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Effect of Soil Amendments and Chemical Fertilization on Growth and Chemical Composition of *Tecoma capensis*, Lindl. Plants

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Abstract: This study was carried out in the experimental nursery of the Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Giza, Egypt during the two successive seasons of 2005/2006 and 2006/2007 with the aim of investigating the response of *Tecoma capensis* plants grown in sandy soil alone or sandy soil amended with clay, cattle manure or poultry manure (soil amendments were added to the sandy soil at 1:5, v/v) to conventional NPK fertilizer (18 N-6 P_2O_5-6 K_2O) at four rates, viz., 3, 4, 5 or 6 g/plant/month. In addition, unfertilized plants were used as the control. The results showed that, in most cases, plants grown in sandy soil amended with clay and fertilized with 5 g NPK/plant/month gave the best vegetative growth parameters.

Key words: *Tecoma capensis* · Fertilization · Soil amendments · Clay · Cattle manure · Poultry manure · NPK

INTRODUCTION

During the last few years, large scale urban development has been taking place in Egypt, including the construction of new cities, residential compounds, as well as coastal touristic resorts and hotels. Such projects usually involve extensive landscape development, most of which takes place in desert areas, with poor sandy or rocky soils. Soil amendments are often used to improve the chemical characteristics of the soil by increasing the supply of macro-and micro-nutrients and organic matter. They also improve the physical properties of sandy soil by increasing their water holding capacity. Soil amendments have shown considerable potential for use in the landscape for improving the impoverished soils, they may simply be soils such as clay, which have better characteristics than the poor sandy soil of the reclaimed areas [1,2] or may be of organic origin, such as cattle and poultry manures [3].

The nutrients supplied by NPK fertilization are necessary for the various biochemical processes that occur within the plant and that are essential for normal plant growth and development [4]. Different NPK fertilization treatments have favourably influenced the growth of several shrubs such as *Plumbago capensis* [2] and *Senna occidentalis* [5].

Tecoma capensis, commonly known as Cape Honeysuckle belongs to family Bignoniaceae. It is a scrambling shrub which is native to Africa. It grows to about 2 to 3 meters in height and a similar width. It is normally an evergreen shrub, but semi-deciduous in colder climates. They are opposite, slightly serrated, green to dark-green, pinnate with 5 to 9 oblong leaflets. Flower color ranges from orange to orange-red to apricot and are produced at different times throughout the year. In addition, these are tubular, narrow, about 7.5 cm long. They are grouped in terminal clusters that are 10-15 cm long. The species occurs naturally in South Africa, Swaziland and southern Mozambique. Cape Honeysuckle has been in cultivation for many years and is often used for hedging, as it is a scrambling shrub. It can be propagated by cuttings or by removing rooted suckers during the active growth phase. It can be planted in semi-shade to full sun. To keep this shrub clean and tidy, it must be pruned back in late winter to promote new growth and flowers. The application of a balanced fertilizer after pruning will enhance the growth and flowering [6].

This study was conducted with the aim of investigating the response of *Tecoma capensis* plants grown in a sandy soil alone or sandy soil amended with some soil amendments to conventional NPK fertilizer rates.

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MATERIALS AND METHODS

This study was carried out in the experimental nursery of the Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Giza during the two successive seasons of 2005/2006 and 2006/2007. The aim of this study was to investigate the response of *Tecoma capensis* plants grown in a sandy soil alone or sandy soil amended with clay, cattle manure or poultry manure to conventional NPK fertilization treatments.

On the 1st of March, 2005 and 2006 (in the first and second seasons, respectively) plantlets of *Tecoma capensis* were obtained from the local nurseries in El-Qanater El-Khaireya, Qalyoubia Governorate. The plantlets, 25 cm tall with 2 branches/plant, were planted individually in plastic pots (30-cm diameter) filled with sand, sand + clay (5:1, v/v), sand + cattle manure (5:1, v/v), or sand + poultry manure (5:1, v/v). The sand was obtained from the Giza desert, while the clay was obtained from the experimental nursery of the Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Giza. The cattle and poultry manures were obtained from Faculty of Agriculture, Cairo University. The physical and chemical characteristics of sand, clay are shown in Table 1, while the physical and chemical characteristics of cattle and poultry manures are presented in Table 2. The pots were placed in a sunny area and thick polyethylene sheets were spread underneath the pots to prevent the roots from growing into the soil.

In both seasons, plants grown in each of the tested growing media were supplied with different fertilization treatments. The fertilization treatments were applied from 1st April 2005 and 2006 in both seasons, respectively till 1st January 2006 and 2007 (in the first and second seasons, respectively). The plants were fertilized with different rates of conventional NPK fertilizer (18 N-6 P_2O_5-6 K_2O). One kilogram of conventional NPK fertilizer was prepared by mixing 391.3 g urea (46% N), 387.1 g calcium superphosphate (15.5% P_2O_5), 125 g potassium sulphate (48% K_2O) and 96.6 g sand as an inert component. Plants receiving conventional NPK fertilizer were treated with monthly applications of this mixture, at four rates, viz., 3, 4, 5 or 6 g/plant. In addition, unfertilized plants were used as the control. Common cultural practices were followed.

Table 1: Physical and chemical characteristics of the sand and clay used for growing *Tecoma capensis* plants during the 2005/2006 and 2006/2007seasons

Soil characteristics	Sand	Clay
Physical characteristics		
Texture	Sand	Clay
Coarse sand (%)	41.40	6.40
Fine sand (%)	52.70	12.70
Slit (%)	3.40	10.30
Clay (%)	2.50	70.60
$CaCO_3$ (%)	0.98	1.70
CEC (meq/100g)	5.30	39.40
Field capacity (%v)	16.00	67.30
Chemical characteristics		
Organic matter (%)	1.10	41.33
pH	7.90	7.12
EC(dS/m)	2.25	1.67
N(ppm)	13.13	93.35
P (ppm)	7.40	20.25
K(ppm)	48.65	71.85

The layout of the experiment was a randomized complete blocks design, with 20 treatments [5 fertilization treatments (including the control) X 4 growing media] and 3 blocks (replicates). Each block consisting of 80 plants (4 plants/treatment).

On the 30th of January 2006 and 2007 (in the first and second seasons, respectively), the experiment was terminated and the following data were recorded: plant height (cm), stem diameter (mm), number of branches/ plant, fresh and dry weights of leaves, stems and roots (g/ plant). Also, chemical composition including total chlorophylls [7], total carbohydrate percentage in dry shoots (leaves + stems) [8] as well as nitrogen [9], phosphorus [10] and potassium by using an Atomic Absorption Flame Spectrophotometer (Philips, model PU 9100X) percentages in shoots after the samples were digested for extracting minerals [11].

Table 2: Physical and chemical characteristics of the cattle and poultry manures incorporated into the sandy soil before planting *Tecoma capensis* plants during the 2005/2006 and 2006/2007seasons

Organic fertilizers	Physical characteristics		Chemical characteristics							
	Density (g/cm^3)	Humidity (%)	Organic matter (%)	N (%)	P (%)	K (%)	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)
cattle manure	0.50	10.5	59.3	1.7	1.3	1.8	850.2	45.8	96.1	15.1
Poultry manure	0.56	15.0	69.7	3.1	1.3	2.5	765.4	61.3	88.5	9.5

The data recoded on vegetative growth, were statistically analyzed. An analysis of variance (ANOVA) was carried out and the means of the recorded data were compared using the Least Significant Difference (L.S.D.) test at the 5% level [12].

RESULTS AND DISCUSSION

The results showed that the *Tecoma capensis* plants failed to survive in sandy soil only.

Vegetative Growth Characteristics

Plant Height: Data tabulated in Table 3 showed that in the first season, plant height of plants grown in sandy soil amended with clay was the significantly higher plant height. In the second season, plants grown in sandy soil amended with poultry manure gave the highest plant height followed by that grown in sandy soil amended with cattle manure and that grown in sandy soil amended with clay with no significant difference among them.

Plants fertilized with NPK gave significantly higher plants as compared to the unfertilized control plants, in most cases. In both seasons, raising NPK fertilization rate resulted in steady increase in plant height, in most cases. In both seasons, plants fertilized with NPK at 5 g/plant/month gave the significantly higher plants as compared to the other treatments.

In the first season, plants grown in sandy soil amended with clay and fertilized with 5 g NPK /plant/month gave the highest plant height. In the second season, plants grown in sandy soil amended with cattle manure and fertilized with 6gNPK /plant/month gave the highest plants. In the second season, plant height of plants grown in sandy soil amended with poultry manure and fertilized with NPK at 3, 4 or 5 g/plant/month and that grown in sandy soil amended with clay or cattle manure and received 5 g/plant/month were not significantly different than the highest plant height.

Table 3: Effect of growing media and chemical NPK fertilizer on plant height (cm), number of branches/plant and stem diameter (mm) of *Tecoma capensis* plants during the 2005/2006 and 2006/2007 seasons

	First season (2005/2006)				Second season (2006/2007)			
	Growing media (G)				Growing media (G)			
NPK Fertilization (F)	Sand + clay	Sand + cattle manure	Sand + poultry manure	Mean (F)	Sand + clay	Sand + cattle manure	Sand + poultry manure	Mean (F)
	Plant height (cm)							
Control	80.50	77.00	82.83	80.11	98.00	93.50	89.00	93.50
3 g/plant/month	115.30	79.33	93.17	95.94	94.00	93.50	106.30	97.94
4 g/plant/month	101.50	94.67	95.83	97.33	98.83	103.00	111.00	104.30
5 g/plant/month	141.20	91.67	108.30	113.7	116.00	112.70	115.80	114.80
6 g/plant/month	82.33	75.33	85.50	81.06	85.67	116.70	101.20	101.20
Mean (G)	104.20	83.60	93.13	----	98.50	103.90	104.70	----
LSD $_{(0.05)}$ G			5.00			6.26		
F			7.19			7.24		
G × F			12.59			11.94		
	Number of branches/plant							
Control	15.7	28.7	21.3	21.9	20.7	28.3	15.7	21.6
3 g/plant/month	23.0	29.0	26.0	26.0	21.3	35.3	20.7	25.8
4 g/plant/month	24.0	30.7	20.3	25.0	21.3	23.7	20.7	21.9
5 g/plant/month	24.0	30.7	19.3	24.7	21.3	19.3	25.0	21.9
6 g/plant/month	13.0	28.3	13.7	18.3	17.7	21.0	21.7	20.1
Mean (G)	19.9	29.5	20.1	----	20.5	25.5	20.8	----
LSD $_{(0.05)}$ G			2.0			1.9		
F			2.9			2.8		
G × F			4.7			4.5		
	Stem diameter (mm)							
Control	4.9	8.5	6.2	6.5	9.2	11.9	12.0	11.0
3 g/plant/month	8.3	10.2	8.7	9.1	9.1	13.7	16.9	13.2
4 g/plant/month	9.5	11.6	13.1	11.4	7.3	13.1	9.8	10.1
5 g/plant/month	15.5	11.8	13.7	13.7	12.8	12.7	10.4	12.0
6 g/plant/month	5.2	9.7	12.6	9.2	8.9	11.3	10.7	10.3
Mean (G)	8.7	10.4	10.8	---	9.5	12.5	12.0	---
LSD $_{(0.05)}$ G			0.8			0.7		
F			1.1			1.3		
G × F			1.9			1.8		

Number of Branches/plant: In both seasons, Table 3 showed that plants grown in sandy soil amended with cattle manure gave the significantly higher number of branches/plant.

Raising fertilization rate to 3 g NPK/plant/month gave the significantly higher number of branches as compared to the other fertilization treatments.

In the first season, plants grown in sandy soil amended with cattle manure and fertilized with 4 or 5 g NPK /plant/month gave the highest number of branches/plant. There was no significant difference in number of branches among plants grown in sandy soil amended with cattle manure either unfertilized or fertilized with 3, 4, 5 or 6 g NPK /plant/month. In the second season plants grown in sandy soil amended with cattle manure and fertilized with 3 g/plant/month gave the highest number of branches/plant.

Stem Diameter: Table 3 revealed that, in the first season plants grown in sandy soil amended with poultry manure had the thickest stems followed by plants grown in sandy soil amended with cattle manure with no significant difference between them. In the second season plants grown in sandy soil amended with cattle manure had the thickest stems followed by plants grown in sandy soil amended with poultry manure with no significant difference between them.

In the first season, the significantly thickest stems were obtained with plants fertilized with 5 g NPK/plant/month. In the second season, the significantly thickest stems were obtained with plants fertilized with 3 g NPK/plant/month followed by that received 5 g NPK/plant/month with no significant difference between them.

In the first season plants grown in sandy soil amended with clay and fertilized with 5 g NPK /plant/month gave the thickest stem followed by plants grown in sandy soil amended with poultry manure and received the same fertilization treatment with no significant difference between them. In the second season, plants grown in sandy soil amended with poultry manure and fertilized with 3 g/plant/month gave the thickest stem.

Fresh Weight of Leaves: Table 4 revealed that the fresh weight of leaves was significantly affected by different growing media in the second season only. In the first season, fresh weight of leaves of plants grown in sandy soil amended with cattle manure gave the heaviest fresh weight. In the second season, plants grown in sandy soil amended with poultry manure gave the heaviest fresh leaves.

Fresh weight of leaves was significantly affected by fertilization treatments, in some cases. In the first season, plants fertilized with 5 g NPK/plant gave the significantly heaviest leaves. In the second season, plants fertilized with 3 g NPK/plant gave the significantly heavier leaves as compared to the other fertilization treatments.

In the first season plants grown in sandy soil amended with cattle manure and fertilized with 5 g NPK /plant/month gave the heaviest fresh leaves followed by that received the same fertilization rate and grown in sandy soil amended with clay and that grown in sandy soil amended with cattle manure and fertilized with 6 g/plant/month with no significant difference among them. In the second season, plants grown in sandy soil amended with clay and fertilized with 4, 5 or 6 g/plant/month gave the significantly heaviest leaves with no significant difference among them.

Fresh Weight of Stems: Table 4 showed that, in both seasons, plants grown in sandy soil amended with poultry manure gave the heaviest fresh weight of stems. In the second season, there was no significant difference between plants grown in sandy soil amended with poultry manure and that grown in sandy soil amended with clay.

Fresh weight of stems was significantly affected by fertilization treatments. In both seasons, plants fertilized with 5 g NPK / plant/month gave the heaviest fresh weight of stems.

In the first season, plants grown in sandy soil amended with poultry manure and fertilized with 3 g/plant/month gave the heaviest stems followed by plants grown in sandy soil amended with clay and received 5 g NPK/plant/month with no significant difference between them. In the second season, plants grown in sandy soil amended with clay and fertilized with 5 g NPK / plant/month gave the heaviest stems.

Fresh Weight of Roots: Table 4 revealed that, in both seasons, plants grown in sandy soil amended with clay gave the significantly heaviest fresh weight of roots. In the second season, there was no significant difference between plants grown in sandy soil amended with clay and that grown in sandy soil amended with cattle manure.

In the first season, plants fertilized with 5 g/plant/month gave the heaviest fresh roots, whereas plants fertilized with 3 g/plant/month gave the heaviest fresh roots in the second season.

Table 4: Effect of growing media and chemical NPK fertilizer on fresh weights of leaves, stems and roots of *Tecoma capensis* plants during the 2005/2006 and 2006/2007 seasons

		First season (2005/2006)				Second season (2006/2007)			
		Growing media (G)				Growing media (G)			
NPK Fertilization (F)		Sand + clay	Sand + cattle manure	Sand + poultry manure	Mean (F)	Sand + clay	Sand + cattle manure	Sand + poultry manure	Mean (F)
		Fresh weight of leaves (g/plant)							
Control		21.6	45.4	68.5	45.2	51.3	12.0	54.4	39.2
3 g/plant/month		63.3	45.4	55.3	54.7	49.5	96.5	58.2	68.1
4 g/plant/month		58.4	39.3	49.2	49.0	62.5	10.8	32.6	35.3
5 g/plant/month		76.8	83.2	34.5	64.8	69.9	11.4	45.7	42.3
6 g/plant/month		41.0	68.8	36.1	48.6	63.7	13.1	44.0	40.3
Mean (G)		52.2	56.4	48.7	---	59.4	28.8	47.0	----
$LSD_{(0.05)}$	G			7.8			6.8		
	F			10.4			8.5		
	G × F			17.4			14.6		
		Fresh weight of stems (g/plant)							
Control		46.9	74.0	135.1	85.3	62.1	56.7	89.1	69.3
3 g/plant/month		122.5	113.8	174.1	136.8	122.8	86.8	143.4	117.7
4 g/plant/month		133.7	151.3	151.5	145.5	156.6	91.9	151.8	133.4
5 g/plant/month		166.6	139.6	142.9	149.7	193.7	61.0	154.5	136.4
6 g/plant/month		103.5	64.8	72.6	80.3	114.3	30.7	141.8	95.6
Mean (G)		114.6	108.7	135.2	----	129.9	65.4	136.1	----
$LSD_{(0.05)}$	G			14.8			13.9		
	F			18.1			17.7		
	G × F			32.3			30.1		
		Fresh weight of roots (g/plant)							
Control		196.7	130.9	169.4	165.7	134.9	129.0	82.0	115.3
3 g/plant/month		248.4	192.2	189.2	209.9	177.8	216.9	129.2	174.7
4 g/plant/month		239.0	158.1	234.2	210.5	138.0	213.4	170.9	174.1
5 g/plant/month		341.4	268.6	176.8	262.3	227.6	127.0	151.1	168.6
6 g/plant/month		225.4	147.2	174.3	182.3	135.3	100.0	134.3	123.2
Mean (G)		250.2	179.4	188.8	----	162.7	157.3	133.5	----
$LSD_{(0.05)}$	G			32.1			18.9		
	F			40.8			24.9		
	G × F			70.4			42.6		

In both seasons the plants grown in sandy soil amended with clay and received 5 g NPK/plant/month gave the significantly heaviest fresh roots.

Dry Weight of Leaves: Table 5 revealed that, in the first season, dry weight of leaves of plants grown in sandy soil amended with cattle manure gave the heaviest weight followed by plants grown in sandy soil amended with poultry manure then sandy soil amended with clay, with no significant difference among them. In the second season, plants grown in sandy soil amended with clay gave the heaviest dry leaves.

In the first season, plants fertilized with 5 g NPK/plant gave the significantly heaviest dry leaves. In the second season, plants fertilized with 3 g NPK/plant gave the significantly heaviest dry leaves.

In the first season, plants grown in sandy soil amended with clay and fertilized with 5 g/plant/month gave the heaviest dry weight of leaves. In the second season, plants grown in sandy soil amended with cattle manure and fertilized with 3 g NPK/plant/month gave the significantly heaviest dry leaves.

Table 5: Effect of growing media and chemical NPK fertilizer on dry weights of leaves, stems and roots of *Tecoma capensis* plants during the 2005/2006 and 2006/2007 seasons

	First season (2005/2006)				Second season (2006/2007)			
	Growing media (G)				Growing media (G)			
NPK Fertilization (F)	Sand + clay	Sand + cattle manure	Sand + poultry manure	Mean (F)	Sand + clay	Sand + cattle manure	Sand + poultry manure	Mean (F)
	Dry weight of leaves (g/plant)							
Control	16.50	10.43	40.13	22.35	24.27	7.31	26.74	19.44
3 g/plant/month	19.18	31.52	27.03	25.91	28.13	53.52	27.76	36.47
4 g/plant/month	15.87	32.03	29.91	25.94	39.71	5.44	16.22	20.4
5 g/plant/month	46.95	37.17	16.61	33.58	37.59	6.67	22.96	22.46
6 g/plant/month	33.41	24.02	19.93	25.79	37.23	7.73	20.40	21.79
Mean (G)	26.38	27.03	26.72	----	33.39	16.13	22.82	-----
LSD $_{(0.05)}$ G			3.85			3.41		
F			5.14			4.57		
G × F			8.56			8.58		
	Dry weight of stems (g/plant)							
Control	37.46	29.55	63.82	43.61	34.00	32.20	35.66	33.96
3 g/plant/month	63.23	78.63	96.32	79.39	74.45	47.54	55.25	59.08
4 g/plant/month	79.14	71.84	79.67	76.88	91.13	49.90	51.82	64.28
5 g/plant/month	85.45	93.07	66.21	81.57	114.00	37.51	72.68	74.74
6 g/plant/month	28.29	53.50	41.59	41.13	71.66	21.42	73.65	55.58
Mean (G)	58.71	65.32	69.52	----	77.05	37.71	57.81	----
LSD $_{(0.05)}$ G			7.69			7.03		
F			10.26			9.11		
G × F			17.09			15.37		
	Dry weight of roots (g/plant)							
Control	116.6	79.4	71.8	89.3	72.6	68.7	28.8	56.7
3 g/plant/month	137.1	109.8	84.4	110.4	88.9	135.4	39.8	88.0
4 g/plant/month	128.5	108.3	115.9	117.6	96.7	113.9	51.7	87.4
5 g/plant/month	181.6	147.3	91.3	140.1	122.2	68.3	61.9	84.1
6 g/plant/month	127.5	84.8	80.1	97.5	72.3	61.3	41.6	58.4
Mean (G)	138.3	105.9	88.7	----	90.5	89.5	44.8	---
LSD $_{(0.05)}$ G			18.0			10.2		
F			24.3			13.3		
G × F			42.4			23.3		

Dry Weight of Stems: Table 5 showed that, in the first season, plants grown in sandy soil amended with poultry manure gave the heaviest dry weight of stems followed by plants grown in sandy soil amended with cattle manure with no significant difference between them. In the second season, plants grown in sandy soil amended with clay gave the significantly heaviest dry weight of stems.

Dry weight of stems was significantly increased by fertilization treatments, in most cases. In both seasons, increasing fertilization rates up to 5 g NPK/plant resulted in a steadily increase in dry weight of stems, so the heaviest dry weight of stems was recorded with plants fertilized with 5 g NPK/plant.

In the first season, plants grown in sandy soil amended with poultry manure and fertilized with 3 g NPK /plant/month gave the heaviest stems. In the second season, plants grown in sandy soil amended with clay and fertilized with 5 g NPK / plant/month gave the heaviest stems.

Dry Weight of Roots: In both seasons, plants grown in sandy soil amended with clay gave the significantly heaviest dry weight of roots. In the second season, there was no significant difference between the plants grown in sandy soil amended with clay and that grown in sandy soil amended with cattle manure.

Table 6: Effect of growing media and chemical NPK fertilizer on total chlorophylls and carotenoids in leaves as well as total carbohydrates, N, P and K% in branches of *Tecoma capensis* plants during the 2005/2006 and 2006/2007 seasons

	First season (2005/2006)				Second season (2006/2007)			
	Growing media (G)				Growing media (G)			
NPK Fertilization (F)	Sand + clay	Sand + cattle manure	Sand + poultry manure	Mean (F)	Sand + clay	Sand + cattle manure	Sand + poultry manure	Mean (F)
	Total chlorophylls content (mg/g fresh matter)							
Control	1.20	1.18	1.11	1.16	1.31	1.21	1.13	1.22
3 g/plant/month	1.35	1.24	1.18	1.26	1.32	1.31	1.18	1.27
4 g/plant/month	1.42	1.35	1.28	1.35	1.48	1.36	1.25	1.36
5 g/plant/month	1.57	1.40	1.30	1.42	1.60	1.44	1.34	1.46
6 g/plant/month	1.69	1.43	1.37	1.50	1.69	1.56	1.36	1.54
Mean (G)	1.45	1.32	1.25	---	1.48	1.38	1.25	---
	Total carotenoids content (mg/g fresh matter)							
Control	0.34	0.30	0.21	0.28	0.35	0.27	0.20	0.27
3 g/plant/month	0.42	0.32	0.26	0.33	0.40	0.37	0.27	0.35
4 g/plant/month	0.57	0.43	0.36	0.45	0.56	0.44	0.33	0.44
5 g/plant/month	0.69	0.53	0.39	0.54	0.64	0.55	0.40	0.53
6 g/plant/month	0.85	0.57	0.45	0.62	0.83	0.67	0.44	0.65
Mean (G)	0.57	0.43	0.33	---	0.56	0.46	0.33	---
	Total carbohydrates content (% of dry matter)							
Control	25.1	21.8	21.1	22.7	22.1	21.7	19.8	21.2
3 g/plant/month	26.7	23.5	22.9	24.4	23.8	22.5	21.4	22.6
4 g/plant/month	26.9	24.3	23.1	24.8	24.7	22.9	21.9	23.2
5 g/plant/month	29.5	24.8	24.1	26.1	24.9	23.7	22.2	23.6
6 g/plant/month	29.8	25.6	24.5	26.6	25.2	23.8	23.7	24.2
Mean (G)	27.6	24.0	23.1	---	24.1	22.9	21.8	---
	N content (% of dry matter)							
Control	1.08	1.05	1.04	1.06	1.29	1.17	1.11	1.19
3 g/plant/month	1.31	1.25	1.15	1.24	1.46	1.25	1.20	1.30
4 g/plant/month	1.49	1.31	1.25	1.35	1.53	1.49	1.28	1.43
5 g/plant/month	1.69	1.42	1.36	1.49	1.69	1.60	1.31	1.53
6 g/plant/month	2.11	1.55	1.40	1.69	1.72	1.70	1.42	1.61
Mean (G)	1.54	1.32	1.24	---	1.54	1.44	1.26	---
	P content (% of dry matter)							
Control	0.11	0.10	0.08	0.10	0.12	0.07	0.06	0.08
3 g/plant/month	0.18	0.13	0.11	0.14	0.15	0.12	0.08	0.12
4 g/plant/month	0.22	0.15	0.12	0.16	0.19	0.15	0.11	0.15
5 g/plant/month	0.23	0.19	0.15	0.19	0.21	0.20	0.18	0.20
6 g/plant/month	0.26	0.21	0.16	0.21	0.30	0.24	0.21	0.25
Mean (G)	0.20	0.16	0.12	---	0.19	0.16	0.13	---
	K content (% of dry matter)							
Control	1.18	1.14	1.11	1.14	1.31	1.25	1.19	1.25
3 g/plant/month	1.63	1.31	1.28	1.41	1.52	1.37	1.29	1.39
4 g/plant/month	1.72	1.45	1.34	1.50	1.64	1.55	1.41	1.53
5 g/plant/month	1.81	1.65	1.48	1.65	1.85	1.74	1.52	1.70
6 g/plant/month	2.18	1.70	1.65	1.84	1.98	1.81	1.60	1.80
Mean (G)	1.70	1.45	1.37	---	1.66	1.54	1.40	---

In the first season, plants fertilized with 5 g NPK /plant/month gave the heaviest dry roots. In the second season, plants fertilized with 3 g/plant/month gave the heaviest dry roots followed by plants fertilized with 4 and 5 g/plant/month with no significant difference among them.

In the first season, plants grown in sandy soil amended with clay and fertilized with 5 g/plant/month gave the heaviest dry roots. In the second season, plants grown in sandy soil amended with cattle manure and fertilized with 3 g NPK / plant/month gave the heaviest dry roots. Plants grown in sandy soil amended with clay and received 5 g NPK/plant/month as well as plants grown in sandy soil amended with cattle manure and received 4 g NPK/plant/month gave insignificantly lower dry weight of roots than that the heaviest dry weight of roots recorded with plants grown in sandy soil amended with cattle manure and fertilized with 3 g NPK/plant/month.

The superior effect of clay, compared to sand and other soil amendments, may be attributed to the ability of the negative charged clay particles to attract and hold the positively charged cations in the soil and to provide the plant roots with these cations (clay has a high cation exchange capacity). Also, clay has a high water-holding capacity which, in turn, allows higher absorption of water and nutrients from the soil and enables photosynthesis to occur efficiently within the plant leaves [13]. Such results were reported on *Senna occidentalis* [1]and *Plumbago capensis* [2].

Chemical Composition: Chemical analysis of fresh leaf samples had revealed that the total chlorophylls, carotenoids content in fresh leaves; carbohydrates content as well as N, P and K% in dry branches (leaves + stems) was considerably affected by the different growing media and NPK fertilizer rates (Table 6). In both seasons, leaves of plants grown in sandy soil amended with clay had higher values followed by those grown in sandy soil amended with cattle manure then plants grown in sandy soil amended with poultry manure. The favourable effect of clay on carbohydrate synthesis and accumulation may be attributed to its high cation-exchange and water-holding capacities. The high cation exchange capacity of clay allows the plant roots to take up the potassium needed for activation of the enzymes necessary for photosynthesis, while the high water-holding capacity ensures a sufficient water supply for nutrient absorption and for efficient photosynthesis. Also, the high water-holding capacity of clay prevents the leaching of NO_3^- ions from the soil and makes them available to the plant roots. The nitrogen absorbed in this form is used by the plants in the synthesis of the porphyrine molecules, which are essential in the structure of chlorophylls and, consequently, the synthesis of carbohydrates [4,14]. Such results were reported on *Senna occidentalis* [1] and *Plumbago capensis* [2].

In both seasons, plants received different fertilization treatments had the higher total chlorophylls, carotenoids content in fresh leaves; carbohydrates content as well as N, P and K% in dry branches (leaves + stems) as compared to unfertilized plants (control). These chemical constituents of *Tecoma capensis* plants were increased as a result of increasing NPK fertilization rate. These results are reasonable, since the nitrogen supplied by fertilization is essential in the structure of porphyrines, which are found in many metabolically active compounds, including chlorophylls. Chlorophylls are bound to and perhaps even embedded within protein molecules. Also, the porphyrine molecules are found in the cytochrome enzymes essential in photosynthesis. This increase in the contents of chlorophylls and cytochrome enzymes results in an increase in the rate of photosynthesis and a promotion in carbohydrate synthesis and accumulation. Moreover, the potassium added by fertilization acts as an activator for several enzymes involved in carbohydrate metabolism [4, 14].

The increase in the content of N was explained by Jain [15], who stated that raising the levels of N, P and K in the root medium leads to an increase in vegetative growth and that this may be accompanied by an increase in the absorption of these essential elements. Such results were reported on *Senna occidentalis* [1] and *Plumbago capensis* [2].

In both seasons, the highest values of the previous chemical constituents were found in the plants grown in sandy soil amended with clay and received 6gNPK /plant/month.

CONCLUSION

From the above mentioned results it can be concluded that plants grown in sandy soil amended with clay and fertilized with 5 g NPK/plant/month gave the best vegetative growth parameters.

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