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Yield and Nutrient Uptake in Leucaena (*Leucaena leucocephala* (Lam.) de Wit.) as Influenced by Row Spacing and Phosphorus Level*

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ABSTRACT

A field experiment was conducted at Agricultural College Farm, Dharwad to evaluate the effect of four row spacings (100 cm, 75 cm, 60 cm and 50 cm) and two phosphorus levels (60 kg and 120 kg P_2O_5 / ha) with control on leucaena during 1981-82 and 1982–83. Planting leucaena at 60 cm row spacing recorded singnificantly higher green and dry matter yields than 75 cm and 100 cm row spacings. The increase in total dry matter yield with 60 cm row spacing over 100 cm was to the extent of 36% and 29% during first and second year, respectively. The total dry matter yields at 60 cm row spacing were 111.5 q. and 167.4 q per ha. during first and second year. Application of either 60 kg or 120 kg P_2O_5 per ha recorded significantly higher green and dry matter yields of leucaena than the control treatment. Both the nitrogen and phosphorus uptake by leucaena were maximum at 60 cm row spacing and with 120 kg P_2O_5 per ha.

India possesses an enormous livestock population of about 343 million. Yet production of milk and other livestock products in the country is lowest, in the world. The main reason for this is the shortage of nutritious, protein rich fodder. Due to recurring dry seasons in the country and in the state, there is a constant need for a perennial drought tolerent legume capable of sustained heavy production of palatable forage rich in protein. Leucaena (*Leucaena leucocephala* (Lam.) de Wit.) possesses the desirable characters to fullfil this requirement. Leucaena responds well to the variation in row spacing and phosphorus level as evidenced by the research work of several workers. Fertilization of leucaena with 20 kg P_2O_5 per ha, along with rhizobial inoculation gave significantly higher biomass compared to control (Chandrasekharan, 1981). The information regarding the effect of row-spacing and phosphorus level on leucaena under transition tract of Karnataka is very meagre. Hence, the present study was undertaken to find out the optimum row spacing and phosphorus level for leucaena to maximise the yield and nutrient uptake.

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MATERIAL AND METHODS

A field experiment was conducted at Agricultural College Farm, Dharwad for a period of two years (1981–82 and 1982–83). The annual rainfall, during 1981–82 and 1982–83 were 749 mm and 792 mm, respectively. The maximum temperature seldom rises beyond 37° C and minimum temperature rarely falls below 12° C. Soil type is deep black clay with a pH of 8.1. The experiment was laid out in randomised block design with 12 treatment combinations consisting of four row spacings (100 cm, 75 cm 60 cm and 50 cm) and two phosphorus levels (60 kg and 120 kg P_2O_5 per ha) with control. The crop was sown with intra-row spacing of 10 cm on 20 th April, 1981. A common fertilizer dose of 30 kg nitrogen and 40 kg potassium per ha was applied at sowing. Phosphorus was applied as per treatments. First forage was cut three months after sowing and subsequent cuttings were made at 60 days interval. Two protective irrigations were given; one at sowing and the other 15 days after sowing.

During 1981–82 there were six cuttings in 13 months period and the data on yield and nutrient uptake were converted for 12 months and reported. Immediately after harvesting, at each cutting the green matter yield per plot was recorded. A unit quantity of representative sample from each plot was dried at 70° C to constant weight. Based on the ratio between green and dry matter yield per plot was worked out. Representative sample from each plot was also separated for stem and forage fractions at each cutting. Forage fraction included leaves, twigs and soft stems. The nitrogen and phosphorus content in leucaena plant samples were analysed and their uptake was worked out based on total dry matter production. Crude protein content in forage was worked out by multiplying with factor, 6.25 to nitrogen content.

RESULTS AND DISCUSSION

1. **Effect of row spacing :** During the first year 60 cm row spacing recorded significantly higher green matter yield (391.6 q/ha), than 100 cm and 75 cm row spacings (Table 1). During the second year also, significantly higher green matter yield was recorded at 60 cm row spacing (589.3 q/ha) compared to all other row spacings. During first year, the dry matter yield of stem fraction with 50 cm row spacing (49.3 q/ha) was significantly higher than 100 cm row spacing but it was on par with 75 cm and 60 cm row spacings (Table 2). During the second year, 60 cm row spacing recorded significantly higher dry matter yield of stem fraction (54.3 q/ha) than 100 cm and 75 cm row spacings. The forage fraction yield at 60 cm row spacing (62.3 q/ha) was significantly higher than 100 cm and 75 cm row spacings during first year. Similar trend was also observed during second year. The total dry matter yield of leucaena was significantly higher at 60 cm row spacing (111.5 q/ha) than 100 cm and 75 cm row spacings during first year. Trend was also similar during the second year. The increase in total dry matter yield at 60 cm row spacing over 100 cm was to the extent of 36% and 29% during first

Table 1. Annual green matter yield of leucaena as influenced by row spacing and phosphorus level.

Treatment	Green matter yield (q/ha)		
	1981–82	1982–83	Mean
Row spacing			
100 cm	287.3	459.4	373.3
75 cm	354.9	510.2	432.4
60 cm	391.6	589.3	490.5
50 cm	385.7	530.3	458.1
C.D. at 5%	22.4	35.5	—
Phosphorus level			
Control (No phosphorus)	329.6	491.8	410.7
60 kg P_2O_5 / ha	360.7	530.0	445.4
120 kg P_2O_5 / ha	374.2	545.1	459.7
C.D. at 5%	19.4	30.7	—

and second year. With the decrease in row spacing from 100 cm to 60 cm, the plant density increased from 1,00,000 to 1,66,000 plants per ha. This increased plant density could contribute to a greater extent for the maximum yield as a result of increased dry matter production per unit area. However, a slight reduction in both green and dry matter yields was observed at 50 cm row spacing compared to 60 cm. This may be probably due to reduced forage fraction as a result ot leaf shedding. The results are in agreement with those of Ferraris (1979) and Shih and Hu (1981) who reported linear increase in green and dry matter yields of leucaena with decreasing row spacing from 90 cm to 30 cm.

During the first year, 60 cm row spacing recorded significantly higher nitrogen uptake (272.39 kg/ha) than 100 cm and 75 cm row spacings (Table 3). During the second year, the nitrogen uptake with 60 cm row spacing (479.10 kg / ha) was significantly higher than other row spacings. The phosphorus uptake by leucaena as influenced by row spacing followed the similar trend as that of nitrogen uptake during both the years. The maximum phosphorus uptake at 60 cm row spacing during first and second year were 29.95 kg and 37.34 kg per ha, respectively. The higher uptake of both the nutrients at 60 cm row spacing are attributed to increased dry matter production. Ferraris (1979) also obtained higher nitrogen uptake at narrow row spacing attributing the reason to higher dry matter yield.

The effect of row spacing had no significant influence on protein content of leucaena forage. However, on an average over two years the protein con-

Table 2. Annual dry matter yield of leucaena as influenced by row spacing and phosphorus level.

Treatment	Dry matter yield (q/ha) 1981–82 Stem fraction	1981–82 Forage fraction	1981–82 Total	1982–83 Stem fraction	1982–83 Forage fraction	1982–83 Total	Average Stem fraction	Average Forage fraction	Average Total
Row spacing									
100 cm	35.7	46.2	81.9	45.7	84.1	129.7	63.5	65.1	105.8
75 cm	44.5	56.5	101.0	45.5	99.5	145.0	45.2	78.0	123.0
60 cm	49.2	62.3	111.5	54.3	113.1	167.4	51.8	87.7	139.5
50 cm	49.3	60.4	109.7	49.1	101.6	150.7	49.2	81.0	130.2
C.D. at 5%	5.8	4.8	6.4	5.5	9.2	10.1	—	—	—
Phosphorus level									
Control (No phosphorus)	41.5	52.3	93.8	47.0	92.2	139.2	44.2	72.3	116.5
60 kg P_2O_5 / ha	45.2	57.5	102.7	49.4	101.2	150.6	47.3	79.4	126.7
120 kg P_2O_5 / ha	47.3	59.2	106.6	49.6	105.3	154.9	48.5	82.3	130.7
C.D. at 5%	3.4	2.8	3.8	5.0	5.5	6.0	—	—	—

Table 3. Annual nitrogen and phosphorus uptake by leucaena as influenced by row spacing and phosphorus level.

Treatment	Nitrogen uptake (kg/ha)			Phosphorus uptake (kg/ha)		
	1981-82	1982-83	Mean	1981-82	1982-83	Mean
Row spacing						
100 cm	200.87	362.02	281.44	22.38	28.48	25.43
75 cm	246.17	418.70	332.43	27.42	32.46	29.94
60 cm	272.39	479.14	375.76	29.95	37.34	33.65
50 cm	265.76	433.04	349.40	29.55	33.43	31.49
C.D. at 5%	19.05	31.50	—	1.68	1.98	—
Phosphorus level						
Control (No phosphorus)	227.68	394.62	311.15	25.00	30.56	27.78
60 kg P_2O_5 /ha	251.47	428.24	339.86	27.63	33.59	30.61
120 kg P_2O_5 / ha	259.75	446.82	353.28	29.04	34.62	31.98
C.D. at 5%	16.50	27.28	—	1.46	2.29	—

tent increased from 24.63% with 100 cm row spacing to 24.91% at 50 cm row spacing (Table 4).

II. Effect of phosphorus level : During the first year, application of either 60 kg or 120 kg P_2O_5 per ha gave signi-

Table 4. The Protein content of leucaena forage as influenced by row spacing and phosphorus level.

Treatment	Protein (%)		
	1981-82	1982-83	Mean
Row spacing			
100 cm	24.44	24.81	24.63
75 cm	24.56	24.88	24.72
60 cm	24.56	25.00	24.78
50 cm	24.75	25.05	24.91
C.D. at 5%	N.S.	N.S.	—
Phosphorus level			
Control (No phosphorus)	24.50	25.06	24.78
60 kg P_2O_5 / ha	24.60	24.69	24.65
120 kg P_2O_5 / ha	24.60	25.06	24.83
C.D. at 5%	N.S.	N.S.	—

NS = Not significant

ficantly higher green matter yield of leucaena than the control treatment (Table 1). Trend was similar during second year. The effect of phosphorus level on stem fraction yield; forage fraction yield and total dry matter yield followed the similar trend as that of green matter yield during both the years (Table 2). The maximum total dry matter yields of leucaena with 120 kg P_2O_5 per ha were 106.6 and 154.9 q per ha during first and second year and were on par with 60 kg P_2O_5 per ha. The increase in total dry matter yield at 120 kg P_2O_5 per ha over the control treatment was to the extent of 13% and 14% during first and second year, respectively. It is indicated from the data that the green and dry matter yields of leucaena were significantly higher at 60 kg or 120 kg P_2O_5 per ha than the control treatment. But the yields at 60 kg and 120 kg P_2O_5 per ha were on par with each other. Therefore, application of phosphorus at 60 kg P_2O_5 per ha is sufficient to increase the biomass of leucaena. Chandrasekaran (1981) reported that manuring of leucaena at 20 kg P_2O_5 per ha was sufficient to increase the biomass under rainfed conditions.

During the first year, application of either 60 kg or 120 kg P_2O_5 per ha recorded significantly higher nitrogen and phosphorus' uptake by leucaena than the control treatment (Table 3). Trend was also similar during second year. Phosphorus uptake by leucaena as influenced by phosphorus level, followed the trend similar to nitrogen uptake during both the years. The higher nitrogen and phosphorus uptake by leucaena either at 60 kg or 120 kg P_2O_5 per ha is attributed to increased total dry matter yields per ha compared to control treatment. Application of phosphorus to leucaena increased the nitrogen uptake (Andrews and Robbins, 1969) and phosphorus uptake (Decayo, 1978) compared to control treatment.

The effect of phosphorus level had also no significant influence on protein content of leucaena forage during both the years (Table 4).

The average data over two years indicated that planting leucaena at 60 cm row spacing and application 60 kg P_2O_5 per ha were found optimum to increase the yield and nutrient uptake. The interaction effects of row spacings and phosphorus levels for all the parameters studied were found nonsignificant.

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