APPLICATION OF ORGANIC LIQUID FERTILIZER LUMBRICOL IN PRODUCTION OF PLANTING MATERIAL FROM ANNUAL FLOWERS

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Abstract

Fertilizer from californian worms Lumbricol is known as one of the most effective organic fertilizes, soil fertilizer, which is used for organic farming and revitalization of exhausted soils. The nutrients therein are water soluble and easily absorbable in the plants form due to humic acids in it. In this study we explore the use of fertilizer in the production of seedlings of annual flowers. The aim is to obtain seedlings with better biometric behaviours for a shorter period of time. The study used the following species of plants: Antirrhinum, Tagetes, Zinnia and Verbena. Fertilizer was used as a component of the substrate in which the seeds were sown. Studied were the following variants: 10%; 20% and 30% of substrate for the sowing of seeds. As a control was used a standard substrate without the addition of fertilizer. The results obtained show that in all experimental variants seeds germinated faster than control, but the acceleration is negligible, within 1-2 days. More significant differences i occur subsequently - the plants in the treated variants form a more vigorous root system, a greater number of leaves with a greater leaf area and enter 6-7 days earlier phase in budding and flowering. The use of 20 percent bio-fertilizer was suggested.

Key words: *liquid fertilizer, lumbricol, production, planting material, annual flowers*

1. INTRODUCTION

Environmental safety and the concern about human health impose certain requirements as to the types of the fertilizers and chemicals as well as application rates and terms in view of keeping their residual quantities in the products and soil within the admissible limits of the international standards (Malinova, 2007; Sengalevich, 2007). A wide range of organic fertilizers have been manufactured and released on the market in the recent years but their effects have not been investigated in all crops (Valchovsky et al.,2007). Flowers need a rational fertilization system that ensures a balanced nutrition during their development (Ivanova and Kadum, 1996; Sapundjieva et al., 2001; Ivanova et al., 2005). The scientific research of the biological tests of organic fertilizers in flowers is much scarcer than in other crops.The Institute of Ornamental Plants in Sofia has conducted such studies on a number of flower species (spray - carnation, chrysanthemum, lilium, gypsophila, aster and calendula, etc.) in order to establish the effect of the complex mineral fertilizers such as Vege, Lactofol, Crystalon and HortiGrow (Ivanova et al.,1995; Atanassova et al.,1999; Kotopanova et al.,1999; Filipova et al.,1999; Atanassova et al.,2000; Kotopanova and Atanassova, 2008; Atanassova, 2012; Atanassova, 2013) as well as the effect of organic fertilizers such as Biostim, Humustim, Plantagra and Baykal in cut flower cultures (spray - carnation, chrysanthemum and gypsophila), flowering pot species (petunia, impatiens, miniature roses, carnation and chrysanthemum) and annual flowers (Atanassova et al.,2007; Kotopanova and Nencheva, 2008; Atanassova, 2011 a; Atanassova, 2012; Atanassova and Nencheva, 2012;Atanassova and Zapryanova, 2013; Zapryanova and Atanassova, 2013). The objective of this research is to study the effect of the biomineral fertilizer Lumbricol on the growth and development of annual flowers and determine the optimal concentration for plant treatment.

2. MATERIAL AND METHODS

In 2013 - 2014, a pot trial was carried out at the Agricultural University, Plovdiv with four species annual flowers Antirrhinum, Tagetes, Zinnia and Verbena that studied the effect of the biomineral fertilizer Lumbricol on the initial growth and development phases of plants. Lumbricol is essentially a biomineral humic product with immobilized enzyme systems and live cells of fungi, bacteria and other

microorganisms that are beneficial for the plants. The biomineral fertilizer Lumbricol is a mineral based well balanced microfertilizer composition of organic substances. The manufacturer of the product is the company Terra organica Ltd., Sofia. The seeds were sownon March 10 in glass and steel glasshouses in pots No. 9 in a substrate of soil, turf and perlite in a ratio of 2:2:0.5.

The trial was carried out in 4 variants with different concentrations with 10 plants per variant and untreated control plants:

I variant – untreated plants (C);

II variant – foliar treatment with 10% Lumbricol;

III variant – foliar treatment with 20% Lumbricol;

IV variant – foliar treatment with 30% Lumbricol.

Statistical data processing was done with ANOVA test. The significant difference between the control and variants was presented as: *(P≤0.05), **(P≤0.01), ***(P≤0.001) and the non – significant – as ns.

3. RESULTS AND DISCUSSION

Table 1 presents the results of the effect of the treatment with biomineral fertilizer Lumbricol on seed germination. The treatment with Lumbricol in all the tested concentrations produced a positive effect in germination. The data in all concentrations (variants) exceeded the control and varied within 2.0% – 81.4%. The differences with the control were very well proved at P≤0.001. The highest germination rate was reported for the treatment with 20% Lumbricol in Antirrhinum, Tagetes, Zinnia and Verbena.

Table 1. Effect of Lumbricol treatment on seeds germination (days)

Variants	Antirrihinum		Tagetes		Zinnia		Verbena	
	G day	%vsC	G day	%vsC	G day	%vsC	G day	%vsC
Control	11.3	100.0	10.1	100.0	10.5	100.0	30.2	100.0
10%	19.7***	174.3	12.7***	125.7	16.6***	158.1	34.7**	114.9
20%	18.4***	162.8	10.3***	102.0	12.8***	121.9	30.3*	100.3
30%	20.5***	181.4	13.1***	129.7	14.7***	140.0	35.2**	116.6

* (P≤0.05); ** (P≤0.01); *** (P≤0.001); non significant - ns

The biomineral fertilizer Lumbricol had a positive effect on the volume of root system, but it was expressed to a smaller degree, compared to the germination rate (Table 2).

Table 2. Effect of Lumbricol treatment on volume of root system (cm^3)

Variants	Antirrihinum		Tagetes		Zinnia		Verbena	
	Volume (cm^3)	%vsC	Volume (cm^3)	%vsC	Volume (cm^3)	%vsC	Volume (cm^3)	%vsC
Control	52.12	100.0	37.81	100.0	48.72	100.0	27.15	100.0
10%	54.34*	104.3	40.08*	106.0	49.79*	102.2	29.31*	108.0
20%	56.18**	107.8	42.18**	111.6	53.19*	109.2	30.41**	112.0
30%	56.21*	107.8	41.34*	109.3	52.41*	107.6	30.07**	110.8

* (P≤0.05); ** (P≤0.01); *** (P≤0.001); non significant - ns

The volume of the root system of the plants, treated with different concentrations, was within the range of 4.3% - 7.8% for Antirrhinum, 6.0% - 11.6 % for Tagetes, 2.2 % – 9.2% for Zinnia and 0.8% - 12.0% for Verbena. The following tendency was observed–the increase of the concentration lead to the increase of the volume of the root system. The best results in terms of volume of the root system were reported for the concentration of 20 % Lumbricol. The differences vs. the control were significant for all variants. The results with reference to the effect of the biomineral fertilizer Lumbricol on the leaf behaviour in tested annual flowers proved the tendency, observed for the germination rate and the volume of the root system, i.e. the increase of the number of leaves and leaf area with the increase of the concentration (Table3). The differences in the leaf behaviour were significant for all variants for Antirrhinum, Tagetes, Zinnia and Verbena. The highest level in data was reported for 20 % concentration of the Lumbricol and exceeded that of the untreated plants with 32.8% and 109.3%, respectively for leaf number and leaf area in Antirrhinum, 62.0 % and 15.3% in Tagetes, 18.7% and 19.6% in Zinnia and 21.1% and 24.1% in Verbena.

Table 3. Effect of Lumbricol treatment on leaf behaviours

Variants	Antirrihinum				Tagetes			
	Leaf number	%vsC	Leaf area	%vsC	Leaf number	%vsC	Leaf area	%vsC
Control	21.81	100.0	1.18	100.0	11.34	100.0	1.83	100.0
10%	24.53**	112.5	1.93***	163.6	14.54***	128.2	1.90*	103.8
20%	28.97**	132.8	2.47***	209.3	18.37***	162.0	2.11**	115.3
30%	27.54**	126.2	2.36***	200.0	17.33***	152.8	2.08**	113.7
Variants	Zinnia				Verbena			
	Leaf number	%vsC	Leaf area	%vsC	Leaf number	%vsC	Leaf area	%vsC
Control	5.71	100.0	3.47	100.0	7.54	100.0	2.41	100.0
10%	6.34**	111.0	3.98**	114.7	8.37**	111.0	2.58*	107.1
20%	6.78**	118.7	4.15**	119.6	9.13***	121.1	2.99***	124.1
30%	6.51**	114.0	4.01**	115.6	8.18**	108.5	2.78**	115.4

* (P≤0.05); ** (P≤0.01); *** (P≤0.001); non significant - ns

Table 4 presents the results of the effect of the treatment with biomineral fertilizer Lumbricol on plant phenophases – budding and flowering. The treatment with Lumbricol in all the tested concentrations produced a positive effect in phenophases and shortened the period from the sowing. The data in all concentrations (variants) exceeded the control and varied within 3.0 % - 13.1% and 3.0%-9.7% respectively for budding and flowering phase in Antirrhinum, 9.8%-20.25 and 3.0%-12.0% in Tagetes, 18.9%-24.3% and 16.0%-22.25 in Zinnia and 5.3%- 10.05 and 6.3%-12.2% in Verbena. The differences with the control were very well proved at P≤0.001. The shortest period was reported for the treatment with 20% Lumbricol in Antirrhinum, Tagetes, Zinnia and Verbena.

Table 4. Effect of Lumbricol treatment on plant phenophases (days)

Variants	Antirrihinum				Tagetes			
	budding	%vsC	flowe-ring	%vsC	budding	%vsC	flowe-ring	%vsC
Control	61.18	100.0	68.34	100.0	36.78	100.0	41.34	100.0
10%	59.34**	97.0	66.31**	97.00	33.18**	90.2	40.11**	97.0
20%	53.17**	86.9	61.73**	90.3	29.34**	79.8	36.41**	88.0
30%	53.24**	87.0	62.43**	91.4	29.31*	79.7	37.01**	89.5
Variants	Zinnia				Verbena			
	budding	%vsC	flowe-ring	%vsC	budding	%vsC	flowe-ring	%vsC
Control	38.78	100.0	45.14	100.0	43.71	100.0	51.34	100.0
10%	31.44**	81.1	37.93**	84.0	41.41**	94.7	48.11**	93.7
20%	28.18*	72.7	35.14*	77.8	39.34**	90.0	45.06**	87.8
30%	29.34*	75.7	38.03**	84.2	39.41**	90.2	47.41**	92.3

* (P≤0.05); ** (P≤0.01); *** (P≤0.001); non significant - ns

The positive results of the treatment of annual flowers with Lumbricol came from the total functional effect of the microbial complex on plant development that stimulated the root system, improved the plant habitus and increased the biometrical behaviour. The good results from the application of the new organic and mineral fertilizers were due to the balanced formulas with rich content of organic matter, macro and micro elements, vitamins, humic acids and hormones, on the one hand and the easily assimilated form of the nutrients, on the other. The investigations on the biomineral fertilizer Lumbricol once again confirmed the advantages of the modern organic and mineral fertilizers. The application of the organic fertilizers Humustim and Plantagra, tested in gypsophila, potted (carnation and chrysanthemum) and annual flowers (petunia and impatiens) also showed a positive effect on plant growth and development (Kotopanova and Nencheva,2008; Atanassova and Nencheva, 2012; Atanassova and Zapryanova, 2013; Zapryanova and Atanassova, 2013). The study of the new complex mineral fertilizer HortiGrow also showed a positive effect on the total habitus and the separated phases of the development of spray-carnation, cyclamen and gypsophila (Atanassova, 2012; Sapundjievaet al., 2001; Atanassova, 2013). The positive effect of the organic fertilizers on flowering cultures is a solid proof of the improved plant growth and development, environmental safety and human health protection.

4. CONCLUSIONS

The results of the study on the effect of the biomineral fertilizer Lumbricol on the annual flowers – Antirrhinum, Tagetes, Zinnia and Verbena lead to the following conclusions:

The treatment with Lumbricol had a positive effect on the seed germination, volume of root system, leaf behaviours – leaf number and leaf area and plant phenophases.

The optimal concentration for the treatment of plants with the biomineral preparation was 20%. The effect of the biomineral fertilizer Lumbricol was species specific and the treatment had a better effect in Antirrhinum. The concentration of 20% of Lumbricol could also be recommended for treatment of annuals for planting material production.

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