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Soil chemical quality in agricultural land uses in the semiarid of Bahia

Qualidade química do solo em áreas agrícolas no semiárido da Bahia

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Abstract: The aim of this work is to define indices of soil chemical quality in intense agricultural activity area surrounding Sobradinho Lake, State of Bahia, Brazil, by means of multivariate statistical techniques. Based on the factor scores, it was determined soil chemical quality index for depths of 0-0.10, 0.10-0.20 and 0.20-0.40 m, respectively, classifying soils as good, fair and poor, according to the performance of its attributes. Then realized the Discriminative Analysis in order to validate the results obtained and, knowing the chemical soil attributes that influence and are associated with soil quality in agriculture of the region. In this way, among the main results could be observed that the attributes exchangeable sodium percentage (ESP) and organic matter (OM) stood out as indicators of soil quality. The ESP was the more important attribute in discrimination models in the depths of 0.00-0.10 and 0.10-0.20 m and OM in the 0.20-0.40 m layer. These variables are the main responsible for discrimination and classification of soil groups. In general, the chemical quality of soils is not considered ideal mainly due to the low contents OM and the extremely sandy texture, denoting environmental fragility.

Keywords: chemical attributes, multivariate analysis, soil management, sandy soils

Resumo: O objetivo deste trabalho foi a definição de índices de qualidade química do solo em área com agricultura intensiva do entorno do Lago de Sobradinho, Estado da Bahia, Brasil, por meio de técnicas de estatística multivariada. Com base nos escores fatoriais, foi determinado o índice de qualidade do solo química (ICSQ) para profundidades de 0-0,10, 0,10-0,20 e 0,20-0,40 m, respectivamente, classificando os solos como bom, regular e ruim, de acordo com o desempenho de seus atributos. Em seguida, realizou-se a análise discriminante (AD) com o objetivo de validar os resultados obtidos, bem como, conhecer os atributos químicos do solo, que influenciam e estão associados à qualidade do solo na área agrícola da região. Dessa maneira, dentre os principais resultados pôde-se observar que os atributos PST, teores de Na^+ e de MO se destacaram como indicadores de qualidade do solo. PST foi o atributo de maior peso relativo nos modelos de discriminação dos sítios amostrados nas profundidades de 0,0-0,10 e 0,10-0,20 m e, teor de MO na profundidade de 0,20-0,40 m. Essas variáveis foram as principais responsáveis pela discriminação e classificação dos grupos de solo. Em geral, a qualidade química dos solos não é considerada ideal, principalmente devido ao baixo conteúdo de MO e à textura extremamente arenosa, denotando fragilidade ambiental.

Palavras-chave: análise multivariada, atributos químicos, manejo do solo, solos arenosos.

Introduction

Forest conversion to cultivated land leads to several changes in soil properties. Intense management promotes soil erosion and depletes organic matter, which decreases soil quality. Soil and crop management directly influence physical, chemical and biological soil properties, which are used to measure soil quality, which means the capacity of soil to serve a desired function, such as sustainably provide food, fiber and forage (Balota et al., 2015). The anthropogenic intervention through the implementation of agricultural systems, for example, can bring a series of negative impacts on the soil, in consequence of the adoption of a model of agriculture burst in practices that do not prioritize their rational use and sustainability of agricultural systems. These impacts, observed in several studies in the semi-arid northeast region (Dantas et al., 2012; Morais et al., 2014; Morais et al., 2015; Silva et al., 2015), are result from the combination of the management of agriculture and environmental characteristics which lead to accelerate the development physical and chemical degradation processes. The use of low efficiency irrigation systems (furrow and flood), the overuse of mineral fertilizers, and in many cases, the unfavorable conditions of natural drainage, coupled with high evapotranspiration demand and pluviometric index, have accelerated the salinization process of these areas, impacting negatively with changes of soil physical and chemical.

According Kuwano et al. (2014), changes in soil properties as a consequence of different land use systems may affect both plants and the microorganisms that live in the soil and play essential roles in the ecosystem. Depending on the intensity of changes, the environmental sustainability of the (agro) ecosystem may be impaired, which makes soil quality indicators an important tool for predicting whether a certain type of soil management or use leads to sustainability or degradation.

The use of multivariate statistical methods has proved to be a powerful tool in the assessment of soil quality, in order to apply and allows to perform researches with the aim of studying a large number of variables, grouped according to their similarity, as well as select the greater discriminating power of pre-selected groups (Pragana et al., 2012; Freitas et al., 2014; Oliveira et al., 2015; Arcoverde et al., 2015; Silva et al., 2015; Vasu et al., 2016).

The aim of this work is to define indexes of soil chemical quality in area of intense agricultural activity surrounding Sobradinho Lake, State of Bahia, Brazil, by means of multivariate statistical techniques.

Materials and Methods

Location

The study was conducted in the surroundings of Sobradinho lake, Bahia state, Brazil. The region is characterized by intense agricultural activity with emphasis on irrigated agriculture and cultivation of vegetables, especially onions and irrigated fruit production, mainly bananas, grapes and mango. In livestock highlights goats, sheep, beef cattle and dairy cattle. The climate classification, by Köppen, is type BSwh'(hot and semiarid climate). The predominant vegetation is caatinga hypoxerophyttic.

Selection of rural properties and collection of samples

Twenty-four rural properties were selected that had at least 5 years of use with agricultural activities and in the proximity of the Sobradinho lake. The soil samples were collected in the depths of 0.00-0.10; 0.10-0.20 and 0.20-0.40 m (Table 1) because it is the region of greatest action of the root system.

Table 1. Rural properties selected by municipality, with their respective soil classes and agricultural use

Geographical coordinates (SAD69)		Soil classification	Agricultural use	Depth (m)	Clay	Silt	Sand
					--------------- $g\ kg^{-1}$	--------------	
			Sobradinho				
293995	8953545	Inceptisol	onion, mango, melon	0.00-0.10	74.38	75.70	849.91
				0.10-0.20	167.94	32.55	799.51
				0.20-0.40	238.85	33.95	727.20
296224	8949582	Ultisol	banana	0.00-0.10	97.37	8.56	894.06
				0.10-0.20	94.31	10.83	894.86
				0.20-0.40	106.50	68.65	824.85
292616	8955249	Alfisol	watermelon	0.00-0.10	142.04	67.53	790.44
				0.10-0.20	169.45	21.70	808.85
				0.20-0.40	174.39	20.62	804.99
296899	8948683	Ultisol	watermelon	0.00-0.10	220.80	90.01	689.19
				0.10-0.20	192.17	116.18	691.66

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				0.20-0.40	237.15	92.89	669.97
			Casa Nova				
278322	8972503	Ultisol	onion	0.00-0.10	61.33	20.27	918.40
				0.10-0.20	81.97	26.30	891.73
				0.20-0.40	70.73	40.90	888.37
263506	8971132	Oxisol	onion	0.00-0.10	351.33	56.73	591.93
				0.10-0.20	341.53	61.13	597.33
				0.20-0.40	342.57	72.87	584.57
262929	8968752	Entisol Quartzipisamment	onion, watermelon	0.00-0.10	134.43	99.63	765.93
				0.10-0.20	142.57	113.93	743.50
				0.20-0.40	202.10	91.10	706.80
208653	8935453	Alfisol	tomato	0.00-0.10	91.30	56.83	851.87
				0.10-0.20	137.93	34.93	827.13
				0.20-0.40	176.83	36.92	786.24
211311	8936607	Ultisol	beans, manioc, corn	0.00-0.10	100.87	22.73	876.40
				0.10-0.20	101.80	28.97	869.23
				0.20-0.40	89.27	35.10	875.63
194314	8935964	Entisol Quartzipisamment	grass, manioc, banana	0.00-0.10	79.23	22.53	898.23
				0.10-0.20	83.30	15.70	901.00
				0.20-0.40	95.23	12.47	892.30
277831	8977046	Inceptisol	onion	0.00-0.10	130.63	15.27	854.10
				0.10-0.20	87.97	63.87	848.17
				0.20-0.40	168.43	18.23	813.33
273599	8989071	Ultisol	onion	0.00-0.10	63.20	9.47	927.33
				0.10-0.20	65.93	16.17	917.90
				0.20-0.40	80.50	15.30	904.20
			Remanso				
806065	8927574	Oxisol	cultivated pasture	0.00-0.10	149.77	90.47	759.76
				0.10-0.20	131.82	38.26	829.92
				0.20-0.40	172.41	14.63	812.96
816948	8934491	Entisol Quartzipisamment	manioc	0.00-0.10	57.01	26.18	916.81
				0.10-0.20	54.47	16.05	929.48
				0.20-0.40	58.36	18.32	923.32
170918	8935889	Oxisol	manioc	0.00-0.10	156.94	19.49	823.57
				0.10-0.20	163.21	22.97	813.82
				0.20-0.40	177.83	25.62	769.55
177892	8934441	Entisol Quartzipisamment	banana, corn	0.00-0.10	103.09	15.46	881.45
				0.10-0.20	130.56	16.89	852.55
				0.20-0.40	143.35	26.40	830.25
			Sento Sé				
275767	8950807	Alfisol	onion, grass	0.00-0.10	219.36	23.69	756.96
				0.10-0.20	189.50	54.70	755.80
				0.20-0.40	194.19	66.07	739.74
271385	8952901	Inceptisol	watermelon	0.00-0.10	114.82	32.21	852.96
				0.10-0.20	107.40	43.02	849.57
				0.20-0.40	92.96	78.48	828.56
193794	8908841	Ultisol	watermelon	0.00-0.10	110.95	22.07	866.98
				0.10-0.20	110.38	16.37	873.26
				0.20-0.40	138.67	11.96	849.37
279181	8950807	Alfisol	onion	0.00-0.10	90.08	111.14	798.78
				0.10-0.20	76.38	119.12	804.51
				0.20-0.40	127.71	138.14	734.15

				0.00-0.10	116.43	70.66	812.91
195934	8911940	Ultisol	onion	0.10-0.20	128.27	38.37	833.36
				0.20-0.40	164.16	52.53	783.31
				0.00-0.10	206.35	101.97	691.68
234119	8917500	Entisol Quartzipisamment	onion	0.10-0.20	231.70	83.42	684.88
				0.20-0.40	240.86	134.23	624.91
				0.00-0.10	106.18	51.90	841.93
196739	8912445	Ultisol	onion, watermelon	0.10-0.20	70.25	42.51	887.25
				0.20-0.40	123.00	87.67	789.33
				0.00-0.10	165.60	23.14	781.80
176187	8919238	Ultisol	watermelon, beans	0.10-0.20	187.90	51.57	760.53
				0.20-0.40	203.90	32.27	763.83

In areas cultivated with annual crops, the system is characterized by intense soil movement with plows and harrows for the planting of each crop. In areas with banana trees and pasture such preparation occurred only in the implantation of the crop, without the use of machines for crops treatment and harvesting. It is noteworthy that irrigation system has been used in the areas cultivated with annual crops and fruit, the practice of superirrigation is common. In the pasture area the irrigation management is reduced.

Soil Chemical characteristics

The soil samples were analyzed following the recommendations of Donagema et al. (2011). The chemical analyzes included: pH in water; assimilable phosphorus; exchangeable cations (Ca^{2+}, Mg^{2+}, Na^{+} and K^{+}); aluminum extracted with KCl 1 mol L^{-1} solution; potential acidity (H + Al) extracted with calcium acetate buffered to pH 7.0; and organic carbon by wet oxidation of organic matter with potassium dichromate in the presence of sulfuric acid (Walkley-Black).

Statistical analysis

Data normality was assessed by the Kolmogorov-Smirnov test (KS) ($p \leq 0.05$). Then, the data were subjected to multivariate analysis using factorial analysis (FA) from the Pearson correlation matrix using data set involving chemical attributes in the depths of 0.00-0.10; 0.10-0.20 and 0.20-0.40 m. The factorial analysis (FA) was performed using principal components analysis (PCA) as method of extraction and the axes were rotated by Varimax method. Remove variables was based on the Pearson correlation matrix. Thus, the variables with lower standard deviations and high correlation between them were taken to avoid multicollinearity problems. Index Chemical Soil Quality (ICSQ) was defined as a combination of factor scores and the proportion of variance explained by each factor in relation to the common variance (Pamplona, 2011) and calculated from the equation (1).

$$ICSQ = \sum_{j=1}^{q} \left(\frac{\lambda_j}{\Sigma_j \lambda_j} (FP_{ij}) \right), i = 1,2, \ldots n \quad (1)$$

λ_j= variance explained by each factor;
$\sum_j \lambda_j$= total sum of the variance explained by the set of common factors;
FP_{ij} = factorial standardized score.

The standardization of factorials scores was performed aiming to obtain positive values of the original scores and allow the classification of soils (Pamplona, 2011; Arcoverde et al., 2015), once the values of ICSQ were situated between zero and one, being obtained by equation 2:

$$FP_i = \left(\frac{F_i - F_{min}}{F_{max} - F_{min}} \right) \quad (2)$$

F_i = factorial score value associated with the sample i
F_{min} = minimum value of the factor score
F_{max} = maximum value of the factor score

ICSQ ranges were established by grouping the soils according to their degree of quality: ICSQ values equal or higher than 0.60 were considered good, values between 0.35 and 0.59 were regular, values less than 0.35 were considered poor (Santana, 2007; Arcoverde et al., 2015).

The discriminant analysis (DA) was used to validate the ICSQ results, verifying if these groups were consistent and the variables most contributed for their formation. Then proceeded the determination of significant discriminant functions (linear combinations of variables) using the stepwise method. The variables selection was performed by the method of Wilks' lambda. Increase in its value, which varies from 0 to 1, indicated no difference among the groups. The statistical analysis of data was carried out with the aid of statistical software STATISTICA 5.0.

Results and Discussion

The matrix of rotated factor loadings of the chemical attributes, the value of commonalities, their eigenvalues, and the explained variance in the layers 0.00-0.10, 0.10-0.20 and 0.20-0.40 m is shown in Table 2.

The first columns refer to factorials loads for each attribute in each factor. The last column gives the value of commonalities, indicating how much variance of each attribute is explained by the factors together. In all layers the attributes have strong relationship with the factors retained as it has high commonalities. The eigenvalues indicate the relative importance of each factor in the explanation of the variance associated with the set of attributes analyzed. It extracts the factors in order of their importance. The factor with significant loadings and opposite signs indicate joint variation, but in the opposite direction.

Factor 1 explains the highest variance, with 53.02%, 53.00% and 54.40% of the total variance, for the layers of 0.00-0.10, 0.10-0.20 and 0.20-0.40 m, respectively. We stand out that the factor was composed differently between the layers. In the layer 0.00-0.10 m, only pH composes the factor 1; in the layer 0.10-0.20 m, contents of the K^{+}, Ca^{2+}, Mg^{2+} and CEC composes this factor and in the layer 0.20-0.40 m, contents of P, Na^{+}, K^{+}, Ca^{2+}, Mg^{2+} and CEC composes this factor. In all layers, the components of factor 1 varied together and in the same direction.

The factor 2 was similar to factor 1, the components varied together and in the same direction. This factor was composed by Na^{+} content and PST value in the layers 0.00-0.10 and 0.10-0.20 m. In the layer the factor 2 was composed only by pH.

The factor 3 was composed by contents of the K^{+}, Ca^{2+}, Mg^{2+} and CEC in the layer 0.00-0.10 m, pH values in the layer 0.10-0.20 m and Na^{+} content and PST value in the layer 0.20-0.40 m. The components of factor 3, ranged together in the same direction in the layers 0.00-0.10 and 0.20-0.40m.

The differentiation of the components of the factors 1, 2 and 3 is result of the variability of soil types and management strategies applied. AF confirms the influence of agricultural management on the soil chemical quality. In the layer of 0.00 to 0.10 m, the factor 1 consisted of pH, as a result of different amount of inputs. Low inputs was observed in maize and cassava crops while high inputs was observed in areas with onion and banana crops, due to contribution mainly phosphates and manure. These factors, together with the management and irrigation (surface) types, affect differently the pH values. Therefore, it has been observed higher values of this attribute in the layer 00,00-0,10 m in areas with higher nutrient contribution, while those whose replacement is insufficient and/or export is higher there acidification trend. Corrêa et al. (2009), evaluating the chemical quality of soil under different uses in the irrigated perimeter of the semiarid region, highlighted the pH is a sensitive indicator for differentiation of agricultural uses regarding the Caatinga. The more intense fertilization practices in areas with short cycle crop and fruit production resulted an increase in the bases. The addition of fertilizers together with the drainage deficiency, verified in situ, may have contributed to the increase of Ca^{2+}, Mg^{2+}, K^{+}, P and Na^{+} in subsurface. In addition, that the composition 2 (Na^{+} and ESP), in layers of 0.00 to 0.10 and 0.10-0.20 m may indicate susceptibility of soils to sodicity. Although in no area was observed ESP value exceeding 15% to be classified as sodic soil. The factorials scores estimated by AF were standardized and it was determined ICSQ. From these indexes soils were classified according to the performance of its chemical attributes more important for the sustainability of systems production.

Table 2. Factorials loads after rotation by Varimax method for the chemical soil attribute data

Attribute	Factor			Commonality
	1	2	3	
		0.00-0.10 m		
OM	-0.09	-0.46	0.58	0.57
pH	**0.90**	-0.23	0.13	0.88
P	0.31	0.38	0.44	0.43
K	0.17	0.51	**0.70**	0.78
Ca	0.41	0.19	**0.86**	0.95
Mg	0.29	0.02	**0.87**	0.84
Na	-0.02	**0.84**	0.50	0.95
ESP	-0.07	**0.85**	0.05	0.73
CEC	0.12	0.17	**0.96**	0.96
Autovalue	6.36	2.09	1.32	9.77
% Variance	53.02	17.45	10.97	81.44
		0.10-0.20 m		
OM	0.45	-0.18	0.10	0.25
pH	0.14	-0.23	**0.90**	0.87
P	0.63	0.10	0.14	0.43
K	**0.86**	0.23	0.15	0.82
Ca	**0.92**	0.08	0.32	0.96
Mg	**0.82**	0.07	0.28	0.75
Na	0.34	**0.93**	-0.01	0.99
ESP	-0.01	**0.97**	0.01	0.94
CEC	**0.96**	0.11	0.10	0.95
Autovalue	6.36	2.01	1.35	9.72
% Variance	53.00	16.75	11.28	81.04
		0.20-0.40 m		
OM	0.48	0.22	-0.12	0.29
pH	0.14	**0.93**	-0.15	0.90
P	**0.73**	0.10	0.02	0.55
K	**0.89**	0.14	0.17	0.84
Ca	**0.92**	0.35	0.10	0.99
Mg	**0.78**	0.36	0.18	0.77
Na	0.46	-0.01	**0.88**	0.99
ESP	-0.01	0.09	**0.96**	0.93
CEC	**0.97**	0.06	0.16	0.97
Autovalue	6.53	1.91	1.50	9.94
% Variance	54.40	15.89	12.54	82.81

OM: Organic matter; pH: Hydrogen potential; P: Phosphorus; K = Potassium; Ca: Calcium; Mg: Magnesium; Na: Sodium; ESP: Exchangeable sodium percentage; CEC: cation exchange capacity; value 0.65 for factorials significant loads.

In the layer 0.00-0.10 m, only three soils were classified as good quality (ICSQ ≥ 0.60), ten as regular quality (0.60 > ICSQ > 0.35) and fourteen as poor quality (ICSQ ≤ 0.35). In the layer 0.10-0.20 m, three soils were classified as good, six as regular and nineteen as poor. In the layer 0.20-0.40 m, four soils were classified as good, five as regular and eighteen as poor. Considering all layers, 12% of the soils were classified as good; 26% as regular and 62% as poor quality. In this case, it is possible that the physical quality may have affected the chemical quality. According to Dexter (2004) and Araújo et al. (2007), there is relationship between the improvement of physical quality and improvement in chemical and biological soil quality.

The data obtained with the AD technique, which validated the results of the indices construction, and the soil chemical attributes that influence and are associated to the quality of these are presented in Table 3.

Table 3. Chemical attributes included in the analysis the Stepwise Procedure, Wilks Lambda values and F-statistic

Attributes	Wilks' Lambda	F	Significantly
0.00-0.10 m			
OM	0.06	5.17	0.02
pH	0.04	2.00	0.17
K	0.05	4.08	0.04
Ca	0.06	6.29	0.01
Mg	0.06	4.49	0.03
Na	0.07	8.89	0.00
ESP	0.08	10.10	0.00
CEC	0.06	4.95	0.02
V	0.04	1.89	0.18
0.10-0.20 m			
Ca	0.10	7.71	0.00
Mg	0.10	8.29	0.00
Na	0.11	9.71	0.00
ESP	0.14	15.32	0.00
V	0.06	1.65	0.22
0.20-0.40 m			
OM	0.13	121.10	0.00
K	0.02	9.49	0.00
Ca	0.01	3.97	0.04
Mg	0.03	24.28	0.00
CEC	0.02	10.39	0.00
V	0.02	6.86	0.01

OM: Organic matter; pH: Hydrogen potential; K: Potassium; Ca: Calcium; Mg: Magnesium; Na: Sodium; ESP: Exchangeable sodium percentage; CEC: cation exchange capacity; V: Percentage by saturation of bases.

It is observed that in the layers 0.00-0.10 m and 0.10-0.20 m, the soil attributes ESP and Na^+ were the main contributors to the groups discrimination, highlighting ESP (largest F-value) (Table 3). In the layer 0.20-0.40 m stand out the attributes OM and Mg^{2+}, with more discriminating power of the OM (largest F value) (Table 3). The other attributes, although not significant, were kept in the model to improve its discriminatory capacity. This suggests that, to improve the agricultural sustainability in the region adopt management practices to reduce the salt contents in the soil (increase of the efficiency of irrigation and fertilization) and to increase of the soil organic matter contents (organic crop, green manure, no tillage). According to Corrêa et al. (2009), the poor irrigation management in semi-arid soils has provoked salinization and/or sodicity of cultivated areas of the region, where the accumulation of Na^+ in surface layers due to high evapotranspiration. These results stand out the importance and necessity of effective management of water in depth. Furthermore, it is observed accumulation of Na^+ surface suggesting that can represent a risk to root development, and soil structural degradation.

In table 4 are presented the values of the Fisher´s classification function coefficients of linear discriminant analysis.

Table 4. Fisher's Linear Discriminant function for chemical soil attributes

0.00-0.10 m
Good = -203.18 -2.21OM + 58.14pH - 37.37K - 45.96Ca - 62.59Mg + 695.51Na - 28.37ESP + 35.08CEC
Regular = -212.29 -2.31OM + 60.77pH - 33.65K - 44.57Ca - 61.65Mg + 674.69Na - 25.83ESP +
Poor = -158.93 + 0.12OM + 44.72pH +6.29K - 16.82Ca - 25.77Mg - 102.83Na + 18.90ESP + 16.16CEC -
0.10-0.20 m
Good = -58.20 + 6.92Ca +24.94Mg - 222.78Na + 22.72 ESP - 0.04V
Regular = -25.09 + 3.36Ca + 9.64Mg - 72.81Na + 10.55 ESP + 0.19V
Poor = -6.91 - 0.54Ca + 4.99Mg - 4.94Na + 2.07 ESP + 0.23V
0.20-0.40 m
Good = -160.93 + 5.55OM + 60.10K - 3.94Ca + 57.05CEC + 0.23V
Regular = -84.34 -1.31OM - 35.44K - 32.39Ca - 35.70Mg + 27.80CEC + 1.77V
Poor = -69.648 - 2.73OM - 47.15K - 36.77Ca - 54.89Mg + 30.31CEC +1.90V

OM: Organic matter; pH: hydrogen potential; K: Potassium; Ca: Calcium; Mg: Magnesium; Na: Sodium; ESP: exchangeable sodium percentage; CEC: cation exchange capacity; V: Percentage by saturation of bases.

The percentage of classification of discriminant functions for grouping the soil in good, regular and poor at depth of 0.00 to 0.10 m, respectively, were 12%, 44% and 44%. In the depth of 0.10-0.20 m, the percentages were of 15%, 21% and 64%; and in the depth of 0.20-0.40 m, 16%, 18% and 66%, respectively (Table 4).

In the layers 0.00-0.10 and 0.10-0.20 m the variable with most discriminant power within the model was Na^+. In the layer 0.20-0.40 m were K^+ and Mg^{2+}, standing out the high variation of these attributes in the various soil classes, being considered good indicators of soil quality (Table 4). The high Na^+ variation in the areas with agricultural use and the highest concentration in surface layers in constantly irrigated areas, such as onion and banana crops, point to the necessity of periodic monitoring of this indicator. In these cases, continuous accumulation of salts should be avoided so as not to compromise productivity in the cultivated areas, making necessary the effective management of irrigation blade (Dantas et al., 2012). This fact reveals the beginning of degradation processes related to compaction and sodicity in the superficial layer of irrigated areas. Faced with the diversity of agricultural soils and managements practiced, it is evident the need to review fertilization practices, liming and rational irrigation, combined with conservation systems of soil tillage that prioritize protection, nutrient cycling and reduced tillage. All these practices are necessary to when aiming to improve the soil fertility and structure. Thus, the evaluation of soil quality through the behavior of chemical attributes in different situations of management practices, water quality and crop specificities and types of irrigation constitute the basis for the identification of sustainable alternatives appropriate to the semi-arid condition.

Obtaining models allows future observations in order to verify the relation between soil management and sustainability of agricultural systems. Chemical soil properties and its the respective discriminant functions to classify the groups as to their chemical quality is important for decision making, as well as it is an essential tool in predicting future scenarios.

Conclusions

The attributes exchangeable sodium percentage and organic matter stood out as indicators of soil quality.

Exchangeable sodium percentage was the more important attribute in discrimination models in the depths of 0.00-0.10 and 0.10-0.20 m and organic matter in the 0.20-0.40 m layer. These variables are the main responsible for discrimination and classification of soil groups.

In general, the chemical quality of soils is not considered ideal mainly due to the low contents organic matter and the extremely sandy texture, denoting environmental fragility.

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