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Phytopathology Prediction in Dry Soil Using Artificial Neural Networks Modeling

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Abstract**—**The rapid expansion of deserts in recent decades as a result of human actions combined with climatic changes has highlighted the necessity to understand biological processes in arid environments. Whereas physical processes and the biology of flora and fauna have been relatively well studied in marginally used arid areas, knowledge of desert soil micro-organisms remains fragmentary. The objective of this study is to conduct a diversity analysis of bacterial communities in unvegetated arid soils. Several biological phenomena in hot deserts related to microbial populations and the potential use of micro-organisms for restoring hot desert environments. Dry land ecosystems have a highly heterogeneous distribution of resources, with greater nutrient concentrations and microbial densities occurring in vegetated than in bare soils. In this work, we found it useful to use techniques of artificial intelligence in their treatment especially artificial neural networks (ANN). The use of the ANN model, demonstrate his capability for addressing the complex problems of uncertainty data.

Keywords**—**Desert soil, Climatic changes, Bacteria, Vegetation, Artificial neural networks.

I. Introduction

THIS bacterial abundance in resource suggests that plant–microbe interactions delay formation of badlands in the area [1]. Dry land ecosystems have a highly heterogeneous distribution of resources, with greater nutrient concentrations and microbial densities occurring in vegetated than in bare soils. Shade, nutrients, and organic matter also contribute to this process of stabilization. These fine-textured soils become microhabitats for entire communities of organisms at all scale [2]. A detailed discussion of minimal requirements that environmental problems should possess in order to make mathematical modeling meaningful is beyond the scope of this short contribution. However, in [3] certain principles are identified that capture what an applied mathematician might call common sense. Violation of these principles should sound a warning that mathematical modeling may not be appropriate in these situations. The resources like total organic carbon accumulation, water content, nitrogen fixation, physical parameters (temperature, wind speed, elevation…) and soil nature as does the number of cultivable bacteria, including *Rhizobium* sp. and *Streptomyces* sp. All these factors are characterized by complexity, and inaccuracy. In this study, we analyzed thus data using artificial neural networks. The ANN demonstrates his capacity to resolve complexes and uncertain data in environment. The ANN model was structured to prevent the nature of bacteria soil according the conditions in inputs of system. After the system is completely constructed, it can learn new information as inputs. A data base is established, the result to the output of the program is the nature of adequate vegetation in this soil conditions.

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II. Materials and Methods

A. Soil

The soil plays an important role in determining the nature and quality of the vegetation. Different types of soil must be taken into consideration. Bedrock, limestone, sand...

The chemical composition of the soil is an essential element in plant growth as nutrients. The Characterization of elements important to bacterial nutrition in soil samples element ($\mu g.g^{-1}$) [Total Carbon, Total Organic Carbon, Total Nitrogen, P, S, Fe, Ca, Mg, K].

The physical characteristics of the ground can be represented by Elevation (m), temperature, wind speed ($m.s^{-1}$), pH, electrical conductivity ($mS.cm^{-1}$) and the concentration of Na expressed by ($mg.g^{-1}$).

B. Population of Micro-Organisms

In the preserved area, the number of cultivable bacteria can include *Rhizobium* sp. and *Streptomyces* sp. This bacterial abundance in resource islands suggests that plant–microbe interactions delay formation of badlands in the area [4]. The desert varnish (or colorization of rocks) is a product of microbial activity. The varnish is composed of micro-organisms that concentrate manganese from their surroundings to produce manganese-rich films that eventually form brown-to-black coatings. These microbes are cultivable and in the laboratory produce manganese rich bio films [5] in [6]. In general, we can summarize the bacterial flora in three levels: soil rich in plant growth promoting bacteria, soil bacteria through rate and poor soils in promoting bacteria growth.

III. Artificial Neural Networks

Neural networks are designed to mimic the performance of the human brain. There is inputs level, output level, and a variable number of internal (or hidden) layers. The inputs are connected to hidden layer and they are in turn connected to output. As the neural network learns from a data set, the connection weights are adjusted. Data are fed into the input nodes, processed through the hidden layer(s), and the connection weights to the output nodes are adjusted. Neural nets are categorized based on their learning paradigm. Neural networks have been used in the ICU setting in a variety of fashions, but most extensively for outcome prediction. Neural network-based systems were successful in predicting ICU mortality [7]-[9]. Neural networks can reveal unexpected and otherwise undetectable patterns in large data sets. The major weakness in neural network solutions is the fact that the methods by which a relationship is discovered are hidden and therefore not readily understood or explained [10]. In the simplest way, a cooperative model [11], [12], can be considered as a preprocessor wherein artificial neural network (ANN) learning mechanism determines the training data. [13].

A. *Expression of the Problem:*

Mapping of the space of parameters involved in the phytopathology inputs are [TOC-Total Organic Carbone-, TN-Total Nitrogen-, P, S, Fe, Ca, Mg, K]. The physical characteristics of the ground can be represented by Elevation (m), Temperature, Wind speed ($m.s^{-1}$), pH, Electrical Conductivity ($mS.cm^{-1}$)….) bacteria can include *Rhizobium* sp. and *Streptomyces* sp with the degree of achievement of each type microbial as output.

Fig. 1 describes the topology with four inputs extensible, two hidden layers, and an output (3-2-1) in the terminology of models of artificial neural networks. W_{ij} and W_{jk} are weights, which represents the connection between the inputs and the output of the system. Weights contain all the information about the network. The objective is the training of the network to reach the minimum value of the reading error at the output observed [14].

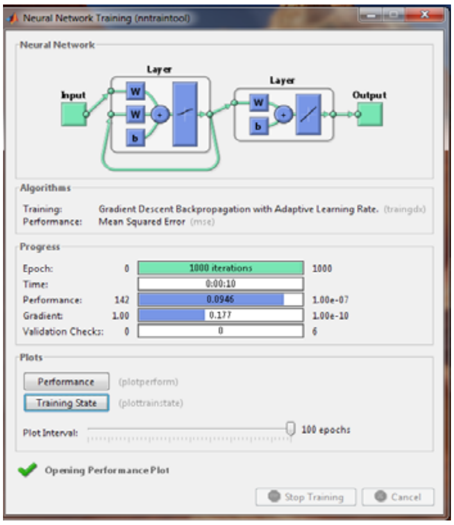

Fig. 1 Structure and block diagram of the system

B. *Model*

Using examples consists of 100 tests of 20 different combinations of factors involved in the Phytopathological process with all possible combinations. We choose to keep 10 tests (50%) while 10 tests (50%) are used for learning. A priori, the relationship between these two spaces is complex (in particular non-linear) which justifies the use of a multilayer network.

C. *Learning of the Neural Network*

It is in this case to introduce different data to the input in correspondence with the degree of pathogenicity resulting. To achieve this, the method is a kind of imitation of the brain: if the answer is correct, it is, but if there is an error, we must modify the network so as not to repeat the mistake. Is repeated several hundred times the operation, until the system has the smallest error value as possible

Note: To change the system, just work on the weights [W] which are in the form of real numbers linking neurons. As these weights involved in the sum made by each neuron (the sum is weighted), it is possible to modify the network by changing their values without changing the network itself. That said, it is not clear how much weight we need to modify these. The goal is to achieve convergence towards a minimum error. In our case, after 142 iterations, the error is 0.0946 (Fig. 1) with a gradient of 0.17 to 1000 iteration (Fig. 2).

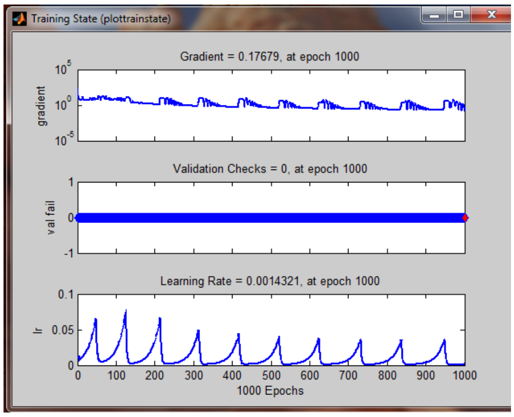

Fig. 2 Error correction functions

The result after training is shown in Fig. 3. The proposed program predicts the degree of pathogenicity based on the input parameters. Test values are fully consistent with the recorded values.

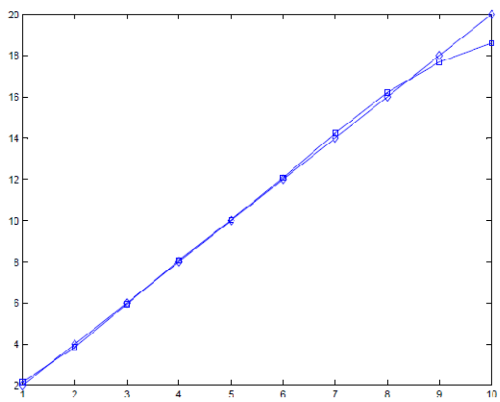

Fig. 3 Example of application between the measured values and test values

IV. Results and Discussion

In practice farmers argue their investment by integrating irrigation potential soil quality and the environment used and implicitly establishes a link between the quality and risk of disease. The proposed system can predict the degree of damage depending on the nature of the environment used. By introducing random values to the input of the system allows us to instantly read the result to predict the output. The lack of precision that can occur is subject to many variables to the system input.

V. Conclusion

The established system used to analyze the factors involved in the occurrence of plant diseases in arid and semi-arid. If the proposed program predicts the degree of involvement of each type of bacteria, it is extensible and allows the introduction of other variables that are considered in this study. A larger studies including all parameters that influences the accuracy are to introduce and this for more reliability. The combination of these factors with their complexity, adapt perfectly to the model proposed data processing.

References

[1] Go´mez-Silva B, Rainey FA, Warren-Rhodes KA, McKay CP, Navarro-Gonza´lez R. Atacama Desert soil microbiology. In: Dion P, Nautiyal CS (eds) Microbiology of extreme soils. Springer, Berlin, pp 117–132. 2008.

[2] Bashan Y.;. de-Bashan L.E, Microbial Populations of Arid Lands and their Potential for Restoration of Deserts. P. Dion (ed.), Soil Biology and Agriculture in the Tropics, Soil Biology 21, DOI 10.1007/978-3-642-05076-3_6, # Springer-Verlag Berlin Heidelberg. 2010.

[3] Filar J. A. Mathematical models. In: Knowledge for Sustainable Systems. An Insight into the Encyclopedia of Life Support Systems, Vol., pp. 339–354, UNESCO Publishing-Eolss Publishers, Paris, France, Oxford, UK. 2002.

[4] Baxt WG, Skora J. 1996. Prospective validation of artificial neural network trained to identify acute myocardial infarction [see comments]. Lancet; 347:12–15

[5] Buchman TG, Kubos KL, Seidler AJ, et *al*. A comparison of statistical and connectionist models for the prediction of chronicity in a surgical intensive care unit. Crit Care Med; 22:750–762. 1994.

[6] Ajith A. “Neuro Fuzzy Systems: state of Art Modelling Techniques”, In proceedings of the sixth international work conference on Artificial and Natural Neural Networks, IWANN 2001, Granada, Springer Verlag Germany, pp.269-276. 2001.

[7] Frize M, Solven FG, Stevenson M, et *al*. Computer-assisted decision support systems for patient management in an intensive care unit. Medinfo; 8:1009–1012. 1995.

[8] Doig GS, Inman KJ, Sibbald WJ, et *al*. Modeling mortality in the intensive care unit: comparing the performance of a backpropagation, associative-learning neural network with multivariate logistic regression. Proc Annu Symp Comput Applications Med Care; 361–365. 1993.

[9] Izenberg SD, Williams MD, Luterman A. Prediction of trauma mortality using a neural network. Am Surg; 63:275–281. 1997.

[10] William C., Hanson III, MD, FCCM, Bryan E., Marshall, MD, FRCP, FRCA. 2001. Artificial intelligence applications in the Ajith A. 2005. “Adaptation of Fuzzy Inference System Using Neural Learning”, Computer Science Department, Oklahoma State University, USA, springer verlag berlin Heidelberg, 2005.

[11] Ajith Abraham , Baikunth Nath. Hybrid Intelligent Systems Design -- A Review of a Decade of Research 2000.

[12] Ajith Abraham. Machine Intelligence. Journal of network and computer applications 28 (2), 167-182, 221, 2005.

[13] Nikam S.R.; Nikumbh P.J.; Kulkarni S.P. Fuzzy Logic And Neuro-Fuzzy Modeling. MPGI National Multi Conference 2012 (MPGINMC-2012) 7-8. 2012.

[14] Baxt WG. A neural network trained to identify the presence of myocardial infarction bases some decisions on clinical associations that differ from accepted clinical teaching. Med Decis Making; 14:217–222. 1994.