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Research Article

THE EFFECT OF USING SOME FILAMENTOUS GREEN ALGAE SPECIES AS FERTILIZER ON GERMINATION AND GROWTH

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ABSTRACT. In this study, 'Deepozym' branded organic liquid algae fertilizer and collected from Sapanca Lake were used in bean (Ada Beyazı), wheat (Nusrat) and corn (Ada 523) (*Phaseoulus vulgaris* L., *Triticum aestivum* L., *Zeamays indentata* Sturt.) cultivars grown in Sakarya province. Two macroalgae (*Spirogyra cylindrica* Czurda 1932 and *Cladophora glomerata* Linneus 1843) were turned into organic liquid fertilizers and used to observe the changes in the physiological and morphological parameters of the plants.

In our study, besides germination for corn, wheat and bean under controlled conditions, pot trials were carried out; In our experiment, control, nutrient solution, commercial algae fertilizer, prepared algae fertilizer, nutrient solution, and prepared algae fertilizer mixture forms were applied. From the moment that the examined seeds start to germinate, the vegetative index, SPAD and the stem, root and leaves of the plants at certain intervals in the laboratory environment; measured in changes in morphological parameters.

In our study, when the effects of fertilizer types were examined, it was observed that commercial algae fertilizer was more effective on plant varieties, and it was determined that the effect in other groups differed according to plant development stages. Although their germination development is close to each other, statistically significant difference between plant groups in Kjeldahl analyzes, while differences between fertilizer types were determined at a very significant level. In our study, it is recommended that the efficiency of the fertilizer obtained from the algae species we have prepared should be used with nutrient additions depending on the concentration level and plant varieties requirement.

Keywords: *Macro Algae, Corn, Wheat, Bean*

INTRODUCTION

In today's world, increase in human population, hunger, climate changes, changing consumption changes in the global sense bring new problems. Especially the effect of nutritional balance all over the world increases the importance of agriculture in terms of food safety. As the importance of agriculture continues to increase, research and development of products have gained importance as a result of the increasing demand for agricultural fertilizers, pesticides, agricultural machinery and seeds. With the change in the trade patterns of the countries, the existence of agriculture and agriculture-based sectors has increased [3].

Corn, wheat, and beans stand out among the plants that are most produced and consumed globally. Wheat is an annual plant grown in continental climates and Anatolia, Western Iran and Caucasia are accepted as gene centers. Wheat ranks first among the cultivated plants used in human nutrition in terms of cultivation and production in the world. The most important reason for this is that the wheat plant has a wide adaptation ability. In addition, wheat grain is the staple food of approximately 50 countries due to its appropriate nutritional value, ease of storage and processing [1].

Corn, which is one of the important plants of agricultural production, is an annual plant. The homeland of corn, one of the grain group plants with high average temperatures, is America. After the discovery of the continent, its distribution to the world was realized. Considering the usage areas of corn, it is an agricultural plant whose importance is increasing day by day, which is known to be used in food products, animal feed, seed corn, industrial and cosmetic fields, and its use in import and export areas.

Considering the economic importance of the bean, it is an agricultural plant that is preferred for food nutrition because of its high protein content in the world and in our country. The homeland of beans is America. The bean, which was discovered in the Americas, has spread all over the world. The distribution of these species is subtropical belts. When we look at the bean varieties produced in the world, mostly *P. vulgaris* and *P. coccineus* species.

Plants use the soil as their general growing area. The effects of micro and macro elements in the soil structure on plant growth are known. It has been revealed by the literature studies that the product and yield are higher in the rightly selected appropriate plants made by determining the physical and chemical properties of the soil. Chemical fertilization is mainly used in agriculture. In addition to the advantages of chemical fertilization, the environmental problems it has created are among the topics of discussion today. Although natural fertilizers have a high content of organic matter, they are one of the methods that should be preferred in terms of environmental gains.

Algae are organisms that contain simple chlorophyll pigment. From microscopic single-celled organisms to complex multi-celled marine algae reaching meters in length. Algae are primary producers in the aquatic environment. With the pigments in their structure, they convert carbon dioxide and water into carbohydrates with the effect of light and increase the nutrient value and dissolved oxygen ratio in the aquatic environment. For this reason, they constitute the food and oxygen source of many aquatic creatures [5].

In this study, 'Deepozym' branded organic liquid algae fertilizer and two macros collected from Sapanca Lake were used in bean (Ada Beyazı), wheat (Nusrat) and corn (Ada 523) (*Phaseoulus vulgaris*, *Triticum aestivum* L., *Zeamays indentata* Sturt.) cultivars grown in Sakarya province. In this study, it is aimed to observe the changes in the physiological and morphological parameters of the plants by turning them into organic liquid fertilizers (*Spirogyra cylindrica* and *Cladophora glomerata*).

MATERIALS AND METHODS

This study was carried out in Eskişehir Osmangazi University, Faculty of Arts and Sciences, Department of Biology (39º44'57"N,30º29'19"E Altitude:823m) Ecophysiology Laboratory in 2020-2021. Corn (Ada 523) wheat (Nusrat) and bean (Ada Beyazı) varieties used in the study were determined by T.C. Obtained from the Corn Research Institute of the Ministry of Agriculture and Forestry. **Ada 523**: Its leaves, which can reach 265-310 cm in length, are upright and have a large yellow horse tooth grain structure. It is medium-late with 130-135 days in terms of maturation days. Grain yield is 1350-1650 kg per decare. In terms of silage yield, it is 9-9.5 tons per decare [6]. **Nusrat**: It is a medium-large, white, semi-hard wheat variety with a height of 95-105 cm, awned, white, medium-density spike structure. Its maturation period is medium, its reaction to fertilizer is good and it is resistant to cold. Thousand grain weight is 38-45 g, hectoliter weight is 78-81 kg, protein in grain is 15-17%. It is moderately resistant to rust and

powdery mildew and is moderately sensitive to driving [7]. **Ada Beyazı**: It is a bean variety that grows 65-87 cm, the first pod height is 13 cm, the average number of pods is 20 per plant, and the average number of 4 pods per pod. It has 98-107 days of early maturation days. It is semi-enveloping. A yield of 173-360 kg can be obtained per decare. Dry hundred grain weight is 37g, wet hundred grain weight is 86g, protein ratio is 20.5-21.7 %. It is tolerant to rust and root rot [8].

Spirogyra cylindrica Czurda 1932 and *Cladophora glomerata* Linneus 1843 samples were taken from Sakarya Province Sapanca Lake, between 0-5 meters depth, from 3 stations (Station1:40º 44' 03" N, 30º 18' 46" E, Station2: 40º 44' 00" N, 30º 18' 12" E, Station3: 40º 44' 05" N, 30º 17' 37" E) was collected in a 5X5 m^2 area in the diving area and the wet weight of the algae collected from this area was determined to be 3 kg. the amount of algae per square meter was calculated as 0.12 kg/m2. After the algae were collected, they were filtered, and the coarse residues were removed and washed first with tap water and then with pure water. It was kept in pure water for 1 night.

Liquid algae fertilizers were prepared according to the method applied by Sivansankari et al. The algae collected according to this method were kept in distilled water for 1 night and then shredded homogeneously with a chopper. The shredded algae are 5 L. as 1 Kg of algae to 1 Liter of pure water. placed in bottles. Prepared 5 L.' The bottles were then placed in a dark environment and allowed to ferment for 2.5 months. Algae fertilizers were reaerated once a week and this process continued until the fermentation period was over. After the fermentation period was completed, solid and liquid forms were separated by filtration and refilled into clean drums. The filtrate (stock) was defined as algae extract at 100% concentration pH (6.9). Algae extracts were prepared as 10% concentration and stored at +4°C [4].

In this study, the seeds selected as a model were selected as Beans, Corn and Wheat, which have high consumption rates in Turkey. The seeds used in the study were grown in Sakarya Province and were obtained from the Corn Research Institute. The selected seeds were Bean (Ada Beyazı), Wheat (Nusrat) and Corn (Ada 523) (*Phaseoulus vulgaris* L., *Triticum aestivum* L., *Zeamays indentata* Sturt.) and their size and color were taken into consideration. All germination studies were carried out as petri and pot trials. Selected seeds were kept in 5% Hydrogen peroxide (H_2O_2) solution for 5 minutes for sterilization before germination. It was then washed with tap water. The washed seeds were taken on the filter paper and made ready for germination. The seeds selected in the same dimensions were arranged in 150cc petri dishes as 10 Wheat, while Beans and Corn were planted in two petri dishes, 5 each in 150cc petri dishes. Each seed was sown in 5 petri dishes so that the sown seeds were in 5 different forms. In total, 50 sowings were made for one seed at a time, and nutrient solution and organic liquid fertilizer forms were applied at fixed intervals. As the experimental groups, Control group, Nutrient Solution, Deepozym branded organic liquid algae fertilizer and liquid algae fertilizer forms that we prepared ourselves were put in 10 ml of 1L water. It was prepared in such a way that it was given to the seeds as 10 ml with an interval of 1 day. Growth conditions of seeds were arranged at an average of 25°C with 70% humidity and photo period after germination was 16 hours of light and 8 hours of dark. Growth parameters (root and stem lengths) were measured on the 7th and 14th days.

In the pot trials, SPAD analyzes were performed with Konica-Minolta brand 502 Plus model SPAD meter and index analyzes with Photon System Instruments brand, Poly Pen RP410 UVIS model xenon lamp spectral reflectometer. In these experiments, nutrient solution and organic liquid fertilizer forms were applied at fixed intervals to Bean, Wheat

and Corn species planted in 5 replications with the random plot method in the pot. Vegetative index measurements (NDVI, SR, MCARI1, OSAVI, G, MCARI, TCARI, TVI, ZMI, SPRI, NPQI, PRI, NPCI, CTR1, CTR2, Lic1) of the examined Bean, Wheat and Corn seeds at regular intervals in the laboratory environment from the moment of germination , Lic2, SIPI, GM1, GM2, ARI1, ARI2, CRI1, CRI2, RDVI, SVI, Lagtime, Gmax, Tolerance Index) as well as stems, roots and leaves; Changes in morphological parameters such as dry weight, wet weight, length, turgor weight of leaves and root, length, leaf proportional germination percentage, root and stem development, water content were determined. In order to determine the amount of nitrogen in the plant samples taken, analysis was carried out according to the Semi Micro Kjeldahl method with the help of Kjeldahl.

The obtained results were evaluated with One-Way ANOVA analysis using the MINITAB v19 program.

RESULTS AND DISCUSSION

According to Table 1, when the root development values in the germination analysis results are examined, from the highest value to the least, prepared algae fertilizer, commercial algae fertilizer, nutrient solution, nutrient solution, and prepared algae solution, and finally the control group. Considering the corn root development data, from the highest value to the least; nutrient solution, prepared algae fertilizer, nutrient solution and prepared algae solution, the control group comes last, commercial algae solution. When we look at the wheat root development data, from the highest value to the least, commercial algae fertilizer, control group, prepared algae fertilizer, nutrient solution, and finally the mixture of nutrients and prepared algae solution.

Table 1. *Germination analysis results of applied fertilizers on bean, corn, wheat plants*

Bitki	Uygulama	Kök Gelişimi	Gövde Gelişimi	% Çimlenme	SVI	Tolerans İndex	G max	Lag time
Fasulye	Kontrol	9,80	17,27	100	1736,47	1,00	0,4	1
Fasulye	Besin çöz.	10,23	17,30	100	1740,23	0,99	0,3	0,325
Fasulye	H.Alg g.	12,03	24,33	100	2445,37	1,08	0,45	0,4
Fasulye	Bsn+Alg	10,20	18,20	100	1830,20	1,01	0,3	0
Fasulye	Alg g.	13,00	20,87	100	2099,67	1,23	0,35	1
Mısır	Kontrol	6,60	3,77	100	383,27	1,00	0,35	0
Mısır	Besin çöz.	12,10	3,97	100	408,77	1,17	0,35	0,5
Mısır	H.Alg g.	5,80	3,80	100	385,80	0,91	0,35	1
Mısır	Bsn+Alg	6,90	4,37	100	443,57	1,04	0,45	1
Mısır	Alg g.	7,67	3,80	100	387,67	1,06	0,3	0,5
Buğday	Kontrol	6,70	3,57	100	363,37	1,00	0,6	0,6
Buğday	Besin çöz.	5,97	3,60	100	365,97	0,85	0,65	1
Buğday	H.Alg g.	8,17	4,77	100	484,83	1,20	0,5	0
Buğday	Bsn+Alg	5,83	6,23	100	629,17	0,91	0,45	0,5
Buğday	Alg g.	6,40	3,57	100	363,07	0,93	0,45	0

When the germination percentages are examined, it is seen that all of them germinated. Considering the SVI data, the highest value was observed in the commercial algae fertilizer in beans, the highest value in the nutrient solution and the prepared algae fertilizer mixture in corn, and the highest value in the nutrient solution and the prepared algae fertilizer mixture in wheat. Looking at the Tolerance Index data, the highest value was observed in prepared algae fertilizer in beans, the highest value in nutrient solution in corn, and the highest value in commercial algae fertilizer in wheat. Looking at the Gmax data, the highest value was observed in the commercial algae fertilizer in beans, the highest value in the nutrient solution and the prepared algae fertilizer mixture in corn, and the highest value in the nutrient solution in wheat. Looking at the lagtime data, the highest value was observed in the control group and prepared algae fertilizer in beans, the highest value in the commercial algae fertilizer and nutrient solution and the prepared algae fertilizer mixture in corn, and the highest value in the nutrient solution in wheat.

Table 2. *Plant-Nitrogen relationship One-Way ANOVA Results*

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Bitki	2	16,39	8,196	3,78	0,029
Error	57	123,50	2,167		
Total	59	139,89			

Table 3. *Fertilizer-Nitrogen relationship One-Way ANOVA Results*

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Gübre	4	33,69	8,423	4,36	0,004
Error	55	106,19	1,931		
Total	59	139,89			

According to the One-Way ANOVA analysis, considering the relationship between plant and nitrogen, it is seen that there is a significant result since the P value is less than 0.05. Again, when the relationship between applications and nitrogen is examined in the ONE-Way ANOVA analysis, a significant difference is seen since the P value is less than 0.05.

Table 4. *Changes of parameters measured in corn plant based on day and fertilizer applications (C.A.F: commercial algae fertilizer)*

	Root Weight	Leaf Weight	Stem Weight	SPAD
		F Values		
Fert.	0.829ns	8.752**	1.449ns	26.539**
Days	8.027**	147.145**	98.884**	2.536ns
Fert. X Days İnt.	0.718ns	7.489**	1.053ns	5.321**
C. V. (%)	81.5769	145.5134	88.2176	12.4026
		Fertilizer		
Control	0.149	1.013A	0.279	29.393B
Nutrient Sol.	0.188	0.739AB	0.304	36.263A
Com. Algea Fert.	0.156	0.620BC	0.271	34.683A
Nut. Sol + C.A.F.	0.168	0.466BC	0.274	34.547A
Prepared Algea Fert.	0.098	0.249C	0.198	28.923B
		Days		
10. Days	0.081B	0.097B	0.096B	33.423
20. Days	0.133AB	0.084B	0.143B	35.549
30. Days	0.239A	1.671A	0.559A	31.840
L.S.D (%)	**Day**s:0.111	**Fert.**:0.380	**Day**s:0.101	**Fert.**:2.534
		Days:0.294		**Fert X Days İnt**:4.389
		Fert X Days İnt:0.658		

Table 5. *Changes in the parameters measured in wheat plant based on day and fertilizer applications (C.A.F: commercial algae fertilizer)*

	Root Weight	Leaf Weight	Stem Weight	SPAD
		F Values		
Fert.	0.895ns	0.985ns	1.783ns	24.535**
Days	2.505ns	2.064ns	7.941**	31.517**
Fert. X Days İnt.	0.562ns	0.927ns	1.926ns	8.850**
C. V. (%)	75.9051	283.1554	98.6016	16.1633
		Fertilizer		
Control	0.009	0.292	0.160	30.481C
Nutrient Sol.	0.007	0.068	0.112	39.553A
Com. Algea Fert.	0.013	0.041	0.117	33.689B
Nut. Sol + C.A.F.	0.007	0.127	0.197	38.655A
Prepared Algea Fert.	0.008	0.042	0.080	33.682B
		Days		
10. Days	0.008	0.028	0.097B	39.086A
20. Days	0.007	0.065	0.083B	34.215B
30. Days	0.012	0.249	0.219A	32.421B
L.S.D (%)			**Day**s:0.103	**Fert.**:2.911
				Days:2.521
				Fert X Days İnt:5.042

Table 6. *Changes in the parameters measured in bean plant based on day and fertilizer applications (C.A.F: commercial algae fertilizer)*

	Root Weight	Leaf Weight	Stem Weight	SPAD
		F Values		
Fert.	1.481ns	7.844**	3.146*	32.448**
Days	16.206**	319.495**	290.406**	3.545*
Fert. X Days İnt.	2.865*	5.996**	3.333**	1.495ns
C. V. (%)	107.3243	130.9918	70.8249	15.8147
		Fertilizer		
Control	0.078	0.523B	0.966BC	46.298B
Nutrient Sol.	0.040	1.104A	1.078AB	53.116A
Com. Algea Fert.	0.064	0.922AB	1.152A	37.111C
Nut. Sol + C.A.F.	0.059	1.092A	1.103AB	38.978C
Prepared Algea Fert.	0.038	1.303A	0.874C	38.532C
		Days		
10. Days	0.020B	0.107B	0.361C	45.565A
20. Days	0.043B	0.197B	0.768B	42.213B
30. Days	0.104A	2.663A	1.975A	43.162AB
L.S.D (%)	**Days:**0.042	**Fert.**:0.409	**Fert.**:0.184	**Fert.**:4.348
	Fert X Days İnt:0.070	**Days:**0.317	**Days:**0.192	**Days:**2.784
		Fert X Days İnt:0.709	**Fert X Days İnt**:0.430	

Table 7. *10th day herbal Index Analysis results (m-1: Corn control, m-2: Corn nutrient solution, m-3: Commercial algae fertilizer application in corn, m-4: Nutrient solution and prepared algae fertilizer application in corn, m-5: Corn Only prepared algae fertilizer application, f-1: Bean control, f-2: Bean nutrient solution, f-3: Commercial algae fertilizer application on beans, f-4: Nutrient solution and prepared algae fertilizer application on beans, f-5: Bean only prepared algae fertilizer application, b-1: Wheat control, b-2: Wheat nutrient solution, b-3: Commercial algae fertilizer application in wheat, b-4: Nutrient solution and prepared algae fertilizer application in wheat, b-5: Only prepared algae fertilizer in wheat algae fertilizer application.)*

	NDVI	SR	MCARI1	OSAVI	G	MCARI	TCARI	TVI	ZMI	SPRI	NPQI	PRI	NPCI
m-1	0,6248	4,3350	0,6830	0,6205	2,2759	0,1902	-0,1838	25,7863	1,7984	1,1052	0,0307	0,0321	-0,0498
m-2	0,6409	4,5740	0,6699	0,6213	2,1127	0,1603	-0,1593	25,2082	1,8790	1,0930	0,0409	0,0329	-0,0443
m-3	0,6813	5,3187	0,6841	0,6496	2,1979	0,1425	-0,1488	26,0038	2,0543	1,1121	0,0317	0,0336	-0,0520
m-4	0,6458	4,6466	0,6697	0,6292	2,3734	0,1747	-0,1715	25,1615	1,8846	1,1298	0,0503	0,0374	-0,0609
m-5	0,5973	4,0182	0,6829	0,6062	2,1376	0,1931	-0,1786	25,6880	1,7464	1,0678	0,0188	0,0268	-0,0270
f-1	0,5831	3,8140	0,7130	0,6026	1,8569	0,1961	-0,1723	27,0878	1,7438	0,9567	0,0308	0,0245	0,0222
f-2	0,5824	3,8036	0,7075	0,6035	1,8800	0,2060	-0,1757	26,8309	1,7237	0,9027	0,0315	0,0202	0,0511
f-3	0,5497	3,4425	0,7115	0,5861	2,0060	0,2351	-0,2012	26,7956	1,5854	0,9362	0,0269	0,0228	0,0330
f-5	0,5685	3,6565	0,7537	0,5945	1,9784	0,2093	-0,1979	28,2906	1,6596	0,9762	0,0213	0,0216	0,0127
b-1	0,5767	3,7301	0,7203	0,5793	1,8002	0,1410	-0,1790	27,0370	1,7758	1,0203	-0,0032	0,0191	-0,0100
b-2	0,5840	3,8111	0,6955	0,5839	1,8542	0,1421	-0,1700	26,0958	1,7597	0,9911	0,0044	0,0199	0,0045
b-3	0,6116	4,1536	0,7772	0,6202	2,0121	0,1819	-0,1859	29,3330	1,7617	1,0420	0,0124	0,0215	-0,0205
b-5	0,3100	1,8955	0,1842	0,2532	1,1838	0,0260	-0,1255	6,9080	1,3564	0,9316	-0,0075	0,0047	0,0353

Table 8. *10th day herbal Index Analysis results (continued) (m-1: Corn control, m-2: Corn nutrient solution, m-3: Commercial algae fertilizer application in corn, m-4: Nutrient solution and prepared algae fertilizer application in corn, m- 5: Algae fertilizer application prepared only in corn, f-1: Bean control, f-2: Bean nutrient solution, f-3: Commercial algae fertilizer application in beans, f-4: Bean nutrient solution and prepared algae fertilizer application, f-5 : Application of only prepared algae fertilizer in beans, b-1: Wheat control, b-2: Wheat nutrient solution, b-3: Commercial algae fertilizer application in wheat, b-4: Nutrient solution and prepared algae fertilizer application in wheat, b-5: Application of prepared algae fertilizer on wheat only.)*

	CTR1	CTR2	Lic1	Lic2	SIPI	GM1	GM2	ARI1	ARI2	CRI1	CRI2	RDVI
m-1	1,3220	0,2862	0,6788	0,8927	0,6652	2,3744	2,7159	-0,7883	-0,3403	3,9406	3,1524	0,5016
m-2	1,2701	0,2702	0,6825	0,8864	0,6721	2,5354	2,8236	-0,6644	-0,2917	3,8353	3,1709	0,5046
m-3	1,2458	0,2313	0,7178	0,9285	0,7057	2,7980	3,2699	-1,0672	-0,4789	4,7232	3,6560	0,5266
m-4	1,2274	0,2650	0,6991	0,9116	0,6781	2,4571	2,8570	-0,9494	-0,4002	4,1111	3,1617	0,5048
m-5	1,4031	0,3109	0,6595	0,8506	0,6518	2,3725	2,5630	-0,4729	-0,1927	3,3732	2,9004	0,4967
f-1	1,5669	0,3334	0,6413	0,7392	0,6453	2,5269	2,4385	0,1797	0,0891	2,6513	2,8310	0,5094
f-2	1,5595	0,3354	0,6435	0,7284	0,6492	2,5110	2,4005	0,2268	0,1115	2,6897	2,9165	0,5073
f-3	1,6553	0,3645	0,6253	0,7046	0,6311	2,2324	2,2041	0,0593	0,0283	2,6253	2,6847	0,4914
f-5	1,5049	0,3377	0,6343	0,8045	0,6295	2,2879	2,3566	-0,1267	-0,0702	2,5872	2,4605	0,5092
b-1	1,2611	0,3086	0,6231	0,9206	0,6104	2,3770	2,5595	-0,3615	-0,1858	2,4120	2,0505	0,4987
b-2	1,3120	0,2994	0,6329	0,9167	0,6246	2,3997	2,5873	-0,3896	-0,1924	2,8027	2,4131	0,4940
b-3	1,3622	0,2882	0,6623	0,8978	0,6530	2,4597	2,6451	-0,3552	-0,1886	3,1547	2,7994	0,5323
b-5	1,1761	0,5693	0,3215	0,8881	0,3472	1,6200	1,6319	0,0634	0,0136	1,5128	1,6107	0,1820

Table 9. *20th day herbal Index Analysis results (m-1: Corn control, m-2: Corn nutrient solution, m-3: Commercial algae fertilizer application in corn, m-4: Nutrient solution and prepared algae fertilizer application in corn, m-5: Corn Only prepared algae fertilizer application, f-1: Bean control, f-2: Bean nutrient solution, f-3: Commercial algae fertilizer application on beans, f-4: Nutrient solution and prepared algae fertilizer application on beans, f-5: Bean only prepared algae fertilizer application, b-1: Wheat control, b-2: Wheat nutrient solution, b-3: Commercial algae fertilizer application in wheat, b-4: Nutrient solution and prepared algae fertilizer application in wheat, b-5: Only prepared algae fertilizer in wheat algae fertilizer application.)*

	NDVI	SR	MCARI1	OSAVI	G	MCARI	TCARI	TVI	ZMI	SPRI	NPQI	PRI	NPCI
m-1	0,6345	4,4883	0,6891	0,6237	2,1955	0,1663	-0,1708	25,9111	1,8979	1,1179	0,0343	0,0293	-0,0545
m-2	0,6420	4,5899	0,6819	0,6231	2,0490	0,1501	-0,1557	25,6945	1,9299	1,0679	0,0332	0,0303	-0,0326
m-3	0,6686	5,0684	0,6820	0,6420	2,1792	0,1396	-0,1495	25,7897	2,0495	1,1203	0,0342	0,0320	-0,0561
m-4	0,6418	4,5844	0,7015	0,6314	2,2618	0,1748	-0,1738	26,4258	1,8898	1,1198	0,0453	0,0335	-0,0565
m-5	0,5994	4,0195	0,6851	0,6062	2,1947	0,1866	-0,1814	25,6866	1,7607	1,0619	0,0161	0,0257	-0,0272
f-1	0,5378	3,3783	0,6924	0,5699	1,8715	0,1984	-0,1850	26,1367	1,6466	0,9412	0,0299	0,0203	0,0305
f-2	0,5494	3,4702	0,6804	0,5750	1,8438	0,1946	-0,1777	25,6690	1,6639	0,9097	0,0319	0,0206	0,0473
f-3	0,5189	3,1751	0,6854	0,5600	1,9457	0,2230	-0,2000	25,7147	1,5508	0,9124	0,0297	0,0199	0,0459
f-4	0,4686	2,8919	0,6469	0,5162	1,8687	0,1991	-0,2213	24,8337	1,4858	0,8942	0,0109	0,0000	0,0257
f-5	0,5354	3,3382	0,7121	0,5684	1,9364	0,2053	-0,1973	26,5868	1,6021	0,9577	0,0360	0,0204	0,0220
b-1	0,5816	3,7844	0,7312	0,5921	1,9955	0,1832	-0,1938	27,3548	1,7124	1,0128	0,0104	0,0205	-0,0063
b-2	0,5866	3,8397	0,6497	0,5761	1,8412	0,1386	-0,1585	24,3993	1,7629	0,9888	0,0045	0,0197	0,0057
b-3	0,6064	4,0891	0,7577	0,6183	2,1138	0,2005	-0,1931	28,4543	1,7214	1,0109	0,0110	0,0225	-0,0052
b-4	0,5647	3,7842	0,6167	0,5492	1,7251	0,1020	-0,1680	23,9657	1,7909	0,9582	-0,0313	0,0014	-0,0071
b-5	0,4467	2,8489	0,4422	0,4269	1,7651	0,1323	-0,1684	16,4115	1,4725	0,9602	0,0029	0,0154	0,0205

Table 10. *Twentieth day herbal Index Analysis results (continued) (m-1: Corn control, m-2: Corn nutrient solution, m-3: Commercial algae fertilizer application in corn, m-4: Nutrient solution and prepared algae fertilizer application in corn, m- 5: Algae fertilizer application prepared only in corn, f-1: Bean control, f-2: Bean nutrient solution, f-3: Commercial algae fertilizer application in beans, f-4: Bean nutrient solution and prepared algae fertilizer application, f-5 : Application of only prepared algae fertilizer in beans, b-1: Wheat control, b-2: Wheat nutrient solution, b-3: Commercial algae fertilizer application in wheat, b-4: Nutrient solution and prepared algae fertilizer application in wheat, b-5: Application of prepared algae fertilizer on wheat only.)*

	CTR1	CTR2	Lic1	Lic2	SIPI	GM1	GM2	ARI1	ARI2	CRI1	CRI2	RDVI
m-1	1,2672	0,2742	0,6811	0,9223	0,6687	2,4662	2,8569	-0,8819	-0,3923	3,8922	3,0103	0,5083
m-2	1,2601	0,2675	0,6786	0,8920	0,6718	2,5872	2,8851	-0,6664	-0,3012	3,7498	3,0834	0,5106
m-3	1,2251	0,2417	0,7077	0,9276	0,6953	2,7189	3,1920	-1,0739	-0,4794	4,4633	3,3894	0,5213
m-4	1,2159	0,2668	0,6896	0,9186	0,6712	2,4850	2,8460	-0,8132	-0,3615	3,8270	3,0138	0,5157
m-5	1,3553	0,3037	0,6609	0,8655	0,6526	2,3108	2,5904	-0,6592	-0,2813	3,5521	2,8928	0,4951
f-1	1,5718	0,3670	0,6085	0,7351	0,6122	2,2755	2,2477	0,0547	0,0281	2,4392	2,4940	0,4808
f-2	1,5562	0,3601	0,6134	0,7284	0,6204	2,3377	2,2733	0,1340	0,0650	2,3917	2,5258	0,4825
f-3	1,6447	0,3875	0,5976	0,7081	0,6068	2,1122	2,1025	0,0202	0,0098	2,4564	2,4767	0,4687
f-4	1,6455	0,3987	0,5548	0,6814	0,5573	1,9750	1,9643	0,0039	-0,0088	2,0677	2,0910	0,4294
f-5	1,5339	0,3687	0,6075	0,7689	0,6050	2,1513	2,2100	-0,1167	-0,0594	2,4044	2,2877	0,4818
b-1	1,3918	0,3147	0,6392	0,8829	0,6271	2,3126	2,4633	-0,3041	-0,1526	2,8582	2,5541	0,5037
b-2	1,3292	0,3047	0,6321	0,8920	0,6270	2,4093	2,5547	-0,3183	-0,1487	3,0683	2,7500	0,4779
b-3	1,4399	0,2960	0,6644	0,8664	0,6582	2,3840	2,5559	-0,3444	-0,1738	3,4220	3,0776	0,5232
b-4	1,2788	0,2880	0,6035	0,8713	0,6032	2,4408	2,5574	-0,2754	-0,1375	2,9067	2,6500	0,4538
b-5	1,3793	0,4485	0,4945	0,8436	0,5003	1,8865	1,9617	-0,1254	-0,0633	2,6505	2,5424	0,3368

Table 11. *Herbal Index Analysis results on the thirtieth day (m-1: Corn control, m-2: Corn nutrient solution, m-3: Commercial algae fertilizer application in corn, m-4: Nutrient solution and prepared algae fertilizer application in corn, m-5: In corn Only prepared algae fertilizer application, f-1: Bean control, f-2: Bean nutrient solution, f-3: Commercial algae fertilizer application on beans, f-4: Nutrient solution and prepared algae fertilizer application on beans, f-5: Bean only prepared algae fertilizer application, b-1: Wheat control, b-2: Wheat nutrient solution, b-3: Commercial algae fertilizer application in wheat, b-4: Nutrient solution and prepared algae fertilizer application in wheat, b-5: Only prepared algae fertilizer in wheat algae fertilizer application.)*

	NDVI	SR	MCARI1	OSAVI	G	MCARI	TCARI	TVI	ZMI	SPRI	NPQI	PRI	NPCI
m-1	0,6443	4,6415	0,6952	0,6270	2,1151	0,1424	-0,1578	26,0360	1,9975	1,1307	0,0380	0,0265	-0,0593
m-2	0,6431	4,6059	0,6938	0,6250	1,9853	0,1400	-0,1521	26,1809	1,9807	1,0427	0,0255	0,0278	-0,0209
m-3	0,6559	4,8180	0,6799	0,6344	2,1606	0,1367	-0,1501	25,5756	2,0448	1,1286	0,0368	0,0305	-0,0602
m-4	0,6378	4,5221	0,7332	0,6335	2,1501	0,1748	-0,1760	27,6901	1,8949	1,1098	0,0402	0,0296	-0,0520
m-5	0,6016	4,0208	0,6873	0,6062	2,2519	0,1801	-0,1843	25,6852	1,7751	1,0561	0,0134	0,0247	-0,0273
f-1	0,4926	2,9425	0,6717	0,5372	1,8861	0,2007	-0,1977	25,1855	1,5494	0,9257	0,0290	0,0162	0,0388
f-2	0,5164	3,1369	0,6534	0,5466	1,8077	0,1833	-0,1798	24,5072	1,6041	0,9167	0,0324	0,0211	0,0434
f-3	0,4881	2,9078	0,6593	0,5339	1,8854	0,2109	-0,1989	24,6338	1,5163	0,8887	0,0326	0,0171	0,0589
f-4	0,4880	2,9113	0,6663	0,5356	1,8881	0,2185	-0,2019	24,8531	1,5052	0,9136	0,0303	0,0195	0,0451
f-5	0,5023	3,0198	0,6705	0,5423	1,8944	0,2014	-0,1967	24,8831	1,5445	0,9392	0,0508	0,0192	0,0313
b-1	0,5865	3,8388	0,7422	0,6050	2,1907	0,2254	-0,2087	27,6726	1,6489	1,0053	0,0240	0,0219	-0,0025
b-2	0,5891	3,8684	0,6040	0,5684	1,8282	0,1351	-0,1470	22,7027	1,7662	0,9865	0,0045	0,0196	0,0070
b-3	0,6012	4,0245	0,7383	0,6164	2,2155	0,2191	-0,2002	27,5756	1,6812	0,9799	0,0096	0,0236	0,0102
b-4	0,5834	3,8029	0,6354	0,5679	1,7438	0,1207	-0,1493	23,9844	1,8096	0,9769	-0,0126	0,0201	0,0117
b-5	0,5834	3,8024	0,7002	0,6007	2,3465	0,2387	-0,2113	25,9151	1,5885	0,9888	0,0132	0,0262	0,0056

Table 12. *Herbal Index Analysis results on the thirtieth day (continued) (m-1: Corn control, m-2: Corn nutrient solution, m-3: Commercial algae fertilizer application in corn, m-4: Nutrient solution and prepared algae fertilizer application in corn, m-5: In corn Only prepared algae fertilizer application, f-1: Bean control, f-2: Bean nutrient solution, f-3: Commercial algae fertilizer application on beans, f-4: Nutrient solution and prepared algae fertilizer application on beans, f-5: Bean only prepared algae fertilizer application, b-1: Wheat control, b-2: Wheat nutrient solution, b-3: Commercial algae fertilizer application in wheat, b-4: Nutrient solution and prepared algae fertilizer application in wheat, b-5: Only prepared algae fertilizer in wheat algae fertilizer application.)*

	CTR1	CTR2	Lic1	Lic2	SIPI	GM1	GM2	ARI1	ARI2	CRI1	CRI2	RDVI
m-1	1,2124	0,2621	0,6833	0,9519	0,6723	2,5579	2,9978	-0,9756	-0,4444	3,8439	2,8683	0,5150
m-2	1,2501	0,2649	0,6747	0,8977	0,6715	2,6391	2,9466	-0,6683	-0,3106	3,6644	2,9960	0,5166
m-3	1,2045	0,2522	0,6976	0,9267	0,6849	2,6398	3,1141	-1,0806	-0,4799	4,2035	3,1229	0,5159
m-4	1,2044	0,2686	0,6801	0,9256	0,6643	2,5129	2,8350	-0,6770	-0,3228	3,5428	2,8658	0,5265
m-5	1,3075	0,2965	0,6623	0,8803	0,6534	2,2490	2,6179	-0,8456	-0,3699	3,7310	2,8853	0,4935
f-1	1,5767	0,4007	0,5756	0,7310	0,5792	2,0241	2,0570	-0,0702	-0,0328	2,2272	2,1570	0,4522
f-2	1,5530	0,3848	0,5833	0,7284	0,5916	2,1645	2,1462	0,0413	0,0184	2,0937	2,1350	0,4577
f-3	1,6342	0,4106	0,5699	0,7116	0,5825	1,9921	2,0009	-0,0189	-0,0088	2,2876	2,2687	0,4460
f-4	1,6649	0,4181	0,5742	0,7008	0,5767	1,9944	1,9837	0,0233	0,0107	2,0871	2,1104	0,4488
f-5	1,5629	0,3997	0,5807	0,7334	0,5805	2,0148	2,0634	-0,1067	-0,0486	2,2217	2,1150	0,4543
b-1	1,5226	0,3208	0,6554	0,8452	0,6439	2,2483	2,3670	-0,2467	-0,1194	3,3045	3,0578	0,5087
b-2	1,3465	0,3101	0,6313	0,8673	0,6295	2,4189	2,5222	-0,2470	-0,1050	3,3339	3,0869	0,4618
b-3	1,5175	0,3039	0,6666	0,8351	0,6634	2,3083	2,4667	-0,3335	-0,1591	3,6894	3,3558	0,5142
b-4	1,2975	0,3067	0,6222	0,8900	0,6219	2,4595	2,5761	-0,2567	-0,1188	2,9254	2,6687	0,4725
b-5	1,5825	0,3278	0,6674	0,7992	0,6535	2,1530	2,2914	-0,3142	-0,1403	3,7883	3,4740	0,4916

CONCLUSION

This is the standard font (Times New Roman, 12-pt) and layout (single spacing) for the individual paragraphs. In the application made on the corn plant; It is seen that there are no significant differences in root and stem weights based on fertilizer types. However, when the development differences between the days were examined, it was seen that the root and stem weights reached the highest level on the 30th day. When the leaf weights and SPAD values were examined, it was observed that there were differences in the fertilizer types, days, and interaction of fertilizer types*day. Considering the leaf weights, although the highest values were obtained in the control group, close results were obtained in the groups where only the nutrient solution was applied. In addition, the highest yield in leaf weights was again obtained on the 30th day. SPAD values represent the chlorophyll capacity of a plant. The high SPAD value is a kind of prediction of the useful chlorophyll amount of the plant and is a parameter that has been used in agriculture for years. It is seen that there are significant differences between fertilizer types in SPAD values. The highest values were obtained in the group in which only the nutrient solution was applied, and close values were observed in the commercial algae fertilizer application and in the nutrient solution and prepared algae fertilizer mixture. When we look at the vegetative index analysis in corn, it is seen that the most efficient results are generally obtained in the application of commercial algae fertilizer. Despite this, it is seen that positive results were obtained in the application of algae fertilizer mixture with a nutrient solution. In the germination data, SVI (seedling viability index) is the highest value in the nutrient solution and the prepared algae fertilizer mixture, Tolerance Index is the highest value in the nutrient solution, Gmax (germination rate) is in the nutrient solution and the

prepared algae fertilizer mixture, Lag time (germination delay time) It is seen that the highest value is in the mixture of commercial algae fertilizer, nutrient solution, and prepared algae fertilizer.

According to the results of the application of fertilizer types in the wheat plant; It is seen that there is no significant difference in root and leaf weights. When the root weights were compared among themselves, the highest yield was obtained on the 30th day, while the lowest yield was obtained on the 20th day. When the comparison is made based on fertilizer types, the highest yield was obtained in the commercial algae fertilizer application. It is seen that the lowest yield is in the nutrient solution. When leaf weights are compared among themselves; Based on days, the highest yield was obtained on the 30th day, and the lowest yield was on the 10th day. When comparing the fertilizer varieties, the highest yield was obtained in the control application, and the lowest yield was observed in the nutrient solution. When the body weight results are examined, a significant difference at the level of 1% was determined between the days. The highest yield was obtained on the 30th day, while the lowest yield was obtained on the 20th day. When the development differences between the applied fertilizers are examined, the highest results were obtained from the nutrient solution and the prepared algae fertilizer mixture. The lowest results were seen only in the prepared algae fertilizer application. Significant differences were observed in SPAD values at the level of 1% in fertilizer types, days and fertilizer*day interactions. Considering the development differences between fertilizers, the highest yield was obtained in the nutrient solution group, and the lowest yield was observed in the control application. When we look at the differences between the days, it is seen that the highest improvement is on the 10th day, and the lowest yield is on the 30th day. When the herbal index analysis results are examined in general, it is seen that the highest results were obtained in commercial fertilizer application in all three measurement periods. In the germination data, SVI (seedling viability index) is the highest value in the nutrient solution and the prepared algae fertilizer mixture, Tolerance Index is the highest value in commercial algae fertilizer, Gmax (germination rate) is in the nutrient solution with the highest value, Lag time (germination delay time) is the highest value in the nutrient solution. appears to be in solution.

Considering the analyzes made on bean plants; There were significant differences at the level of 1% in the growth differences between days in root weights. On the other hand, 5% differences were found in the fertilizer types*day interaction. Considering the development differences between the days, the highest results were obtained on the 30th day, while the lowest results were obtained on the 10th day. Considering the differences between fertilizer types, the highest yield was obtained in the control group, while the lowest yield was obtained in the prepared algae fertilizer application. Considering the leaf weights, significant differences were found at the level of 1% in the fertilizer types, the differences between days and the fertilizer types*day interaction. Considering the results among the fertilizer types, the highest results were obtained from the prepared algae fertilizer, while the lowest results were seen in the control group. Considering the development differences between the days, the highest yield was obtained on the 30th day, and the lowest results were obtained on the 10th day. Considering the results of the stem weights of the bean plant, the interaction of days and fertilizer types*day was significant at the level of 1%, while differences at the level of 5% were observed between the fertilizer types. Looking at the differences between fertilizer types, the highest results were obtained in commercial algae fertilizer. Considering the development differences

between the days, the highest yield was obtained on the 30th day. According to SPAD results, there were significant differences at the level of 1% between fertilizer types, while differences at the level of 5% were observed between days. Considering the development differences between fertilizer types, the highest results were obtained in the nutrient solution application, while the lowest results were observed in the prepared algae fertilizer application. Looking at the differences between the days, the highest results were obtained on the 10th day, while the lowest results were observed on the 20th day. When the herbal index analyzes were examined in general, it was seen that the best results were obtained in the nutrient solution application in the bean plant. In the germination data, SVI (seedling viability index) is the highest value in commercial algae fertilizer, Tolerance Index is the highest value in prepared algae fertilizer, Gmax (germination rate) is the highest value in commercial algae fertilizer, Lag time (germination delay time) is the highest value in the control group and appears to be in prepared algae fertilizer.

When the effects of fertilizer types were examined in our study, it was observed that commercial algae fertilizer was more effective on plant varieties, and it was determined that the effect in other groups differed according to plant development stages. Although their germination development is close to each other, statistically $P>0.05$ between plant groups was found in Kjeldahl analysis, and the difference was significant. Since $P>0.01$ among fertilizer varieties, the Kjeldahl analysis difference between fertilizer varieties was determined at a very significant level. For the efficiency of the fertilizer obtained from *Spirogyra cylindrica* Czurda 1932 and *Cladophora glomerata* Linneus 1843 species that we prepared in our study, to show the expected effect compared to other fertilizers, it is recommended to use the fertilizer with additives depending on the concentration level and plant varieties requirement.

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