PROBLEMS IN CROP ROOT DEVELOPMENT IN LATOSOLS IN THE CERRADO REGION

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Introduction

To increase crop production in the cerrado region it is important to improve the soil chemical and physical properties to accelerate root development.

Studies on crop root development in the cerrado region have been conducted by many researchers. The cause of poor root development in the subsurface layer has been mainly attributed to the low content of nutrients.

In this study, vertical root development of the crops in latosols in the Cerrados was investigated, and the correlation between the soil physical and chemical properties and crop root growth were analysed.

Materials and Methods

The observation of the root system was conducted using the crops planted in clayey Latosols at the CPAC field.

Phaseolus bean..... Central pivot field
Alfalfa..... Field for soil amendment experiment
Soybean (Variety: Tropical and Paranagoiana)
..... Field for breeding experiment
Maize (Treatment: Compost 20 t/ha and compost not applied
..... Field for soil amendment experiment

Root distribution was investigated by applying the Monolith method. (50 cm x 100 cm x 12 cm) (Photo 1).

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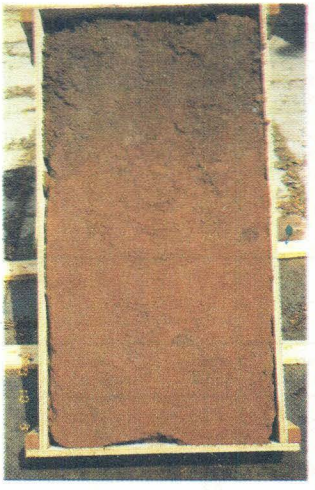

PHOTO 1 - Monolith of Latosols in the Cerrados.
(Central pivot field in CPAC)

Results

1) Plowed layer contained a higher concentration of calcium, magnesium, potassium and phosphorus (Table 1).

TABLE 1 - Soil chemical properties.

(1) *Phaseolus* bean

cm	pH H_2O	Organic matter %	P Mehlich µg/ml	K µg/ml	Ca meq/100 ml	Mg meq/100ml	Al meq/100ml
0-10	5.4	3.38	50.1	23.8	3.04	1.45	0.04
10-20	5.4	3.34	14.6	130	4.07	2.73	0.0
20-30	5.6	3.19	2.7	32	2.72	1.62	0.06
30-40	5.5	2.21	1.0	17	1.24	0.83	0.28
40-50	5.5	2.06	0.9	13	0.90	0.76	0.21
50-60	5.1	1.91	0.9	9	0.40	0.48	0.28
60-70	5.0	1.57	0.9	8	0.48	0.45	0.08
70-80	4.9	1.37	0.9	7	0.44	0.45	0.02
80-90	4.8	1.28	0.8	6	0.40	0.35	0.03
90-100	4.7	1.23	0.8	5	0.42	0.45	0.03

TABLE 1 - Soil chemical properties (continue).

(2) Alfalfa

cm	pH H_2O	Organic matter %	P Mehlich µg/ml	K µg/ml	Ca meq/100 ml	Mg meq/100ml	Al meq/100ml
0-10	5.8	2.75	16.3	63	6.74	1.34	0.0
10-20	6.0	2.75	11.0	55	5.51	1.08	0.02
20-30	6.0	2.52	10.0	54	5.74	1.10	0.02
30-40	5.8	2.29	1.5	13	1.71	0.60	0.02
40-50	5.1	1.97	1.0	8	1.02	0.30	0.81
50-60	5.0	1.60	0.8	4	1.36	0.42	0.49
60-70	5.1	1.37	0.7	3	0.91	0.28	0.50
70-80	5.4	1.60	0.9	4	0.42	0.10	0.56
80-90	5.1	1.37	0.7	3	0.50	0.18	0.36
90-100	5.3	1.24	0.7	3	0.44	0.16	0.34

(3) Soybean (Tropical)

cm	pH H_2O	Organic matter %	P Mehlich µg/ml	K µg/ml	Ca meq/100 ml	Mg meq/100ml	Al meq/100ml
0-10	5.6	1.92	8.2	43	5.52	7.83	0.04
10-20	5.8	1.97	5.0	21	5.43	8.60	0.05
20-30	5.6	1.77	1.6	15	2.73	3.36	0.28
30-40	5.7	0.94	0.9	7	1.47	1.23	0.28
40-50	5.3	1.03	0.9	5	1.58	1.15	0.22
50-60	5.4	0.99	0.9	4	1.68	1.18	0.19
60-70	5.5	0.59	0.8	3	1.49	1.28	0.11
70-80	5.2	0.44	0.8	1	0.75	1.00	0.10
80-90	5.0	0.79	0.8	1	0.58	1.35	0.10
90-100	5.0	0.74	0.7	1	0.55	1.27	0.03

(4) Soybean (Paranagoiana)

cm	pH H_2O	Organic matter %	P Mehlich µg/ml	K µg/ml	Ca meq/100 ml	Mg meq/100ml	Al meq/100ml
0-10	5.8	1.63	16.4	131	4.11	5.46	0.13
10-20	5.6	1.72	7.3	53	4.50	6.68	0.16
20-30	5.3	1.33	2.0	19	1.69	1.84	0.37
30-40	4.9	1.03	1.1	8	1.83	1.53	0.36
40-50	5.5	0.69	1.0	7	1.57	0.63	0.22
50-60	5.7	0.84	1.0	5	1.28	0.48	0.21
60-70	5.5	0.49	1.0	3	0.88	0.33	0.13
70-80	5.4	0.54	0.9	2	0.89	0.33	0.06
80-90	5.3	0.30	0.9	2	0.93	0.39	0.02
90-100	5.3	0.64	0.9	2	0.85	0.54	0.0

(5) Maize (Compost not applied)

cm	pH H_2O	Organic matter %	P Mehlich µg/ml	K µg/ml	Ca meq/100 ml	Mg meq/100ml	Al meq/100ml
0-10	5.9	1.44	8.9	75	5.96	0.73	0.02
10-20	5.8	1.49	1.2	22	2.74	0.45	0.23
20-30	5.7	1.82	6.2	28	5.31	0.75	0.02
30-40	5.9	1.58	0.9	17	1.30	0.21	0.52
40-50	5.9	1.35	0.8	17	1.38	0.16	0.49
50-60	5.6	1.12	0.7	11	1.76	0.16	0.36
60-70	5.8	1.35	0.7	7	1.65	0.14	0.27
70-80	5.9	1.21	0.7	5	0.58	0.06	0.37
80-90	5.8	1.12	0.6	5	0.65	0.06	0.32
90-100	5.8	1.12	0.6	5	0.60	0.05	0.30

TABLE 1 - Soil chemical properties (continue).

(6) Maize (Compost applied)

cm	pH H_2O	Organic matter %	P Mehlich µg/ml	K µg/ml	Ca meq/100 ml	Mg meq/100ml	Al meq/100ml
0-10	5.8	2.80	10.2	61	4.61	0.38	0.18
10-20	5.7	2.52	8.9	34	5.07	0.55	0.05
20-30	5.8	2.33	7.7	37	3.55	0.47	0.14
30-40	5.8	2.52	3.5	29	2.83	0.38	0.36
40-50	5.8	2.05	3.5	18	2.20	0.24	0.41
50-60	5.9	1.63	0.8	13	1.44	0.17	0.52
60-70	5.6	1.49	0.7	9	1.65	0.18	0.36
70-80	5.4	1.44	0.7	7	1.64	0.18	0.24
80-90	5.6	0.98	0.8	4	0.32	0.14	0.25
90-100	5.5	1.17	0.7	5	0.80	0.08	0.21

2) There was a compacted layer (about 20-40 cm) under the plowed layer (Figura 1).

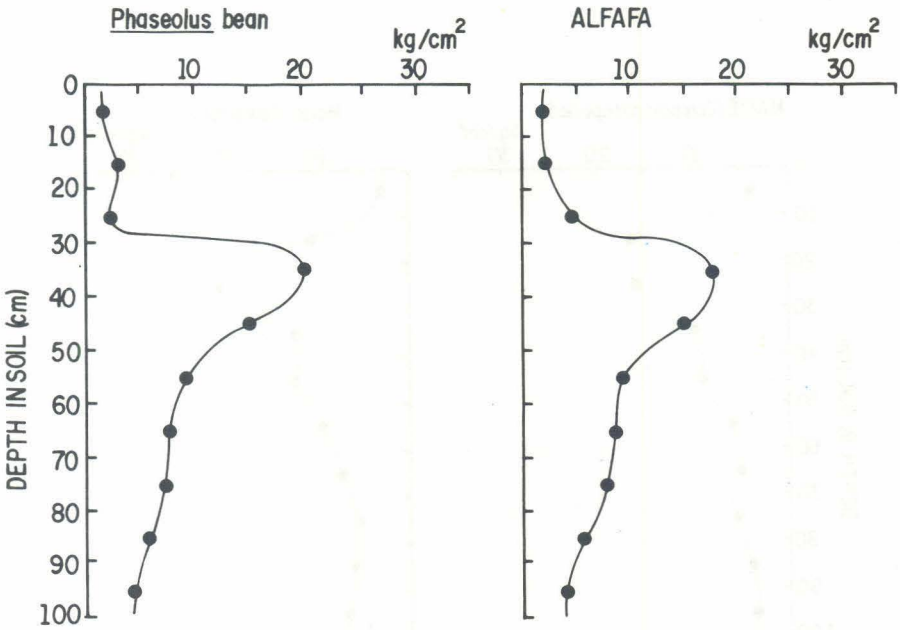

FIG. 1 - Vertical change in soil hardness.

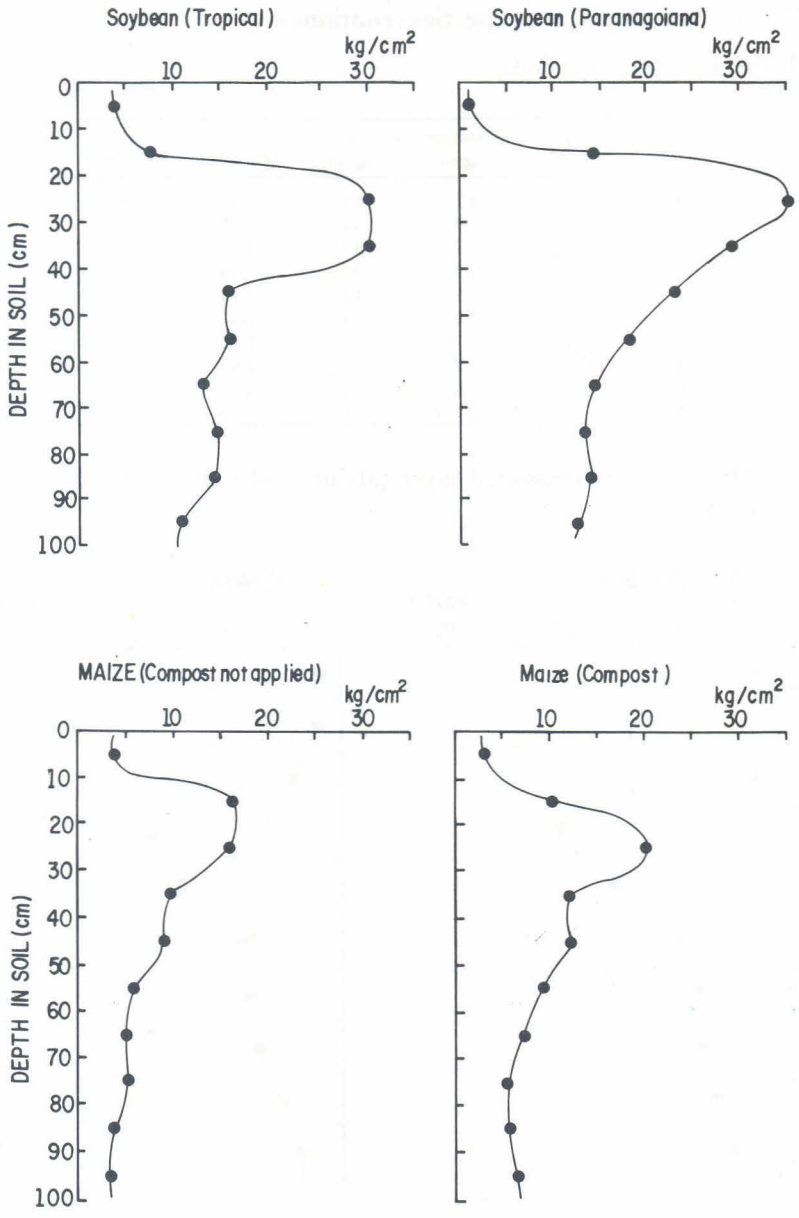

FIG. 1 - Vertical change in soil hardness (continuação).

3) Roots were concentrated in the plowed layer. (Photo. 2, 4, 5, 6, 7, 8. 9, 10; Figure 2-7)

PHOTO 2 - Root system of *Phaseolus* bean.
(Central pivot field)

PHOTO 3 - Root system of *Phaseolus* bean.
(Central pivot field)

PHOTO 4 - Root system of *Phaseolus* bean.
(Central pivot field)

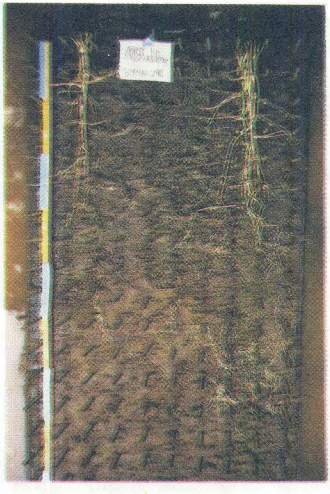

PHOTO 5 - Root system of alfafa.
(Field for soil amendment experiment)

PHOTO 6 - Root system of alfafa.
(Field for soil amendment experiment)

PHOTO 7 - Root system of soybean variety Tropical.
(Field for breeding experiment)

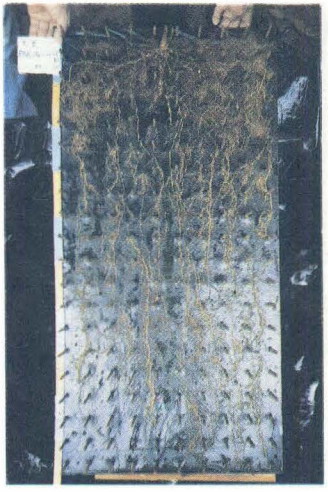

PHOTO 8 - Root system of soybean variety Paranagoiana.
(Field for breeding experiment)

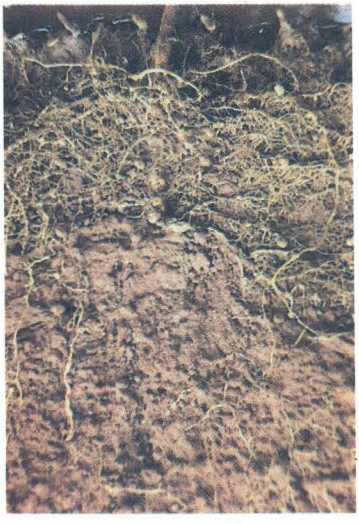

PHOTO 9 - Root system of soybean variety Paranagoiana.

PHOTO 10 - Root system of soybean variety Paranagoiana.

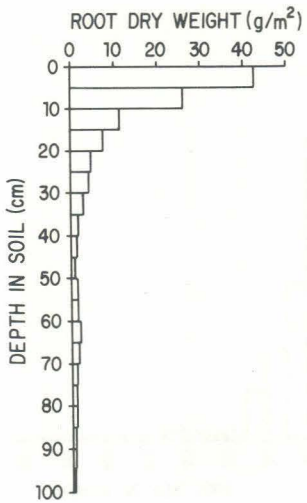

FIG. 2 - Root distribution of *Phaseolus* bean.

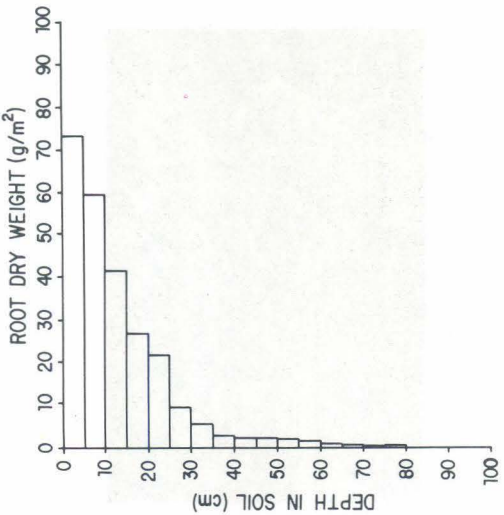

FIG. 3 - Root distribution of alfafa.

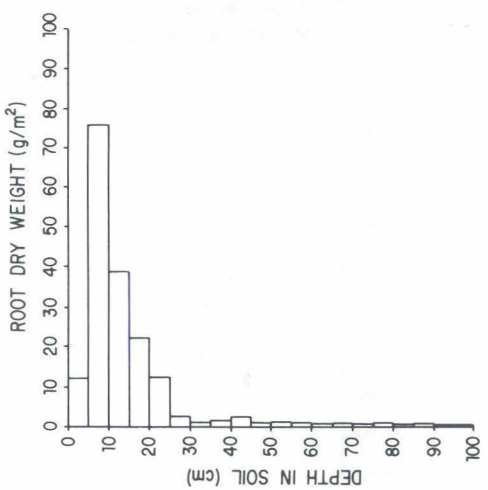

FIG. 4 - Root distribution of soybean variety Tropical.

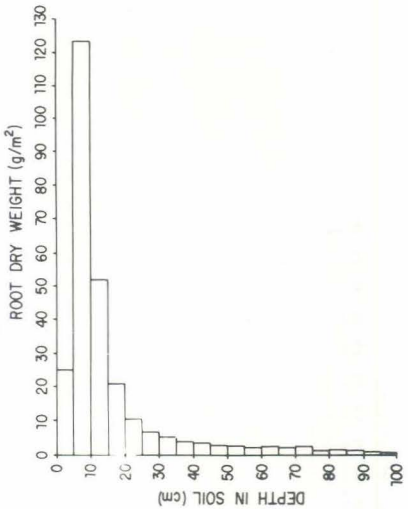

FIG. 5 - Root distribution of soybean variety Paranagoiana.

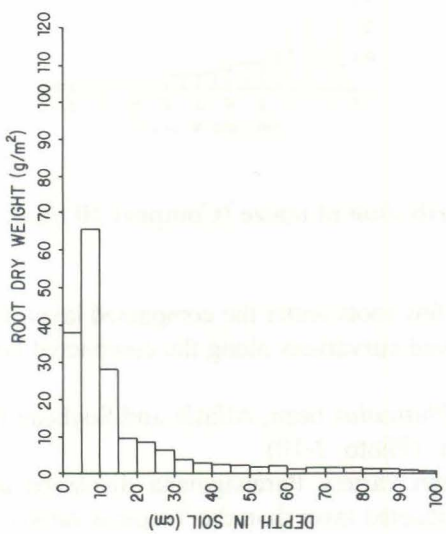

FIG. 6 - Root distribution of maize (Compost not applied).

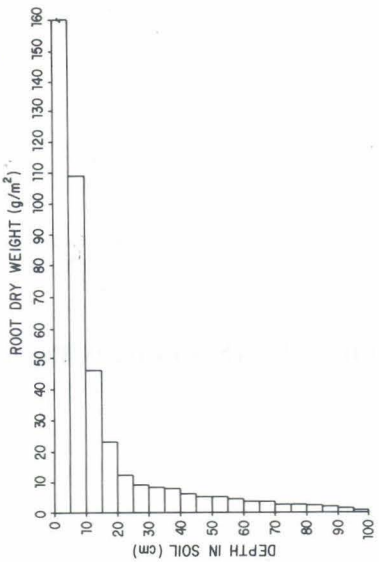

FIG. 7 - Root distribution of maize (Compost 20 t/ha).

There were a few roots under the compacted layer. (Photo. 4-10)

4) Roots showed curvatures along the compacted layer. (Photo. 3, 4, 5, 6,9,10)

The roots of *Phaseolus* bean, Alfalfa and Soybean did not grow well in the compacted layer. (Photo. 2-10)

5) The soybean variety Paranagoiana displayed a larger number of roots under the compacted layer than the Tropical variety. (Photo. 7, 8)

6) Maize showed a large number of roots under the compacted layer compared with *Phaseolus* bean, Alfalfa or Soybean. (Photo. 11,12)

PHOTO 11 - Root distribution of maize. Non compost.
(Soil amendment experiment field)

PHOTO 12 - Root distribution of maize. Compost 20 t/ha
(Soil amendment experiment field)

Conclusion

The roots did not grow well in the compacted layer of soil.

It is necessary to break up the compacted layer to facilitate crop root penetration in order to reduce plant damage caused by water stress during the short dry season "veranicos".

Moreover, it is important that plant breeding studies be conducted to develop varieties with a deeper root system.

Acknowledgement

I. KAWAUCHI stayed at the Centro de Pesquisa Agropecuária dos Cerrados, Brasília D.F., as a short term consultant under the Cooperation Project for the Research Program on Agricultural Production in the Acid "Savanna" region of the Cerrados, for 80 days from September 5 to November 21, 1989.

During this period, we conducted some experiments on root development in Latosols. The results obtained are described in the following paper.

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