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RESEARCH ARTICLE

AGRO-MORPHOLOGICAL CHARACTERIZATION OF THREE SPECIES OF *VETCH* USING ARTIFICIAL NEURAL NETWORKS

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ABSTRACT

Despite the diversity of species of annual forage legumes that may be grazed in Algeria, few have been used to feed livestock. The use of these forages can improve livestock nutrition in the context of sustainable development. The valuation of plant genetic resources and knowledge of species and research pastoral interest in food is of paramount importance hence the choice of this work aimed at the agro-morphological characterization of three species of vetch ((*Vicia ervilia, V. narbonensis and V. sativa*) in the semi-arid region of Setif - Algeria-. Since data on these variables are characterized by uncertainty, vagueness and complexity, we found it useful to analyze them with an artificial neural network system as a technique of artificial intelligence. We propose in this reading performance of the study a package rates. It is then necessary to relate the parameters species, variety and quantitative variables that the input space to the study area in terms of actual measured values. The function mapping input parameters performance is adjusted by the network from a set of real measured values of pitch. After learning all random variables introduced at the input used to read the expected yield of the output.

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INTRODUCTION

The use of legumes, including vetch, is expected to improve the nutrition of cattle in the context of sustainable development. Several studies are done on the agronomic potential of vetch in arid and semi-arid areas indicate that they are more productive in grain and straw and they adapt better to these regions. In Algeria, the cultivation of vetch is used in combination with oats only for hay production; the crop accounts for over 70% of artificial forages consumed dry (Mebarkia *et al*., 2010). The valuation of plant genetic resources and knowledge of species foraging and pastoral interest represents an essential concern hence the choice of this work that aims to agro-morphological characterization of three species of vetch (Vicia ervilia, and V.narbonensis V. sativa) in the semi-arid region of Setif – Algeria-.Since data on these variables are characterized by uncertainty, vagueness and complexity, we found it useful to analyze them with an artificial neural network system as a technique of artificial intelligence. Artificial neural networks currently various applications in the field of science and technology.

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They have the dynamics and the ability to read the experimental data of the real environment and therefore are able to solve complex systems of biophysical processes. Neural networks are systems learning to perform mapping functions between two spaces, space entries and exits of space.

We propose in this study reading performance of a parcel rates. It is then necessary to link the species parameters, variety and quantitative variables as input space to the study area in terms of actual measured values. The function associating input parameters to the yield is then learned by the network from a set of real values measured on land.

MATERIALS AND METHODS

Presentation of the study environment

This study was conducted in the northern region of Setif at an EAC (collective farm). The plot on which the test was made is part of a total farm area (SAT) of 330 ha, including 30 ha of uncultivated and a utilized agricultural area (UAA) of 300 ha. As part of the North zone of the province, this farm has the same climatic characteristics of the area and the following

Tables (1a; 1b) shows the physical and chemical characteristics of the soil of their land.

Table 1a. Physical properties of soil

Soil	Value in percent (%)
Clay	53,5
Fine limon	14,9
Coarse limon	8,7
Fine sand	19,4
Coarse sand	0,08

Table 1b. Soil chemical properties

Nature	Depth (0-20cm)	Depth (20-40cm)	Average
PH	8,01	7 ,94	7,98
PH Kcl	7,29	7,24	7,26
Total limestone (%)	14,30	13,06	14,18
Electric conductivity (Mmhos/cm)	0,31	0,31	0,31

Climatic conditions of the experiment

According to Table 2, we see that the season of the experiment was dry, characterized by low rainfall (316.78 mm) which is not even the usual average in the area (450 mm) plus a poor distribution of rainfall.

As for temperatures, the lower are common in this season (2007/2008) and they coincide mostly with the stages of flowering legumes where certain flowers abortion (March, April and May).

The maximum temperatures are also very important, they occur at the end of legumes cycle where they promote fertility pods (filling).

The data indicate that it is colder during the months of December (2007) and January (2008) respectively 6.7 ° C and 7.8 ° C, while for the other months the temperatures were relatively mild given that, month of August was the warmest with an average temperature of 28.2°C.

Table 2. Weather (2007-2008)

Month		Sept	Oct	Nov	Des	Jan	Feb	mar	Apr	May	jun	jul	total
Temp °C	MAX	35.80	28.10	20.20	15.80	18.20	21.20	21.10	19.25	32.49	39.56	39.20	/
	MIN	11.40	08.20	00.20	-2.40	-2.60	-1.44	-0.06	07.55	08.36	10.57	14.60	/
Rainfall (mm)		10	53	26.6	60.8	12	21	13.03	27.5	68.75	1.7	22.4	316.78

Table 3. List of species and varieties tested

	Spe. 1 *Vicia ervilia L.*	Spe.2 *VicianarbonensisL.*	Spe.3 (local) *Vicia sativa L*
V1	IFVE 2799 Sel2510	2561-ICARDA	José
V2	IFVE 2801 Sel2511	2580-ICARDA	Fig
V3	IFVE 2801 Sel2512	2583-ICARDA	Baraka
V4	IFVE 2801 Sel2513	2588-ICARDA	715
V5	IFVE 2801 Sel2515	2590-ICARDA	709
V6	IFVE 2801 Sel2516	2591-ICARDA	Hifa

The winds are common in this area but that mention here is the sirocco; the hot and dry wind is very common from June. Frosts are common, but those at the end of spring, causing considerable damage to cereal crops. Early frosts are concentrated during the winter period (December, January).

EXPERIENCED PLANTS

Material

The trial included three species of vetch as shown in Table 3.

Experimental protocol and conduct of the experiment

The trial was established according to an experimental protocol blocks following a complete randomization. Fig. 1 showing was done manually on 26/12/2007 at a depth of 2-3 cm, on a plot with a previous crop as "fallow" and different cropping on which work was performed (Table 4).

The main plot is divided into elementary particles, spaced 80 cm from one another and distributed in three replicates. Each of these elementary particles is represented by two lines of 2.5 m long and spaced 60 cm; 15 seeds were sown per line.

Collection and analysis of data

Measurements and notations made were carried out on field and laboratory for each species and at different times of the growing season.

Ten variables were selected to be measured. They cover biometric characters and yield components. These are all continuous or quantitative variables (Table 4).

-The Counting was done at early maturity at each plant.

-Just Before complete maturity, we counted the number of pods produced by each plant and at this level, we noticed the presence of the ginning phenomenon in some species especially *V.sativa*.

-At a full maturity, we proceeded to harvest plant, and in the laboratory, weighing pods which many of them were empty (for some species); according Abdelmouneim *et al*. (1992), that ginning phenomenon is related much more to the species itself; that is, it is intrinsic and purely genetic. All these data generated were the subject of a treatment using an intelligent system approach "artificial neural networks system".

Table 4. List of measured variables

Variables	Notation
Number of branches	Nr
The major axis length	Lrp
Number of leaves on the main axis	Nfe
Number of flowers	Nfr
Number of pods / plant	Ngp
Pod weight / plant	Pgp
Number of seeds / pod	Ngrg
Number of seeds / plant	Ngrp
Seed weight / plant	Pgrp
Yield	Rdt

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. The artificial neural network systems are widely used in the prediction of complex processes (Friz *et al*., 1995 and Izenberg *et al*., 1997). 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 (Wiliam *et al*., 2005). In the simplest way, a cooperative model, (Ajith *et al*., 2000; 2005), can be considered as a preprocessor wherein artificial neural network (ANN) learning mechanism determines the training data (Nikam *et al*. 2012).

Expression of the Problem

Mapping of the space of parameters involved in the inputs are [species, variety, bloc, individual, number of branches, major axis length, number of leaves on the main axis, number of flowers, number of pods/plant, pod weight/plant, number of seeds/pod, number of seeds/plant, seed weight/plant] with the yield as output. Fig. 1 describes the topology with inputs extensible, hidden layer, and an output (13-1-1) 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 Baxt *et al*. (1994). (In particular non-linear) this justifies the use of a multilayer network (Fig. 1).

Learning of the Neural Network

It is in this case to introduce different data to the input in correspondence with the input variables 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 (Fig. 1). The goal is learning network to reach the minimum value of the read error observed at the output (DG Chen *et al*., 2000). In our case, after 142 iterations, the error is 0.0946 with a gradient of 0.17 to 1000 iteration (Fig. 2).

Model

Using examples consists of 540 measurements on all input parameters. We chose to keep 270 tests (50 %) while 270 other tests (50%) are used for learning. In principal, the relationship between these two areas is complex (in particular non-linear), which involves the use of a multi-layer structure.

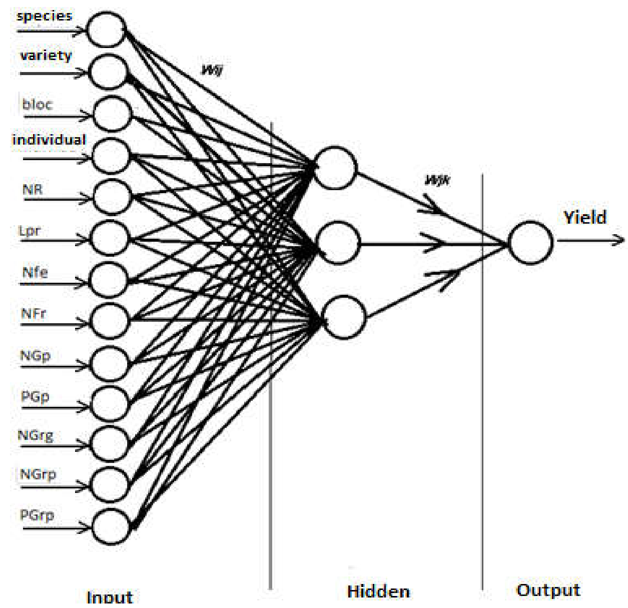

Figure 1. The rate of yield according to the input parameters through a hidden layer

Data processing

Initial data are:

Input parameters

Thirteen measured parameters:

Species, Variety, Bloc, Individual, Number of branches (Nr), length of the main branch (Lrp) Number of sheets of the main axis (Nfe) Number of flowers (Nfr) Number of pods per plant (Ngp) Weight of pods per plant (Pgp) Number of grains per pod (Ngrg) Number of grains per plant (NGRP) and weight of grains per plant (Pgrp).

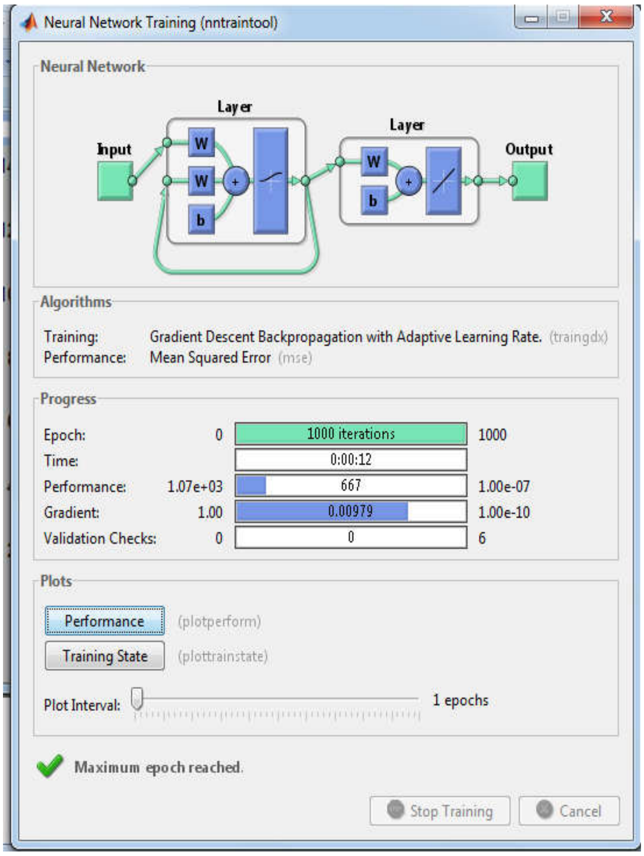

Figure 2. Schematic global network

Output settings

The rate of return (yield) recorded

Chose 3 – Networking

Multi network layer (with a hidden layer).

The activation function

Sigmoid type

Error correction

In computer terms, the epoc is the number of repetitions in order to adjust and refine the mapping between input and output of the system. In our case we chose:
1000 EPOCS.

DISCUSSION OF RESULTS

- The input and output parameters are presented in an Excel file. The program uses this file as a data source.
- The result after training presented in Figure 3 demonstrates the direct reading of the rate of return from other input variables. The system refers to the function that connects the inputs to the output established during the operation of learning.
- Automatic forecasting artificial neural networks yield shows its ability to respond to treatment data on parameters measured on land.
- Eight show the yield variation curve and allows us to visualize the synthesis of the prediction model. From 540 observations (270 were used for learning), the result shows that the measurement error is negligible intermittently (1to1) from 0 to 540 and the remaining 270 or 50% are taken to test. The superposition of test values and those learning is a proof of the validity and accuracy of the predictive model.

Conclusion

The identification of species and varieties of forage and forecasting yields are elements of great interest to farmers, ranchers and government agencies responsible for monitoring agricultural productivity. For botanists, observation of the number of branches, the length of major axis, the length of the sheet or leaflet, the number of sheets on the main axis, the number of flowers, number of pods/plant, weight of pods/plant, number of seeds/pod, number of seeds/plant, weight of seeds/pod and seed weight/plant and so many other morphological characters, have an element of confirmation identification.

The main purpose of this study is the identification of species and the most efficient varieties in a field. The results have identified the characters of most species and varieties that can be grown in the study area to be introduced into animal feed. In this sense, the proposed system can predict the yield on one side of a given line from its morphological characteristics and on the other hand, the identification of this lineage or species through its agronomic and morphological characters.

We try through the use of neural complete analysis already made networks using a fuzzy logic system to arrive at a neuro-fuzzy hybrid system to establish a key to identify and evaluate the performance of species or varieties of data in a field based agro-morphological characters.

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