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Growth Response of Lead Plant (*Leucaena leucocephala* Lam de Wit) Seedlings to Application of Molybdenum

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Abstract

A preliminary trial was conducted at the University of Benin Teaching and Research Farm to determine the response of lead plant *Leucaena leucocephala* (Lam) de Wit*)* seedlings to different levels of Mo in a completely randomized design replicated 3 times. The levels of Mo include 0, 50, 100, 150 200 mgMo per 10 kg soil. Results showed that the number of nodules, number of leaves, plant height, stem girth, shoot and root dry matter yield increased with increasing Mo treatments with the 200 mgMo significantly exceeding other treatments including control at final harvest. The soil nutrient components after the trial revealed that there were no consistencies in K, Na, Mg, Ca, organic carbon, ECEC, with increasing Mo treatments. The P and Mo components of the soil however, decreased with increasing Mo application while N and exchangeable acidity content increased with increasing Mo application. The soil pH was fairly constant after the trial and generally, there was an improvement in the nutrient components of the soil after the trial compared to pre-trial nutrient content.

Keywords: *Leucaena leucocephala,* molybdenum, decreasing, increasing, nutrient components,

Introduction

Molybdenum (Mo) is one of those trace elements required in smaller amount for plant normal growth. It is an essential component of nitrate reductase (Remison 1997) and nitrogenase which controls the reduction of inorganic nitrate reductase. The Mo is an essential constituent of leghaemglobin pigment in root nodules of Legume (FAO, 1983). Plants with Mo deficiency have restricted growth, rolled-up or curled leaves and at times their leaves become pale and eventually die-off (Cobbina *et al* 1989). However, Aghatise (1992) recorded increased growth and dry matter yield in Soybean with Mo application. Similarly, Orhue (2001) reported improved growth in *Dialium guinense* seedlings with Mo treatments.

The lead plant (*Leucaena leucocephala)* is a good source of food for ruminants (Lemma, 1992) because of its high palatability, digestibility and nutrient content. Generally, the lead plant is a very good source of protein, carbohydrate, vitamins and minerals (Deman and Rahman, 1985). The seeds contain more protein than the leaves (NAS 1980) and the tree is also very good for reforestation (FAO, 1983). The tree can also fix 75-584 kgN ha^{-1} per year (FAO, 1984) thereby helping to improve the fertility of the soil.

As a result of its wide utilization, its cultivation is being encouraged in the tropics especially in the humid zone of Nigeria where legume production is yet to be adequately entranced. The low cultivation of legumes is because of its non-adaptability and inability of most legumes to carry out N-fixation when macro and micro elements such as Mo are deficient in the soil. Therefore, this study reports the response of *Leucaena leucocephala* seedlings to Mo treatments.

Materials and Methods

The pot trial was conducted at the University of Benin Teaching and Research Farm, Benin City in a completely randomized design with 3 replicates. Ammonium molybdate ($(NH_4)_6Mo_7O_{24}.4H_2O$) was applied at the rates of 0, 50, 100, 150, 200 mg per 10 kg soil. Top soil obtained from 0-15 cm depth was thoroughly mixed, air-dried and 10 kg of the soil was placed into each polythene pot. Each treatment was replicated four times..

The *Leucaena leucocephala* seeds were soaked in hot water at 100°C for 5 minutes and then soaked in ordinary water for 24 hours at room temperature to break seed dormancy. The seeds initially sown 3 seeds per pot were thinned to one seedling 2 weeks after germination while the various rates of Mo were applied 2 weeks after thinning. The seedlings were watered every other day and left to grow under palm frond shade for 84 days. During data collection, regular destructive sampling was
by difference. The exchangeable acidity was determined by KCl extraction and titration methods of Mclean (1965). The effective cation exchange capacity was calculated as the sum of exchangeable bases (Ca, Mg, K, and Na) and exchangeable acidity. The Mo was determined by methods of Soon and Abboud (1993). The data generated were analyzed by Genstat statistical version 6.1.0 234 (Payne, 2002).

Results and Discussion

Effect of Mo on root nodules and plant growth

Nodulation commenced with Mo treated plants 6 weeks after emergence whereas nodules were first noticed in the control plants 8 weeks after emergence (Table 1). This indicates that nodulation in *Leucaena leucocephala* was expedited by Mo application. Also the number of Nodules (Table 1) increased with increasing Mo treatments throughout the growth period. These findings further confirm earlier reports by Cheng and Quellete (1994) and FAO (1983, 1984) that Mo application facilitate nodule formation in legumes.

The application of Mo significantly increased plant height (Table 2) stem girth (Table 3) and number of leaves (Table 4) for most of the growth period which may be due to the effective uptake of most required nutrients needed for growth as a result of the Mo treatments. At final harvest, the plants treated with 200 mgMo performed significantly better than other treatments. Similar result has earlier been reported by Skerman (1977) and Orhue (2001) that Mo increase the development of vegetative growth in legumes provided the soil is not acidic to cause nutrient fixation. The application of Mo also significantly improved on the shoot (Table 5) and root (Table 6) dry weight compared to control except at 8 weeks and 10 weeks after emergence for root dry weight. At final harvest however, the 200 mgMo treatment had the randomly carried out at 15-days interval beginning from 6 weeks after sowing. Measurements were taken on plant height, stem growth, number of leaves and number of nodules. At final harvest, the plants were carefully up –rooted and separated into components of root and shoot, oven dried of 72°C for 48 hours to a constant weight.

Soil analysis was carried out before and after the trial. The soil pH was determined at a soil to water ratio of 1:1 using a glass electrode pH meter. Particle size analysis was determined by the hydrometer method as modified by Day (1965).The N and organic carbon content of the soil were determined by using the methods Okalebo *et al* (1993). The Phosphorus was extracted using Bray No. 1 P solution (Bray and Kurtz 1945) and the P in the extract assayed colorimetrically by the molybdenum blue colour method of Murphy and Riley (1962). The exchangeable bases were extracted using IN neutral ammonium acetate solution. The Ca and Mg content of the extract were determined volumetrically by the EDTA titration procedure (Black, 1965). The K and Na were determined by flame photometry and Mg content obtained highest significant shoot and root dry matter yield. Orhue (2001) also reported similar result with *Dialium guinense* plant.

Table 1: Effect of molybdenum on number of nodules of *Leucaena leucocephala* seedlings

Rate	Weeks After sowing(WAS)			
mg/10 kg soil	6	8	10	12
0	0.00c	1.00a	1.33b	1.33b
50	1.00b	3.00a	3.67a	4.33a
100	1.67a	3.00a	4.00a	4.33a
150	2.00a	3.33a	4.00a	4.67a
200	2.00a	3.67a	4.33a	4.67a
LSD(0.05)	0.4861	1.140	1.498	1.891

Mean values with the same letter in the column are not significantly different from one another at $P < 0.05$

Soil physico-chemical properties before the trial

The chemical properties of the soil before trial are shown in Table 7. The pre – trial soil properties revealed that the soil was acidic, texturally sandy loam with low nutrient content.

Table 2: Effect of molybdenum on height (cm) of *Leucaena leucocephala* seedlings

Rate	Weeks After sowing(WAS)			
mg/10 kg soil	6	8	10	12
0	12.03c	15.32d	16.54d	16.93c
50	12.50c	17.62c	21.43c	25.24b
100	13.83b	20.72b	23.42bc	28.57b
150	14.70ab	21.59b	24.80b	29.45b
200	15.10a	25.68a	32.45a	41.19a
LSD (0.05)	1.003	1.761	2.151	4.122

Mean values with the same letter in the column are not significantly different from one another at P < 0.05

Table 3: Effect of molybdenum on stem girth (cm) of *Leucaena leucocephala* seedlings

Rate	Weeks After sowing(WAS)			
mg/10 kg soil	6	8	10	12
0	0.26b	0.40b	0.49d	0.63c
50	0.38a	0.40b	0.58c	0.84b
100	0.39a	0.40b	0.64b	0.87b
150	0.40a	0.49a	0.67b	0.88b
200	0.40a	0.50a	0.72a	0.98a
LSD (0.05)	0.0647	0.0483	0.0413	0.0456

Mean values with the same letter in the column are not significantly different from one another at P < 0.05

Table 4: Effect of molybdenum on number of leaves of *Leucaena leucocephala* seedlings

Rate	Weeks After sowing(WAS)			
mg/10 kg soil	6	8	10	12
0	5.77a	9.30	11.20d	13.07b
50	5.90a	10.30	13.00c	17.97a
100	6.00a	10.87bc	13.63c	18.67a
150	6.00a	11.40ab	14.60b	22.50a
200	6.07a	12.30a	16.27a	24.50a
LSD (0.05)	0.5035	1.048	0.743	2.412

Mean values with the same letter in the column are not significantly different from one another at P < 0.05

Table 5: Effect of molybdenum on shoot dry weight (g) of *Leucaena leucocephala* seedlings

Rate	Weeks After sowing(WAS)			
mg/10 kg soil	6	8	10	12
0	0.08b	0.10c	0.13d	0.23c
50	0.10a	0.15b	0.36c	1.50b
100	0.10a	0.06b	0.37ab	1.50b
150	0.10a	0.16b	0.37ab	1.50b
200	0.11a	0.19a	0.38a	1.68a
LSD (0.05)	0.4861	1.140	1.498	1.891

Mean values with the same letter in the column are not significantly different from one another at P < 0.05

Table 6: Effect of molybdenum on root dry weight (g) of *Leucaena leucocephala* seedlings

Rate	Weeks After sowing(WAS)			
mg/10 kg soil	6	8	10	12
0	0.01b	0.05a	0.08a	0.10b
50	0.01b	0.05a	0.09a	0.11b
100	0.02ab	0.05a	0.09a	0.11b
150	0.03a	0.05a	0.09a	0.11b
200	0.03a	0.05a	0.09a	0.13a
LSD (0.05)	0.0137	0.0342	0.0206	0.0141

Mean values with the same letter in the column are not significantly different from one another at P < 0.05

Soil physico-chemical properties after the trial

The chemical properties of the soil after the trial are shown in Table 7. The fluctuations in some of the soil nutrient elements such as K, Mg, Ca, Mo and Na may be due to their uptake by the plant as well as mineralization of organic matter in the soil. This mineralization also may be responsible for the increase in organic carbon content of the soil. The decreased Mo with increasing Mo treatments may due to the synergistic effect of P and Mg on Mo uptake as earlier reported by Tisdale *et al* (1985) that Mg and P enhance the absorption and translocation of Mo by plants. The present level of soil pH may have facilitated the uptake of Mo as reported by Tisdale et al (1985) that the availability of Mo unlike other micro nutrients increases with decreasing soil acidity. The significant increase in N may be tied to the N-fixation effected by Mo application as earlier reported by Aghatise (1992) and FAO (1984). The pH and exchangeable acidity were however fairly constant with no significant differences recorded among the various Mo treatments while the effective cation exchange capacity was however not consistent with increasing Mo application but significant differences were recorded.

Conclusion

The study indicated that the plants treated with Mo performed better than the control in the growth parameters with the 200 mgMo treatment significantly higher than other treatments including the control. In addition, the soils treated with Mo had higher N after the trial compared to control. Thus it can be said that Mo is good for *Leucaena leucocephala* seedlings especially at 200 mgMo treatment where more N is fixed in the soil. However more trials are recommended to ascertain the level of Mo required by the plant.

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Table 7: Some physico-chemical properties of the soil used before and after the trial

Rate mg/10kg Soil	pH(H_2O 1:1)	Org C gkg^{-1}	Av P $mgkg^{-1}$	Total N gkg^{-1}	Ca	Mg	K	Na	Exch acidity	ECEC	Mo $mgkg^{-1}$	sand	Silt	clay
					←		cmolkg^{-1}			→		←	gkg^{-1}	→
Before	the	Trial												
	5.40	8.23	5.10	0.50	0.05	0.06	0.10	0.05	0.61	0.87	0.50	876	39.50	84.50
After	the	Trial												
0	5.42a	12.51a	5.09a	3.86b	0.52a	0.06d	0.50a	0.16a	0.62a	1.86b	0.41d	877.00a	38.50a	84.50a
50	5.50a	10.30b	2.53b	4.00b	0.30c	0.15a	0.29b	0.15a	0.68a	1.47c	1.78a	877.30a	40.53a	82.17b
100	5.50a	10.00b	2.31b	4.60ab	0.32bc	0.14ab	0.38b	0.15a	0.70a	1.69c	1.23b	875.00b	40.50a	84.50a
150	5.50a	9.80b	2.10b	5.10a	0.34b	0.12bc	0.57a	0.15a	0.70a	1.88ab	0.83c	877.30a	38.13a	84.57a
200	5.50a	9.60b	1.10c	5.60a	0.53a	0.10c	0.50a	0.16a	0.70a	1.99a	0.82c	877.30a	39.20a	83.50b
LSD(0.05)	0.813	1.125	0.5667	1.017	0.0245	0.0285	0.0993	0.1028	0.0918	0.1218	0.0969	1.191	19.49	0.4861

Mean values with the same letter in the column are not significantly different from one another at $P < 0.05$