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INVESTIGATION OF PHYSIOMORPHOLOGICAL CHARACTERISTICS OF SIRVAN WHEAT CULTIVAR USING AMENDMENT MATERIALS

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ABSTRACT

In order to investigate the effect of some amendment materials on physiomorphological characteristics of the Sirvan wheat cultivar, a randomized complete block design experiment and replicated three times, was carried out in the years 2018-2019 on a farm in Dasht-e Armou, Dareshahr Ilam Province, Iran. The aim of this study was to investigate and compare the effects of two factors, namely the type of amendment materials and the number of insoluble matters (alfalfa residues at 5, 10, and 15 t/ha, straw and wheat straw at 5, 10 and 15 t/ha, poultry manure at 2, 4 and 6 t/ha and the required 100-percent mineral fertilizer) on the plant. The results showed that the use of amendment materials significantly increased the number of spikes (15 to 143 percent), chlorophyll index (18 to 122 percent), number of leaves (8 to 51 percent), relative water content (6 to 21 percent), plant height (5 to 16 percent) and leaf area index (5 to 33 percent) of wheat. The highest number of leaves (19), plant height (115 cm), leaf area index (5.76), and relative water content (70 percent) were observed in 15 t/ha of alfalfa residues while the highest number of spikes (5.67) and chlorophyll index leaf (18.6) was obtained in 6 t/ha of poultry manure. Based on findings, it can be stated that the use of amendment materials, especially in raw form and poultry manure, will have beneficial effects on the growth and yield of wheat.

Keywords: amendment materials, chlorophyll index, leaf area index, relative water content

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INTRODUCTION

Wheat (Triticum aestivum L.) is the first and most important plant to meet the nutritional needs of humans and also is the primary source of human carbohydrates, which has been domesticated for about 100 centuries (FAO, 2013). Wheat seeds contain a lot of starch and some protein (Shewry, 2009). In Iran, wheat is the most important crop for cultivation and its cultivation area is about two million hectares, equal to about 53 percent of Iran's crops (Ramyar & Jamnejad, 2010). The area under cultivation of wheat is 55 thousand hectares in Ilam province and three thousand hectares in the Dareshahr city (Agricultural Organization of Ilam, 2012). In Iran, the average yield of irrigated wheat is 3.13 t/ha whereas the average yield of unirrigated wheat is 920 kg/ha (Ramyar & Jamnejad, 2010).

Plant remains are parts of the plant which remain after harvesting the crop in the field. Plant remnants can either replace or provide nutrients in the soil, maintain soil fertility, increase soil organic matter concentration, maintain water in the soil, and stimulate microbial activity (Liu, Rong, Zhou, & Liang, 2017). Animal manure and plant remain to improve the physical, chemical, and biological properties of the soil and increase the photosynthesis, growth, and yield of the product (Rezaei, 2013).

The leaf area index (LAI) is one of the essential variables in climate, ecological and agronomic research (Carretero, Serrago, Bancal, Perello, & Miralles, 2010). The leaf area is an indicator for estimating the amount of radiation received by the plant, which has a great impact on the biological function of the plant. Therefore, accurate measurement of LAI is essential for understanding interactions between plant growth and the environment (Keshavarznejad, Kazemeini, & Bahrani, 2015). Relative water content (RWC) represents the aquatic condition of the plant, which reduces water potential around the root causing a decrease in the RWC of the leaf. Water shortages reduce RWC in the leaf (Siddique, Hamid, & Sirajul Islam, 2000). Plant height is affected by various environmental factors such as soil fertility, moisture content, nitrogen content, number of plants per unit area, and other environmental factors (Attia, 2013). The number of leaves is influenced by genotype and environmental conditions (Bakry, Elewa, EL-Karamany, Zeidan, & Tawfik, 2011; Ataei & Gholamhosseini, 2021).

Researchers in Ghana, who assessed the effects of livestock manure on the characteristics of spring barley, stated that manure increased the content of leaf chlorophyll and the height of spring barley plant (Ofosu-Anim & Leitch, 2009). Investigating the effect of plant residues on soil nitrogen and its relationship with yield and yield components in wheat showed that LAI was highest for treatments of urea fertilizer and alfalfa residues while corn and wheat residues had the lowest LAI (Poori, 2010). Due to the poor soil cover of most parts of the Iran country in terms of organic matter and also given the importance of livestock manure and agricultural residues in soil production potential, this study aimed to adopt sustainable farming practices such as management of plant residues.

The aim was to study and compare the effects of two factors, namely type of amendment materials and amount of insoluble matters (alfalfa residues at 5, 10 and 15 t/ha, straw and wheat straw at 5, 10 and 15 t/ha, poultry manure at three levels of 2, 4 and 6 t/ha and the required 100-percent mineral fertilizer) on the physiomorphological characteristics (number of spikes, chlorophyll index,

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number of leaves, RWC, plant height, and LAI) of Sirvan wheat cultivar in the area of Dasht-e Armou, Dareshahr City, Ilam Province, Iran.

MATERIALS AND METHODS

This research was carried out in a field in the area of Dasht-e Armou, Dareshahr city, Ilam province, Iran, in the years 2018-2019. The area is geographically located between 47°24' to 47°30' E with 33°5' to 33°10' N, with an average of 660 meters above sea level. The soil in the area has 21% sand, 44% silt, and 35% clay (clay loam texture). The monthly average the daily air temperature is 21.3 °C. The annual evaporation is about 2655 mm and the average precipitation is 417.1 mm. Moreover, thermal and moisture regimes are Xeric and Thermic, respectively.

A Field experiment was laid out as a randomized complete block design, with 11 treatments; poultry manure of 2 t/ha (BM2), 4/ha (BM4), and 6 t/ha (BM6); straw and wheat straw of 5 t/ha (BG5), 10 t/ha (BG10), and 15 t/ha (BG15); alfalfa residues of 5 t/ha (BY5), 10 t/ha (BY10), and 15 t/ha (BY15); required 100-percent mineral fertilizer (BCh3) and control (BS) and replicated three times. The soil was tested from 0 to 30 centimeters of the field and then exposed to air. Some chemical and physical parameters of the soil were measured as follows: the pH and electrical conductivity of the soil (in a 1:5 soil-to-water suspension) using the pH meter of 744 (Metrohm) (Thomas, 1996) and Senses 7 Digital Guidance (HACH) (Rhoades, 1996); bulk density using intact cylinders (Blake & Hartge, 1986); calcium carbonate equivalent by neutralizing calcium carbonate with chloride and extra acidity titration with profits (Loeppert & Sparks, 1996); soil organic matter by oxidation (Nelson & Sommers, 1996); total soil nitrogen using the Kjeldahl method and with the Kjeldahl model Behr labor-Technik (Nelson & Sommers, 1998); available phosphorus by the Olsen method and a UV7500 Techomp spectrophotometer (Olsen & Sommers, 1982); soluble calcium and magnesium by the complexometric method (Lanyon & Heald, 1982); absorbable potassium using the Corning Model 410 flame detector (Helmke & Sparks, 1996); absorption of micronutrient soils after extraction of samples with DTPA using an atomic absorption device GBC 932 and anatomic absorption spectrometer (Lindsay & Norvell, 1978), and soil texture by the hydrometer method (Burt, 2004). Moreover, wheat straw and shoots as well as alfalfa residues were prepared from the fields of the city of Dareshahr. Some of the chemical properties of the soil tested and the amendment materials are presented in *Table 1*.

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Table 1: Results of the soil analysis of the test site and the amendment materials

Characteristics	Electrical conductivity	pH	Organic carbon	Total nitrogen	Available phosphorus	Available potassium	DTPA-Zn
Unit	dS/m	-	%	%	%	ppm	mg/kg
Straw and wheat straw	0.911	7.32	22.99	0.96	0.25	1.02	19.66
Alfalfa residues	1.023	7.81	24.44	1.24	0.32	1.44	41.06
Poultry manure	8.270	7.76	38.59	2.06	0.75	2.37	102.58
Soil	1.92	7.65	1.52	0.15	0.13	1.63	0.78

In June 2018, a relatively deep plow was introduced to an experimental farm in order to destroy the insect larvae and improve the physical properties of the soil. In mid-August, the seedbed was prepared and experimental plots were created by a worker. After this stage, in the planned plots, amendment materials were used in a specific amount and mixed uniformly and accurately at a depth of 0-30 cm with the soil. An amendment material (poultry manure) was added to the plots 20 days before planting and then mixed with the soil.

The plot size was 2m×2m for 15 cm row spacing in 12 rows, with plant spacing on a row of 2.5 cm. All field activities (land preparation, planting, fertilizer application, and weeding) were done according to local production practices. During the growth of the plants in the field, irrigation to reach the soil moisture to field capacity was carried out manually. It should be noted that during the cultivation of any chemical fertilizers, herbicides, poisons, and insecticides were not used.

In order to measure vegetative parameters such as plant height, the number of leaves, and a number of spikes per plot among the middle shrubs, five plants were selected and the parameters were measured. Average plant height as plant height, number of leaves in five random plants number of leaves per plant, and number of spikes in five random bushes were considered as the number of spikes per plant.

The chlorophyll index of the leaves was measured by chlorophyll meter (SPAD-502-Minolta-Japan) at the early stage of clustering (Yadava, 1986).

In relation 1, the percentage of the RWC of the leaves was calculated (Schonfeld, Johnson, Carver, & Morhinweg, 1988):

$$\mathrm{RWC} = [(\mathrm{F_w} - \mathrm{D_w})/\mathrm{T_w} - \mathrm{D_w}] \times 100 \quad (1)$$

Where Fw is equal to leaf fresh weight immediately after sampling, DWis dry leaf weight after oven placement, and Tw is equal to the saturated leaf weight after putting in the distilled water.

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LAI was calculated using Equation 2:
LAI= (pla×den)/10000 (2)
Where LAI is equal to the leaf area index, pla is the average leaf area per plant (square centimeters) and den is the actual density (plant per square meter).

Before analyzing the variance of the data, a normality test was conducted using SAS software (9.2) after recording the experiment data. The results, determined through the Shapiro-Wilk test and Kolmogorov-Smirnov test, showed a probability level exceeding 5%, confirming the normal distribution of the data.
Following this, the impact of using amendment materials on the studied traits was analyzed, with the Duncan test utilized for comparing averages at a 5% probability level.

RESULTS AND DISCUSSION

The results of the analysis of variance and comparison of the averages of the effect of the amendment materials on some physiomorphological traits of wheat are presented in *Table 2* and *Table 3*, respectively.

Table 2 Analysis of variance (F quantity) of the effect of the amendment materials on some physiomorphologicaltraits of wheat

Source of change	Df	Number of leaves	Plant height	Number of spikes	Leaf area index	Chlorophyll index	Relative water content
Treatment	10	94**	52.73**	29.15**	75.31**	66.01**	42**
Replicate	2	78.71**	8.14**	11.06**	6.09**	4.83*	16.7**
Error	20	-	-	-	-	-	-
CV%	-	1.91	0.97	9.73	1.81	4.8	1.43

* and ** are respectively significant at a probability level o

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Table 3 Comparison of the averages of some physiomorphological traits of wheat under the influence of different treatments of the amendment materials

Treatment	Number of leaves	Plant height	Number of spikes	Leaf area index	Chlorophyll index	Relative water content
M_2	15 ^{d}	108 ^{cd}	3.3 ^{cd}	4.7 ^{cde}	13.4 ^{e}	63.6 ^{c}
M_4	17 ^{b}	112 ^{b}	5 ^{b}	5.1 ^{b}	16.3 ^{b}	67.3 ^{b}
M_6	18 ^{a}	114 ^{a}	5.6 ^{a}	5.7 ^{a}	18.6 ^{a}	70 ^{a}
G_5	15 ^{d}	107 ^{d}	3.3 ^{cd}	4.6 ^{ef}	12.1 ^{f}	64.3 ^{c}
G_{10}	16 ^{c}	109 ^{c}	3.3 ^{cd}	4.8 ^{cd}	14.9 ^{c}	65 ^{c}
G_{15}	14 ^{e}	104 ^{e}	2.6 ^{ef}	4.5 ^{f}	9.9 ^{g}	61.6 ^{d}
Y_5	15 ^{d}	109 ^{c}	3 ^{de}	4.7 ^{de}	13.5 ^{de}	64.3 ^{c}
Y_{10}	17 ^{b}	111 ^{b}	4.6 ^{b}	5.2 ^{b}	16.6 ^{b}	67.3 ^{b}
Y_{15}	19 ^{a}	115 ^{a}	5.6 ^{a}	5.7 ^{a}	18.1 ^{a}	70.3 ^{a}
Ch_3	16 ^{c}	109 ^{c}	3.6 ^{c}	4.8 ^{c}	14.6 ^{cd}	65.1 ^{c}
S	13 ^{f}	99 ^{f}	2.3 ^{f}	4.3 ^{g}	8.3 ^{h}	58.3 ^{e}

In each column, the means of treatments with at least one common letter have no significant difference at 5% probability level with the Duncan's test.

M_2: 2 t/ha, M_4: 4 t/ha, M_6: 6 t/ha of poultry manure, G_5: 5 t/ha, G_{10}: 10 t/ha, G_{15}: 15 t/ha of straw and wheat straw Y_5: 5 t/ha, Y_{10}: 10 t/ha, Y_{15}: 15 t/ha of alfalfa residues Ch_3: The required 100-percent mineral fertilizer, S: Control

The analysis of contrast variance is presented in *Table 4.*

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Table 4 Analysis of contrast variance (F quantity) for different treatment groups on some traits of wheat

Contrast	Df	Number of leaves	Plant height	Number of spikes	Leaf area index	Chlorophyll index	Relative water content
G vs Y	1	170.91**	100.34**	56.17**	168.71**	135.21**	69.42**
G vs M	1	133.06**	83.29**	76.45**	143.22**	137.63**	57.37**
Y vs M	1	2.37ns	0.79ns	1.56ns	1.04ns	0.01 ns	0.57 ns
all vs Ch	1	309.81**	259.73**	55.34**	152.63**	244.41**	179.8**
G vs S	1	18.92**	11.99**	4.88**	11.23**	26**	5.55**
G vs Ch	1	106.75**	104.67**	9.56**	31.27**	76.29**	73.44**
Y vs S	1	23.95**	13.11**	9.56**	34.02**	9.75**	12.5**
Y vsCh	1	383.23**	299.77**	70.41**	218.53**	287.53**	209.12**
M vs S	1	14.49**	8.94**	15.8**	26.12**	10.22**	9**
M vs Ch	1	341.83**	278.37**	86.01**	197.53**	290.02**	193.92**

ns,* and ** are respectively insignificant, significant at a probability level of 5% and 1%.

The effect of the amendment materials on some hysiomorphological characteristics of wheat

The results of this study showed that the physiomorphological characteristics of wheat had a rising trend in the treatments that received the amendment materials compared to the control treatment. This was proportional to the increase in the amounts of the use of the amendment materials (*Table 3*). The results of *Table 2* showed that the effect of the amendment materials (all the treatments) on plant height was significant at a 1% level. A comparison of the averages showed that the highest plant height (115 cm) was obtained in the treatment of 15 t/ha alfalfa residues while the lowest height (99 cm) was obtained in the control treatment (*Table 3*) and that after alfalfa residues, poultry manure was influenced at a later stage (*Figure 1*). In this regard, researchers in a study on the influence of soil amendments on the growth and yield of rice in acidic soil stated that the soil amendment treatments showed significantly higher readings of plant height compared to the untreated groups (NPK and control) (Abdul Halim et al, 2018). In a study that investigated the effect of plant residues and levels of nutrients on yield and yield components of wheat, plant height was affected by plant residues and high levels of fertilizer so that the highest plant height was obtained from wheat straw and wheat residues along with mushrooms (green manure) (Khamadi,

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Mesgarbashi, Hasibi, Farzaneh, & Enayatyzamir, 2016). In another study, the simultaneous influence of poultry manure and NPK fertilizer on the growth and yield of carrots showed that significantly high plant height was recorded with the combination of 150 kg/ha NPK and 5 t/ha of poultry manure while the lowest plant height was obtained in the absolute control (Habimana, Uwamahoro, & Uwizerwa, 2014). Plant height is among the basic characteristics observed when assessing plant crops, where plants tend to grow to a certain height in each stage (Sritarapipat, Rakwatin, & Kasetkasem, 2014). The processes that occur during the decomposition of residues in the soil will enable the plant to maximally benefit from nutrients needed, moisture, and a better building of the soil, which stimulates vegetative growth and prolongs the growth period. On the other hand, plants, after utilizing amendment materials, will have easier access to nutrients and are better established, resulting in more cellular inflammation and more cell division and consequently increased vegetative growth and plant height. Significant roles of alfalfa residues to plant height might be due to its high N content which influences the vegetative at the earlier stage of plant growth. Also, the reason taller plants were produced in alfalfa residues treatment was probably due to the positive impact of the nutrient on their growth and vice-versa.

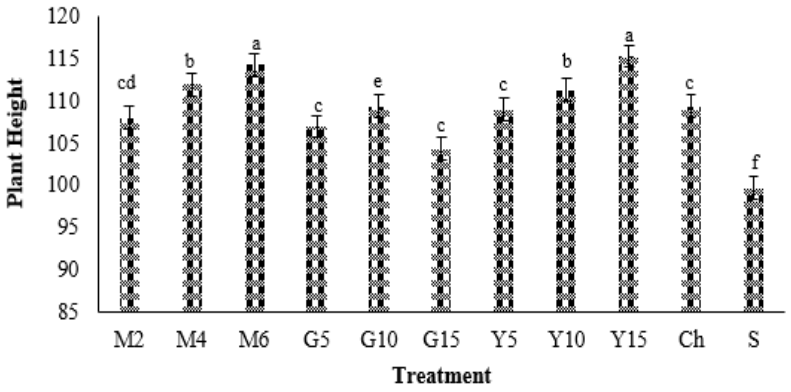

Figure 1 Effect of the amendment materials on the wheat plant height

According to the results obtained from the table of variance analysis (*Table 2*), the amendment materials had significant effects on spike number at 1% probability level. A comparison of the averages also showed that with the increase of the amendment materials to the soil in all the treatments, the number of spikes increased in comparison with the control treatment. This increase, except in the treatment of 15 t/ha of straw and wheat straw, showed a significant difference at a 1% probability level for the treatments other than the control treatment. The highest number of spikes (5.67) was observed in the treatment of six t/ha of poultry manure while the lowest number (2.3) was observed in the control treatment, and after poultry manure, alfalfa residues were influenced at a later stage (*Figure 2*). The increase in spike number in response to the application of that poultry manure is probably due to the enhanced availability of nutrients. These results are supported by the findings of other researchers (Siavoshi, Nasiri, & Lawre, 2011). In this regard, researchers investigated the effect of chemical, organic, and biological fertilizer systems on yield and yield components of bread and durum wheat cultivars in Ahwaz, Iran. Their findings showed that manure and combined systems had the highest number of spikes (Lotfi Jala Abadi, Siadat,

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Bakhsandeh, Fathi, & Alemi-Saeid, 2013). Moreover, in the study of the effects of crop rotation and residue management on bread wheat, it was stated that the effect of different crop rotations on the spike number per square meter of wheat was significant (Zare Feizabady, 2013). Investigating of short term response of spring wheat to tillage, residue management and split nitrogen application in a rice-wheat system showed that the highest number of spikes per square meter of wheat were obtained at zero tillage, straw retained and four splits application of total N at sowing, 20, 45 and 70 d after sowing (Usman et al, 2014). Studies have shown that organic fertilizers increase the number of spikes and number of seeds per wheat spike by increasing the amount of organic matter in the soil, increasing the water holding capacity in the soil, and increasing the available nitrogen in the plant. Poultry manure is one of the most valuable organic fertilizers, which is known as a rich source of high-consumption and low-energy elements for plant cultivation (Ibrahim, Hassan, Iqbal, & Valeem, 2008). The nutrient content of poultry manure (especially phosphorus), with increasing LAI and dry matter production in the plant and maintaining the active photosynthesis level during flowering, leads to an increase in the number of materials stored in flowers and the number of growing cubes.

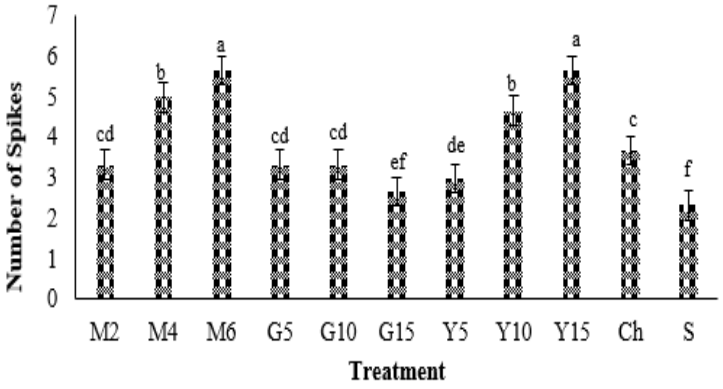

Figure 2 Effect of the amendment materials on the number of spikes of wheat

The results of *Table 2* showed that the effect of the amendment materials (alfalfa residues, straw and wheat straw, poultry manure, and fertilizer) in all the treatments was significant on leaf number at a 1% probability level. A comparison of the means showed that the highest number of leaves (19) was obtained in the treatment of 15 t/ha alfalfa residues whereas the lowest number (13) was obtained in the control treatment (*Table 3*) and that after alfalfa residues, poultry manure was influenced at a later stage (*Figure 3*). Researchers in a study of irrigation management and manure administration order to increase water use efficiency in corn crop of single cross 704 stated that increasing the use of poultry manure due to its high phosphorus content increased leaf number and leaf luster in corn (Hassanzadeh, Chavoshi, Madani, & Asgari, 2008). Also, researchers a studying the simultaneous influence of poultry manure and NPK fertilizer on the growth and yield of carrots showed that the combination of 150 kg/ha NPK and 5 t/ha of poultry manure recorded numerically the highest mean number of leaves and the lowest was obtained in the absolute control (Habimana, Uwamahoro, & Uwizerwa, 2014). In another study, the effect of simultaneous compaction of soil and organic fertilizers on wheat nutrition and growth showed that with 30 grams of sludge and

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manure, the number of leaves increased, but there was no significant difference with the control treatment (Mohammadnezhad, 2013).

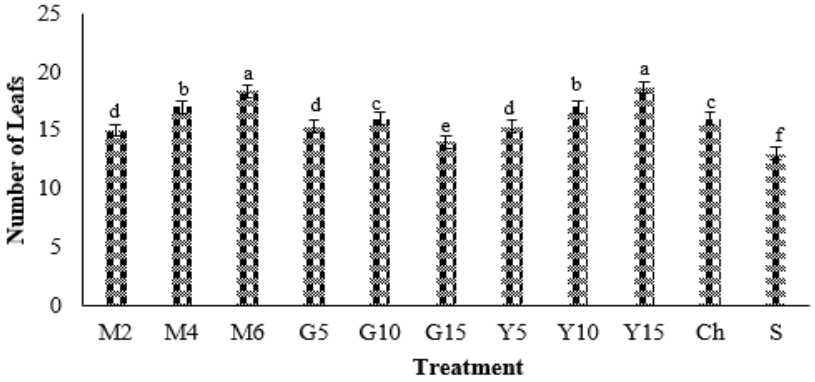

Figure 3 Effect of the amendment materials on the number of leaf wheat

A comparison of the means in *Table 3* showed that the different levels of the amendment materials increased the chlorophyll index of leaves, which was significant in all the treatments at a 1% probability level, as compared to control. The highest chlorophyll index of leaves (18.6) was observed in the treatment of six t/ha of poultry manure whereas the lowest index (8.3) was observed in the control treatment, and after poultry manure, alfalfa residues were influenced at a later stage (*Figure 4*). This significant increase may be due to the improvement of the nutritional condition of the soil, which can reflect the growth of the plant and the chlorophyll content (Panhwar, Naher, Mohd Razi, Shamshuddin, & Razi, 2014). Research that examined the effect of animal manure and superabsorbent polymer on corn leaf relative water content, cell membrane stability, and leaf chlorophyll content under dry conditions indicated that the leaf chlorophyll index increased by applying animal manure and superabsorbent polymer, and animal manure had high effect on leaf chlorophyll index compared to superabsorbent polymer (Khadem et al, 2010). Other researchers also examined the effect of organic and nitrogen fertilizers on water use efficiency, yield, and growth characteristics of wheat (Alvand cultivar), and indicated that raising the level of manure from 30 to 60 t/ha significantly increased the leaf chlorophyll index (Ahmadinejad, Najafi, Aliasgharzad, & Oustan, 2013). Increasing available nutrients and nitrogen and improving the nutritional conditions of the plant, especially in the stages of seed filling, increase the content of chlorophyll leaves (Ibrahim, Hassan, Iqbal, & Valeem, 2008). Chlorophyll is one of the major chloroplast components for photosynthesis, and the relative chlorophyll index has a positive relationship with the photosynthetic rate (Farooq, Wahid, Kobayashi, Fujita, & Basra, 2009). Leaf chlorophyll index (SPAD) readings in plants can be affected by the treatments, where higher values can be indicators of a higher yield (Parthasarathi, Vanitha, Lakshamanakumar, & Kalaiyarasi, 2012) and photosynthetic rate (Anjum et al, 2011). It is also one of the most important biochemical indicators for plants (Liu, Yue, Li, Shen, & Wang, 2014). The leaf chlorophyll index is one of the key factors in determining the rate of photosynthesis and the production of dry matter in the plant. Therefore, its reduction can be considered a non-limiting factor in photosynthesis.

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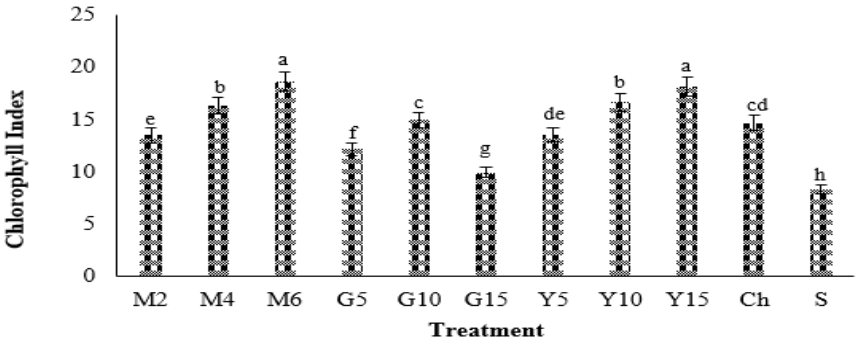

Figure 4 Effect of the amendment materials on the chlorophyll index of wheat

According to the results obtained from the table of variance analysis (*Table 2*), the use of the amendment materials on LAI was significant at 1% probability level. Comparison of the averages also showed that with the increase of the soil amendment materials, LAI increased in all the treatments as compared to the control treatment. The highest LAI (5.76) was observed in the treatment of 15 t/ha of alfalfa residues whereas the lowest LAI (4.3) was observed in the control treatment, and after alfalfa residues, poultry manure was influenced at a later stage (*Figure 5*).
These results are consistent with the findings of a research that investigated the effect of plant residues and salinity stress on LAI and chlorophyll content in barley-cultivated soils, indicating that soils containing alfalfa residues had a maximum leaf area and chlorophyll index. It was also stated that increasing any plant residues would increase the leaf area and amount of chlorophyll and that the planting power of the plant and its intensity depended on the type and quality of plant remains (Alizadeh, Chorom, & Enayatyzamir, 2015). Another research that investigating of wheat yield and soil properties as influenced by crops residues and nitrogen rates showed that type of crop residues had different effect on LAI and the highest LAI was obtained when wheat was sown into the sunflower residues. While, LAI decreased with rapeseed residues (Keshavarznejad et al, 2015). Amendment materials and poultry manure provide the most essential nutrients and thus improve the properties of the soil, such as increasing water holding capacity and soil fertility, leading to an increase in LAI in the plant. Also, sufficient nutrient facilitated to plant might have maximum cell longation or cell division rendering better size of leaves and hence be maximum leaf area index.

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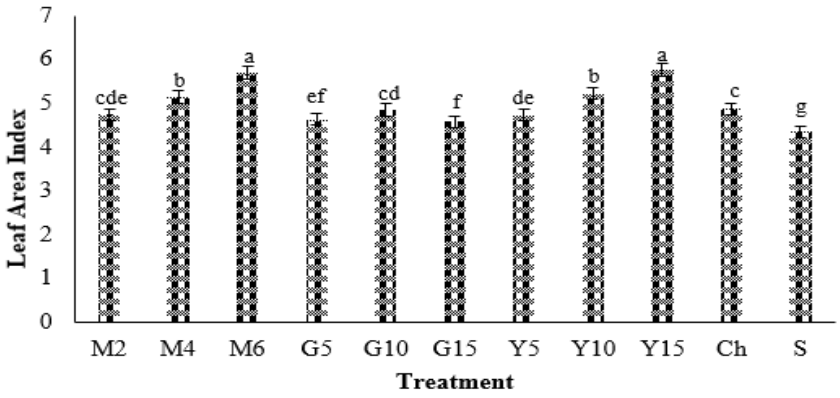

Figure 5 Effect of the amendment materials on the leaf area index of wheat

Moreover, comparison of the means in Table 3 showed that the different levels of the amendment materials increased the RWC of the leaves, which significant in all the treatments at 1% probability level, as compared to the control. The highest RWC of leaves (70.3 %) was observed in the treatment of 15 t/ha of alfalfa residues while the lowest RWC (58.3 %) was observed in the control treatment, and after alfalfa residues, poultry manure was influenced at a later stage (*Figure 6*). In a study on the effect of drought stress and straw and wheat straw on morpho-physiological characteristics of sesame, it was found that application of straw in comparison to its non-application led to a significant increase in leaf RWC at drought stress levels of 60 and 40 % crop capacity (Behzad Nejad, Tahmasebi Sarvestani, Aien, & Mokhtassi Bidgoli, 2018). In a study on the agronomic and physiological characteristics of Alvand cultivar under conditions of water stress, manure and bentonite, it was stated that simultaneous consumption of zeolite and manure under both stress conditions and in favorable conditions led to the increased RWC of leaves compared to the control (Farmahini Farahani, Mirzakhani, & Sajedi, 2015). Relative water content (RWC) is one of the important characteristics that influence plant water relations. Relative water content is considered a measure of plant water status, reflecting the metabolic activity in tissues. RWC related to water uptake by the roots as well as water loss by transpiration (Anjum et al, 2003). The use of amendment materials can improve water retention in the soil and thus can increase the moisture content of the soil. For this reason, there is a positive correlation between leaf relative humidity and moisture content of the soil, which is why the relative amount of leaf water has increased in the treatment of alfalfa residues.

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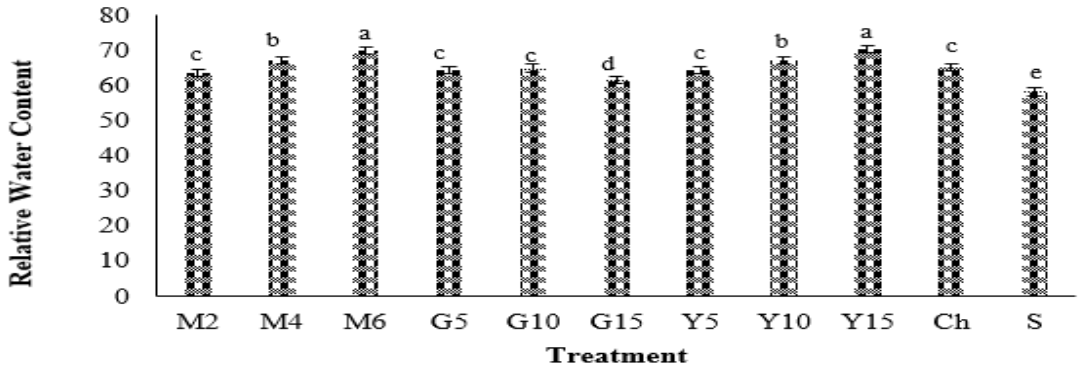

Figure 6 Effect of the amendment materials on the relative water content of wheat

CONCLUSION

From the above discussion it is clear that amendment materials have a significant influence on the productivity of wheat plant. Based on the findings, degradation of nutrients provided the nutritional needs of the plant at the beginning of the growth period. Then, the long-term straw decomposition and elemental release as well as the increase of organic matters increased the growth needs of the plant in the next stages of growth and improved the growth characteristics of the wheat plant. Amendment materials can be a better supplement of inorganic fertilizer to produce better growth of wheat. As a result of these amendment materials, alfalfa residues had more effect than the poultry manure, straw and wheat straw and chemical fertilizer treatments in increasing LAI, number of leaves, RWC and wheat height. In contrast to the use of poultry manure there was a better effect on the leaf chlorophyll index and spike number than the other treatments. It is deduced that the increase of nutrients in alfalfa residues improves the growing green of plant, and by increasing the growth, leaf area index increases. It appears that there is a direct relationship between the initial water content of plant tissues and amount of available water of the plant, and in fact, the amount of water present in cells and plant tissues is affected by the climatic conditions of the growing region. Thus, if due to lack of moisture in the soil, the amount of water released by the plant is not absorbed by the roots, the percentage of water will be reduced in the plant tissues. Instead, if the amount of moisture in the soil is sufficient to compensate for the water withdrawal from the plant, in this case, the cells and tissues of the plant will always be at a high level of turgescence. According to the results, it can be stated that the amendment materials, because of the high moisture content in the soil, can have a great influence on the RWC of the leaf. Moreover, regarding the lower price of alfalfa residues (15 t/ha) than that of poultry manure as well as their availability in most parts of the country, such residues are more suitable compared to other fertilizer levels and are recommended.

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A SIRVAN BÚZAFAJTA FIZIOMORFOLÓGIAI JELLEMZŐINEK VIZSGÁLATA MÓDOSÍTÓ ANYAGOK FELHASZNÁLÁSÁVAL

ÖSSZEFOGLALÁS

Néhány módosító anyag hatásának vizsgálata érdekében a Sirvan búzafajta fiziomorfológiai jellemzőire, egy háromszor megismételt, véletlenszerű, teljes blokktervezési kísérletet került elvégzésre a 2018-2019-es években Irán (Dasht-e Armou, Dareshahr Ilam tartomány) egyik mezőgazdasági üzemében. A vizsgálat célja két tényező, nevezetesen a módosító anyagok típusa és az oldhatatlan anyagok száma (lucernamaradék 5, 10 és 15 t/ha, szalma és búzaszalma 5, 10 és 15 t/ha, baromfitrágya 2, 4 és 6 t/ha és az előírt 100 százalékos ásványi műtrágya) hatásának vizsgálata és összehasonlítása volt. Az eredmények azt mutatták, hogy a módosító anyagok használata jelentősen növelte a búzakalászok számát (15-143 százalékkal), klorofillindexét (18-122 százalékkal), levélszámát (8-51 százalékkal), relatív víztartalmát (6-21 százalékkal), növénymagasságát (5-16 százalékkal) és levélfelület-indexét (5-33 százalékkal). A legmagasabb levélszámot (19), növénymagasságot (115 cm), levélfelület-indexet (5,76) és relatív víztartalmat (70 százalék) 15 t/ha lucernamaradékban figyelték meg, míg a legmagasabb levélfelület-indexet (5,67) és klorofillindexet (18,6) 6 t/ha baromfitrágyában kapták. Az eredmények alapján megállapítható, hogy a módosító anyagok használata, különösen nyers formában és baromfitrágya formájában, kedvezően hat a búza növekedésére és termésére.
Kulcsszavak: módosító anyagok, klorofill index, levélfelület index, relatív víztartalom

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