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Response of the Physical-Chemical Solid Variables Irrigated with Wasterwater and Wells on Dairy Farms

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Abstract: The purpose of this research was to determined if the 227 ha used in the cultivated soils of the five different stables destined for the production of milk and specimens of the Holstein Friestan stock found in Guadiana valley in Durango are affected by the well waters used in irrigation and the residual waters of the automatic milking process. The variables of the study included: apparent density (Da), total Nitrogen (N), Phosphorus (P), potassium (K), sodium (Na), Calcium (Ca) and Magnesium (Mg). The experimental period consisted of 3 consecutive days in each of the production units using the method of cutting for the recollection of the samples consisting of soil, for its future analysis in a lab. The obtained results were processed through the program of statistics (SAS) Version 8 with a module completely at random. Analyzing the results between each stable the variable measurements can be observed in the tables from 1 through 5. The variables found in the comparison between the five production units were: density, the stable with the highest amount was stable 2 and the stable with the least was the stable 1 with a difference between the stables of high significance; recorded in the table provided ($p<0.05$). Nitrogen was another element present in the stables with the highest number was the first stable and the one with the lowest was the third stable with a difference between stables of $p<0.05$. Phosphorous appeared in the stables with the highest measurements found in the fourth stable and the slightest was the first stable with a difference between stables of highly significant readings ($p<0.05$). Sodium in the stables appeared with the highest number in the first stable and the tiny amount in the third stable with a difference that was significant ($p<0.05$). In the meantime, the correlation showed the following results: the highest correlation (0.95715) appeared between the magnesium and the calcium which results in a significant number ($p<0.01$). A significant correlation ($p<0.05$) between the variales of total nitrogen and potassium with a value of 0.58496 appear in the findings.

Key words: Include pollution, apparent density, primary macronutrients, secondary macronutrients

INTRODUCTION

Fertility is the indirect way of measuring the capacity of the production of soils and the classic way of measuring it has been through the processes of Chemistry, Physics and Biology. The conservation of the soil is based on the balance of nutrients in the minerals which include the quantities present in the soil, the quantity extracted from the fields for a production waiting and the efficiency of absorption of the nutrients by plants applied as fertilizers used in production. Researchers consider that the soil is an ecosystem that is alive and complex composed of water, air, solids and an infinite amount of living creatures that interact actively. Every one of these elements is a determinant for the presence and availability of nutrients which lay on the soil and the presence of the agricultural activities in a productive system (Siavosh *et al*., 2008). Because of this, the analysis was of the quality of the soil in broader terms because it included parameters that are physical, chemical, biological and of the ecosystem.

The density apparent in the soil is a good indicator of certain important characteristics of soil, such as porosity, grade of airflow and capacity for infiltration.

In a type of soil, the low values of density present imply porous soils with good airflow, good drainage and good penetration of its roots, all of which signifies a good growth and development of the plants. On the other hand

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if the values are high it means that the soil is compact or has little porosity, bad air flow, the infiltration of the water is slow which can produce inundation and the roots have difficulties in growing and penetrating until they find water and nutrients. In these conditions, the development and growth of the trees is impeded or stunted consistently (Ibarra, 2005). The extensive livestock and the intensive livestock of milk production are categorized between the systems with medium density between 0.98 and 1.05 g cc^{-1} (Siavosh *et al.*, 2008).

The required and necessary elements of the construction of the plants are 16 which vegetables, for their normal growth and production, take from their surrounding environment: atmosphere C and O_2 water (O_2 e H) and the soil.

Nutrients are divided into three groups' macronutrients or essential primary nutrients: carbon, hydrogen, oxygen, nitrogen, phosphorous and potassium; secondary nutrients including calcium, magnesium and sulfate and micronutrients like boron, chlorine, copper, iron, magnesium, molybdenum and zinc (www.anser.com.ar/nutrientes.htm). Sodium is considered by some researchers as an essential nutrient and others classify it as a micronutrient. Macronutrients are assimilated by the plants in higher quantities than the micronutrients. These are all important components of amino acids, proteins and nucleic acids.

Nitrogen is necessary for the production of proteins; a component of the chlorophyll molecules, phosphorous allows the transfer of compounds (ATP and ADP), maintaining internal pressure and the function of the enzymes. Potassium (K) regulates the exchange between the membranes of the plants. Calcium (Ca) is an important component of the cellular walls. Magnesium (Mg) is necessary for the construction of chlorophyll and the majority of the micronutrients are utilized for building the enzymes in plants. Boron (B), Cobalt (Co) and Molybdenum (Mo) are essential cofactors in the process of binding the nitrogen. Sodium (Na) is an inorganic mineral nutrient, not essential for plants but it is for animals. The deficiencies of sodium never occur in nature because its quantities in the soil are comparable to some of the macronutrients (Thompon and Troe, 2004).

In turn, sodium can partially substitute for potassium in order to meet the needs of the plants. Basically, soils are composed of a particular set of minerals called silicated which compose the fundamental products of earth's crust (95%), for they are found forming part of many rocks and minerals.

The most important silicates are that of sodium and potassium. The role of sodium in the species C_4 serves as a stimulator of growth. The deficiencies of sodium report morphing, anatomic, cellular and metabolic effects (Mengel and Kirkby, 1987). However if sodium is found in excessive quantities the soil could become affected. The micronutrients are indispensable for a variety of essential functions in the metabolism of plants because with the exception of chlorine they play the role of the activators in numerous enzyme systems.

In addition, they are components of enzymes and coenzymes of the vegetable makeup, activating them to vary its number of oxidations.

The plants absorb the nutrients contained in the air through the stoma of the leaves and the remaining nutrients are absorbed generally in the dissolved soil between numerous radical hairs that are on the roots. The nutritional elements that are taken from the soil come from the rocks (minus the nitrogen that comes from the air) that as they slowly degrade they become soluble compounds which dissociate in the water of the soil into positive ions (cations) and negative ions (anions), to be assimilated under this form by plants (Vottleler, 2003). Consequently, given the strong relation between soil and plant, the absorption of a certain element does not depend solely on the content assimilated but also on other physical or chemical characteristics of the soil such as the acids, capacity for change, salinity, etc. This means that the analysis of the soil is a guide of the great use to prevent the nutritional deficiencies, a condition interpreted accordingly.

The objective was to determine the density and nutrients in the soil of the areas of growth of the studied stables with the purpose of making suggestions to the producer so they can improve their yield.

MATERIALS AND METHODS

This study took place in five stables situated in the Valley of Guadiana Durango, dedicated to the production of milk and replacements of the race Holstein Friestan, the cultivated area that the experimental units as a whole rely on are 227 ha in total. The coordinates of these centers of production are: latitude North 24°10'00. Found at an altitude of 6200.787 feet (1890 m) above sea level (INEGI, 2000).

The climate is type BS1 (w) (e) that corresponds to dry-mild according to the classification of Koppen with a medium precipitation annually of 1.47637 feet (450 mm) and a temperature of approximately 63.5°F (17.5°C) (INEGI, 2000).

The irrigation of the cultivated soil is principally done by canal with the water found on the storage dam

Guadalupe Victoria, Satiago Bayacora and Pena del Aguila, in addition to the surface of the pumping station (watering wells) and the possible infiltration of residual waters from the automatic milking halls. The harvested foods in the experimented units are destined for the feeding of livestock in the same stables. Inside of the harvested perennial one can find alfalfa, rye grass, orchards, brome grass, etc. and in the annual harvest are dominated by corn, oatmeal, sorghum and alfalfa. The type of soil dominant in the area is Castanozem Luvico (SEMARNAT, 2000).

The experimental period covered the springtime Summer cycle and consisted of three repetitions for each stable. The soils were tested at 7:00 a.m. by the way of cutting in a zigzag pattern with seven harvests per compound sample that was prepared with sub-samples to later homogenize and weighed to obtain a measurement of 1 k sample^{-1} taken from each stable with a depth of 0.984251 feet (30 cm).

Afterwards, researchers transported them to the Laboratory of the Technological Institute of Villa Montemorelos (Instituto Techonologico de Villa Montemorelos) for its posterior analysis. Following the protocol for the samples, analysis and interpretation of the results for the soil realized according to the Official Mexican Norms (Norma Official Mexicana-RECNAT-021-20 NOM-021-SEMARNAT in 2000) and methods of analysis of the Technological Institute of Villa Montemorelos in Durango.

The results obtained in each analyzed variable were processed with a designed base completely at random with the system of statistical analysis (SAS) Version 8.

RESULTS AND DISCUSSION

Differences between stables: The density, the nitrogen and minerals was different between stables ($p<0.05$, Table 1). The density was highest mean was stable with the number 2 and the lower mean was stable 1. The content of nitrogen was highest mean was stable with the number 1 and the lower mean was stable 3. While, the phosphorus was highest mean was stable with the number 4 and the lowest mean was stable 5. The value highest of sodium was stable with the number 1 and the lower mean was 3.

The content of potassium was highest mean was stable with the number 1 and the lower mean was 3. The value of calcium was highest in the stable with the number 2 and the lowest mean was 4. The content of magnesium was highest mean in stable with the number 5 and the lowest mean was in stable 4.

Correlations between variables: Correlations between magnesium and calcium concentrations (0.95715) were observed which is highly significant ($p<0.01$). There were significant correlation between total nitrogen and potassium variables with a value of 0.58496 ($p<0.05$).

Table 1: Classification of soil variables and interpretation of results

		Mean and interpretation (Stable)				
Variables	FAZ-UJED	1	2	3	4	5
Density (g mL^{-1})	Clayey 1.0-1.19 Loamy 1.2-1.32 Sandy >1.32	1.14333 Loamy soil, below the norm	1.36333 According to the rule	1.23333 Below the norm	1.27333 Below the norm	1.18667 Below the norm
TN (%)	Low 10-20 Middle 20-40 High 40-60	14.333 Classified as low	10.333 Classified as low	6.000 Classified as very low	9.667 Classified as very low	11.667 Classified as low
P (ppm)	Low 5.5 Middle 5.5-1 High >11	46.860 Classified as high	15.447 High above the recommendations	41.203 Classified as high	55.993 Classified as high	15.447 Classified as high
K (ppm)	50-60 High above the recommendations	1653.3 High above the recommendations	1126.7 High above the recommendations	293.3 High above the recommendations	463.3 High above the recommendations of the Facultad de Agricultura y Zootecnia UJED	420.0 High above the recommendations of the Facultad de Agricultura y Zootecnia UJED
Na (ppm)	3-4	0.0 Under the recommendations	66.7 Above the recommendations	200.0 Above the recommendations	463.3 At the bottom of the recommendations of the FAZ-UJED	983.3 Above the recommendations of the FAZ-UJED
Ca (ppm)		2640.0	5960.0	1560.0	1020.0	1380.0
Mg (ppm)		8.64	9.40	8.29	8.28	11.68

CONCLUSION

The cultivation of the soil variables analyzed show a density (g cm^{-3}) 80% is below indicating the Norma Oficial Mexicana and 20% is subject to the rule. With respect to total nitrogen, 60% of the soil shows a low concentration and the remaining 40% a very low concentration of the element. For phosphorus (ppm) all samples show a concentration above that makes the rule. Potassium (ppm) presents in all cases a very high concentration. The results related to sodium, 60% showed results above recommendations and the rest (40%) were below. With regard to calcium (ppm) showed all samples rich in this element. Magnesium (ppm) expressed in 60% of cases a concentration slightly above the recommended while 20% was slightly below and above 20% of the recommendations.

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