

ORGANIC FERTILIZER AND HUMIC SUBSTANCE EFFECTS ON LETTUCE CHARACTERISTICS AND NUTRITION

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ABSTRACT

The aim of this work was to test organic fertilizers, liming, and levels of soil a conditioner composed by humic and fulvic acids on the characteristics and nutrition of "iceberg" lettuce. The experimental design was completely randomized in a 5x3x2 factorial scheme, in which 5 levels of soil conditioner (0, 20, 40, 100, 200 L ha⁻¹), 3 fertilizers (chicken manure, organic compost and mineral), and liming (with or without). Lettuce shoot fresh and dry weight, shoot commercial fresh and dry weight, height, circumference, and number of leaves were evaluated. Lettuce grown with chicken manure rendered the greater circumference and higher shoot fresh commercial weight, which are the most important lettuce characteristics affecting consumer purchase decisions. The soil conditioner did not influence on plant growth, except height and dry shoot weight on a very small scale.

INTRODUCTION

Nowadays, studies on the use of organic materials are very important as the price of fertilizers is increasing globally. Chicken as well as cattle manure complex toxic AI, enhances soil pH, and phosphorus, calcium, and magnesium content. However, there is a small amount of information concerning effects of chicken manure, and organic compost on lettuce characteristics and nutrition. Several kinds of soil conditioners, produced from organic sources, such as organic composts, humus, and coal, are being sold in the market. The humic compounds may be absorbed by roots and transported to shoots, thus enhancing the growth of the whole plant (Lulakis and Petsas, 1995). Effects of soil conditioners on plants were reported to improve the soil chemically, increases cation exchange capacity, stimulates microbial activity, increases soil capacity to complex and solubilize ions, complexes nutrients and toxic aluminum (Stevenson, 1994). However, there are divergent findings about humic substance effects on plants. Its effects may be attributed to many factors, including the nature, source and concentration of humic substances, soils, pH, plant species and growth parameters being measured (Lulakis and Petsas, 1995).

OBJECTIVE

Evaluate effects of organic and mineral fertilizers, liming, and use of soil conditioners on the characteristics and nutrition of "iceberg" lettuce.

MATERIALS & METHODS

The experiment was conducted in a greenhouse. Samples of a Typic Dystrudepts were collected. Soil physical and chemical characteristics were: $pH_{water} = 5.2$; P (Mehlich I) = 0.6 mg dm³; K = 12.0 mg dm³; Ca = 0.8 cmol_c dm³; Mg = 0.2 cmol_c dm³; AI = 0.5 cmol_c dm³; H+AI = 3.2 cmol_c dm³; Mn = 8.1 mg dm³; Cu = 0.5 mg dm³; B = 0.5 mg dm³; Fe = 25 mg dm³; Mn = 8.1 mg dm³; Cu = 0.5 mg dm³; B = 0.5 mg dm³; Sulphate = 4.9 mg dm³; Sand = 130 g kg⁻¹; Silt = 280 g kg⁻¹; Clay = 590 g kg⁻¹.

Table 1 Organic fertilizers and soil conditioner characteristics.

Characteristics [§]	OCP	CKM*	SCN∆	
pH em água	7.6	8.9	14.3	
N-total (g kg ⁻¹)	12.0	25.8	4	
P (g kg ⁻¹)	4.24	25.75	34.44	
K (g kg ⁻¹)	6.81	22.28	37.12	
Ca (g kg ⁻¹)	25.48	102.5	1.66	
Mg (g kg ⁻¹)	3.02	6.12	0.26	
S-sulfato (g kg ⁻¹)	5,23	5.23	7,5	
B (mg kg ⁻¹)	106	35	-	
Cu (mg kg ⁻¹)	43	68	0	
Fe (g kg ⁻¹)	48.38	2.8	102.1	
Mn (mg kg ⁻¹)	468	552	7.1	
Zn (mg kg ⁻¹)	473	503	16.2	
Umidade (dag kg ⁻¹)	6,16	16,58	-	
CO (mg g-1)	128	94	59	
Densidade (g cm ⁻³)	-	-	1.23	

#EC = electrical conductivity, "CKM = dry chicken manure, OCP = dry organic compost, SCN = soil conditioner OC = organic carbon (dry basis).

•The organic fertilizers were mixed to the soil to provide the recommended nitrogen doses (300 mg N kg⁻¹, Novais et al., 1991).

•Mineral fertilization was performed by mixing 300 mg simple superphosphate kg⁻¹ of soil. Nitrogen (N-urea, 300 mg N kg⁻¹), potassium (potassium phosphate, 300 mg K kg⁻¹), Micronutrients (0.5 mg B kg⁻¹, 5.0 mg Zn kg⁻¹, 1.5 mg Cu kg⁻¹, 0.15 mg Mo kg⁻¹) and soil conditioner were applied after planting.

•The soil (2.75 kg pot⁻¹) was incubated for ten days before planting. Lettuce (iceberg, cv. Raider) was planted 35 days after germination when they had four leaves. Plants were harvested 57 days after planting.

•DIC, factorial scheme 5x3x2. Five doses of soil conditioner (0, 20, 40, 100, 200 L ha⁻¹), 3 fertilizers (CKM, OCP and mineral), with or without liming were studied, with five replications

RESULTS AND DISCUSSIONS

•Analysis of variance showed that lettuce height data interacted with SCN, fertilizers and liming significantly. Data of other lettuce characteristics, such as number of leaves, circumference, shoot fresh weight, and shoot commercial dry weight interacted significantly only with fertilizers and liming. Data of shoot dry weight and shoot commercial fresh weight interacted significantly only with fertilizers.
•No liming: lettuce grown with mineral and CKM fertilizers was taller than with OCP. When lime was applied, lettuce height followed the order: mineral fertilization > CKM > OCP. Increases in soil pH were noticed after CKM and OCP were applied. Increases in pH were probably the main responsible for lettuce greater increase in height with CKM than with mineral fertilizers. However, when lime was applied, lettuce grown with mineral fertilizers was taller than that produced with organic fertilizers.

•Liming: did not change lettuce height when organic fertilizers were used, except with OCP at 200 L SCN ha⁻¹. In spite of that, liming increased lettuce height in treatments with mineral fertilizers for all SCN doses, except at 200 L SCN ha⁻¹. Without liming, lettuce plants grown with mineral fertilizers increased in height with increases in SCN doses, according to the equation: y = 20.53 + 0.0112x (R² = 0.86). However, lettuce increases in height at this situation were not meaningful.

•<u>CKM</u>: Increased number of leaves, circumference, shoot fresh weight, and shoot commercial dry weight when compared with lettuce grown with OCP or mineral fertilizers. Content of P, Ca and Mg in leaves were higher in lettuce grown with CKM than with other used fertilizers, and it may have accounted to the increased lettuce growth characteristics when CKM was used (Table 2). Except the number of leaves, lettuce characteristics did not change with liming when grown with CKM, which were higher without liming.

Lettuce grown with CKM produced the same weight of dry shoot than with mineral fertilizers. However, shoot commercial fresh weight, important lettuce characteristic which attract consumers, was greater when produced with CKM than with mineral fertilizers.

•<u>OCP</u>: liming increased all evaluated characteristics, except circumference. Symptoms of B toxicity in lettuce (Figure 1) appeared at the edges of leaves, and progressed to a browning and drying of margins and tips for most of the fully expanded leaves. •Mineral Fertilizers: only shoot fresh weight increased with liming, the other characteristics remained the same.

Table 2. Nutrient content in lettuce plants grown in a Typic Dystrudepts

Liming	N§	Р	К	Са	Mg	S	В	Cu	Fe	Mn	Zn	
	g kg ^{.1}								mg kg ⁻¹			
	CKM*											
Without	19.77±5.83 ⁿ	4.99±0.53	11.99±3.07	8.52±1.23	2.46±0.46	2.19±0.31	59.79±15.22	10.33±1.08	90.95±15.56	93.99±29.31	25.17±2.53	
With	20.00±3.87	4.20±0.28	11.32±1.81	8.80±1.22	2.29±0.36	2.16±0.18	58.13±18.02	9.86±0.53	91.20±12.47	74.70±24.32	24.15±3.87	
	OCP											
Without	19.75±2.84	3.42±0.30	11.12±2.85	7.27±1.16	1.73±0.28	1.27±0.44	195.84±38.79	8.09±0.54	85.57±19.11	66.66±11.17	61.81±14.33	
With	21.36±3.90	3.64±0.23	10.77±1.85	7.69±0.90	1.88±0.26	1.62±0.20	160.37±34.96	8.47±0.89	97.00±30.99	61.21±11.37	38.63±4.77	
	Mineral											
Without	31.80±5.87	3.24±0.27	10.81±2.57	7.00±1.41	0.83±0.11	2.80±0.25	53.47±7.65	9.34±0.78	85.45±11.90	72.75±20.33	68.41±14.63	
With	24.56±3.19	3.12±0.26	11.05±2.54	7.08±1.15	1.69±0.22	2.71±0.22	53.02±12.03	8.58±0.66	89.38±16.82	59.33±17.67	50.42±9.70	

[§]Embrapa (1999), N-total, *CKM = dry chicken manure, OCP = dry organic compost. ^{II} nutrient content±standard error.



Figure 1. Iceberg lettuce grown with mineral fertilizers and liming (left); organic compost without liming center; and chicken manure without liming (right).

CONCLUSIONS

Lettuce grown with chicken manure rendered the greater circumference and higher shoot fresh commercial weight, which are the most important lettuce characteristics affecting consumer purchase decisions. The soil conditioner did not influence on plant growth, except height and dry shoot weight on a very small scale.

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