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Effect of Oxygen Consumption of Thylakoid Membranes (Chloroplasts) From Spinach after Inhibition Using JNN

Hisham Ziad Belbeisi, Youssef Samir Al-Awadi, Muhammad Munir Abbas, Samy S. Abu-Naser

Department of Information Technology,
Faculty of Engineering and Information Technology,
Al-Azhar University - Gaza, Palestine

Abstract: *In this research, an Artificial Neural Network (ANN) model was developed and tested to predict effect of oxygen consumption of thylakoid membranes (chloroplasts) from spinach after inhibition. A number of factors were identified that may affect of oxygen consumption of thylakoid membranes from spinach. Factors such as curve, herbicide, dose, among others, as input variables for the ANN model. A model based on multi-layer concept topology was developed and trained using the data from some inhibition of photosynthesis in farms. The evaluation of testing the dataset shows that the ANN model is capable of correctly predicting the effect of oxygen consumption of thylakoid membranes (chloroplasts) from spinach after inhibition with 100% accuracy.*

Keywords: Artificial Neural Networks, oxygen consumption, ANN, Predictive Model.

1. INTRODUCTION

The main objective predict the effect of oxygen consumption of thylakoid membranes (chloroplasts) from spinach after inhibition, to know the amount of oxygen consumption to protect the spinach plant from some diseases.

This study seeks to explore the possibility of using the artificial neural network model to predict the effect of oxygen consumption of thylakoid membranes (chloroplasts) from spinach after inhibition, at the lowest possible time and high accuracy in the results [1,2]. Of course one would expect the effect of oxygen consumption after inhibition to be associated with several influential factors as mentioned earlier. On the other hand it is clear that it will be very difficult to find a mathematical model that may be an appropriate model for this relationship between performance/factors. However, one realistic method to prediction of the oxygen consumption after inhibition may be to study data on the background of the some factors [3,4].

The practical approach to this type of problem is to apply a regression analysis in which data is better integrated into some functions. The result is an equation in which both input x_j is multiplied by w_j; the sum of all these products is constant, and then an output of $y = \Sigma w_j x_j +$, is given, where j = 0.n.
The problem here is that it is difficult to choose a suitable function to capture all data collection as well as automatically adjust the output in the case of more information, because prediction is controlled by a number of factors, and this control will not be any clear and known regression model.
The artificial neural network, which simulates the human brain in solving a problem, is a more common approach that can address this type of problem. Thus, attempting to develop an adaptive system such as artificial neural network to predict the temperature based on the results of these factors [1].

The objectives of this study are:

- To identify some appropriate factors that affect the oxygen consumption.
- To convert these factors into appropriate models for adaptive system coding.
- Designing an artificial neural network that can be used to predict effect oxygen consumption based on some predefined data.

2. THE ARTIFICIAL NEURAL NETWORKS

An Artificial Neural Network (ANN) is an application of Artificial Intelligence [5]. ANN is an arithmetical model that is motivated by the organization and/or functional feature of biological neural networks. A neural network contains an interrelated set of artificial neurons, and it processes information using a connectionist form to computation. As a general rule an ANN is an adaptive system that adjusts its structure based on external or internal information that runs through the network during the learning process. Recent neural networks are non-linear numerical data modeling tools. They are usually used to model intricate relationships among inputs and outputs or to uncover patterns in data. ANN has been applied in numerous applications with considerable attainment [16-20]. For example, ANN has been effectively applied in the area of prediction, handwritten character recognition, evaluating prices of lodging [6].

Neurons are often grouped into layers. Layers are groups of neurons that perform similar functions. There are three types of layers. The input layer is the layer of neurons that receive input from the user program. The layer of neurons that send data to the user program is the output layer. Between the input layer and output layer are hidden layers. Hidden layer neurons are only connected only to other neurons and never directly interact with the user program. The input and output layers are not just there as interface points. Every neuron in a neural network has the opportunity to affect processing. Processing can occur at any layer in the neural network. Not every neural network has this many layers. The hidden layer is optional. The input and output layers are required, but it is possible to have on layer act as both an input and output layer [7].

ANN learning can be either supervised or unsupervised. Supervised training is accomplished by giving the neural network a set of sample data along with the anticipated outputs from each of these samples. Supervised training is the most common form of neural network training. As supervised training proceeds the neural network is taken through several iterations, or epochs, until the actual output of the neural network matches the anticipated output, with a reasonably small error. Each epoch is one pass through the training samples. Unsupervised training is similar to supervised training except that no anticipated outputs are provided. Unsupervised training usually occurs when the neural network is to classify the inputs into several groups. The training progresses through many epochs, just as in supervised training. As training progresses the classification groups are "discovered" by the neural network [8].

Training is the process by which these connection weights are assigned. Most training algorithms begin by assigning random numbers to the weight matrix. Then the validity of the neural network is examined. Next the weights are adjusted based on how valid the neural network performed. This process is repeated until the validation error is within an acceptable limit [9].

Validation of the system is done once a neural network has been trained and it must be evaluated to see if it is ready for actual use. This final step is important so that it can be determined if additional training is required. To correctly validate a neural network validation data must be set aside that is completely separate from the training data [10].
About 60% of the total sample data was used for network training in this paper. About 30% of the total sample data served as test and the remaining 10% used for validation of the system[11].

3. METHODOLOGY

By looking deeply through literature and soliciting the experience of human experts in agriculture a number of factors have been identified that have an impact on of oxygen consumption of thylakoid membranes (chloroplasts) from spinach after inhibition. These factors were carefully studied and synchronized in an appropriate number to encode the computer in the ANN environment. These factors were classified as input variables. Configuration variables reflect some possible levels of know effect of oxygen consumption from chloroplasts from spinach by values and factors.

3.1 The Input Variable

This database includes 105 cases. Each case represents oxygen consumption of thylakoid membranes (chloroplasts) from spinach after inhibition. It consists of four input variables and one output variable.

The input variables specified are those that can be obtained simply from the farms. Input variables are:

Table 1: Attributes of the Data set

No.	Attributes	
1.	Id	Id of each case
2.	curve	A numeric vector specifying the assay or curve (a total of 5 independent assays where used in this experiment).
3.	herbicide	A character vector specifying the herbicide applied: bentazon or diuron
4.	dose	A numeric vector giving the herbicide concentration in muMol.

3.2 The Output Variable

The output variable represents the performance of the farms. The output variable depends on the input.

Table 2: Output variables

S/N	Attributes	
1.	slope	A numeric vector with the measured response: oxygen consumption of thylakoid membranes.

3.3 Data Normalization

Linear scaling of data is one of the methods of data normalization. Linear scaling requires that a minimum and maximum values associated with the facts for a single data input be found. Let's call these values *Xmin* and *Xmax*, respectively. The formula for transforming each data value to an input value *X* is:

$$X_i = (X_i - X_{min}) / (X_{man} - X_{min}) \qquad \text{Eq.(1)}$$

Our desired range varies in the interval between zero and one. In this study we normalized all numeric variables to be in the range between 0 and 1.

3.4 Design of the Neural Networks

We have used Just Neural Network (JNN) tool [13] to build a multilayer ANN model. The proposed model consists of 3 Layers: Input Layer with 4 nodes, one Hidden Layer with 6 nodes and Output Layer with one node as can be seen in Figure 3.

We have sat the parameters of the proposed model as follows: Learning Rate 0.6 and the Momentum to be 0.8, and Average Error rate to be 0.01 (as shown in Figure 2).

3.5 The Back-propagation Training Algorithm

- Initialize each wi to some small random value
- Until the termination condition is met, Do
- For each training example <(x1,…xn),t> Do
- Input the instance (x1,…,xn) to the network and compute the network outputs o_k
- For each output unit k: δk=ok(1-ok)(tk-ok)
- For each hidden unit h: δh=oh(1-oh) Σk wh,k δk
- For each network weight wj Do wi,j=wi,j+Δwi,j,where Δwi,j= η δj xi,j and ηis the learning rate.

3.6 Evaluating the ANN model

The spinach dataset [12] consists of 105 samples with 6 attributes as in Table 1 and Table 2. We imported the preprocessed CSV file of the spinach dataset into the JNN environment (as seen in Figure 1). We divided the imported dataset into two sets (Training and Validation) randomly using the JNN tool. The Training consists of approximately 67% (70 samples) and the validation set consists of 33% of the dataset (35 samples). After making sure that the parameter control was sat properly, we started training the ANN model and kept eye on the learning curve, loss error and validation accuracy. We trained the ANN model for 7001 cycles. The best accuracy we got was 100% (as seen in Figure 4). We determined the most influential factors in the spinach dataset as in Figure 5. Figure 6 shows the summary of the proposed model.

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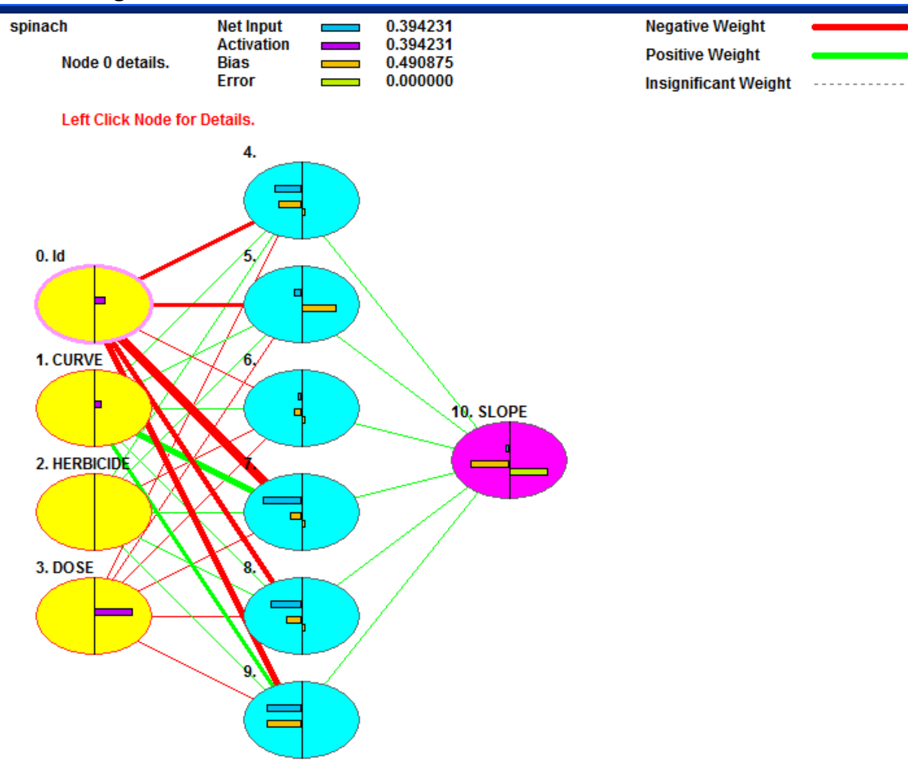


Figure 3: Shows the Design of the Neural Networks

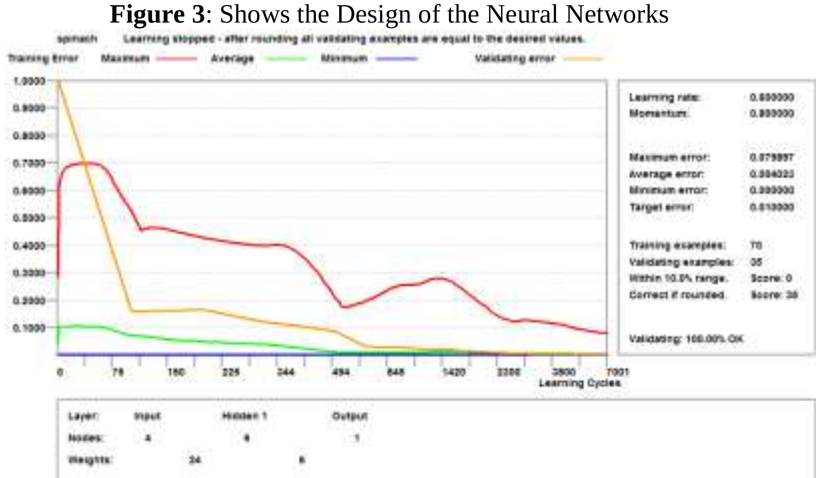
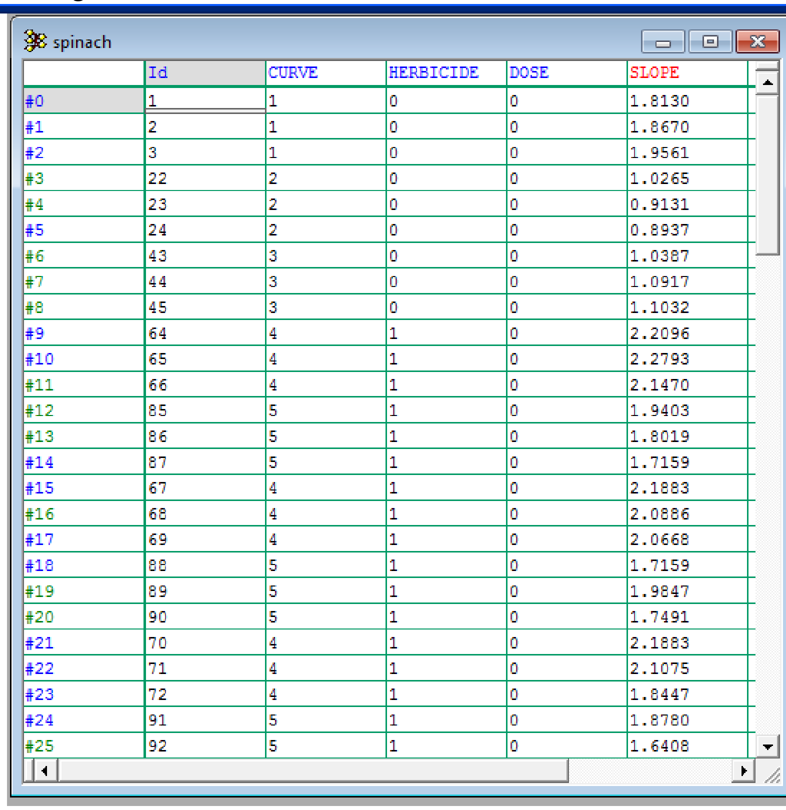


Figure 4: Shows the Training, error, and validation of the data set.



spinach

	Id	CURVE	HERBICIDE	DOSE	SLOPE
#0	1	1	0	0	1.8130
#1	2	1	0	0	1.8670
#2	3	1	0	0	1.9561
#3	22	2	0	0	1.0265
#4	23	2	0	0	0.9131
#5	24	2	0	0	0.8937
#6	43	3	0	0	1.0387
#7	44	3	0	0	1.0917
#8	45	3	0	0	1.1032
#9	64	4	1	0	2.2096
#10	65	4	1	0	2.2793
#11	66	4	1	0	2.1470
#12	85	5	1	0	1.9403
#13	86	5	1	0	1.8019
#14	87	5	1	0	1.7159
#15	67	4	1	0	2.1883
#16	68	4	1	0	2.0886
#17	69	4	1	0	2.0668
#18	88	5	1	0	1.7159
#19	89	5	1	0	1.9847
#20	90	5	1	0	1.7491
#21	70	4	1	0	2.1883
#22	71	4	1	0	2.1075
#23	72	4	1	0	1.8447
#24	91	5	1	0	1.8780
#25	92	5	1	0	1.6408

Figure 1: Imported dataset into JNN environment

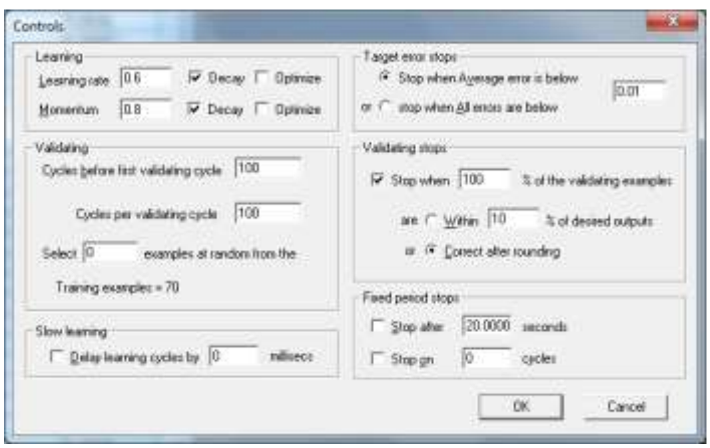
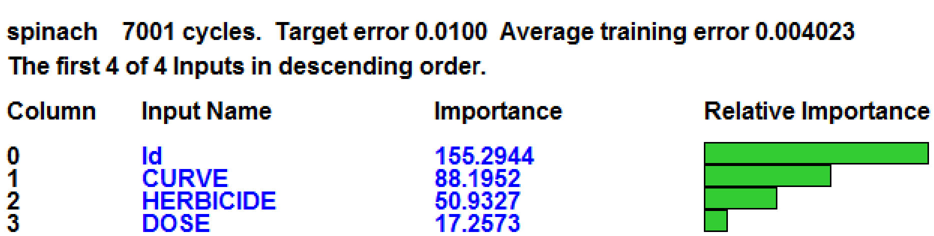


Figure 2: Control of the parameters of the proposed ANN model



spinach 7001 cycles. Target error 0.0100 Average training error 0.004023
The first 4 of 4 Inputs in descending order.

Column	Input Name	Importance	Relative Importance
0	Id	155.2944	
1	CURVE	88.1952	
2	HERBICIDE	50.9327	
3	DOSE	17.2573	

Figure 5: The most influential Feature in the proposed ANN model

Figure 6: Details of the proposed ANN model

Conclusion

The purpose of this experiment was to predict the effect of oxygen consumption of chloroplasts from spinach after inhibition. Where we used data, which provides the possibility to implement and test the neural network and its learning algorithm. Our neural network is a sensor expression designed to detect the presence of one of two sets of materials. Alternatively, human reading may be wrong. After training and validation, the network was tested using the test data set and the following results were obtained. This involves inputting variable input data into the grid without output variable results. The output from the grid is then compared with the actual variable data. The neural network was able to accurately forecast 100% of the excellent data (representing 4 inputs and based on the inputs.) We have outputs 100% is correct.

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