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Production potential of *Plumbago zeylanica* L. under different harvest schedules and crop geometry

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Abstract

A field experiment on *Plumbago zeylanica* with three plant densities, namely, 4.9 m^{-2} , 2.7 m^{-2} and 1.2 m^{-2} and three harvesting schedules, namely, after first year, second year and third year, was conducted during 1999–2001 at Jorhat (Assam). Plant density significantly influenced number of branches $plant^{-1}$, shoot and root biomass $plant^{-1}$ and total yield of roots ha^{-1}. Plant height was found to reduce with the age of the plant. The total dry root yield was maximum in the plant density 2.7 m^{-2} (5.2 t ha^{-1}). The yield attributing characters, namely, number of branches $plant^{-1}$ (25.6), shoot biomass $plant^{-1}$ (408.2 g), root biomass $plant^{-1}$ (607.4 g) and total root yield (7.1 t ha^{-1}) were maximum when harvested at third year. Maximum phenol, carbohydrate and protein contents were recorded in roots (5.06%, 31.70% and 13.04%, respectively) and leaves (3.40%, 10.60% and 7.84 %, respectively) of plants harvested during the third year.

Key words: crop geometry, harvest management, *Plumbago zeylanica*, quality, yield.

Plumbago zeylanica L. (Plumbaginaceae) is a woody perennial medicinal shrub grown throughout India with well distributed rainfall. The major active compound in the plant, plumbagin, has anticancer, antifungal and antibacterial properties (Krishnaswamy & Purushothaman 1980). The performance of this crop has been studied in various regions of India (Shah *et. al.* 2000; Tiwari *et al.* 2000) except North East India. Therefore, the present study was undertaken to find out suitable crop density and harvest management schedules for obtaining higher biomass under the agroclimatic conditions of Jorhat (Assam). Phytochemical aspects of the plant were also studied at different ages of the crop to assess the quality of the produce.

The experiment was conducted at the Experimental Farm of Regional Research Laboratory, Jorhat (Assam) (26' 45^0 N, 94' 46^0 E, 87 m MSL) during 1999-2001. The soil was sandy loam with pH 5.47, 0.76% organic matter and 0.4%, 0.012% and 0.006% available nitrogen, phosphorus and potassium, respectively. The experiment was laid out in a randomized block design with nine treatment combinations replicated thrice. The treatments consisted of three plant densities (4.9 m^{-2} (45 cm x 45 cm), 2.7 m^{-2} (60 cm x 60 cm) and 1.2 m^{-2} (90 cm x 90 cm)) and three harvest management periods (harvesting after first year, second year and third year). Organic manure was supplied through farm yard manure @ 5 t ha^{-1} before planting. The crop was grown under

rainfed condition. Thirty day old seedlings (15 cm height) were planted in May. Data on various growth parameters like plant height, number of branches plant^{-1}, shoot biomass plant^{-1} and root biomass plant^{-1} were recorded on randomly selected five plants at harvest after first year, second year and third year, whereas total root biomass was calculated on the basis of produce received from net plot at harvest. Estimation of phenol, carbohydrate and protein contents was done for root and leaf at different harvest stages following the method of Wood *et al.* (1964); Hedge & Hofriter (1962) and Lowry *et al.* (1951), respectively.

Number of branches plant^{-1}, shoot and root biomass plant^{-1} and total yield of root were influenced by various treatments, whereas plant height remained unaffected (Table 1). Number of branches increased with increase in plant density and maximum number of branches (20.8) was recorded under plant density 1.2 m^{-2} which was at par with 2.7 m^{-2}. Shoot and root biomass plant^{-1} were 418.0 g and 450.4 g, respectively, under plant density 1.2 m^{-2} which was superior to other treatments. Plant density of 2.7 m^{-2} gave significantly highest root yield. Root and shoot biomass plant^{-1} under lower plant density might be due to crowding within the rows which causes severe competition for nutrients, sunlight and space. However, total dry root yield in higher plant density may be due to more number of plants unit area^{-1}.

The crop harvested after 3 years showed better performance in respect of number of branches plant^{-1} (25.6), shoot biomass plant^{-1} (408.2 g), root biomass plant^{-1} (607.4 g) and total dry root yield (7.08 t ha^{-1}) when compared to other harvesting periods. The interaction between plant density and harvest management was not significant.

Phenol, protein and carbohydrate contents exhibited positive correlation with plant age. The roots harvested during the third year showed maximum phenol, carbohydrate and protein contents (5.06%, 31.70% and 13.00%, respectively) (Table 2). In the leaves, phenol content was maximum during the third year (3.4%). Carbohydrate content was higher during the second (9.10%) and third year

Table 1. Yield and yield attributes of *Plumbago zeylanica* under various crop density and harvest schedules

Treatment	Plant height (cm)	No. of branches plant^{-1}	Shoot biomass plant^{-1} (g)	Root biomass plant^{-1} (g)	Total yield of root (t ha^{-1})
Plant density (m^{-2})					
4.9 (45 cm x 45 cm)	155.7	14.5	311.1	307.1	3.7
2.7 (60 cm x 60 cm)	154.5	19.8	372.8	440.3	5.2
1.2 (90 cm x 90 cm)	154.1	20.8	418.0	450.4	3.1
CD (P=0.05)	NS	1.9	17.8	71.9	0.3
Harvest period					
1st year (1999)	158.1	7.3	341.6	190.6	1.2
2nd year (2000)	157.5	22.3	352.1	400.8	3.8
3rd year (2001)	154.9	25.6	408.2	07.4	7.1
CD (P=0.05)	NS	1.9	17.8	71.9	0.3

Table 2. Phytochemical characteristics of *Plumbago zeylanica* at different harvest periods

Harvest period	Phenol content (%)		Carbohydrate content (%)		Protein content (%)	
	Root	Leaf	Root	Leaf	Root	Leaf
1st year (1999)	4.40	2.28	17.60	8.72	10.87	4.66
2nd year (2000)	4.69	2.93	23.25	9.10	11.32	5.58
3rd year (2001)	5.06	3.40	31.70	10.20	13.04	7.84

(10.2%). Maximum protein content was obtained during the third year (7.84%). The study indicated that an optimum plant density of 2.7 m^{-2} (60 cm x 60 cm) provides maximum yield and harvesting can be recommended after third year of planting to obtain maximum root biomass in *P. zeylanica*.

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