Banat's University of Agricultural Sciences and Veterinary Medicine "*Regele Mihai I al României***" from Timisoara,**
Contact: web: http://www.bjbabe.ro, e-mail: bjb@usab–tm.ro

STUDY ON MAXGROW UNIVERSAL LIQUID FERTILIZER EFFECT ON ALFALFA (*Medicago Sativa* L.) FOR FORAGE AND SEED PRODUCTION

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Ivan PACHEV

*Institute of Forage Crops–Pleven, **BULGARIA**; e–mail: Iv_Pachev@abv.bg*

Abstract. Liquid complex fertilizers find wide application in agriculture. The share of the used liquid fertilizers in the world is over 40%. The use of liquid fertilizers in Bulgaria has a very great future, due to their low price and minimum costs of application. They are convenient to dose when preparing the working solution, contain the essential macro and micro nutrients in the best possible form for assimilation by the plants. They are particularly effective for outside root additional nutrition–the so–called foliar fertilizing, which results in better absorption of nutrients (1.2). The last studies showed that the liquid fertilizers had a positive influence on the processes of foliar and root additional nutrition of plants with the purpose of increasing the yield and quality of seeds. Other authors recommended the combined application of leaf fertilizers with growth regulators, which increased the effect. The researches in our country on these matters are still insufficient and incomplete. The objective of this study was to establish the influence of the all–purpose liquid fertilizer "MaxGrow" on lucerne for forage and seed. The doses of treatment of lucerne from 0, 03 to 0, 05 l/ha MG for seed production were of interest, since on average for the period the yield was the highest: 356.3; 321.9 and 315.6 kg/ha, respectively. The increase, as compared to the untreated control, varied from 35.4 to 231.3 kg/ha. The highest yield of forage green mass, on average for the period of study, was produced at the dose of 0.06 l/ha MG with an yield of 12540 kg/ha, followed by the doses of treatment of 0,05 and 0,04 l/ha MG with produced green mass from 12490 to 10330 kg/ha, respectively.

Key words: fertilizing, liquid fertilizers, lucerne, seed production.

Introduction

The success for alfalfa growing is predetermined already before its sowing. It is of great importance the choice of the area and the soil tilling being prepared for garden cultivation as well as the choice of suitable seeds to ensure long and high yield in alfalfa seed production.

The structural changes in the plant and animal raising as well as in the market prices of basic energy sources for agricultural production–fuels and lubricants, fertilizers, irrigation water, *etc*. imposed the need of reexamining the past practice of agricultural production.

For alfalfa growing it was used starting doses of mineral nitrogen to be applied–over 6 kg/dka although it absorbed large amounts of atmospheric nitrogen.

Traditionally the phosphate fertilizers used to be applied as a reserve however that proved to be not economically profitable at present.

Despite the availability of potassium in the soil, it was also applied as fertilizer with high doses.

That imposed lower doses of fertilizers to be used consistent with the presence of organic matter in soil [PACHEV AND KERTIKOV, 2003].

For plant growing it is necessary not only the availability of certain nutrients, but these nutrients should be at an appropriate rate and applied in the respective phase of plant development.

Plants need certain amounts of micro fertilizers for their normal development.

The micro fertilizers included in the liquid fertilizers composition are part of the general problem of mineral nutrition, related to agricultural crops yield.

It is of utmost importance the production of fertilizers having a balanced composition of macro and micro elements simultaneously meeting plant needs without a negative effect on end

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2014, V(9),

consumers–humans and animals [KIRILOV *et al.*, 2010].

The liquid complex fertilizers are widely used in plant growing. The share of used liquid fertilizers in the world is over 40%. The use of liquid fertilizers in Bulgaria has a very great future because of its low cost and minimal application expenses.

They are suitable for dosing while preparing the solution and contain the main nutritious macro and micro elements in the best possible form for absorption by plants. They are particularly effective for non root feeding–the so called foliar fertilizing, thus achieving better absorption of nutrients [ATANASOVA *et al.*, 1999; IVANOVA *et al.*, 1995].

Recent studies [PACHEV and KERTIKOV, 2003; PACHEV and KERTIKOV, 2004; PACHEV *et al.*, 2008; PACHEV I., 2013], have shown that liquid fertilizers have a positive impact on plant leaf and root feeding to increase the yield and seeds quality. Other authors, [PACHEV I., 2013, GEORGIEVA and NIKOLOVA, 2010] have recommended the simultaneous application of leaf fertilizer and growth regulators that enhances the effect. The investigations in our country on these issues are still insufficient and incomplete.

The objective of the present study was to determine MaxGrow universal liquid fertilizer effect on alfalfa for forage and seed production.

Material and methods

A field experiment was carried out in the period 2009–2011 with Dara alfalfa variety in accordance with the block method in the Second Experimental Field of the Institute of Forage Crops (IFC) with yield plots of 10 m^2, in four replicates and the following variants:

1) Reference – not fertilized
2) 0.02 l/ha – MaxGrow universal liquid fertilizer
3) 0.03„–MaxGrow universal liquid fertilizer
4) 0.04„–MaxGrow universal liquid fertilizer
5) 0.05„–MaxGrow universal liquid fertilizer
6) 0.06„–MaxGrow universal liquid fertilizer
7) 0.07„–MaxGrow universal liquid fertilizer
8) 0.08„–MaxGrow universal liquid fertilizer

MaxGrow universal liquid fertilizer is well balanced with the main macronutrients–nitrogen (N) 9% in amide form, phosphate (P_2O_5) 9%, potassium (K_20) 9% water–soluble. Microelements: boron (B) 0.01%, copper (Cu) 0.008%, iron (Fe) 0.02%, manganese (Mn) 0.01%, molybdenum (Mo) 0.001% and zinc (Zn) 0.004%. All microelements are in the form of chelates and water–soluble. The liquid fertilizer was applied in the buttoning phase–beginning of flowering.

The biometrical indices of seed productivity (yield) were determined in accordance with the method of [NIKOLOV *et al.*, 1981].

Results and discussion

The results analysis for the biological yield in green mass and dry matter (Table 1) allowed some tendencies to be identified.

Table 1.

Alfalfa green mass yield–2010, treated with MaxGrow universal liquid fertilizer, field experiment for forage production

Variants Indices	1 Reference	2 0.2l/ha MG	3 0.3 l/ha MG	4 0.4 l/ha MG	5 0.5 l/ha MG	6 0.6 l/ha MG	7 0.7 l/ha MG	8 0.8 l/ha MG
Number of alfalfa stems	159	162	152	159	197	167	122	177
Alfalfa weight (kg)	0.182	0.196	0.207	0.244	0.269	0.291	0.238	0.245
Alfalfa height (cm)	45.0	48.0	52.0	52.0	57.0	58.0	54.0	52.0
Dry matter	31.93	32.58	31.93	31.64	32. 63	33.26	32. 03	31.78
Green mass weight (m^2)	0.728	0.784	0.828	0.976	1.076	1.164	0.952	0.980
Green mass yield (kg/ha)	7280	7840	8280	9760	10760	11640	9800	952 0

Samples were taken from the plots as the number of stems ranged from 122 to 177.

The rates of the plant height were higher for all variants compared to the unfertilized and untreated reference.

The plants treated with background fertilizing components 0.06 l/ha MG was the tallest (58 cm), followed by the variant treated with 0.04 l/ha MG.

The weeds number and weight were not recorded.

The values of the dry matter quantity were almost similar however the variants treated with background fertilizing components 0.06 l/ha MG and background fertilizing components 0.04 l/ha MG had higher rates than the reference.

The tendency was repeated for the green mass yield as the highest quantity of green mass was obtained with the variant treated with background fertilizing components 0.06 l/ha MG–1164.0 kg/da respectively, followed by the variant background fertilizing components 0.04% MG–1076.0 kg/da.

During the second year of the crop for the index plant height the results were higher for all variants compared to the reference (Table 2).

The plants treated with 0.03 l/ha – MG was the tallest (56 cm), followed by the variant treated with 0.04 l/ha MG –51 cm, as the rest of the variants had almost similar rates.

Table 2.

Alfalfa green mass yield–2011, treated with MaxGrow universal liquid fertilizer, field experiment for forage production

Variants Indices	1 Reference	2 0.2 l/ha MG	3 0.3 l/ha MG	4 0.4 l/ha MG	5 0.5 l/ha MG	6 0.6 l/ha MG	7 0.7 l/ha MG	8 0.8 l/ha MG
Number of alfalfa stems	168.0	165.0	165.0	170.0	179.0	161.0	197.0	187.0
Alfalfa weight (kg)	0.244	0.192	0.217	0.168	0.199	0.225	0.191	0.240
Alfalfa height (cm)	45.0	50.0	56,0	51.0	51.0	49.0	47.0	51.0
Number of weeds	3	6	21	40	17	2	6	9
Weeds weight, (kg)	2.0	6.0	13.0	22.0	19.0	6.0	2.0	15.0
Dry matter	24.91	24.51	26.10	24.82	25.22	25.0	24.69	24.58
Green mass weight (m^2)	0.980	0.792	0.920	0.760	0.872	0.920	0.772	1.020
Green mass yield (kg/ha)	7600	7920	9800	8720	9200	9200	7720	10200

Concerning the weeds number and weight it was found out that the highest number of weeds were recorded when the alfalfa was treated with 0.4 l/ha MG–40 respectively, the lowest values–in the reference–3 as their numbers gradually were decreasing towards the highest dose 0.08 l/ha MG.

The highest weight rates were determined for the variant treated with 0.04 l/ha MG–22.0 g, followed by the variants treated with 0.05 and 0.03 l/ha MG.

The values of the dry matter quantity were almost similar however the variants treated with 0.03 l/ha MG and 0.05 l/ha MG had higher rates compared to the reference, 26.10 and 25.22 % respectively.

The tendency was repeated for the green mass yield as the highest quantity of green mass was obtained with the variant treated with 0.08 l/ha MG–10200 kg/ha respectively, followed by the variant–0.03 l/ha MG–9200 kg/ha respectively, as the same quantity was obtained also for the treatment with 0.6 l/ha MG.

The rates of the plant height during the third year were higher for all variants compared to the reference (Table 3).

The plants treated with 0.04 l/ha MG were the tallest–72 cm, followed by the variant treated with 0.03 l/ha–MG (68 cm) and 0.05 l/da–MG (70 cm).

The rest of the variants had almost similar rates in the range from 63 to 68 cm.

Concerning the weeds number and weight it was found out that the highest number of weeds were recorded when the alfalfa was treated with 0.5 l/ha MG–0.68

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2014, V(9),

g, the lowest values for the variant 0.2 l/ha MG–0.25 g, the reference–33 g as their numbers gradually were decreasing towards the highest dose 0.8 l/ha MG. The highest weight rates were determined for the variant treated with 0.5 l/da MG–22.0 g, followed by the variants treated with 0.6 l/ha MG.

Table 3.

Alfalfa green mass yield–2012, treated with MaxGrow universal liquid fertilizer, field experiment for forage production

Variants Indices	1 Reference	2 0.2 l/ha MG	3 0.3 l/ha MG	4 0.4 l/ha MG	5 0.5 l/ha MG	6 0.6 l/ha MG	7 0.7 l/ha MG	8 0.8 l/ha MG
Number of alfalfa stems	159	129	122	89	140	111	133	130
Alfalfa weight (kg)	0.483	0.360	0.313	0.268	0.370	0.283	0.295	0.383
Alfalfa height (cm)	58	65	68	72	70	65	65	63
Weeds weight, (kg)	0.033	0.025	0.040	0.040	0.068	0.060	0.043	0.038
Dry matter	24.59	25.29	24.87	25.53	26.46	25.47	22.99	24.46
Green mass weight (m^2)	1.230	1.560	1.410	2.060	1.750	1.680	1.570	1.350
Green mass yield (kg/ha)	1230	1560	1410	2060	1750	1680	1570	1350

The values of the dry matter quantity were almost similar however the variants treated with 0.5 l/ha MG and 0.4 l/ha MG had higher rates compared to the reference, 26.46 and 25.53% respectively.

The tendency was repeated for the green mass yield as the highest quantity of green mass was obtained with the variant treated with 0.4 l/da MG–20600 kg/ha, followed by the variant–0.5 l/da MG–17200 kg/ha and the variants treated with 0.6 l/da MG–16800 kg/ha.

The rainfall in 2010 was almost even during the active vegetation period (Figure 1), as the dry months were August and September.

The insufficient moisture was a result of the intensive rainfalls that was unfavorable for the rain to penetrate deep in soil. In 2011 and 2012 there was a water deficit almost during the entire vegetation period, except in July (2011) and May (2012), that had a depressing effect on yield (Figure 1)

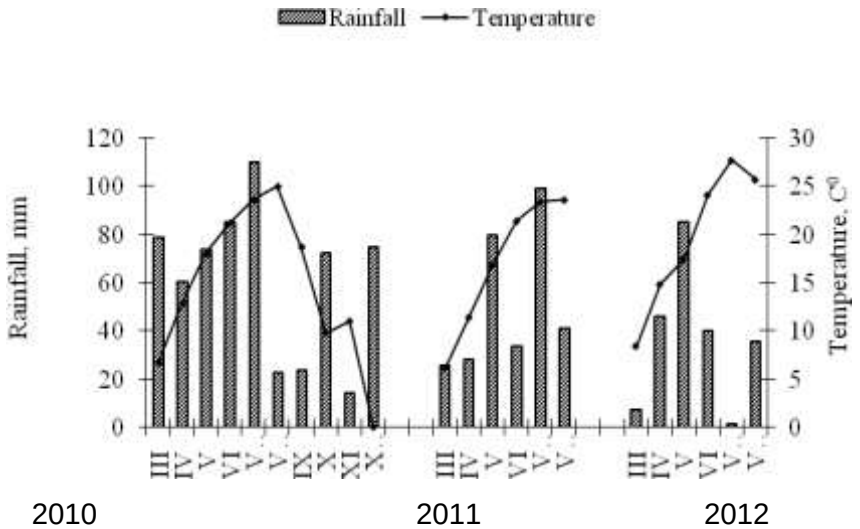

Figure 1. Diagram of climate in the vegetation period by years

During the first year of alfalfa raising the seeds yield varied depending on the treatment doses (Table 4). The highest yield was obtained for the variant treated with 0.03 l/ha MG–410.0 kg/ha, followed by the variants treated with 0.05 l/ha

MG–321.9 kg/ha, the third being variants treated with 0.04 l/ha MG–315.6 kg/ha.

The obtained yield was fully correspondent to index mass of 1000 seeds–29.5 g in variant treated with 0.03 l/ha MG. The same tendency was determined for alfalfa growing in 2011 and 2012.

The seeds yield (Table 4) varied with the increasing of the applied dose as the highest yield was obtained for the variants treated with 0.03 l/ha MG–490.63 kg/ha, followed by the variants 0.05 l/ha MG–350.0 kg/ha, and the third being the variant treated with 0.04 l/ha MG–331.25 kg/ha.

Table 4.

Yield and mass of 1000 seeds alfalfa treated with MaxGrow universal liquid fertilizer by years and averagely for the period 2010–2012

Indices Variants	Mass of 1000 Seeds g	Seeds yield (kg/ha)	Mass of 1000 Seeds g	Seeds yield (kg/ha)	Mass of 1000 Seeds g	Seeds yield (kg/ha)	Average alfalfa seeds yield kg/ha	Exceeding yield compared to the untreated reference kg/ha
	2010		2011		2012		2010–2012	
1. Control	1,98	125	1,95	375	2,08	212,50	125	–
2. 0.02 l/ha MG	2,07	1604	2,10	625	2,09	258,40	160,4	+ 35,4
3. 0.03 l/ha MG	2,95	410,0	2,00	400,6	2,28	329,40	356,3	+ 231,3
4. 0.04 l/ha MG	2,10	31 ,56	1,95	33,12	2,25	30,00	31,56	+ 190,6
5. 0.05 l/ha MG	2,14	32,19	1,90	35,00	2,24	29,380	32,19	+ 196,9
6. 0.06 l/ha MG	2,06	22,50	1,94	18,12	2,18	26,880	22,50	+ 10,00
7. 0.07 l/ha MG	2,09	24,06	2,00	22,50	2,18	25,630	24,06	+ 115,6
8. 0.08 l/ha MG	2,01	21,22	1,85	18,43	2,12	24,00	21,21	+ 87,1

In the rest of the variants the yield was higher compared to the reference but lower than those with maximum yield.

In 2012 the highest yield was obtained for the variant treated with 0.03 l/ha MG–329.40 kg/ha, followed by the variant 0.04 l/ha MG–300.0 kg/da, as the third was the variant treated with 0.05 l/ha MG–293.80 kg/ha.

In the rest of the variants the yield was higher compared to the reference but lower than those with maximum yield.

Conclusions

The following conclusions could be made based on the above data:

The doses of alfalfa treatment from 0.03 to 0.05 l/ha MG for seeds production were of interest, as averagely for the period the highest yield was 356.3, 321.9 and 315.6 kg/ha respectively. The excess compared to the untreated reference ranged from 35.4 to 231.3 kg/ha.

The highest yield of green mass for forage, averagely for the period of investigation, was the dose of 0.06 l/ha MG with yield 12540 kg/ha, followed by the dose of treatment from 0.05 and 0.04 l/ha MG with obtained green mass from 12490 to 10330 kg/ha respectively.

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