ŽEMĖS ŪKIO MOKSLAI. 2013. T. 20. Nr. 2. P. 75–83

The effect of the microelement fertilizers and biological preparation Terra Sorb Foliar on spring rape crop

Elena Jakienė

Aleksandras Stulginskis University,
Studentų 11,
LT-53361 Akademija, Kaunas Distr.,
E-mail: elena.jakiene@asu.lt

In 2009–2011 field trials were completed at the Experimental Station of Aleksandras Stulginskis University. The aim of the trial was to establish the effect of additional leaf spray fertilization with sollutions of the microelement fertilizers ARVI and biological free amino acid preparation Terra Sorb Foliar on spring rape (*Brassica napus* L. *oleifera annua* Metzg.) seed yield and quality indices.

SW 'Landmark' spring rape was under the trial in the experiment. Before the trial, the field was fertilized with complex fertilizers NPK 16:16:16 250 kg ha^{-1} and ammonium saltpetre (N_{34}) 150 kg ha^{-1} (basal fertilisation – control). Spring rape was sown in the third decade of April. The seed norm was 7 kg ha^{-1}. At the bud stage of the spring rape (stage 53–54 according to BBCH scale), the trial plots were leaf sprayed with ARVI of the microfertilizer solution (6 l ha^{-1}), solution of the preparation Terra Sorb Foliar (2 l ha^{-1}), and the mixture of the ARVI microfertilizers + Terra Sorb Foliar solution. Other agrotechnical applications were carried out according to the spring rape growing technologies applied at the experimental station. Rape seeds were harvested by a combine harvester and samples for the chemical analyses were taken. Trial results were estimated by means of the dispersive analysis, employing the computer program ANOVA.

The trial results revealed that the additional leaf spray fertilization with the ARVI microfertilizers at the bud stage resulted in the statistically significant increase in the spring rape yield by 0.08 t ha^{-1} or 3.5%. The application of the Terra Sorb Foliar solution resulted in the statistically significant increase of the seed yield by 0.09 t ha^{-1} or 4.0%. In comparison to the control, leaf spray fertilization of the spring rape with the ARVI micro + preparation Terra Sorb Foliar solution mixture resulted in the significantly higher 0.11 t ha^{-1} or 4.9% higher seed yield.

The additional leaf spray fertilization contributed to higher accumulation of fats in the rape seeds. The leaf spray fertilization of the rape with ARVI microfertilizers, Terra Sorb Foliar, and ARVI micro + Terra Sorb Foliar solution mixture resulted in the significant increase in the fats accumulated in the rape seeds by 0.76%, 0.40%, and 1.23%, respectively. The effect of the Terra Sorb Foliar contributed to the reduction in glycosinolades by 0.71–0.81 μmol g^{-1}, and increase in erucic acid by 0.17–0.28%. In comparison to the control, the additional leaf spray fertilization with the ARVI microfertilizers resulted in 0.26% higher amount of the erucic acid.

Key words: spring rapes, biological amino acid preparation Terra Sorb Foliar, spray fertilization, fertility, seed quality

INTRODUCTION

Plant leaf spray nutrition is one of the most perspective means of additional fertilization with small amounts. Having received the mineral elements through leaves, the living cells further absorb them as those received through roots. From leaves they travel to the other parts of the plant.

It is established that some nutritious elements can migrate from the leaves surface through stems and roots down to soil. This feature of the plant leaves to absorb nutritious elements is exploited for additional leaf spray fertilization.

Leaf spray fertilization of the plants have numerous advantages: 1) taking into consideration both plant and meteorological conditions, plant growth and development can be regulated; 2) fertilization expenses are reduced and fertilization efficacy increases; 3) functional plant diseases occurring due to the lack of some elements can be rapidly removed; 4) plant protection from many infectious diseases can be improved. Key shortcomings of the leaf spray fertilization are related to meteorological conditions, expensive labour, only well dissolving concentrated fertilizers can be applied (Liakas, Malinauskas, Šiuliauskas, 2006; Šidlauskas, 2000). Additional leaf spray fertilization justifies itself especially in the case of combined fertilization with microelements, plant growth regulators, herbicides, insecticides or fungicides (Amelung, Schulz, Daebeler, 1996).

As soon as fertilizers are on the leaves, they rapidly travel to other parts of the plant: stem, fruit, and roots, and become involved in metabolism, affect many of physiological processes, and photosynthesis among them (Darginavičienė, Novickienė, 2002). Additional leaf spray fertilization affects plant nutrition as well. There is a close relationship between leaf spray fertilization and plant nutrition through roots. Leaf spray fertilization makes photosynthesis processes more intensive, improves root provision with organic nutritious materials (Jakienė, Venskutonis, 2008). Leaf spray fertilization with amino acids has also a positive effect on plant growth and development. Free amino acids or amino acids in proteins take an important part in many of plant physiological processes; therefore their synthesis and metabolism are important during the entire plant life cycle (Velička, 2002).

Under unfavourable for growth conditions, plants use different ways to protect themselves. Plants save energy, water, while maintaining life functions using their reserves. Plants close their stomata in order not to lose moisture and slow down photosynthesis processes. Stomata closure caused by unfavourable for growth conditions (high temperature, low relative humidity, etc.) reduces plant photosynthesis activity, inhibits all metabolic processes (Spiekers, Pothast, 2004). Reception of additional amino acids from the outside favours the opening of stomata and helps to keep water what in turn results in stimulation of photosynthesis, maintenance of necessary respiration speed and slowdown of withering. Plant resistance to unfavourable growth conditions depends on the ability to regulate osmotic pressure in cells. Amino acids, together with other organic solvents, have high potential to regulate osmotic pressure in cells, which increases cell resistance to unfavourable factors (Magyla, Brazauskienė, 1999). Amino acids affect the level of intrinsic hormone regulation in plants. Disbalanse of phytohormones occurs in plants due to external factors or some special phenological states. Amino acids are able to form or metabolize hormones according to the plant needs.

Leaf spray fertilization with the preparations of amino acids results in direct provision of the plants with amino acids what in turn helps the plant to save energy intended to synthesize these acids and which can be used in other vital processes (Velička, Rimkevičienė, Spruogis, 1998). Amino acids participate in many of vital processes occurring in plants: stimulate root development, seed germination, photosynthesis and formation of chlorophyll, regulate osmotic pressure and opening of the stomata. Therefore amino acids are used to: 1) fight unfavourable for plant growth stages; 2) strengthen the immune system of plants; 3) increase crop productivity and improve yield quality; 4) improve the absorption of nutritious materials and plant protection means. Application of amino acids together with microelement fertilizers guarantees an instant effect when unfavourable conditions for plant growth occur as well as at the critical stages of growth.

The aim of the trial was to establish the effect of the additional leaf spray fertilization with sollutions of the microelement fertilizers ARVI and biological free amino acid preparation Terra Sorb Foliar on summer rape (*Brassica napus* L. *oleifera annua* Metzg.) seed yield and quality indices.

MATERIALS AND METHODS

Field trials were carried out in the Experimental Station at Aleksandras Stulginskis University in

2009–2011. Soils were *Calc(ar)i-Epihypogleyic Luvisol (LVg-w-cc)*. Acidity of the tillage surface was pH 6.8–7.0, humus content 1.9–2.2%, content of mobile phosphorus (P_2O_5) 240–320 mg kg^{-1}, content of mobile potassium (K_2O) 120–165 mg kg^{-1}.

The effect of additional fertilization with the microelement fertilizers ARVI micro and biological preparation Terra Sorb Foliar on the productivity of summer rape formed the basis of the study.

Spring rape preplant was winter wheat. In autumn, after the preplant was harvested, the soil was tillaged. In spring soil was cultivated using the seed bedding aggregate – germinator. Before sowing, the field was fertilized with NPK 16:16:16 250 kg ha^{-1} + ammonium saltpetre (N_{34}) 150 kg ha^{-1}. Spring rape of SW 'Landmark' variety was planted in the third decade of April. The seed norm was 7 kg ha^{-1}. When the abundant germination of weeds started in May, the crop was sprayed with Butizano 400 solution (2.5 l ha^{-1}). With the appearance of flea-beetle and pollen-beetle, the spring rape was fertilized with the solution of Karate Zeon (150 g ha^{-1}). At the stage of bud formation (53–54 growth stage according to BBCH scale), the spring rape according to the trial scheme was sprayed with ARVI micro fertilizers and solution of the biological preparation Terra Sorb Foliar. At the beginning of August, Folikur (1 l ha^{-1}) solution was applied. Before harvesting seed samples for chemical analyses were extracted. A SAMPO 500 combine harvester was used to thrash rape in the second decade of August.

The data were treated by using the Anova PC programme (Tarakanovas, Raudonius, 2003).

Trial scheme. 1. Control. Fertilization before sowing NPK16:16:16 (250 kg ha^{-1}) + N_{34} ammonium saltpetre (150 kg ha^{-1}); 2. Fertilization NPK before sowing + ARVI micro 6 l ha^{-1} (53–54 BBCH); 3. Fertilization NPK before sowing + Terra Sorb Foliar 2 l ha^{-1} (53–54 BBCH); 4. Fertlization NPK sowing + ARVI micro 6 l ha^{-1} + Terra Sorb Foliar 2 l ha^{-1} (53–54 BBCH).

The trial consisted of four replications. The total area of the plot 14 × 4 = 56 m^2 trial plot area: 14 × 3.5 = 49 m^2. The results of the trial were statistically estimated by means of the dispersive analysis, employing the computer programme ANOVA (Tarakanovas, Raudonius, 2003).

Chemical analyses of rape seeds were performed in the Laboratory of the Experimental Station at Aleksandras Stulginskis University with a spectrophotometer of infrared rays PSCO/ISI IBM – PC 4250 according to calibrations of the data bases formed with the help of referent metals.

ARVI micro – fast penetrating and effective microelement fertilizer was applied for preventive curative purposes. Composition of the fertilizer was as follows: total nitrogen (N) 14%, ammonium nitrogen (NH_4-N) 14%, magnesium (MgO) 5.3%, sulphur (S) 19.5%, manganese (Mn) 0.117%, copper (Cu) 0.1%, zinc (Zn) 0.067%, boron (B) 0.017%, molybdenum (Mo) 0.003%.

Terra Sorbs Foliar is a complex of amino acids and microelements used for additional leaf spray fertilization. It is recommended to be used to activate physiological functions of plants when they are damaged by hard winter frosts, drought, heat, sudden temperature changes or burned with pesticides. To stimulate plant growth it has to be applied at early stages of growth at the beginning of vegetation, before flowering. Composition of the preparation was as follows: amino acids 12% (of them free amino acids 9.3%), total nitrogen (N) 2.1%, boron (B) 0.019%, manganese (Man) 0.046%, zinc (Zn) 0.067% (Tumosienė, Jakienė, Beresnevičius, Mikulskienė, 2006).

Meteorological conditions. Meteorological conditions in 2009 were favourable for the growth and development of spring rape. However, at the time of germination, in the first and second decades of May, it cooled down, abundant rains prevailed. The amount of precipitation in May exceeded the average of many years (Fig. 1). At the time of spring rape germination, soils were soaked. In June, the amount of precipitation and air temperature were close to the averages of many years, consistently the conditions for summer rape growth were favourable.

There was a lack of humidity in the first decade of July but the plants were well rooted and the drought had no substantial effect on rape growth. Abundant rains prevailed in the first decade of August. The amount of precipitation exceeded the average of many years by 67.8 mm. The average temperature of twenty four hours was close to that of many years. Rape harvesting was interrupted by often and abundant rains (Fig. 1).

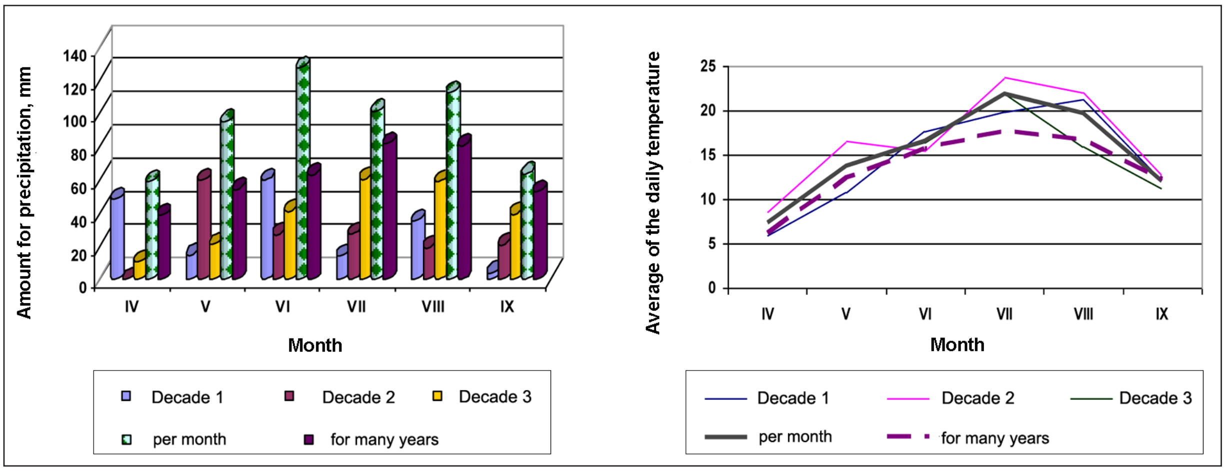

Fig. 1. Meteorological conditions in the year of field trial (data of Kaunas Meteorological Station, 2009)

In April 2010, the average temperature of twenty four hours was close to that of many years, however, there was a lack in humidity. The precipitation amount per month was by 12.1 mm lower than the average for many years. The precipitation in the first two decades of May made 2.2–3.8 mm (Fig. 2).

Abundant rains were characteristic of the third decade of May. Soils were soaked. The amount of precipitation in the third decade of May made 61.9 mm, i. e. it exceeded a monthly average for many years by 28.1 mm. The conditions for rape growth were unfavourable. The precipitation amount in June was not abundant, and the average temperature of twenty four hours was close to that of many years. There was no rain in the first decade of July, and the average temperature of twenty four hours was around 22.2 °C. Abundant rains prevailed in the second decade of July. The amount of precipitation made 64.3 mm. August was rainy. The precipitation amount for this month made 165.6 mm or exceeded the average for many years by 95.7 mm.

In comparison to the annual mean, the precipitation amount in April 2011 was by 16.4 mm lower, nonetheless the moisture content was sufficient for the rape seeds to germinate (Fig. 3). In May and June, the precipitation amount was close to the annual mean for many years. The conditions for the rape growth were favourable. July and August were extremely rainy. The precipitation amount was by 62.3 and 82.2 higher than that of the annual mean for many years. The summer of 2011 was hot. The average temperature over all

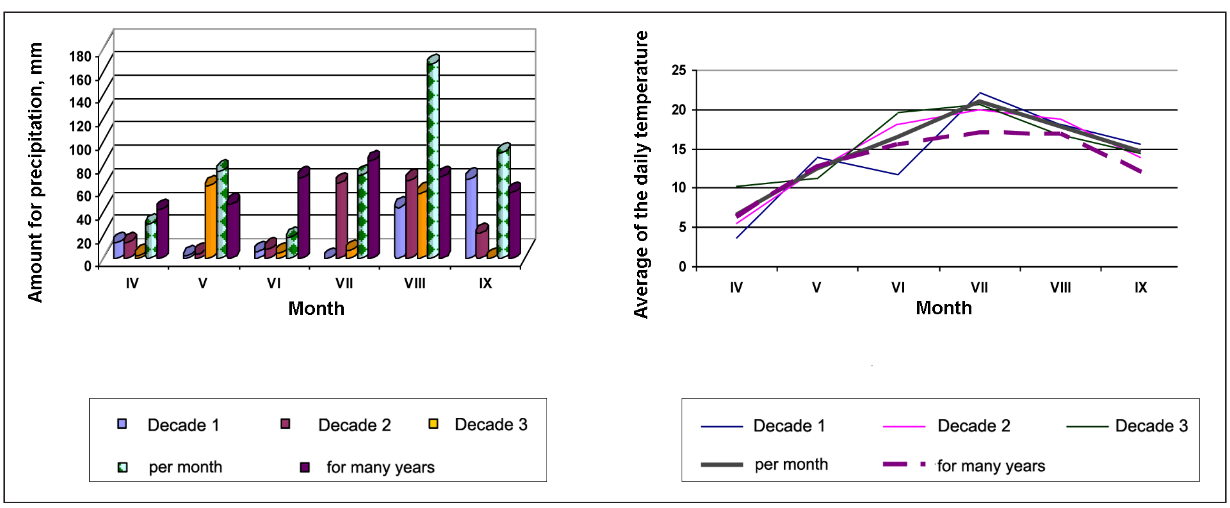

Fig. 2. Meteorological conditions in the year of field trial (data of Kaunas Meteorological Station, 2010)

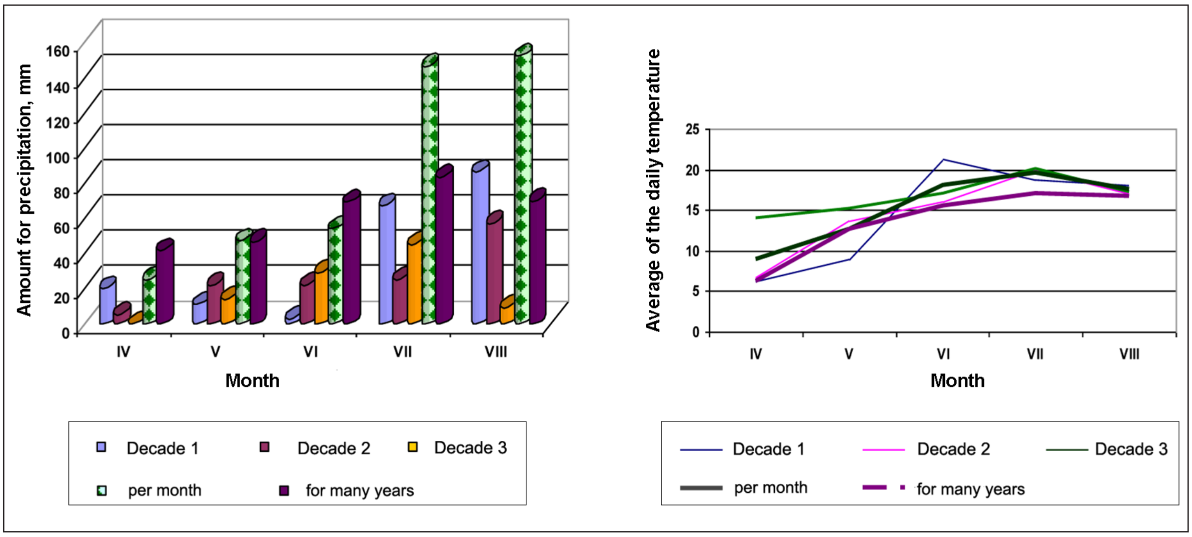

Fig. 3. Meteorological conditions in the year of field trial (data of Kaunas Meteorological Station, 2011)

summer months was higher than that of the average mean for many years. The conditions for the spring rape growth and ripening were favourable.

RESULTS AND DISCUSSION

Microelements not only stimulate physiological processes in rape but also have a possitive effect on yield increase. Boron and zinc are extremely important for rape (Grant, 1993; Grewal, 1998) while insufficient amounts of other microelements prove their effect (Velička, 2002). ARVI microelement fertilizers applied in this trial contain the necessary amounts of boron, zinc, etc. The obtained trail results revealed that additional leaf spray fertilization of spring rape with ARVI microfertilizers at the stage of bud formation resulted in by 0.08 t ha^{-1} or 3.5% statistically higher yield than that in the control.

Free amino acids or amino acids in protein composition are important for many of plant biological processes, in turn to their synthesis and metabolism and are important during the entire plant life cycle. Application of amino acid preparations in early vegetation stages and before rape flowering contributes to stimulation of growth and formation processes of generative organs what results in higher seed yield (Thurling, 1979). Application of the ARVI microfertilizers and biological preparation Terra Sorb Foliar resulted in higher by 0.11 t ha^{-1} or 4.9% yield than the yield from the rape seeds of the control plots (Table 1).

Comparison of the yield obtained from the spring rape sprayed with the biological preparation Terra Sorb Foliar solution with the yield obtained from the control showed that it was by 0.09 t ha^{-1} or 4.0% higher.

The key element of rape seed quality is the content of fat and protein, amount of erucic acid in composition of fat acids, and amount of glucosinolates in bagasse. The sum of protein and fat is nearly a constant quantity and ranges in

Table 1. **Effect of the microelement fertilizer ARVI micro and preparation Terra Sorb Foliar on spring rape productivity, Experimental Station at ASU, 2009–2011**

Trail variants	Seed yield, t ha^{-1}	Difference in comparison with the control	
		t ha^{-1}	%
Control (background fertilization – F)	2.23	–	100.0
F + ARVI micro	2.31	0.08	103.5
F + ARVI micro + Terra Sorb Foliar	2.34	0.11	104.9
F + Terra Sorb Foliar	2.32	0.09	104.0
LSD_{05}	0.057		

rape seed from 61 to 63%. High nitrogen fertilizer norms and lack of moisture during vegetation usually contribute to the change in this parameter. Under the influence of these factors the content of fat in seeds decreases (Holmes, 1978). Additional leaf spray fertilization of the spring rape with the microelement fertilizers and biological preparation of amino acids Terra Sorb Foliar had a possitive effect on rape seed quality. Meteorological conditions in trial years were favourable for fat accumulation in rape seeds. The additional application of ARVI microfertilizers reliably increased fats in seeds by 0.76% if compared with the control where additional fertilization was not applied (Table 2). Additional fertilization with the microelement fertilizer ARVI micro and biological preparation Terra Sorb Foliar resulted in the highest accumulation of fats in plants. It was by 1.23% higher in comparison with the control where additional fertilization was not applied. Application of the biological preparation Terra Sorb Foliar solution at the bud formation stage resulted in 0.40% reliably higher accumulation of fats than in the control trial plots.

With the Terra Sorb Foliar solution plants receive additional amounts of amino acids what most probably stimulates their physiological processes. The Terra Sorb product contains all amino acids necessary for plant protein synthesis what results in reliably higher protein amount (Uppstrom, 1995) so the amount in summer rape seeds was found only in the rape seeds fertilized with the solution of amino acid preparation Terra Sorb Foliar. Application of this preparation resulted in by 0.62% higher protein accumulation if compared with the control where NPK fertilizers were not applied. Additional leaf spray fertilization of rape with ARVI microfertilizers had no substantial effect on protein accumulation (0.12%). Additional application of the combination of microelement fertilizers and biological preparation resulted in the decrease of the amount of protein in rape seeds by 0.40%, and was lower than that in the control variants.

External factors highly affect the accumulation of glucosinolates in rape seeds. Precipitation, high temperatures during flowering increase the amount of glucosinolates in rape seeds (Cramer, 1990). Besides, ARVI microelement fertilizers contain sulphur (S) what had an additional effect on accumulation of gucosinolates in rape seeds. Rape seeds accumulated more glucozinolates when rape was additionally fertilized with ARVI microfertilizers. Under the effect of this additional fertilization, rape seeds accumulated 0.37 μmol g^{-1} higher amount of glucosinolates than the seeds in the control variant. The amount of 12.99 μmol g^{-1} of glucozinolates was found after application of these fertilizers what did not exceed the norms of food oil. Under the effect of Terra Sorb Foliar amino acid preparation and microelement fertilizer solutions, the amount of glucozinolates in rape seeds decreased by 0.71–0.81 μmol g^{-1} in comparison with the amount of glucosinolates determined on the control trial plots (Table 2).

In rape oil oleinic acid composes the greatest part, and according to its amount rape oil is close

Table 2. **Effect of additional leaf spray fertilization on the quality of rape seeds, Experimental Station at ASU, 2009–2011**

Trial variants	Fats		Protein		Glucozinolates	
	% s. m.	Difference in comparison with control, %	% s. m.	Difference in comparison with control, %	μmol g^{-1}	Difference in comparison with control, μmol g^{-1}
Control (background fertilization – F)	37.01	–	31.00	–	12.62	–
F + ARVI micro	37.77	0.76	31.12	0.12	12.99	0.37
F + ARVI micro + Terra Sorb Foliar	38.24	1.23	30.60	–0.40	11.91	–0.71
F + Terra Sorb Foliar	37.41	0.40	31.62	0.62	11.81	–0.81
LSD_{05}	0.223		0.298		0.158	

to olive oil. Plant scientists attempt to breed rape varieties the seeds of which would contain higher amounts of oleinic and linolenic acids (Velička, 2002). Amounts of these acids can partially be increased by agrotechnical means. In this trial additional fertilization of the plants with Terra Sorb Foliar solutions and ARVI microfertilizers, and the mixture of this biological preparation resulted in the highest accumulation of the oleinic acid in rape seeds (Table 3). The amount of oleinic acid in the rape seeds on these trial plots was by 0.33% or 0.24% reliably higher than that in the control variants.

Additional fertilization with the ARVI micro fertilizers, ARVI micro and preparation Terra Sorb Foliar resulted in higher accumulation of linoleic acid in rape seeds. Rape seeds from these plots contained reliably 0.87% and 0.70% higher amount of linoleic acid than that in the control.

Under the effect of this additional fertilization, the amount of linolenic acid in spring rape was at an average by 0.25–0.44% higher than that in the control where the plants were not fertilized. Under the effect of the additional leaf spray fertilization, rape seeds accumulated a slightly higher amount of palmitic acid (0.13–0.17%); however, the amount of eikozenoic acid was lower. In comparison with the control, under the effect of additional leaf spray fertilization rape seeds accumulated by 0.26–0.69% less eikozenoic acid (Table 4).

Under the effect of additional fertilization with microelement and amino acid solutions, rape seeds accumulated a higher amount of erucic acid. Additional leaf spray fertilization of rape with the ARVI microfertilizers or ARVI micro and preparation Terra Sorb Foliar increased the amount of erucic acid in seeds by 0.26% and 0.28%. Under the effect of leaf spray fertilization with the Terra Sorb Foliar solution, the amount of erucic acid in rape seeds was by 0.17% higher than that in the control where this preparation was not applied.

Table 3. **Effect of additional leaf spray fertilization on the rape seeds quality, Experimental Station at ASU, 2009–2011**

Trail variants	Oleinic acid		Linoleic acid		Linolenic acid	
	% s. m.	Difference in comparison with control, %	% s. m.	Difference in comparison with control, %	% s. m.	Difference in comparison with control, %
Control (background fertilization – F)	71.13	–	7.12	–	9.51	–
F + ARVI micro	71.25	0.12	7.99	0.87	9.95	0.44
F + ARVI micro + Terra Sorb Foliar	71.46	0.33	7.82	0.70	9.76	0.25
F + Terra Sorb Foliar	71.37	0.24	7.35	0.23	9.81	0.30
LSD_{05}	0.178		0.189		0.243	

Table 4. **Effect of additional leaf spray fertilization on the rape seeds quality, Experimental Station at ASU, 2009–2011**

Trail variants	Palmitic acid		Eikozenoic acid		Erucic acid	
	% s. m.	Difference in comparison with control, %	% s. m.	Difference in comparison with control, %	% s. m.	Difference in comparison with control, %
Control (background fertilization – F)	6.83	–	1.93	–	0.89	–
F + ARVI micro	6.96	0.13	1.24	– 0.69	1.15	0.26
F + ARVI micro + Terra Sorb Foliar	7.02	0.19	1.48	– 0.45	1.17	0.28
F + Terra Sorb Foliar	7.00	0.17	1.67	– 0.26	1.06	0.17
LSD_{05}	0.145		0.039		0.126	

CONCLUSIONS

1. The additional leaf spray fertilization of rape with the ARVI micro and amino acid preparation Terra Sorb Foliar solutions resulted in by the 0.08–0.11 t ha^{-1} or 3.5–4.9% reliably higher seed yield than that of the control.

2. Seeds of the additionally fertilized rape accumulated a reliably higher amount of fats (0.78–1.23%), the protein amount was by 0.12–0.40 lower than that in the control where spring rape was not additionally fertilized.

3. Under the effect of additional leaf spray fertilization, rape seeds accumulated by 0.71–0.81 μmol g^{-1} more glucosinolates, however, the amount of erucic acid increased by 0.17–0.28% if compared with the control.

4. In comparison with the control under the effect of additional leaf spray fertilization with the ARVI micro and preparation Terra Sorb Foliar solutions, rape seeds accumulated by 0.12–0.33% more oleinic acid, by 0.70–0.87% more linoleic acid, by 0.25–0.44% more linolenic acid, by 0.13–0.19% more palmitic acid.

Received 23 January 2013
Accepted 17 June 2013

REFERENCES

1. Amelung D., Schulz R., Daebeler F. 1996. Einfluss der Fruchtfolge auf Rapskrankheiten. *Raps*. Nr. 2. S. 52–56.
2. Cramer N. 1990. *Raps: Anbau und Verwertung*. Stuttgart: Ulmer. 148 s.
3. Darginavičienė J., Novickienė L. 2002. *Augimo problemos šiuolaikinėje augalų fiziologijoje*. Vilnius: Lietuvos mokslų akademijos leidykla. 99 p.
4. Grant C. A., Bailey L. D. 1993. Fertility management in Canola production. *Canadian Journal of Plant Science*. Vol. 73. P. 651–670.
5. Grewal H., Graham R. D., Stangoulis J. 1998. Zinc-boron interaction effects in oilseed rape. *Journal of Plant Nutrition*. Vol. 21. No. 10. P. 2231–2243.
6. Holmes M. R., Ainsley A. M. 1978. Seed bed fertilizer requirements of winter oilseed rape. *Journal of the Science of Food and Agriculture*. Vol. 29. P. 657–666.
7. Jakienė E., Venskutonis V. 2008. *Augimo reguliatoriai augalininkystėje*. Akademija, Kauno r. 80 p.
8. Liakas V., Malinauskas D., Šiuliauskas A. 2006. Žieminių rapsų pasėlio tankumo įtaka jų augalų produktyvumui ir derliui. *Žemės ūkio mokslai*. Nr. 2. P. 18–23.
9. Magyla A., Brazauskienė I. 1999. Žieminiai rapsai sėjomainoje. *Žemdirbystė-Agriculture*. T. 68. P. 74–88.
10. Spiekers H., Pothast V. 2004. *Erfolgreiche milchviehfütterung*. DLG-Verlag. 446 s.
11. *Statistikos departamentas prie Lietuvos Respublikos Vyriausybės*. 2009 (žiūrėta 2013 01 08). Prieiga per internetą: <http://www.stat.gov.lt/lt/news/id=6991>
12. Šidlauskas G. 2000. Vasarinių rapsų pasėlio tankumo įtaka azoto, fosforo ir kalio kiekiui augaluose, sėklų derliui bei žalių baltymų ir riebalų išeigai. *Žemdirbystė-Agriculture*. LŽI ir LŽUU mokslo darbai. Akademija. T. 70. P. 176–185.
13. Tarakanovas P., Raudonius S. 2003. *Agronominių tyrimų duomenų statistinė analizė taikant kompiuterines programas ANOVA, STAT, SPLIT-PLOT iš paketo SELEKCIJA ir IRRISTAT*. Akademija, Kėdainių r. 58 p.
14. Tumosienė I., Jakienė E., Beresnevičius Z., Mikulskienė G. 2006. N-Fenil- ir N-karboksietil-β-alaninų dihidrazidų sintezė ir savybės. *Cheminė technologija*. Nr. 3(41). P. 58–64.
15. Uppstrom B. 1995. Seed chemistry. In: D. S. Kimber, D. I. McGregor (eds.). *Brassica Oilseeds: Production and Utilization*. Cambrige University Press. P. 217–242.
16. Velička R. 2002. *Rapsai*. Kaunas: Litutė. 319 p.
17. Velička R., Rimkevičienė M., Spruogis V. 1998. *Rapsų auginimas*. Kaunas. 52 p.
18. Velička R., Rimkevičienė M., Trečiokas K. 2000. Vasarinių rapsų ploto sėjomainoje įtaka dirvožemio agrocheminėms savybėms ir humuso sudėčiai. *Žemdirbystė-Agriculture*. T. 71. P. 154–163.

Elena Jakienė

MIKROELEMENTINIŲ TRĄŠŲ IR BIOLOGINIO PREPARATO TERRA SORB FOLIAR TYRIMAI VASARINIŲ RAPSŲ PASĖLYJE

Santrauka

Lauko bandymai atlikti Aleksandro Stulginskio universiteto Bandymų stotyje 2009–2011 m. Tirta papildomo tręšimo per lapus mikroelementinių trąšų ARVI mikro ir biologinio preparato Terra Sorb Foliar tirpalais įtaka vasarinio rapso (*Brassica napus* L. *oleifera annua*) sėklų derliui ir jų kokybei. Bandyme auginti veislės 'SW Landmark' vasariniai rapsai. Prieš sėją bandymų laukas patręštas kompleksinėmis trąšomis NPK 16:16:16 250 kg ha^{-1} ir amonio salietra (N_{34}) 150 kg ha^{-1} (foninis tręšimas – kontrolė). Vasariniai rapsai pasėti balandžio mėn. trečiąją dekadą. Sėklos norma – 7 kg ha^{-1}.

Vasariniams rapsams esant butonizacijos tarpsnyje (53–54 tarpsnis pagal BBCH skalę) bandymo laukeliai pagal schemą apipurkšti ARVI mikro trąšų tirpalu (6 l ha^{-1}), preparato Terra Sorb Foliar tirpalu (2 l ha^{-1}) ir ARVI mikro trąšų + Terra Sorb Foliar tirpalų mišiniu. Kitos agrotechninės priemonės atliktos pagal Bandymų stotyje naudojamą vasarinių rapsų auginimo technologiją. Rapsų sėklos nukultos kombainu ir paimti pavyzdžiai atlikti cheminę analizę. Bandymo rezultatai įvertinti dispersinės analizės metodu naudojant kompiuterinę programą ANOVA.

Gauti bandymo rezultatai parodė, kad papildomai per lapus vasarinius rapsus butonizacijos tarpsniu patręšus ARVI mikro trąšomis, sėklų derlius statistiškai patikimai padidėjo 0,08 t ha^{-1} arba 3,5 %; rapsus apipurškus preparato Terra Sorb Foliar tirpalu, sėklų derlius padidėjo 0,09 t ha^{-1} arba 4,0 %; vasarinius rapsus apipurškus trąšų ARVI mikro + preparato Terra Sorb Foliar tirpalų mišiniu, sėklų prikulta 0,11 t ha^{-1} arba 4,9 % iš esmės daugiau, palyginti su papildomai netręštų rapsų sėklų derliumi.

Papildomai per lapus patręštų vasarinių rapsų sėklos sukaupė daugiau riebalų. Rapsus apipurškus ARVI mikro trąšomis, sėklos sukaupė 0,76 %; apipurškus Terra Sorb Foliar tirpalu – 0,40 %; apipurškus ARVI mikro + Terra Sorb Foliar tirpalų mišiniu – 1,23 % riebalų iš esmės daugiau nei papildomai netręštų rapsų sėklos. Dėl preparato Terra Sorb Foliar įtakos rapsų sėklose 0,71–0,81 µmol g^{-1} sumažėjo gliukozinolatų kiekis, tačiau 0,17–0,28 % padidėjo eruko rūgšties. Rapsus papildomai patręšus ARVI mikrotrąšomis, eruko rūgšties kiekis sėklose nustatytas 0,26 % didesnis, palyginti su papildomai netręštų rapsų sėklomis.

Raktažodžiai: vasariniai rapsai, biologinis aminorūgščių preparatas Terra Sorb Foliar, mikroelementinės trąšos, derlius, sėklų kokybė