Control Of Weed Threshold Using Artificial Neural Networks

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Abstract: Cereal production is a function of several parameters. Weeds play an important role according to their density and the period in which they proliferate. Their spatial distribution in terms of wheat competition is also a factor that should not be overlooked. The use of pesticides, the adaptability of crops, the agricultural mode, the climatic impact, the nature of the soil, the weed species and the crop species are combined parameters. What characterizes this environment is complexity and imprecision. This study proposes an intelligent analysis system with artificial neural networks. The proposed network has three layers. An input layer comprising the variables that enter the process, a hidden layer and an output layer express the wheat yield. It is a question of making the correspondence between the two spaces of inputs and output starting from the real values measured. This phase represents the learning of the network. Once the transfer function is established, it will be possible to predict the yield of a plot from the conditions and the growing environment.

Keywords: Weeds, crop, environmental conditions, yield, ANN

1. Introduction

In addition to the density and period effects of weeds on the cereal production, pesticides uses and agricultural method, other factors such as the spatial structure effect can be studied. The period of competition and the distribution of plants on the ground are equally important factors. The incidence of climate (with differences observed depending on the climatic zone: continental or maritime, for example) on the harmfulness of weeds, the nature of the soil, the species of weeds, the cultivated species. What characterizes these variables is complexity, uncertainty and imprecision. Also, with intensive use of herbicides, resistance to them is developed. Weed control remains a major problem for farmers. Despite the existence of data on the impact of these products, there is uncertainty as to their use [1]. In this study, we propose to analyze these variables using an intelligent model. An artificial neural network system is proposed. The proposed network has a six inputs and one output. Factors favoring weeds (the density, period, climate zone, nature of the soil, species of weeds and the cultivated species are considered as input variables to the network. The fall in the yield caused is considered as an output variable. It is then necessary to match the inputs to the output. According to the recorded results, the learning of the network is carried out. The established system makes it possible to instantly read the drop in the expected output as a function of the input variables fixed randomly. This can be a preventive tool and allows preventive measures to be taken in the control of weeds for improved production.

2. Control methods and adaptation

Generally, herbicides are often the most used means; however, they are not the ideal solution [2]. What has been observed is that weeds adapt easily and develop resistance to these herbicides [3]. This has been a major problem for agriculture [4]. But if the weeds have a direct effect on wheat productivity, this involves the economic aspect such as the costs of labor, equipment, chemicals and other management inputs. Weeds compete with wheat, especially in water management [5]. It is therefore preferable that weed control should be combined with crop rotation. Thus, some cover crops can participate in improving the competitiveness of market garden crops [6]. Also, it is necessary to control the weed control [7]. This requires a historical knowledge of the effect of these species [8], the nature of the species [9] and their period of appearance [10]. In order to minimize the use of pesticides, solutions are proposed to increase competitiveness against weeds by combining wheat crops as well as genetic improvement and cultivation techniques such as density and row spacing. The most promising breeding techniques remain the choice of wheat variety that adapts to the nature of the weeds. For this, studies remain to be implemented in this area. It is natural for the principle of evolution that cereals develop competitiveness against weeds without weeding or chemical or mechanical treatment [7]. Plants modify their morphology to keep themselves in competition to optimize their use of factors of production [11]. During the selection of cultivars, the priority is not competitiveness against weeds [12].. but often the priority is the environmental aspect, the biological system and the adapted varieties [13]. Study results show differences in competitive ability [14]. Other experiments have shown that competitive wheat cultivars are a solution to the non-use of herbicides [15]. Thus, winter wheat crop size and fast till ability were demonstrated with weed control [16]. Examples have shown the increase in the competitiveness of winter wheat against in semi uniform [17]. Also, increased density in spring wheat plots reduced weeds by acting on biomass in the presence or absence of nitrogen fertilizer [18]. Other studies have shown that cereal crop yields increase by weed reduction through a combination of density by acting on spatial uniformity. This saves the costs of weed control. Add to that, the gain in environmental preservation by reducing the use of chemicals [19]. For this, different environmental scenarios are needed to explore the effect of each technique applied to improve performance. These scenarios take into account the different factors that influence, among other things, the climatic and phenotypic conditions of the harmful species [20].

2.1. Factors influencing the result of competition

Changes in precipitation in time and quantity influence how farmers approach. Insufficient or abundant rains have a direct effect on heat stress, especially in sensitive phases of the plant cycle. Add to this the effect of pests in phyto-pathology. Soil conditions are to be considered. Deforestation, resource depletion, soil erosion are also a function of climatic conditions [21]. The adaptability of crops sometimes becomes very difficult in the face of climatic changes that induce water stress and changes in the frequency of infestations [22].

3. Artificial neural networks analysis

The natural neural system is considered as a model for artificial neural networks in the way it processes information. This is to build a set of artificial neurons interconnected to the image of the biological neuronal system. Signals of the senses in the natural system are replaced by mathematical parameters that influence the system. The reaction or decision-making in the natural system is replaced by the result obtained by these variables upon input into the artificial neural system. This data analysis technique is applied in different fields of biology, environment or medicine, where the system is very complex to analyze by the classical mathematical tool [28]. The basic principle is the creation of two input-output spaces. The system proposed in this study is composed of three layers: An input layer, a hidden layer and an output layer. The next step is to match the two input-output spaces. The entering variables at the input of the system according to the value corresponding to the output from the actual measured data, the network creates a mapping function between these two spaces. With each combination introduced, the system adjusts the function for optimization until it reaches the minimum error. The advantage of this system in addition to its ability to handle a large number of variables is that it keeps the same function for each combination of variables. The adjustment is done only by the variation of the (weights) which are in the form of mathematical coefficients. That is, it is not necessary to change the network. The main phase of artificial neural networks is learning the network. During this phase, the network builds the optimal function. Once this is in focus, it is sufficient to introduce random variables at the input to instantly read the result at the output. It just refers to the function already built. Therefore, by its ability to analyze a large combination of data, it can predict a result as accurate as possible from the variables introduced at the entrance. The basic architecture of the built network is presented on (Figure 1).

4. Application

In this study, it is a matter of building a network with the input variables that constitute the various factors that influences yield. (Weeds, their density, the period in which they proliferate, their spatial distribution, the use of pesticides, the adaptability of crops, the agricultural mode, the climatic impact, the nature of the soil, the weed species and the crop species). These variables are the input variables to the system. the crop yield is considered output variable. it is then necessary to introduce all the possible combinations by making the correspondence between the factors at the input and the output corresponding to the output. a large number of combinations make it possible to create a function as precise as possible during this learning phase. Then randomly introduces input variables to accurately predict output as a result of these factors.

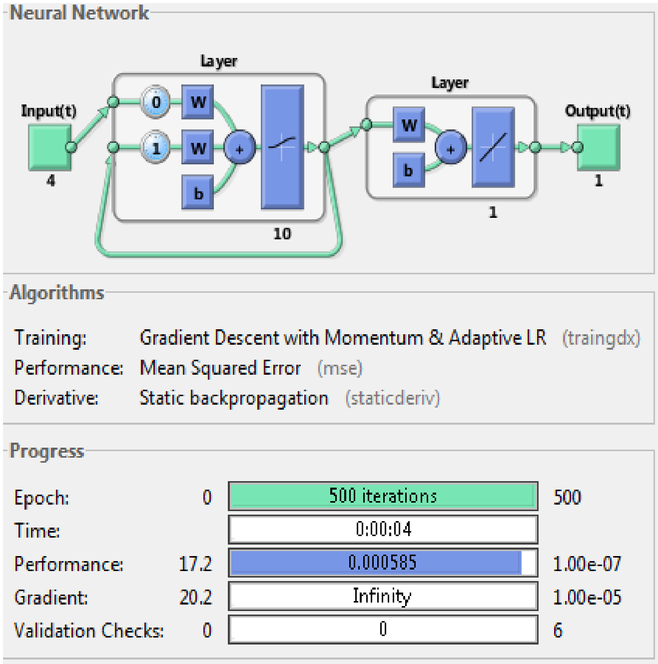

Figure 1. *Block diagram of the system.*

5. Result

The density, period, climate zone, nature of soil, species of weeds, cultivated species as inputs are coded in equivalent numbers (1,2,3). The fall in the yield as output is also encoded in number equivalents (1,2,3). After the learning phase of the network, it becomes possible to predict the fall in the yield according to inputs variables. The optimum of the learning is reached at 75 iteration with a performance of 0.005 with a learning rate 0.005 at 75 epoc. A performance of 10^{-7} is achieved with a gradient of 10^{-5} (Figure 2). Figure3 demonstrates that the test values coincide perfectly with the learning values

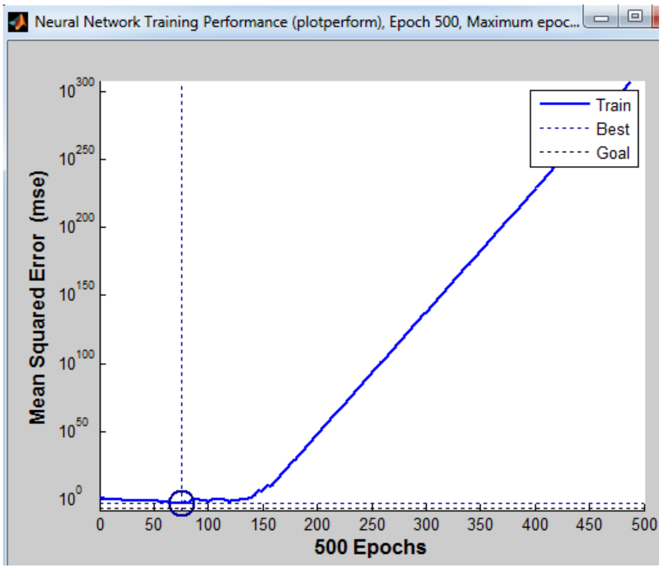

Figure 2. *Optimum at75 ecpc.*

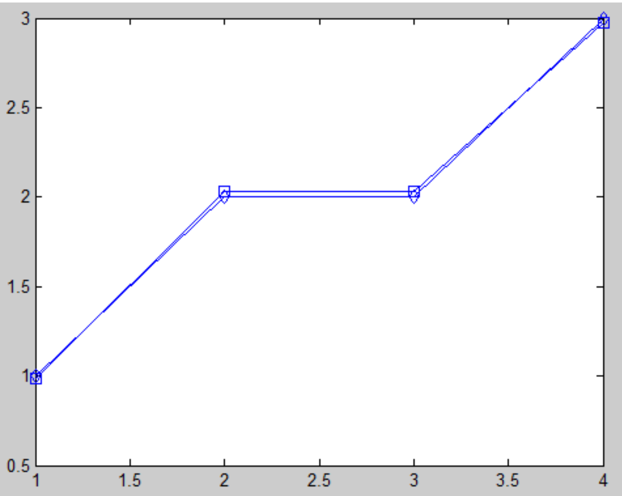

Figure 3. *Test resultsand learning*

Conclusion

Using ANN can help us study the effect of some factors and competition between weeds and on crop yield, weed seed production. They can be used to study the impacts of a wide range of management options and their interactions with other factors such as the environment and weed biology. As the factors involved in cereal production are multiple and complex. Weeds are the main factor. However, the proliferation of weeds is also a function of many elements. By proposing this tool to analyze these factors through an artificial neural network, we implement a tool that supports these complexities. The variables are numerically encoded. A learning phase of the network is carried out. The result is that all test values of the network coincide perfectly with the learning values. This makes it possible to predict the effect of weeds on production just by randomly introducing values at the input of the system.

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