Black Sea Journal of Agriculture
doi: 10.47115/bsagriculture.1110022

Open Access Journal
e-ISSN: 2618 – 6578

Research Article
Volume 5 - Issue 3: 288-299 / July 2022

DETERMINATION OF THE EFFECT OF DIFFERENT NITROGEN DOSES ON THE YIELD, YIELD COMPONENTS AND CHLOROPHYLL CONTENTS OF BREAD WHEAT (*TRITICUM AESTIVUM* L.) CULTIVARS USING ARTIFICIAL NEURAL NETWORK

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Abstract: This research investigates an artificial neural network for predicting the chlorophyll concentration index and the effect of different nitrogen doses on the yield, yield components of Bread Wheat (*Triticum aestivum* L.). Plants were fertilized with 5, 10, 15, 20, and 25 kg da^{-1} nitrogen doses. The chlorophyll concentration index of each leaf was measured using a SPAD meter. The coefficient of determination values was found to be 0.99. In artificial neural network modeling, chlorophyll concentration values were estimated with SPAD readings. Artificial neural network modeling successfully described the relationship between actual chlorophyll concentration index values and predicted chlorophyll concentration index values. Agronomic parameters plant height (110.66-92.73 cm), the number of spikes per square meter (461.01-355.50), the number of seeds per spike (43.88-23.83), the weight of seed per spike (2.07-0.91 g), hectoliter weight, thousand-grain weight (43.10-35.89 g), grain yield (638.76-343.06 $kg.da^{-1}$), protein contents (11.16-8.34 %), the value of sedimentation (19.40-11.94) were found statistically important.

Keywords: Artificial neural network, Chlorophyll, Breat wheat, Yield

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Received: April 27, 2022
Accepted: June 07, 2022
Published: July 01, 2022

Cite as: Öner F, Kayhan G, Ergün E, Özkorkmaz F, Odabaş MS. 2022. Determination of the effect of different nitrogen doses on the yield, yield components and chlorophyll contents of bread wheat (*Triticum aestivum* L.) cultivars using artificial neural network. BSJ Agri, 5(3): 288-299.

1. Introduction

In recent years, studies as to the expression of the plant growth in agriculture by mathematical models have been carried out extensively. The relationship between plant growth and yield and the changes in plant growth under the influence of environmental conditions (such as light, air, soil temperature, etc.) are aimed to be expressed by plant growth models (crop model). The development of information technologies and their applicability to all areas demonstrate the availability of computer-assisted models. In this study, chlorophyll content in the plant was estimated by using computer assisted machine learning methods. From this perspective, this study serves as an interdisciplinary study that will create a hardware and theoretical infrastructure for other studies in the field of precision agriculture practices (Odabas et al., 2009).

Wheat sprouts include 90 of 102 natural minerals, along with 20 types of amino acids and hundreds of different enzymes. When consumed fresh, it regulates metabolism, increases heart function, normalizes blood pressure, lowers cholesterol and cleanses the intestines. Wheatgrass juice is a substance that has a stronger detox effect than carrot juice, vegetable juices and other juices. In the light of this information, it is our objective to determine how different doses of nitrogen applied to wheat varieties change the content of chlorophyll (Akgun and Topal, 2006). For this purpose, in our study conducted using different nitrogen doses, chlorophyll measurements were carried out from the seed germination, these measurements were recorded and the content of chlorophyll was determined using artificial neural networks (Temizel et al., 2014).

The model is a simplified picture of reality and reveals the characteristics of the system being studied. The model can also be defined as an explanation of the main components of a system using mathematical and/or statistical formulas (Dhillion et al., 2002). A model that accurately and adequately represents a real system contains the characteristics of the system studied in the model. We do not expect that a model contains all the features of the system being studied, because in this case it becomes the system itself, which is impossible (Freeman and Skapura, 1991). Another feature of models is that they are accurate and adequate (Gao et al., 2000). After the establishment of a model, validation and verification tests should be applied to the model. If the model passes these tests successfully, the model created is considered to accurately and adequately represent the system being studied. A model can be used for a variety of purposes (Hoareau and Dasilva, 1999). For this reason, the modeling process should begin with the determination of the purpose that will essentially be considered in the model to be established. The goals in this study determine for what purpose the entire model which makes up the characteristics of the model will be used, and what should be expected of this model. If a model consists of a certain number of sub-models, the goals of these sub-models must also be determined. Models are potentially powerful means but must be used within a strict discipline (Kocabas, 1995).

Recent developments in model studies on plants have revealed the importance of structural and functional components of the plant canopy. The leaves and other photosynthetic organs on the plant serve as collectors of the solar energy and gas exchangers. The trunk and branches are arranged in such a way that these exchange surfaces are effectively formed by radiative conversions (Monteith, 1996). All processes of growth and development in plants result in yield. In recent years, intensive research has been carried out to fully clarify the impact of environmental conditions on the growth and yield of plants. These studies have comprised an important basis for understanding the factors affecting crop photosynthesis, which are the cause of most of the changes in yield (Uzun et al., 1998). In developed countries in terms of agriculture, intensive studies have been performed in recent years on the expression of plant growth via mathematical models. Therefore, the impact of environmental conditions (light, air, soil temperature, etc.) and changes in plant growth have been tried to be expressed through plant growth models (Crop model).

2. Material and Methods

The research was carried out for 2 years in the experimental field of the Faculty of Agriculture at Ordu University. 11 different wheat varieties (Es-26, Alpu 2001, Soyer 02, Mesut, Altay 2000, Mufitbey, Nacibey, Harmankaya 99, Sultan 95, Yunus and Sönmez 2001) were used as materials and 5 different nitrogen doses (5, 10, 15, 20 and 25 kg da^{-1}) were applied. Regarding agronomic properties; plant height, the number of spike per square meter, the number of seed per spike, the weight of seed per spike, hectoliterweight, thousand grain weight, grain yield, protein contents, the value of sedimentation, leaf area and chlorophyll contents were analyzed.

In the study, all analyses were combined for 2 years and carried out using SAS-JMP 11.0 package program by the factorial arrangements in randomized complete block design. Some quality parameters of the study (protein content, Zeleny sedimentation value and hectoliter weight) were analyzed through NIT in the Department of Field Crops at the Faculty of Agriculture of Dicle University. For regression and correlation analysis, the SPSS package program was used. Artificial neural networks were modeled with MATLAB.

Chlorophyll is found in significant amounts, especially in leaves. For this reason, the development of leaves, leaf area and therefore the amount of chlorophyll are important. Chlorophyll analyses of leaf samples taken at certain intervals during the development period of the plant were carried out. This measurement was made with the chlorophyll meter (SPAD-502 chlorophyll meter) device. This saves time for other operations.

2.1. Artificial Neural Network

This network consists of three layers: the input layer, the output layer, and at least a hidden layer. The hidden layer and the number of nodes in the hidden layer can be changed (Haykin, 1994). Increasing number of nodes increases the network's ability to remember, but also extends the learning time (Gomm and Yu, 2000). The output signals of neurons in a layer are passed on to the next layer as inputs via weights (Hagan and Menhaj, 1994). The input layer transmits the inputs it receives from the external inputs to units at the hidden layer without changing; the inputs are processed at the hidden layer and at the output layer, determining the output of the network (Kermani et al., 2005). In Figure 1, the MLNN (Multi Layered Neural Network) structure consisting of H hidden layers, N inputs, M outputs and L neuron were given. Activation functions that can be used in these networks are given in Figure 2 (Hagan and Menhaj, 1994).

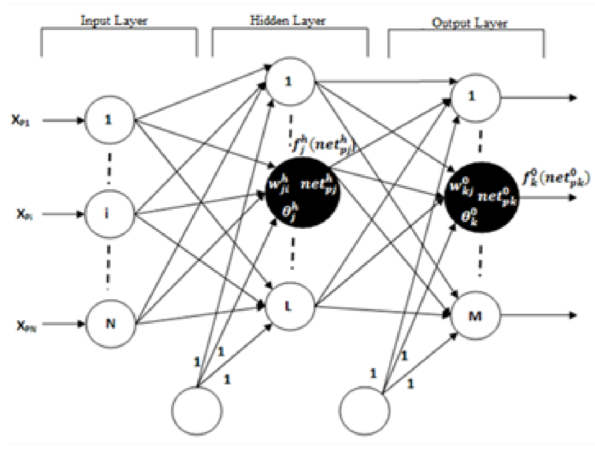

Figure 1. Example of multi layered neural network.

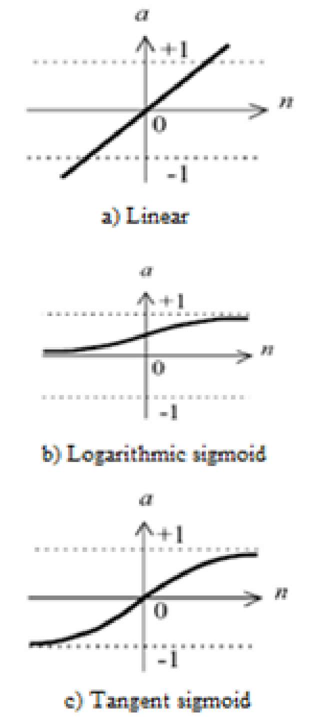

Figure 2. Activation functions.

An algorithm commonly used in the training of artificial neural networks is the Back Propagation Algorithm. The back propagation learning method is an optimization process based on reducing the system error, as in the rule which is known as the delta learning rule or least squares method. Because it also performs the process of reducing this error through changing weights, in other words, it propagates the output error back; it is called "Back Propagation". Back propagation consists of feed-forward and back propagation. In Feed-Forward, the output of the network is calculated. In back propagation, weights are changed (Bogdan et al., 1999).
When back propagation learning is used, the weights of the hidden layer are arranged using errors in the output layer. This process repeats in the same format till the first hidden layer. In this way, errors are propagated back by making weight arrangements of the related layer (layer by layer), and these operations are repeated until the total error is minimized (Singh et al., 2005). According to the network structure given in Figure 1, the output of artificial neuron J belonging to layer h is defined in Equation 1.

$$net_{pj}^{h} = \sum_{i=1}^{N} w_{ji}^{h}\, x_{pi} + \theta_{j}^{h} \tag{1}$$

In this equation w_{ji}^{h} i. from the input unit h. hidden layer j. θ_{j}^{h} is defined as the threshold value of layer h for j units.
It is obtained by passing the net input through the activation function, i_{pj}^{h} being hidden layer unit outputs (Equation 2, 3).

$$i_{pj}^{h} = f_{j}^{h}(net_{pj}^{h}) \tag{2}$$

$$net_{pk}^{0} = \sum_{i=1}^{N} w_{kj}^{0}\, x_{pj} + \theta_{k}^{0} \tag{3}$$

Equation 4 is obtained for k output units:

$$o_{pk}^{o} = f_{k}^{0}(net_{pk}^{0}) \tag{4}$$

For the training vector *p* of a feed forward network *n*. The performance function of recursion is given by Equation 5. Here the epk error is the number of all neurons in the output layer of the *M* network.

$$E_{p}(n) = \frac{1}{2}\sum_{j=1}^{M} e_{k}^{2}(n) \tag{5}$$

As y_{pk} requested output, opk network output, the epk error is given by Equation 6.

$$e_{pk}(n) = y_{pk}(n) - o_{pk}(n) \tag{6}$$

In case some error values are negative, the total squared error is calculated to find the total error of the network. The purpose of the training is to minimize the total squared error value (E), also called (the total) error energy, by arranging the network parameters. One of the training algorithms used for this purpose, the backward propagation algorithm, is based on reducing the error by changing weights in the backward calculation phase (Neruda and Kudova, 2005). For this purpose, it calculates the negative derivative of the error energy for weights, multiples it with the leaning parameter and adds it to the previous weights. This equality is obtained by calculating the partial derivative, since the derivative of the error is in question for weights.
The back propagation method which involves trial and error remains slow in solving many problems, despite improvements in changing the learning rate, using momentum, and in scaling variables. One of the most effective algorithms for training weights of an artificial neural network is the Levenberg-Marquardt (LM) algorithm, which includes standard optimization techniques (Neruda and Kudov, 2005).

3. Results and Discussion

3.1. The Number of Spikes per Square-meter

In the experiment, a very significant ($P<0.01$) statistical difference was found in terms of the analyzed varieties and in terms of the treatment, treatment x variety interaction and the number of spikes per square meter. Variant analysis results regarding the number of spikes per square meter are offered in Table 1 while mean values and materiality group is available in Table 2. As can be seen in Table 2, the number of spikes per square was measured from the Soyer 02 variety (461.01) as the highest whereas the number of spikes per square was measured from the Yunus cultivar (355.50) as the lowest.

Table 1. Variance analysis results of the agronomic properties

S.O.V.	df	NSSM	Y	TGW	SWS	PH	SSN	PC	SV	HW
Block	2	ns	ns	ns	ns	ns	ns	ns	ns	4.96**
Cultivar	10	6.74**	13.71**	26.65**	63.65**	16.42**	38.40**	53.08**	44.17**	11.41**
Application	4	6.66**	21.94**	1.43	25.12**	70.15**	7.35**	51.96**	90.58**	10.93**
Cultivar x Application	40	2.64**	2.58**	4.09**	3.07**	8.84**	4.86**	4.94**	10.12**	7.59**
Error	108									
Total	164									
% CV		13.87	18.59	4.66	11.17		10.93	4.41	8.58	2.05

S.O.V.= source of variance, df= degree of freedom, NSSM= number of spike per square meter, Y= yield, TGW= thousand grain weight, SWS= seed weight per spike, PH= plant height, SSN= seed per spike number, PC= protein content, SV= sedimentation value, HW= hectoliter weight, **= significant at 0.01 level.

Table 2. Mean values and significance groups of the number of spikes per square meter

Cultivar /Application	5	10	15	20	25	Mean
Soyer 02	400.00 $^{g-n}$	517.83 ^{abc}	405.17 $^{f-n}$	441.83 $^{c-j}$	540.21 ^{ab}	461.01 ^{A}
Müfitbey	475.00 $^{b-g}$	394.09 $^{g-n}$	374.53 $^{i-o}$	408.66 $^{f-n}$	593.33 ^{a}	449.12 ^{AB}
Nacibey	358.11 $^{j-o}$	387.50 $^{g-o}$	503.00 $^{a-e}$	506.66 $^{a-d}$	457.67 $^{b-i}$	442.58 ^{AB}
ES-26	390.00 $^{g-o}$	416.00 $^{d-j}$	462.66 $^{b-i}$	389.36 $^{g-o}$	496.00 $^{b-f}$	430.80 ^{AB}
Sultan-95	445.55 $^{c-j}$	390.55 $^{g-o}$	386.67 $^{g-o}$	466.33 $^{b-h}$	408.07 $^{f-n}$	419.43 ^{BC}
Harmankaya 99	365.00 $^{j-o}$	381.51 $^{h-o}$	472.50 $^{b-h}$	421.66 $^{d-k}$	420.66 $^{d-l}$	412.27 ^{BCD}
Sönmez - 2001	404.69 $^{g-n}$	430.00 $^{c-j}$	321.66 ^{nop}	355.00 $^{j-o}$	413.00 $^{e-m}$	384.87 ^{CDE}
Alpu – 2001	257.55 ^{p}	373.33 $^{i-o}$	383.33 $^{h-o}$	435.00 $^{c-j}$	433.33 $^{c-j}$	376.50 ^{DE}
Altay 2000	330.00 $^{l-p}$	373.97 $^{i-o}$	337.83 $^{k-p}$	442.16 $^{c-j}$	357.50 $^{j-o}$	368.29 ^{E}
Mesut	354.69 $^{j-o}$	362.57 $^{j-o}$	372.50 $^{i-o}$	338.03 $^{k-p}$	383.50 $^{h-o}$	36.26 ^{E}
Yunus	300.00 ^{op}	318.66 ^{nop}	444.25 $^{c-j}$	391.42 $^{g-n}$	323.16 $^{m-p}$	355.50 ^{E}
Mean	370.96 ^{C}	395.09 ^{BC}	405.82 ^{B}	417.83 ^{AB}	438.76 ^{A}	405.69

Cultivar LSD= 40.75, Application LSD= 27.47, Interaction of Cultivar x Application LSD= 91.13.

Cekic (2007) states that the most important effect of the drought in wheat is the reduction of the number of spike per square meter and a 14.3% decrease occurs as the result of the drought. On the other hand, Onder (2007) reports that varieties effectively protecting the viability of tillering under dry conditions rather than only varieties of appearance of much tillering are suitable for use and there is a very significant negative relationship between the number of spike per square meter and the number of grains per spike under dry conditions while there is no relationship between the number of spike per square meter and grain yield under wet conditions.

Yilmaz and Simsek (2012) found that the effect of different nitrogen doses that they used in their study on the number of spikes per square meter in wheat was statistically significant and reported that the number of spikes per square meter increased with the increased nitrogen doses. Cifci and Dogan (2013) reported that the highest number of spikes per square meter is obtained from 1 per 20 kg doze of nitrogen with a total of 823.19 while the lowest number of spike per square meter is obtained from parcels to which no nitrogen is applied and in higher doses of nitrogen than 1per 20 kg, the number of spike per square meter has showen decrease. Atar and Akman (2014) reported that the effect of nitrogen doses on the number of spikes per square meter is positive and that while 514.3 spikes were found in parcels to which nitrogen is not applied, 561.1 spikes were detected in 15 kg of Nitrogen doses. It is believed that the effect of nitrogen on increasing plant development is also effective in creating a spike. Asif et al. (2019) in a study of pot in which they investigated the effects of nitrogen and zinc on the bread wheat found out that the effect of nitrogen on the number of spikes is very significant because as the nitrogen dose increased, the number of spikes increased as well.

In order to obtain a higher yield from wheat, it is necessary to use genotypes with a high number of fertile spikes per square meter (Ozturk and Akten, 1999). Donmez (2002) reported the mean of fertile spikes per square meter in a study with 25 varieties of bread wheat is 242.8-597.5. Similarly, Kaydan and Yagmur (2008) reported the mean of fertile spikes per square meter in their study with 16 varieties of bread wheat is 265.25-412.25. The values stated are similar to our findings. The change in the number of fertile spikes and fertile flowers according to genotypes represents the source of the difference in the number of seeds (Bayram et al., 2017). How many fertile tillers the plant can feed with the photosynthesis products as a result of photosynthesis is of great importance in terms of the grain yield. For this reason, it is very important to know the contribution rates to the grain yield according to the appearance order of fertile tillers in the plant (Destro et al., 2001).

3.2. Yield (kg, da^{-1})

In the experiment, a very significant (P<0.01) statistical difference was found in terms of yield of varieties, treatment and variety x treatment interaction. Results of variant analysis of yield values are shown in Table 1 while mean values and materiality level is given in Table 3. As can be seen in Table 3, the highest yield was measured from the Nacibey variety (638.76) and the lowest yield was measured from the Mufitbey variety (343.06). Ozen and Akman (2015) reported that yield values are as 427-638.5 kg da^{-1} in their study of different wheat varieties. Coskun and Oktem (2003) reported that the effects of nitrogen doses on the grain yield and yield components are significant, and a significant increase in grain yield occurs with an increase in the nitrogen dose. Haque et al. (2017) reported that the effect of applied nitrogen doses on the wheat yield is significant and that the lowest yield value is obtained from parcels to which nitrogen is not applied, and that yield values increase with the increasing nitrogen doses.

Grain yield occurs as a result of the combined effects of environmental factors and genetic potential. At the beginning of the factors limiting wheat yield are varieties, and there is a decrease in the yields of varieties that are still grown (Ozen and Akman, 2015). Yield in wheat is significantly affected by the genotype and purity of the variety used as well as its adaptation to the region (Naneli et al., 2015). A previous study on this subject showed that grain yield on the basis of wheat differs according to the variety used, cultivation techniques and environmental conditions of the region (Dokuyucu and Akkaya, 1999; Mut et al., 2007).

3.3. Thousand Grain Weight (g)

In the experiment, a very significant (P<0.01) statistical difference was found in terms of varieties analyzed, variety x treatment interaction and thousand grain weight. No statistical differences were found in terms of the treatment. Results of variance analysis as to the values of thousand grain weight are shown in Table 1 while mean values and materiality group are available in Table 4. As can be seen in Table 4, the highest thousand grain weight was measured from the Harmankaya 99 variety (43.10), and the lowest thousand grain weight was measured from the Sultan-95 variety (35.89).

In the selection of the plant material; seed size, germination speed and power, emergence rate, homogeneity quotient, the development of the first plant in a strong way, resistance to unfavorable conditions are the desired characteristics in terms of the efficient cultivation (Kara and Akman, 2007; Asif et al., 2019).

Table 3. Mean values and significance groups for yield

Cultivar/Application	5	10	15	20	25	Mean
Soyer-02	393.33 $^{m-t}$	656.00 $^{a-d}$	505.90 $^{e-n}$	533.47 $^{c-m}$	533.75 $^{c-m}$	524.61 ^{BCD}
Müfitbey	276.44 ^{stu}	245.90 ^{tu}	277.49 ^{stu}	309.61 $^{q-u}$	605.87 $^{b-g}$	340.06 ^{E}
Nacibey	569.78 $^{b-i}$	507.41 $^{e-n}$	666.36 ^{abc}	755.06 ^{a}	695.18 ^{ab}	638.76 ^{A}
ES-26	450.00 $^{h-r}$	587.11 $^{b-h}$	493.57 $^{e-o}$	445.37 $^{h-r}$	550.08 $^{b-l}$	505.22 ^{CD}
Sultan-95	411.74 $^{k-s}$	302.64 $^{r-u}$	328.52 $^{p-u}$	556.84 $^{b-k}$	405.68 $^{l-s}$	401.08 ^{E}
Harmankaya-99	416.66 $^{j-s}$	581.4 $^{c-m}$	695.82 ^{ab}	689.21 ^{ab}	613.57 $^{a-f}$	590.68 ^{AB}
Sönmez-2001	224.12 ^{u}	444.09 $^{h-r}$	389.37 $^{m-t}$	511.17 $^{d-n}$	423.99 $^{i-s}$	398.55 ^{E}
Alpu-2001	344.69 $^{o-u}$	502.52 $^{e-n}$	483.00 $^{e-o}$	629.26 $^{a-e}$	666.03 ^{abc}	525.10 ^{BCD}
Altay 2000	430.00 $^{i-r}$	458.36 $^{g-q}$	469.07 ^{f}	666.87 ^{abc}	756.94 ^{a}	556.24 ^{BC}
Mesut	394.96 $^{m-s}$	511.87 $^{d-n}$	422.84 $^{i-s}$	456.28 $^{h-q}$	681.27 ^{abc}	493.44 ^{CD}
Yunus	380.00 $^{n-t}$	428.29 $^{i-r}$	560.74 $^{b-j}$	478.06 $^{f-o}$	492.62 $^{e-o}$	467.94 ^{D}
Mean	390.15 ^{C}	471.17 ^{B}	481.15 ^{B}	548.29 ^{A}	584.09 ^{A}	494.97

Cultivar LSD= 66.60, Application LSD= 44.90, Interaction of Cultivar x Application LSD= 148.93.

Table 4. Mean values and significance groups of thousand grain weight

Cultivar/Application	5	10	15	20	25	Mean
Soyer 02	36.66 $^{o-s}$	39.79 $^{f-n}$	41.82 $^{c-g}$	38.69 $^{i-p}$	40.46 $^{e-l}$	39.48 ^{C}
Müfitbey	38.17 $^{k-q}$	38.23 $^{k-q}$	37.67 $^{l-r}$	38.26 $^{k-q}$	37.82 $^{k-q}$	38.03 ^{DE}
Nacibey	40.58 $^{e-l}$	43.00 $^{b-e}$	38.71 $^{h-p}$	40.26 $^{e-n}$	41.80 $^{c-g}$	40.87 ^{B}
ES-26	36.00 $^{p-s}$	37.61 $^{l-r}$	34.69 ^{rst}	35.54 $^{q-t}$	36.21 $^{o-s}$	36.01 ^{F}
Sultan-95	40.12 $^{e-n}$	33.91 st	38.15 $^{k-q}$	34.28 st	33.01 ^{t}	35.89 ^{F}
Harmankaya 99	41.66 $^{c-i}$	43.75 $^{a-d}$	44.25 $^{a-d}$	44.57 ^{abc}	41.30 $^{d-j}$	43.10 ^{A}
Sönmez - 2001	38.27 $^{k-q}$	42.92 $^{b-e}$	42.68 $^{b-f}$	46.31 ^{a}	38.95 $^{g-p}$	41.83 ^{AB}
Alpu – 2001	37.45 $^{m-r}$	39.19 $^{g-o}$	38.53 $^{j-q}$	36.68 $^{o-s}$	36.34 $^{o-s}$	37.64 ^{E}
Altay 2000	38.00 $^{k-q}$	40.37 $^{e-m}$	42.42 $^{b-f}$	44.14 $^{a-d}$	41.93 $^{c-g}$	41.37 ^{B}
Mesut	44.10 $^{a-d}$	37.28 $^{n-r}$	41.68 $^{c-h}$	41.28 $^{d-j}$	45.36 ^{ab}	41.94 ^{AB}
Yunus	38.00 $^{k-q}$	40.70 $^{e-k}$	39.18 $^{g-o}$	37.89 $^{k-q}$	40.17 $^{e-n}$	39.19 ^{CD}
Mean	39.00	39.70	39.98	39.81	39.39	39.57

Cultivar LSD= 1.33, Interaction of Cultivar x Application LSD= 2.98.

Components of grain yield in wheat are grain weight and number of grains per unit area and increasing grain yield depend on the increasing grain weight. In terms of milling, it is desirable that the thousand grain weight is high. As grain size increases, the protein content, bran and ash content decreases. On the other hand, hectoliter weight, thousand grain weight and flour yield increase (Gaines et al., 1997). Naneli et al., (2015) reported that the difference among thousand grain weight in different bread wheat varieties is significant at the level of 1%. Altuntas and Akgun (2016) reported the effect of different nitrogen doses on the mean thousand grain weight in wheat are insignificant and they also obtained a thousand grain weight of 38.89 g in 8 kg da^{-1} application and 39.89 g in 14 kg da^{-1} application. Mert et al. (2003) reported a thousand grain weight between 34.53-38.67 g in wheat varieties with the application of different nitrogen doses. According to them the effect of nitrogen doses on a thousand grain weight was insignificant. However, the effect of varieties was reported as significant. El-Temsah (2017) in a study with 3 different nitrogen doses in wheat (60-80-100 kg of nitrogen) reported that thousand grain weight is respectively as 42.14-46.29-47.55 g according to the doses. The effect of the nitrogen on the thousand grain weight is statistically significant and the grain weight has increased with the increasing nitrogen doses.

3.4. Seed Weight/Spike

In the experiment, a very significant (P<0.01) statistical difference was found in terms of the analyzed varieties, treatment, x variety treatment interaction and seed weight. Variance analysis results for seed weight values are available in Table 1. Besides, mean values and materiality groups are shown in Table 5. As can be observed in Table 5, the highest seed weight was measured from Harmankaya99 and Altay (2000) variety (2.07), the lowest seed weight was measured from Mufitbey variety (0.91).

Ozturk and Akten (1999) reported that with increasing seed weight and spike number per unit area, grain yield also increases and that for a high yield, an increase in the spike number per unit area is more effective than an increase in seed weight. Yildirim et al. (2005) reported that the seed number is higher in varieties having a long spike length and they recommend varieties with a large number of seed numbers to achieve a high grain yield. Dokuyucu and Akkaya (1999) reported that seed weight between is 1.50-1.97 g. Hussain et al. (2006) reported that the effect of nitrogen doses (0-50-100-150-200 kg ha^{-1}) on seed weight (2.8-3.2-3.3-3.2-3.5 g) is significant.

3.5. Plant Height (cm)

In the experiment, a very significant (P<0.01) statistical difference was found in terms of varieties studied, treatment and variety x treatment interaction and the plant height. Results of variance analysis for plant height values are shown in Table 1. Mean values and materiality groups are, on the other hand are available in Table 6. As shown in Table 6, the highest plant height was measured from the Nacibey variety (110.66) and the lowest plant height was measured from the Alpu-2001 variety (92.73).

In cereals, the plant height is affected by the factors such as the genetic potential of the variety, high fertilizer levels (especially nitrogen) and low light (Hussain et al., 2006; Yürür et al., 1987; Genctan and Saglam, 1987; Kun, 1988). Mut et al. (2005) found in their study on different wheat varieties and ecotypes that the plant height was between 66.9-98.8 cm according to the mean of locations, and the difference within genotypes was statistically very significant.

In their study with different varieties and different nitrogen doses in wheat, Oncan Sumer et al. (2010) found that the plant height is between 65.1-109.8 cm and reported that the effect of the fertilizer-variety interaction and fertilizer and variety factors are significant in terms of the plant height.

Ozseven and Bayram, (2005) in their study investigating the effects of nitrogen doses (6-12-18-24 kg da^{-1}) in different wheat varieties, showed that increasing nitrogen doses have an increasing effect on the plant height in wheat. They also reported that this happens in the form of a continuous increase according to varieties up to a certain point, then of a decrease.

Table 5. Mean values and significance groups of seed weight per spike

Cultivar/Application	5	10	15	20	25	Mean
Soyer 02	1.30 $^{r-u}$	1.59 $^{j-q}$	1.53 $^{l-s}$	1.48 $^{m-t}$	2.08 $^{c-f}$	1.59 ^{CD}
Müfitbey	0.70 ^{z}	0.76 ^{yz}	0.93 ^{wx}	0.92 ^{xyz}	1.24 $^{s-v}$	0.91 ^{F}
Nacibey	1.88 $^{f-j}$	1.72 $^{g-n}$	1.72 $^{g-x}$	2.00 $^{d-g}$	2.18 $^{b-e}$	1.90 ^{B}
ES-26	1.00 $^{v-z}$	1.25 $^{r-v}$	1.31 $^{q-u}$	1.43 $^{n-t}$	1.37 $^{p-t}$	1.27 ^{E}
Sultan-95	1.29 $^{r-v}$	1.02 $^{u-y}$	1.06 $^{u-x}$	1.50 $^{l-t}$	1.28 $^{r-v}$	1.23 ^{E}
Harmankaya 99	1.60 $^{j-q}$	1.91 $^{e-i}$	2.21 $^{a-d}$	2.34 ^{abc}	2.32 ^{abc}	2.07 ^{A}
Sönmez - 2001	1.21 $^{t-w}$	1.54 $^{k-r}$	1.69 $^{h-o}$	1.73 $^{g-m}$	1.41 $^{o-t}$	1.51 ^{D}
Alpu – 2001	1.49 $^{l-t}$	1.71 $^{g-n}$	1.78 $^{g-l}$	1.87 $^{f-j}$	1.53 $^{l-s}$	1.67 ^{C}
Altay 2000	1.70 $^{h-o}$	1.82 $^{f-k}$	1.97 $^{d-h}$	2.50 ^{a}	2.38 ^{ab}	2.07 ^{A}
Mesut	1.86 $^{f-j}$	1.88 $^{f-j}$	1.73 $^{g-m}$	1.97 $^{d-h}$	2.39 ^{ab}	1.96 ^{AB}
Yunus	1.50 $^{l-t}$	1.91 $^{e-ı}$	1.66 $^{ı-p}$	1.54 $^{k-r}$	1.72 $^{g-n}$	1.66 ^{C}
Mean	1.41 ^{C}	1.55 ^{B}	1.60 ^{B}	1.75 ^{A}	1.81 ^{A}	1.62

Cultivar LSD= 0.13, Application LSD= 0.08, Interaction of Cultivar x Application LSD= 0.29.

Table 6. Mean values and significance groups of plant height

Cultivar/Application	5	10	15	20	25	Mean
Soyer 02	102.33 $^{h-p}$	108.33 $^{f-l}$	104.66 $^{g-o}$	110.66 $^{d-h}$	119.66 $^{b-e}$	109.13 ^{A}
Müfitbey	88.14 $^{q-w}$	92.00 $^{p-t}$	109.53 $^{d-j}$	102.30 $^{h-p}$	128.15 ^{ab}	104.02 ^{B}
Nacibey	99.33 $^{i-q}$	103.66 $^{g-o}$	123.33 ^{abc}	109.00 $^{e-j}$	118.00 $^{b-f}$	110.66 ^{A}
ES-26	79.00 $^{v-y}$	104.33 $^{g-o}$	96.00 $^{m-s}$	107.00 $^{f-m}$	131.00 ^{a}	103.46 ^{B}
Sultan-95	88.00 $^{q-w}$	77.33 ^{wxy}	110.00 $^{d-ı}$	114.66 $^{c-g}$	85.00 $^{s-x}$	95.00 ^{C}
Harmankaya 99	91.00 $^{q-u}$	80.33 $^{u-x}$	76.00 ^{xy}	103.00 $^{h-p}$	97.66 $^{k-r}$	89.60 ^{D}
Sönmez - 2001	73.00 ^{y}	82.00 $^{t-y}$	108.66 $^{e-k}$	82.66 $^{t-y}$	128.33 ^{ab}	94.93 ^{C}
Alpu – 2001	82.00 $^{t-y}$	77.33 ^{wxy}	98.66 $^{j-r}$	108.33 $^{f-l}$	97.33 $^{l-r}$	92.73 ^{CD}
Altay 2000	106.66 $^{g-n}$	95.00 $^{o-s}$	95.66 $^{n-s}$	131.33 ^{a}	120.66 $^{a-d}$	109.86 ^{A}
Mesut	103.33 $^{h-o}$	97.66 $^{k-r}$	103.00 $^{h-p}$	90.00 $^{q-v}$	122.00 ^{abc}	103.20 ^{B}
Yunus	110.00 $^{d-ı}$	73.33 ^{y}	94.00 $^{o-s}$	104.66 $^{g-o}$	120.66 $^{a-d}$	100.53 ^{B}
Mean	92.98 ^{D}	90.12 ^{D}	101.77 ^{C}	105.78 ^{B}	115.31 ^{A}	101.19

Cultivar LSD= 5.03, Application LSD= 3.39, Interaction of Cultivar x Application LSD= 11.25.

In varieties where the plant height constantly increases, the amount of increase usually decreases after nitrogen dose of 12 kg da^{-1}. Hussain et al. (2006) reported that the effect of 5 different doses of nitrogen (0-50-100-150-200 kg ha^{-1}) on the plant height in wheat (65.6-76.3-82-81.1-82.2 cm) is significant, with the increase of nitrogen doses, plant height increases, and plant height values obtained from 100, 150 and 200 kg ha^{-1} doses take place in the same statistical group.

3.6. Seed/Spike Number

In the experiment, a very significant (P<0.01) statistical difference was found in terms of the number of the varieties, treatment and variety x treatment interaction and seed number. Variance analysis results of seed number values are presented in Table 1. Mean values and materiality groups are, however, offered in Table 7. As can be seen in Table 7, the highest seed number was measured from the Mesut variety (43.88), and the lowest seed number spike was measured from the Mufitbey variety (23.83).

Ozen and Akman, (2015) reported that the seed number is between 22 and 46. Tunca, (2012) on the other hand, reported that the seed number is between 12.5 and 31. Caglar et al. (2006) reported that it is between 19.9 and 30.4.

3.7. Protein Content

A very significant (p<0.01) statistical difference was found in terms of analyzed varieties in the study, treatment and variety x treatment interaction and protein contents of varieties. Results of variance analysis of protein content values are available Table in 1. In addition, mean values and materiality groups are given in Table 8. As can be seen in Table 8, the highest protein content was measured from the Mufitbey variety (11.16%) and the lowest protein content was measured from the ES-26 variety (8.34%).

The protein content of wheat is very important in bread making, because flours with high-protein wheat are important in bread making that is high in volume, that can make more water absorption and that is better stored (Schofield, 1994). It is reported that the protein content in wheat varies depending on factors such as climate, variety, amount of nitrogen fertilizer applied, time of application, soil fertility, plantation date (Unal, 2002) Cereals are evaluated as very low (9% and below), medium (11.6%-13.5%), high (13.5%-15.5%) and extra high (17.5% and above) according to the protein content (Williams et al., 1988). Mou and Kronstad (2002) noted that there are statistically significant relationships between protein content, long grain filling and, low grain filling periods in wheat, and early flowering rate.

Table 7. Mean values and significance groups for the number of seed per spike

Cultivar/Application	5	10	15	20	25	Mean
Soyer 02	25.00 $^{s-x}$	32.00 $^{l-r}$	35.66 $^{g-n}$	27.66 $^{q-v}$	35.66 $^{g-n}$	31.20 ^{DE}
Müfitbey	19.50 ^{x}	23.98 $^{t-x}$	22.93 $^{u-x}$	29.01 $^{o-t}$	23.74 $^{t-x}$	23.83 ^{F}
Nacibey	37.33 $^{e-m}$	37.00 $^{e-m}$	26.33 $^{r-w}$	39.33 $^{d-j}$	40.66 $^{b-h}$	36.13 ^{C}
ES-26	21.33 ^{wx}	29.33 $^{o-t}$	29.00 $^{o-u}$	28.86 $^{p-u}$	22.77 ^{vwx}	26.26 ^{F}
Sultan-95	24.00 $^{t-x}$	25.33 $^{s-x}$	32.50 $^{k-q}$	34.00 $^{ı-p}$	34.66 $^{h-p}$	30.10 ^{E}
Harmankaya 99	30.66 $^{n-s}$	42.00 $^{a-f}$	40.00 $^{c-i}$	37.00 $^{e-m}$	46.66 ^{ab}	39.26 ^{B}
Sönmez - 2001	43.66 $^{a-d}$	38.00 $^{d-l}$	37.33 $^{e-m}$	39.33 $^{d-j}$	33.00 $^{k-q}$	38.26 ^{BC}
Alpu – 2001	28.66 $^{p-v}$	31.66 $^{m-r}$	43.00 $^{a-e}$	35.00 $^{h-o}$	28.66 $^{p-v}$	33.40 ^{D}
Altay 2000	36.33 $^{f-n}$	27.66 $^{q-v}$	41.66 $^{a-g}$	38.00 $^{d-l}$	37.66 $^{d-m}$	36.26 ^{C}
Mesut	45.66 ^{abc}	41.33 $^{a-g}$	46.66 ^{ab}	47.33 ^{a}	38.43 $^{d-k}$	43.88 ^{A}
Yunus	35.00 $^{h-o}$	46.33 ^{ab}	41.33 $^{a-g}$	37.00 $^{e-m}$	33.33 $^{j-q}$	38.60 ^{BC}
Mean	31.56 ^{C}	34.05 ^{B}	36.03 ^{A}	35.68 ^{AB}	34.11 ^{B}	34.28

Cultivar LSD= 2.71, Application LSD= 1.83, Interaction of Cultivar x Application LSD= 6.07.

Table 8. Mean values and significance groups of protein content

Cultivar /Application	5	10	15	20	25	Mean
Soyer 02	8.60 $^{m-r}$	8.70 $^{k-q}$	9.27 $^{f-l}$	9.55 $^{c-h}$	10.01 $^{b-d}$	9.23 ^{BC}
Müfitbey	12.00 ^{a}	11.50 ^{a}	9.71 $^{c-g}$	10.63 ^{b}	12.00 ^{a}	11.16 ^{A}
Nacibey	9.21 $^{g-m}$	9.34 $^{e-k}$	9.02 $^{h-o}$	8.83 $^{ı-p}$	10.10 ^{bc}	9.30 ^{BC}
ES-26	7.53 ^{u}	7.84 $^{s-u}$	8.04 $^{r-u}$	8.45 $^{n-t}$	9.88 $^{c-f}$	8.34 ^{G}
Sultan-95	8.96 $^{h-p}$	8.50 $^{o-r}$	8.35 $^{p-t}$	8.50 $^{o-r}$	9.69 $^{c-g}$	8.80 ^{DEF}
Harmankaya 99	9.16 $^{g-n}$	9.40 $^{d-j}$	9.80 $^{c-g}$	9.42 $^{d-ı}$	9.40 $^{d-j}$	9.43 ^{B}
Sönmez - 2001	7.59 ^{u}	8.67 $^{l-r}$	8.77 $^{j-p}$	9.21 $^{g-m}$	9.90 $^{c-f}$	8.82 ^{DE}
Alpu – 2001	7.77 $^{s-u}$	8.10 $^{q-u}$	8.50 $^{o-r}$	8.81 $^{ı-p}$	9.43 $^{d-ı}$	8.52 ^{FG}
Altay 2000	8.40 $^{o-s}$	8.75 $^{j-q}$	9.01 $^{h-o}$	9.95 $^{c-e}$	10.10 ^{bc}	9.24 ^{BC}
Mesut	8.81 $^{ı-p}$	8.50 $^{o-r}$	8.96 $^{h-p}$	8.93 $^{h-p}$	10.01 $^{b-d}$	9.04 ^{CD}
Yunus	7.63 ^{u}	7.74 ^{tu}	9.49 $^{c-h}$	8.68 $^{l-r}$	9.25 $^{f-m}$	8.56 ^{EFG}
Mean	8.69 ^{D}	8.82 ^{CD}	8.99 ^{BC}	9.18 ^{B}	9.98 ^{A}	9.13

Cultivar LSD= 0.14, Application LSD= 0.19, Interaction of Cultivar x Application LSD= 0.65.

Acer (2004) reported in a study that according to the two-year results of different nitrogen applications, the protein content in wheat in the first year was obtained from 12.90 kg da^{-1} nitrogen dose as well as from %12.548 kg da^{-1} nitrogen dose. It was also obtained from 12.194 kg da^{-1} nitrogen dose in the second year, from 14.7312 g.da^{-1} nitrogen dose, from 14.328 kg da^{-1} nitrogen dose and from 13.494 kg da^{-1} nitrogen dose. Haque et al. (2017) reported that the effect of different nitrogen doses applied to wheat (0-60-120-180 kg da^{-1}) on the protein content is significant and that the protein content increases as doses increase (10.64-11.23-12.45-13.41%).

Oncan-Sumer et al. (2010) reported that the protein content increases in increased nitrogen doses in wheat varieties where they applied different doses of nitrogen. Although the protein content is determined by the genotype and the environment, the effect of the nitrogen fertilizer application on the protein content is greater (Triboi et al., 2000)

3.8. Sedimentation Value

A very significant (P<0.01) statistical difference was found in terms of analyzed varieties, treatment and variety x treatment interaction and sedimentation value. Results of variance analysis of sedimentation values are presented in Table 1. Mean values and materiality groups are, however, given in Table 9. As can be seen in Table 9, the highest sedimentation value was measured from the Nacibey cultivar (19.40) and the lowest sedimentation value was measured from the ES-26 cultivar (11.94).

Sedimentation value is a quality criterion that determines the quality of the protein contained in the grain and has a high degree of heritability. It gives information about the bread value of wheat and it is desired to be high (Kocak et al. 1992). Mini SDS sedimentation values in bread wheat are analyzed as weak (10 ml and below), medium (10-12 ml) and strong (13 ml and above) (Pena et al., 1990). Kinaci and Kinaci (2004) reported that wheat has a mean sediment value of 30.2 ml while Aydin et al. (2005) reported it is between 26.3 ml and 54.5 ml. Koc and Akgun (2018) explained that the sedimentation value varies depending on the genotype but is also affected by environmental factors.

3.9. Hectoliter Weight

A very significant (P<0.01) statistical difference was found in terms of analyzed varieties, treatment and variety x treatment interaction and hectoliter weight of varieties. Results of variance analysis of hectoliter weight values are shown in Table 1. Mean values and materiality groups are also given in Table 10.

Table 9. Mean values and significance groups of sedimentation (mm) value

Cultivar /Application	5	10	15	20	25	Mean
Soyer 02	14.06 $^{h-n}$	14.29 $^{h-m}$	18.57 $^{c-e}$	20.00 $^{b-d}$	22.10 ^{ab}	17.80 ^{B}
Müfitbey	16.00 f^{-h}	13.00 $^{k-q}$	14.41 $^{h-m}$	18.54 $^{c-e}$	13.50 $^{ı-o}$	15.09 ^{D}
Nacibey	17.21 $^{e-g}$	23.19 ^{a}	20.15 ^{bc}	17.21 $^{f-h}$	20.47 ^{bc}	19.40 ^{A}
ES-26	8.80 ^{u}	9.05 ^{tu}	11.24 $^{p-s}$	11.53 $^{o-s}$	19.09 $^{c-e}$	11.94 ^{F}
Sultan-95	11.00 $^{q-t}$	10.50 $^{r-u}$	11.50 $^{o-s}$	11.50 $^{o-s}$	18.73 $^{c-e}$	12.64 ^{F}
Harmankaya 99	12.92 $^{k-q}$	12.50 $^{l-s}$	14.50 $^{h-l}$	14.90 $^{h-k}$	14.50 $^{h-l}$	13.86 ^{E}
Sönmez - 2001	10.41 $^{s-u}$	15.87 $^{f-h}$	14.95 $^{h-k}$	15.34 $^{g-j}$	13.50 $^{i-o}$	14.01 ^{E}
Alpu – 2001	13.19 $^{j-p}$	15.48 $^{g-ı}$	17.85 $^{d-f}$	17.23 $^{e-g}$	21.49 ^{ab}	17.05 ^{BC}
Altay 2000	12.06 $^{n-s}$	14.58 $^{h-l}$	17.24 $^{e-g}$	18.50 $^{c-e}$	21.37 ^{ab}	16.75 ^{C}
Mesut	12.28 $^{m-s}$	12.61 $^{l-r}$	14.32 $^{h-m}$	14.22 $^{h-m}$	19.96 $^{b-d}$	14.68 ^{DE}
Yunus	12.03 $^{n-s}$	13.16 $^{k-p}$	23.36 ^{a}	17.95 $^{d-f}$	18.61 $^{c-e}$	17.02 ^{BC}
Mean	12.72 ^{D}	14.02 ^{C}	16.19 ^{B}	15.97 ^{B}	18.48 ^{A}	15.47

Cultivar LSD= 0.96, Applicaiton LSD= 0.64, Interaction of Cultivar x Application LSD= 2.15.

Table 10. Mean values and significance groups of hectoliter weight (kg)

Cultivar /Application	5	10	15	20	25	Mean
Soyer 02	74.00 d-k	74.14 d-j	66.87 t	74.32 d-j	78.37 ab	73.54 BC
Müfitbey	72.66 g-o	69.50 rs	69.77 q-s	67.84 st	76.00 b-d	71.15 EF
Nacibey	73.00 f-n	72.60 g-o	70.48 o-r	71.44 l-r	69.55 rs	71.41 EF
ES-26	71.00 m-r	72.30 h-p	70.04 p-s	73.75 d-l	73.24 e-m	72.06 DE
Sultan-95	71.00 m-r	70.00 p-s	72.50 h-o	74.50 d-ı	65.98 t	70.79 F
Harmankaya 99	72.00 j-q	70.50 o-r	72.50 h-o	70.26 n-r	71.50 l-r	71.42 EF
Sönmez - 2001	75.17 d-f	78.93 a	69.90 p-s	74.20 d-j	75.00 d-g	74.64 A
Alpu – 2001	74.62 d-h	74.03 d-j	72.18 ı-q	71.59 k-r	72.00 j-q	72.88 CD
Altay 2000	72.06 j-q	72.53 h-o	73.50 e-l	74.50 d-ı	77.86 b-c	74.09 AB
Mesut	74.22 d-j	71.26 l-r	71.11 l-r	71.11 l-r	71.21 l-r	71.78 EF
Yunus	72.00 j-q	75.62 c-e	72.24 h-p	73.00 f-n	74.09 d-j	73.39 BC
Mean	72.88 A	72.85 A	71.00 B	72.44 A	73.16 A	72.46

As can be observed in Table 10, the highest hectoliter weight was measured from the Sönmez-2001 variety (44.64 kg) and the lowest hectoliter weight was measured from the Sultan-95 variety (70.79 kg).

The hectoliter weight in wheat varies depending on factors such as variety, environmental conditions, cultural practices, lodging, disease and damage (Sener et al., 1997; Atli et al., 1999). The shape, density, size and homogeneity of the grain are also important properties that affect the hectoliter weight. Since the hectoliter weight in wheat and flour yield are positively related (Ozkaya and Kahveci, 1990) it is also important in breeding as a selection criterion due to its being the subject of milling and trade. Cifci and Dogan (2013) determined hectoliter weights of varieties as 75.94 and 76.84 kg, while they observed that nitrogen doses do not effect on the hectoliter weight and the mean values range from 75.90 to 76.91 kg.

3.10. Artificial Neural Network

A database was created with the chlorophyll values obtained within the scope of the project. Determination of the targeted chlorophyll content with an artificial neural network was completed with this project study. At this point, it is the first step in which an interdisciplinary collaboration is carried out in the project area. In addition, studies of obtaining some information from the image (for example, determination of chlorophyll concentration index, plant growth, yield estimates) with the help of computer have come to conclusion.

In this study, 70% of the data set was used as training data. Output error (MSE) and maximum iteration value were found to be 0.001 and 1000 epoch, respectively. The number of hidden layers and the number of neurons in the hidden layer were determined by the training error method. In this study, MSE and R^2 value determine the performance of the artificial neural network. These criteria are calculated according to the Equations 7 and 8.

$$MSE = \frac{\sum_{i=1}^{N} \left(y_{ai} - y_{pi}\right)^2}{N-1} \quad (7)$$

$$R^2 = \frac{\left(\sum_{i=1}^{N} \left(y_{ai} - \bar{y}_a\right)\left(y_{pi} - \bar{y}_p\right)\right)}{\sum_{i=1}^{N} \left(y_{ai} - \bar{y}_a\right)^2 \left(y_{pi} - \bar{y}_p\right)^2} \quad (8)$$

R^2 performance values obtained as a result of the data analysis via artificial neural networks are offered below (Figure 3). Considering the graphs of the training, testing, validation and all values of the artificial neural network, it is seen that the network performs 99% calculations with high accuracy.

Looking at the performance graph of the network (Figure 4), the artificial neural network width performance was also shown in 933 epoch.

A linear relationship was found between SPAD readings and leaf chlorophyll (Chl), and R2 value was taken into account in the evaluation of this relationship. The best relationship between Chl and SPAD is shown in the figure below (Figure 5).

The linear equation obtained from these graphs and the R2 value for chlorophyll (y = 1.81x + 5.166) and the R2 value as 98.1% were found as a result of the training of SPAD values with ANN. The high R2 value indicates the accuracy of the values measured with the SPAD meter and its usability with ANN in predicting the chlorophyll content in the plant.

4. Conclusion

In this study, bread wheat varieties which can be grown in Ordu Province, Türkiye have been tested. In the experiment, differences of these varieties in terms of yield and yield components were determined in Ordu Province. The experiment focused particularly on the chlorophyll content. ANN has been shown to predict leaf chlorophyll concentration index. The use of an artificial neural network has been shown as an alternative solution to determine the chlorophyll concentration index instead of expensive optical based devices. This method is a non-destructive approach and simple, rapid, and accurate estimation of SPAD values. In addition, nowadays increasingly importance of computer-aided smart farming systems was highlighted.

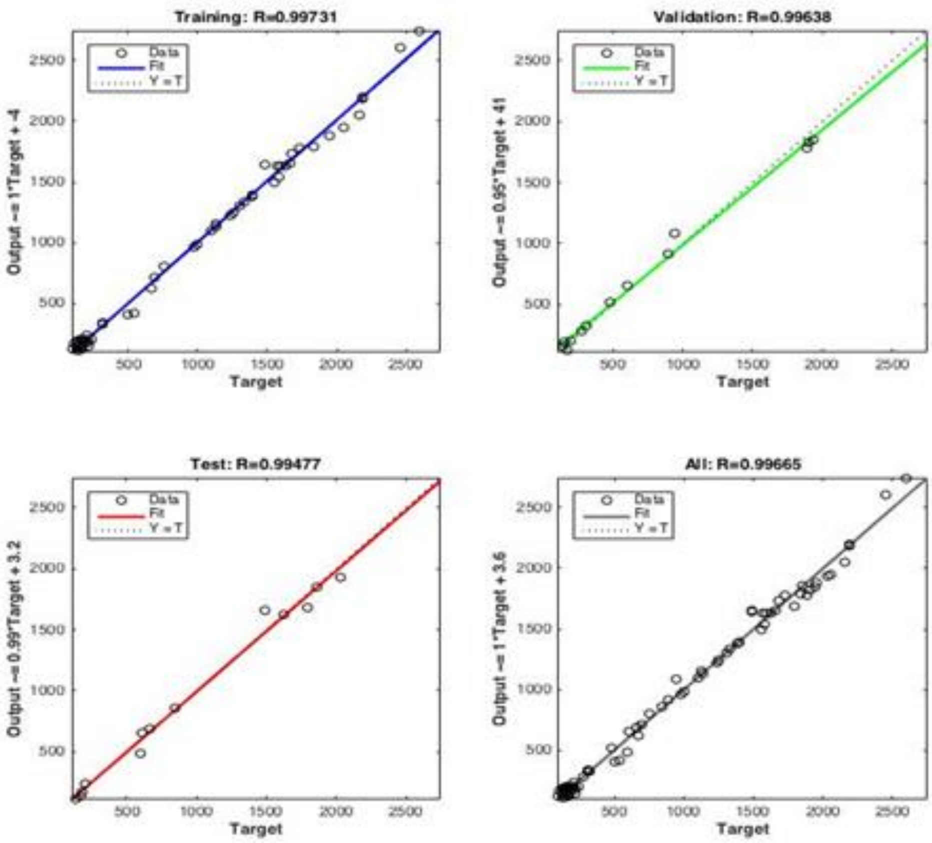

Figure 3. R^2 performance values.

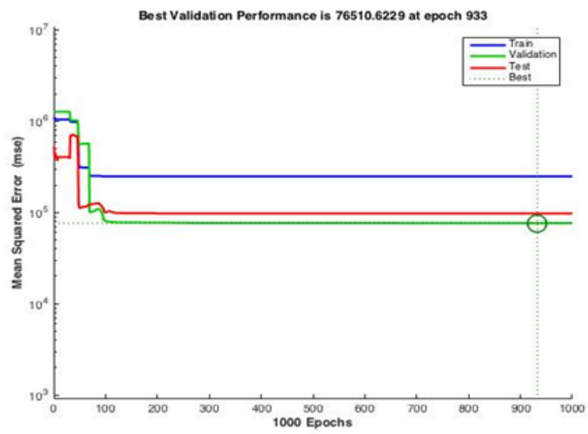

Figure 4. Network performance.

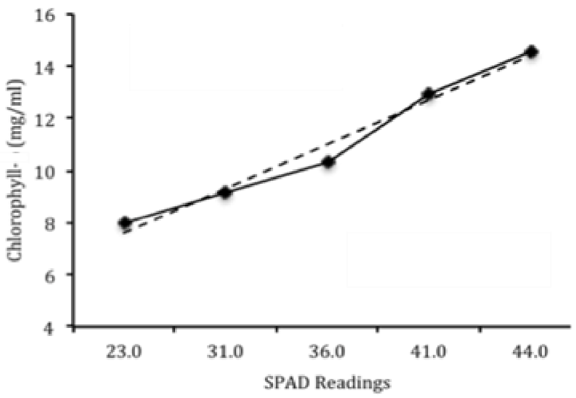

Figure 5. Relationship between SPAD value and chlorophyll.

Author Contributions

F.Ö. (25%), G.K. (15%), E.R. (15%), F.Öz. (15%), R.O. (15%) and M.S.O. (15%) design of study. F.Ö. (25%), G.K. (15%), E.R. (15%), F.Öz. (15%), R.O. (15%) and M.S.O. (15%) data acquisition and analysis. F.Ö. (25%), G.K. (15%), E.R. (15%), F.Öz. (15%), R.O. (15%) and M.S.O. (15%) writing up. F.Ö. (25%), G.K. (15%), E.R. (15%), F.Öz. (15%), R.O. (15%) and M.S.O. (15%) submission and revision. All authors reviewed and approved final version of the manuscript.

Conflict of Interest

The authors declared that there is no conflict of interest.

Acknowledgments

We are thankful to Scientific Research Projects Unit (BAP) of Ordu University for providing financial support to this research, with the number of AR-1327 BAP Project.

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