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Effects of Baikal EM 1 and Biohumus on Growth Parameters of Amaranthus Caudatus Var. Bulava and Amaranthus Tricilor Var. Valentina

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Abstract

The effects of natural substances, Baykal EM1 and Biohumus, on growth processes of *Amaranthus caudatus* var. *bulava* and *Amaranthus tricilor* var. *valentina* which are indigenous in Bartın, Turkey, were researched. Length, number of leaves, number of flowers, length of flowers, stem girth, fresh root weight, amount of chlorophyll a+b, amount of Amaranthin and total nitrogen were taken into account. The study was carried out in the garden of Günye Forest Enterprise of Bartin Forest Directorate in 2006 and 2007. Three different treatments of Baikal EM1, Biohumus and Baikal EM1+Biohumus were applied along with untreated control plants. Growth of the plants was measured three times, at beginning of vegetative growth (May), at the beginning of flowering (July) and at the end of the vegetative growth (October). Biochemical properties, such as total nitrogen, chlorophyll a+b and amaranthin, was measured three times at the beginning of flowering (July), middle of flowering (August) and end of the vegetative growth (October). These natural substances had positive effect on the growth and development of *Amaranthus caudatus* var. *bulava* and *Amaranthus tricilor* var. *valentina*.

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In addition, the combination of Baikal EM1+Biohumus was more effective in promoting during and at the end of the vegetative growth.

Keywords: Amaranthus caudatus var. bulava; Amaranthus tricilor var. valentina; Baikal EM1; Biohumus; Bartin-Turkey.

1. Introduction

The plants, which are morphologically and physiologically strong and resistant to the environmental stress, are generally preferred especially in the urban places. Adaptation and development are given priority at the annual plants applied to the field once the vegetation period starts. Accordingly, using of chemical-based fertilizer started to increase. However, the use of such fertilizers causes pollution both directly and indirectly. Especially the chemical fertilizers lead to such environmental problems as the pollution of soil and water resources in case of extreme and unbalanced application unlike the proper application method. The plant developers with natural origin have been started to gain importance in many countries [1].

In the last decades, ecologists and soil microbiologists tend to classify soil microorganisms as harmful and beneficial, according to their effects on plant and soil. Beneficial microorganisms, which are also called effective microorganisms (EM), are naturally-occurring microorganisms that can be applied as inoculants to increase microbial diversity and the quality of soil and plants [2, 3]. Addition of EM cultures to the soil/plant ecosystem improves soil quality, soil health and growth, yield and quality of crops and immunity to environmental stress [4, 5, 6, 7, 8, 9]. An EM preparation, called Baikal EM1, developed by the Russian Science Institute [10].

Another organic substance used to increase and improve the soil fertility and crop yields is Biohumus. This product consists of decomposed biological organic compounds containing humic acid (HA) [11, 12, 13]. HA is complex polymeric organic acid with a wide range of molecular weight and it is the most resistant fraction to microbial degradation of organic matter in soil [14, 15, 16].

It has been known that Amaranths were the most important food grain for Aztecs and used as an item in their religious ceremonies[17, 18, 19, 20] Amaranths are widely distributed plants throughout the temperature and tropical regions around the world. Amaranth species were used for various purposes by the people. It has been planted for centuries to use their leaves as vegetable and seeds as grains besides their showy leaves and flowers [21, 22, 23, 24]. The biggest problem in the cultivation of amaranths is the quality of soil. These species demand high amounts of nitrogen [25, 26].

From this point of view, this study aims to determine the effects of such natural fertilizers as Biohumus and Baikal EM1 on the growth of *Amaranthus caudatus* var. *bulava* and *Amaranthus tricilor* var. *valentina*.

2. Material and methods

Both Baikal EM1 and Biohumus, used as natural fertilizer, were purchased from the Russian Academy of

Agricultural Sciences, Research Institute of Agro Chemistry Moscow Russia. Baikal EM-1 contains nitrogen fixing bacteria, lactic acid bacteria, photosynthetic bacteria, Saccharomyces yeasts and microbial cultivation media. Lactic acid bacteria have been isolated from rhizosphere of fruit trees.

Effective microorganisms (EM) are a mixed culture of beneficial microorganisms including a predominant population of lactic acid bacteria (*Lactobacillus sp.*), yeast (*Saccharomyces sp.*), a small proportion of photosynthetic bacteria (*Rhodopseudomonas sp.*), actinomycetes and fermenting fungi [27]. In addition, Baikal EM1 consists of a water solution that contains compounds that promote nitrogen fixation and photosynthesis, along with lactic acid bacteria, yeast and other components that these microorganisms need to live [10].

The main substance of Biohumus is ruins of silt at the bottom of the Baikal Lake. Biohumus include organic compounds such as natural substances (humic acids and proteins) as well as macro and micro elements that are required for the plants [11, 13]. The seeds of *Amaranthus caudatus* var. *bulava* and *Amaranthus tricilor* var. *valentina* were obtained by All-Russia Institute of Vegetable Selection and Seed Breeding.

2.1. Field study and experimental arrangements

The field experiment was carried out at the research area of Günye Forest Enterprise of Bartin Forest Directorate, Bartin, Turkey during the vegetation period of 2006 and 2007. The experiment was a randomized complete block design (RCBD) with three replications. The plot size was 0.75 x 3 m. with 20 cm. between plants. The seeds were planted at the beginning of May in both years and were irrigated twice a week between May and August and once a week between September and November.

The experimental treatments were; Untreated control (T_0), Baikal EM1+ Water (1:100, vv^{-1}) (T_1). Biohumus + Water (1:100 vv^{-1}) (T_2), Biohumus + Baikal EM-1 + Water (0.5:0.5:100, vv^{-1}) (T_3). The plants were treated with the above mentioned mixtures at beginning of each month (1 lt per each plant) [4, 12]. Weed removal was conducted before the treatments.

Chemical analysis of surface soil from the experimental site was performed at the Eastern Mediterranean Forestry Research Institute, Mersin, Turkey. The soil in the test field was found to be sandy clay loam. The pH was 8.00, total $CaCO_3$ was 4.18 %, organic matter was 5.05% and total salt was 0.57 mS/cm according to analysis results of the surface soil of the experimental site. Meteorological data of 2006, 2007 and the average long term values were obtained from Turkish State Meteorological Service (Table 1).

2.2. Measurement of growth analyses

Length, number of leaves and flowers, length of flower, stem girth and fresh root weight were measured three times during the vegetative period; In May, at the beginning of vegetative growth, in July, at the beginning of flowering, and in October, at the onset of leaf yellowing in the both 2006 and 2007.

2.3. Analysis of biochemical properties

Analysis was re-conducted three times for both plants on July, August and September of 2006 and 2007. The analysis was carried out in Agrochemical Research Institute of the Russian Academy of Agricultural Sciences. The chlorophyll (Chl) content of the leaves was determined (2% homogenate in 100% acetone) by a spectrophotometer at wavelengths of 645 and 663 nm [29]. The content of amaranthine (*C*) was determined photometrically with correction for the molar extinction coefficient of this pigment $\mathcal{E}= 5.66x10^4$ (Piattelli et al 1969). Optical density D_{537} was measured in a 1-cm path length cell.

The content was calculated as $C= D_{537}/ \mathcal{E}$. The molecular weight of free amaranthine was assumed to be 711 Da. [30]. The N content was determined using the Kjeldahl method [31].

Statistical analysis was carried out by one-way ANOVA using Duncan's test to estimate the significance of differences between means at $p<0.005$.

Table 1: Meteorological data of 2006, 2007 and the average values of long years were obtained from Turkish State Meteorological Service [28].

		May	June	July	August	September	October
Temperature (^{o}C)	The average values of long years	18.4	9.7	21.6	21.3	17.6	13.4
	2006	20.6	21.8	24.3	24.3	18.4	15.3
	2007	17.2	21.6	23.5	23.7	19.1	15.4
Rainfall (mm/m^2)	The average values of long years	53.9	69.8	66.5	85.3	85.7	100.7
	2006	34.8	23.2	16.2	3.5	128.9	85.8
	2007	33.7	38.5	2.0	67.0	94.1	141.5
Relative humunity (%)	The average values of long years	76.0	74.0	75.0	76.0	81.0	82.0
	2006	73.5	72.2	70.0	70.3	77.8	80.9
	2007	73.5	72.4	66.1	75.8	76.9	80.0

3. Result and discussion

To determine the effect of Baikal EM1 and Biohumus on the growing parameters such as, Length, Number of leaves Stem girth Flower length Number of flowers Fresh root weight of *plants* were measured for three times in the vegetation.

All of the measurements were done both in 2006 and 2007 (Table 2 and Table 3). In addition, total nitrogen of *plants* was measured for three times in the vegetation to determine the effect of Baikal EM1 and Biohumus on biochemical components such as, chlorophyll a+b, amaranthin, (Table 4).

Table 2: Effect of Biohumus Baikal EM1 and integrated both on growth components of *Amaranthus caudatus* var. *bulava*

Months	Years	Treatment	Length (cm)	Number of leaf	Stem girth (cm)	Terminal flower length (cm)	Number of flower	Fresh root weight (g)
May	2006	T_0	12.74±1.10^{c}	5.33±1.39^{d}	0.46±0.14^{c}			
		T_1	14.20±1.09^{a}	5.92±1.29^{b}	0.54±0.14^{b}			
		T_2	13.19±0.51^{b}	5.86±1.64^{c}	0.57±0.16^{ab}			
		T_3	14.03±0.56^{a}	6.01±1.57^{a}	0.59±0.17^{a}			
	2007	T_0	12.94±1.44^{d}	5.36±1.38^{d}	0.45±0.14^{c}			
		T_1	13.94±0.79^{b}	5.98±1.37^{b}	0.57±0.15^{b}			
		T_2	13.33±0.64^{c}	5.86±1.67^{c}	0.60±0.15^{ab}			
		T_3	14.17±0.73^{a}	6.07±1.56^{a}	0.58±0.16^{a}			
	P (2006 - 2007)		0.355^{NS}	0.504^{NS}	0.553^{NS}			
July	2006	T_0	100.35±7.02^{c}	120.35±6.22^{d}	1.18±0.34^{d}	15.76±0.57^{d}	23.28±6.39^{b}	
		T_1	130.23±10.01^{b}	147.78±7.57^{b}	1.47±0.28^{b}	20.54±0.97^{d}	28.30±4.59^{a}	
		T_2	129.80±7.83^{b}	140.10±12.93^{c}	1.36±0.35^{c}	19.46±2.32^{c}	27.60±5.56^{a}	
		T_3	132.73±7.87^{a}	155.10±10.12^{a}	1.56±0.22^{a}	22.45±1.32^{a}	28.40±5.06^{a}	
	2007	T_0	101.03±7.10^{c}	121.33±6.56^{d}	1.20±0.35^{c}	15.88±0.66^{b}	22.26±6.97^{c}	
		T_1	132.88±9.97^{a}	148,39±10.40^{b}	1.44±0.30^{b}	20.79±1.42^{a}	27.98±4.98^{a}	
		T_2	129.19±7.39^{b}	143.19±14.68^{c}	1.44±0.32^{b}	19.75±2.85^{a}	27.93±5.66^{b}	
		T_3	133.14±6.70^{a}	152.67±13.16^{a}	1.56±0.26^{a}	22.03±1.95^{a}	28.21±5.32^{a}	
	P (2006 - 2007)		0.565^{NS}	0.604^{NS}	0.663^{NS}	0.565^{NS}	0.525^{NS}	
October	2006	T_0	116.16±2.39^{c}	123.16±2.32^{c}	1.49±0.08^{c}	77.58±7.10^{b}	85.21±11.14^{b}	8.96±0.43^{b}

	T$_1$	154.08±2.54^{a}	160.27±2.13^{a}	2.09±0.22^{a}	93.41±11.24^{a}	99.28±11.58^{a}	10.96±1.22^{a}
	T$_2$	147.06±3.12^{b}	154.64±2.22^{b}	1.92±0.20^{b}	92.62±11.67^{a}	98.05±1.67^{a}	10.75±0.97^{a}
	T$_3$	157.56±2.83^{a}	164.49±2.34^{a}	2.21±0.22^{a}	93.66±10.03^{a}	99.43±9.81^{a}	11.08±0.86^{a}
2007	T$_0$	116.05±2.69^{c}	130.40±2.62^{c}	1.51±0.11^{c}	77.40±7.01^{b}	86.74±9.09^{c}	8,90±0.43^{b}
	T$_1$	153.86±3.66^{a}	160.63±3.18^{a}	2.08±0.24^{a}	94.13±11.54^{a}	100.03±10.99^{a}	10.95±1.22^{a}
	T$_2$	148.06±4.25^{b}	155.91±4.06^{b}	1.95±0.25^{b}	93.22±9.64^{a}	98.97±5.64^{b}	10.77±0.97^{a}
	T$_3$	157.78±3.14^{a}	163.24±3.43^{a}	2.18±0.24^{a}	95.04±11.03^{a}	100.12±9.83^{a}	11.02±0.86^{a}
P (2006 - 2007)		0.948^{NS}	0.780^{NS}	0.8523^{NS}	0.405^{NS}	0,511^{NS}	0.943^{NS}

T$_0$: control, T$_1$: Baikal EM1, T$_2$:Biohumus T$_3$: Biohumus+Baikal EM1. Within a treatment, treatment means followed by the same letter are not significantly different based on Duncan's test at P=0.05, ^{NS}: Not Significant (one way ANOVA).

Table 3: Effect of Biohumus, Baikal EM1 and integrated both on growth components of *Amaranthus tricolor* var. *valentina*

Months	Years	Treatment	Length (cm)	Number of leaf	Stem girth (cm)	Terminal flower length (cm)	Number of flower	Fresh root weight (g)
May	2006	T$_0$	5.50±0.97^{d}	5.43±1.13^{b}	0.30±0.14^{c}			
		T$_1$	6.04±1.02^{b}	5.89±1.16^{a}	0.36±0.14^{a}			
		T$_2$	5.77±0.87^{c}	5.60±1.14^{b}	0.33±0.13^{b}			
		T$_3$	6.10±0.73^{a}	6.13±1.05^{a}	0.40±0.16^{ab}			
	2007	T$_0$	5.77±0.98^{c}	5.36±1.14^{b}	0.31±0.14^{c}			
		T$_1$	6.11±1.08^{ab}	5.90±1.15^{a}	0.41±0.14^{ab}			
		T$_2$	5.94±0.91^{b}	5.63±1.21^{b}	0.35±0.14^{b}			
		T$_3$	6.52±0.86^{a}	6.07±1.05^{a}	0.40±0.15^{a}			
	P (2006 -		0.729^{NS}	0.521^{NS}	0.254^{NS}			

	2007)							
July	2006	T_0	28.32±4.34 ^{d}	46.80±3.45^{c}	1.05±0.19^{d}	9.90±0.91^{c}	8.22±1.96^{b}	
		T_1	39.52±3.56^{b}	64.71±3.64^{a}	1.39±0.16^{b}	13.03±0.94^{a}	9.69±2.02^{a}	
		T_2	36.78±3.27^{c}	61.61±3.68^{b}	1.35±0.17^{c}	12.17±1.07^{b}	9.62±2.13^{a}	
		T_3	40.04±3.27^{a}	65.50±2.80^{a}	1.46±0.14^{a}	13.07±0.97^{a}	9.70±2.35^{a}	
	2007	T_0	28.08±3.03^{d}	45.20±3.42^{c}	1.11±0.15^{c}	10.15±1.17^{c}	8.08±1.94^{b}	
		T_1	39.96±3.74^{b}	65.01±4.10^{a}	1.40±0.22^{a}	12.98±1.07^{a}	9.50±2.22^{a}	
		T_2	37.25±3.51^{c}	60.91±4.17^{b}	1.38±0.16^{b}	12.52±1.11^{b}	9.24±2.13^{a}	
		T_3	40.02±3.74^{a}	66.80±3.26^{a}	1.44±0.17^{a}	13.00±0.99^{a}	9.55±2.16^{a}	
	P (2006 - 2007)		0.899^{NS}	0.865^{NS}	0.577^{NS}	0.837^{NS}	0.523^{NS}	
September	2006	T_0	45.02±2.19 ^{c}	55.87±2.48^{c}	1.30±0.14^{d}	31.11±1.43^{c}	20.35±2.82^{b}	3.91±0.50^{b}
		T_1	60.68±2.03^{a}	72.43±2.51^{a}	1.62±0.17^{b}	40.80±2.00^{a}	29.58±5.18^{a}	4.43±0.75^{a}
		T_2	59.17±2.03^{b}	71.13±2.68^{b}	1.57±0.13^{c}	38.62±1.50^{b}	28.32±6.18^{a}	4.50±0.95^{a}
		T_3	63.21±2.24^{a}	73.69±2.81^{a}	1.66±0.15^{a}	41.62±1.82^{a}	30.25±6.03^{a}	4.77±0.94^{a}
	2007	T_0	44.93±2.16^{c}	55.66±2.38^{c}	1.44±0.14^{c}	31.08±1.42^{c}	20.70±2.86^{b}	3.93±0.48^{b}
		T_1	61.65±2.08^{a}	72.60±2.54^{a}	1.31±0.14^{ab}	40.89±2.01^{a}	29.78±6.08^{a}	4.62±0.90^{a}
		T_2	59.42±2.32^{b}	71.83±2.90^{b}	1.60±0.16^{b}	38.78±1.55^{b}	28.62±6.10^{a}	4.50±0.76^{a}
		T_3	63.32±2.28^{a}	73.39±2.95^{a}	1.58±0.13^{a}	41.44±1.94^{a}	30.30±5.95^{a}	4.71±0.94^{a}
	P (2006 - 2007)		0.971^{NS}	0.826^{NS}	0.991^{NS}	0.922^{NS}	0.548^{NS}	0.642^{NS}

T_0: control, T_1: Baikal EM1, T_2:Biohumus T_3: Biohumus+Baikal EM1. Within a treatment, treatment means followed by the same letter are not significantly different based on Duncan's test at P=0.05, ^{NS}: Not Significant (one way ANOVA)

Table 4: Effect of Biohumus, Baikal EM1 and integrated both on biochemical components of both plants

			Amaranthus caudatus var. bulava			Amaranthus tricolor var. valentina		
Months	Years	Treatment	Klorofil a+b (mg/g)	Amaranthin (mg/g)	Total N %	Klorofil a+b (mg/g)	Amaranthin (mg/g)	Total N %
July	2006	T_0	9.53±0.05[c]	19.46±0.15[b]	0.55±0.01[c]	10.52±0.06[c]	30.16±0.20[c]	0.62±0.02[c]
		T_1	10.41±0.01[a]	20.83±0.20[a]	1.38±0.05[a]	11.88±0.08[a]	33.60±0.26[a]	1.44±0.03[a]
		T_2	10.12±0.03[b]	19.36±0.30[b]	1.30±0.04[b]	11.51±0.12[b]	32.83±0.05[b]	1.36±0.04[b]
		T_3	10.18±0.04[b]	20.73±0.15[a]	1.42±0.03[a]	11.75±0.03[a]	32.93±0.11[b]	1.49±0.01[a]
	2007	T_0	9.49±0.02[d]	19.50±0.26[b]	0.56±0.02[c]	10.60±0.06[d]	30.06±0.05[c]	0.62±0.03[c]
		T_1	10.33±0.02[a]	20.60±0.17[a]	1.38±0.06[ab]	11.91±0.01[a]	33.50±0.26[a]	1.43±0.01[a]
		T_2	10.12±0.00[c]	19.56±0.35[b]	1.31±0.05[b]	11.50±0.01[c]	32.80±0.17[b]	1.36±0.05[b]
		T_3	10.17±0.04[b]	20.20±0.17[a]	1.42±0.04[a]	11.74±0.01[b]	33.00±0.10[b]	1.49±0.02[a]
	P (2006 - 2007)		0.892[NS]	0.857[NS]	0.995[NS]	0.995[NS]	0.996[NS]	0.999[NS]
August	2006	T_0	9.65±0.02[d]	19.66±0.10[c]	1.15±0.04[c]	10.83±0.03[d]	30.56±0.15[c]	1.22±0.02[b]
		T_1	10.79±0.02[a]	21.46±0.01[a]	2.11±0.04[a]	12.48±0.06[a]	34.36±0.23[a]	2.20±0.03[a]
		T_2	10.43±0.07[c]	20.60±0.04[b]	1.99±0.03[b]	11.83±0.05[c]	33.40±0.30[b]	2.14±0.03[a]
		T_3	10.57±0.06[b]	20.70±0.01[b]	2.13±0.03[a]	11.94±0.05[b]	33.66±0.15[b]	2.21±0.04[a]
	2007	T_0	9.61±0.05[d]	19.80±0.17[c]	1.17±0.07[c]	10.83±0.02[c]	30.60±0.17[d]	1.23±0.02[c]
		T_1	10.67±0.03[a]	21.40±0.26[a]	2.13±0.05[b]	12.40±0.12[a]	34.33±0.20[a]	2.19±0.04[b]
		T_2	10.35±0.05[c]	20.60±0.17[b]	2.02±0.08[ab]	11.83±0.00[b]	33.30±0.26[c]	2.15±0.02[ab]
		T_3	10.45±0.05[b]	20.70±0.17[b]	2.16±0.02[a]	11.96±0.06[b]	33.70±0.10[b]	2.21±0.04[a]
	P (2006 - 2007)		0.841[NS]	0.989[NS]	0.945[NS]	0.998[NS]	1.000[NS]	0.972[NS]

September	2006	T_0	9.65±0.04[c]	20.03±0.47[c]	1.75±0.05[c]	10.85±0.02[c]	30.86±0.40[d]	1.94±0.03[c]
		T_1	10.71±0.02[a]	21.53±0.25[a]	3.07±0.04[a]	12.52±0.09[a]	35.53±0.11[a]	3.20±0.05[a]
		T_2	10.41±0.03[b]	20.60±0.10[b]	2.89±0.06[b]	11.87±0.01[b]	33.73±0.25[c]	3.08±0.06[b]
		T_3	10.56±0.08[b]	20.66±0.15[b]	3.10±0.06[a]	11.95±0.03[b]	34.43±0.20[b]	3.20±0.06[a]
	2007	T_0	9.63±0.04[d]	20.00±0.26[c]	1.78±0.01[c]	10.86±0.02[d]	30.90±0.17[c]	1.95±0.02[c]
		T_1	10.73±0.04[a]	21.60±0.17[a]	3.10±0.03[a]	12.57±0.05[a]	35.60±0.20[a]	3.21±0.06[a]
		T_2	10.42±0.01[c]	20.60±0.17[b]	2.91±0.06[b]	11.88±0.03[c]	34.00±0.17[b]	3.09±0.04[b]
		T_3	10.54±0.01[b]	20.70±0.17[b]	3.13±0.05[a]	11.99±0.02[b]	34.30±0.26[b]	3.21±0.06[a]
	P (2006 - 2007)		0.997[NS]	0.986[NS]	0.990[NS]	0.996[NS]	0.991[NS]	0.998[NS]

T_0: control, T_1: Baikal EM1, T_2:Biohumus T_3: Biohumus+Baikal EM1. Within a treatment, treatment means followed by the same letter are not significantly different based on Duncan's test at P=0.05, [NS]: Not Significant (one way ANOVA)

3.1. Length

EM alone or in combination with organic substances is known to have a significant impact in increasing the length of plant [32, 3]. Considering the length of these both plants, Baikal EM1 (T_1), Biohumus (T_2) and Baikal EM1+Biohumus combination (T_3) were taller compared to the control. Regarding the September values, Baikal EM1 and Baikal EM1+Biohumus combination had the highest value and a statistical difference was observed between them.

3.2. Number of leaves

Plant improvement is related not only with its height but also with the number of its leaves. Leaf development is an important criteria for amaranth, which is raised as an ornamental plant and for vegetable leaves [33]. Fertilizer is known to have a positive effect on the leaves of amaranth [21]. The number of leaves was highest in plants treated with T_1 and T_3 except in the data of May and July. Considering the October data of both years, the leaves of the plants treated with T_1 and T_3 increased by 30% compared to the Control.

3.3. Stem girth

During the May measurements, the highest value of stem girth *A. caudatus* was observed in Biohumus (0,60 cm.) in 2007. T_1 had the highest value in October. As for *A. tricolor*, the highest value (1,66 cm) was in the plants treated with T_3 in 2006. However, the highest value was in the plants treated with T_1 and T_3 (1,58 cm, 1,31cm) in 2007. No statistical difference was observed between these two years.

3.4. Flower length

Considering the amaranth using as ornamental plant [19, 20]. Length of flower is one of the important factors in determining the visual characteristics of amaranths. Compared to control, flower length increased approximately by 20 % in *A. caudatus* , 40 % in *A. tricolor*. But there was no significant difference observed between treatments in October (*A. caudatus*) and in September (*A. tricolor*).

3.5. Number of flowers

Number of flowers is one of the important features both to improve the visual quality and to obtain seed. As for *A. caudatus*, while the number of flowers in October was determined 85, in control, T_1 and T_3 was determined 100, T_2 was also found as 98 both in 2006 and 2007. The highest value (30,30) for *A. tricolor* was obtained in plants treated with T_3 in September, 2006. The results indicated that there was a significant increase in all treatments. However, there were no differences among each other statistically.

3.6. Fresh root weight

Fresh root weight was determined only in October (*A. caudatus*) and in September (*A. tricolor*) just at the end of the vegetation. There was an important increase in all treatments which was almost 20 % over control. Besides, a statistical difference was not seen in each of the whole treatments. There were no clear differences between 2006 and 2007.

3.7. Chlorophyll a+b

The chlorophyll a+b analysis were conducted both for *A. caudatus* and *A. tricolor* in the research (Tablo 4). According to the results, the highest chlorophyll amount was in T_1 for *A. caudatus* in July and in T_1 and T_3 for *A. tricolor*. At the end of the vegetation period (September), the highest chlorophyll a+b amount was observed in the plants treated with $T_{1.}$

3.8. Amaranthin

It is one of the important pigments of carotenoids besides the chlorophyll. The amaranthin ($C_{29}H_{31}O_{19}N_2$), as the biggest carotene group found in Amaranthus species, is important compound act a role in photosynthesis and its being a color pigment [30]. Considering the September data, the highest amaranthin amount was reached in plants treated with T_1 for both plants. The increase was around 9%.

3.9. Total Nitrogen

Biohumus and EMs are known to increase the nitrogen amount almost 10% and 20% in plants [32]. Considering the results, total nitrogen amount was determined as the highest in both plants treated with T_1 and T_2. The total increase in nitrogen was 60% at average for *A. caudatus* and 55% at average for *A. tricolor*.

4. Conclusions

The study indicates the effects of Biohumus and Baikal EM1 on some growing parameters of *Amaranthus caudatus* var. *bulava* and *Amaranthus tricilor* var. *valentina*. It was observed that growing parameters increased by the use of both Baikal EM1 and Biohumus on the two species of *Amaranthus*. Besides, in the end of vegetation Baikal EM1 and Baikal EM1+Biohumus were more effective than only Biohumus. There was not a considerable difference among each other. However, during the vegetation Baikal EM1+Biohumus were determined to be more influential than only Baikal EM1 or Biohumus use on the growing of *Amaranthus caudatus* var. *bulava* and *Amaranthus tricilor* var. *valentina.* This is an important factor for Amaranth, which is not only used as a crop but also as an ornamental plant.

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