPK/ha). Comparatively higher tuber yield (307.67 q/ha) was recorded in treatment T<sub>6</sub> (70:180:70kg NPK/ha). Hence it is being recommended to farmers to grow beetroot under poplar based agroforestry system for better economic returns. These observations are based on the results of experiment conducted for one season only however, an extensive trial may be conducted to confirm these results

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Yadav A, Gretter S, Hambrusch S, Sands P. Expanding computer science education in schools: understanding teacher experiences and challenges. Computer Science Education. 2016; 26(4):235-254

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