Oil content of spring oilseed rape seeds according to fertilisation

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Abstract. Field trials, to investigate the effect of microfertilisers on the oil content of seeds of the oilseed rape cultivar 'Mascot', were carried out at the Department of Field Crop Husbandry in 2002–2003. We used in our trial 7 different microfertilisers. Prior to the sowing, the field was sprayed with herbicide EK Trifluralin and mineral fertiliser OptiCropNPK 21-08-12+S+Mg+B+Ca, calculating 120 kg N ha^{-1}. Plants were treated with microfertilisers on 26 June. Analyses of test results revealed that different microelements influenced the oil content of rape seeds. The positive effect was noted in variants where rape plants were treated with micronutrients and micronutrients mixtures. The highest oil content, 43.4% of seeds dry matter, had Molybdenum-treated rape.

Key words: *spring oilseed rape*, *micronutrients, fertiliser, oil content*

INTRODUCTION

Rapeseed (*Brassica napus L. var. Oleifera subvar. annua*) is now the third most important source of vegetable oil in the world. Nowadays rapeseed cultivars are low in erucic acid and glucosinolates. Rapeseed oil is considered healthy for human nutrition due to its lowest content of saturated fatty acids among vegetable oils and a moderate content of poly-unsaturated fatty acids (Starner et al., 1999). The growing area of spring rape in Estonia has increased year by year. In last ten years, the area of rapeseed increased from 1 thousand hectare to 40 thousand hectares (Statistical Office of Estonia, 2002). The rapeseed yield has been only 1.2–1.3 t ha^{-1} for years (Kaarli, 2004), but in 2002 the average yield in Estonia was already 1.9 t ha^{-1} (Statistical Office of Estonia, 2002). In the countries belonging to the European Union, the average yield is 3 t ha^{-1} whereas in the entire world the figure is 1.5 t ha^{-1} (http://apps.fao.org/...). The low level of the yield is due to mistakes in agrotechnical principles. Plant scientists have found that among more than 100 known chemical elements there are 16 that are essential for the growth of all of the world's major crops. All of the essential chemical elements found in any particular plant come from soil, water and air around the plant. In estimating fertiliser requirements for oilseed rape, growers use soil tests, field cropping history, balance sheets based on estimated nutrient removal, plant testing to assess crop nutrient status and test strips in fields to see if adequate fertiliser has been applied (http://ssca.usask.ca/Fertility/FertilityIntro.htm). The most suitable ones are complex granular combined fertilisers were all the nutrients, essential for the plant, are in an optimum proportion. An oilseed of good quality contains 40–44% of oil and the meal contains 43–48% of protein. It depends on many factors: variety, growth environment, agrotechnics, fertilisation, etc. To produce seeds of good quality, special attention must be paid to the rate, placement and timing of fertiliser application. Excessive N application increases lodging, reduces oil content and results in green seeds that increase the chlorophyll content of the oil. Banding of P 2.5 cm below and 2.5 cm to the side of the seed is required for maximum yield, efficient use of P and increased oil content. The best responses in yield and seed quality are obtained when all the required nutrients are applied early in spring, at or immediately before sowing. The crop needs more S and other micronutrients than either wheat or barley (Grant and Bailey, 1990).

The aim of the present field experiment was to study the effect of microelements on the oil content of oilseed rape.

MATERIALS AND METHODS

The experiment was performed in 2002–2003 at the Department of Field Crop Husbandry of the Estonian Agricultural University to establish the effect of micronutrients on the oil content of oilseed rape. In the experiment there was used the spring oilseed rape variety ‘Mascot’, bred by the Swedish company Weibull. Technical data of the variety: raw fat content 40–43%, mass of 1,000 grains 3.5–4.5 g, growth period 90–108 days (Velička, 2003). The soil type was a pallescent soil LP (Kõlli & Lemetti, 1999), a glossisol by FAO classification and a Stagnic Luvisol by WRB classification (Deckers et al., 1998).

The trial soil was neutral – pH_{KCl} 6.2; humus 2.4%; available phosphorus 77.66 mg kg^{-1} (AL); mobile potassium 169.8 mg kg^{-1} (AL); calcium 5,648 mg kg^{-1}; sulphur 13.54 mg kg^{-1} of the soil.

The trial variants were in four replications. The field was divided into plots of 10×1 m. Seeds were sown by calculating 200 germinating seeds per m^2, sowing depth 2–3(4) cm, pre-crop being potato. Prior to the sowing, the field was sprayed with intra soil herbicide EK Trifluralin (0.15 l ha^{-1}) and mineral complex granular combined fertiliser OptiCropNPK 21-08-12+S+Mg+B+Ca, calculating 120 kg of the active substance agent of nitrogen per hectare (exclusion variants 0 and 0+Fastac). To control pest insects, Fastac was used, calculating 0.15 l ha^{-1} (active substance agent) (Hiiesaar et al., 2003). The trial variants were: 0 (no pesticides or mineral fertilisers used); 0+Fastac (no fertilisers used, insect pest control on 28 May); HydroPlus™ Micro Manganese (Mn) (active substance agent 1 l ha^{-1}); HydroPlus™ Micro Rape (active substance agent 2 kg ha^{-1}); Sulphur F3000 (S) (active substance agent 7 l ha^{-1}); HydroPlus™ Micro Copper (Cu) (active substance agent 0.5 l ha^{-1}); HydroPlus™ Micro Boron (B) (active substance agent 2 l ha^{-1}); Hydromag 300 (Mg) (active substance agent 7 l ha^{-1}); HydroPlus™Micro Molybdenum (Mo) (active substance agent 0.25 l ha^{-1}). For insect pest control, the plants were sprayed on 28 May (exclusion variant 0), 26 June and 3 July (exclusion variants 0 and 0+Fastac). Liquid microfertilisers (water amount 400 l ha^{-1}) were sprayed on oilseed rape leaves on 26 June, when the plants had reached the growth-stage 27–31, according to the BBCH scale (Lancashire et al., 1991).

RESULTS AND DISCUSSION

Growing of one ton of conditioned rape requires 55 kg of nitrogen, 25 kg of phosphorus, 50 kg of potassium, and 20 kg of sulphur. Besides principal mineral fertilisers rape is very exacting to microelements as well: it needs 3–5 times more calcium, boron, magnesium and manganese than corn (Velička, 2001; Malkowski, 1990; Kaarli, 2004).

Rape should be fertilised according to the data of a soil agrochemical analysis. Harvest forming depends on both the lack of fertilisers and an excessive fertilisation (Velička et al., 2001). For the synthesis of various combinations, rape uses much sulphur. Sulphur is immobile in plants, its deficiency at any growth stage during growing can drastically reduce oilseed rape yield (Malhi & Leach, 2000). If its lack in the soil increases rape leaves become yellowish white, the formation of pods gets deranged and most flowers fail to form pods (Velička et al., 2001; Hocking et al., 1999). The methods of sulphur application were their incorporation into soil, sideband and in seedrow at sowing, and topdress and foliar application at bolting and flowering (Malhi & Leach, 2000). The common recommendation is to apply sulphur and nitrogen at a ratio of about 1:5 to 1:10 to oilseed rape (Thomas, 1984).

Micronutrients are necessary for plant growth. Too little or too much micronutrients will reduce plant yield as much as a lack of nitrogen (Malhi & Leach, 2000). Deficiencies of micronutrients as boron, copper, manganese and molybdenum could reduce the oilseed yield (Hocking et al., 1999). Foliar application of different micronutrients had an influence on the oil content in the rape seeds. Liquid micronutrients had been sprayed on the leaves when the plants had the biggest leaf area (growth-stage 27–31) and the ability to assimilate was higher.

In the years 2002–2003, oil content in the seeds dry matter was 40.7–44.5% in different variants (Table 1). Compared to 0-variant all the micronutrients had a positive effect on oil content in the seeds. The strongest influence was exerted by microelements like manganese and molybdenum. These elements increased oil content in rape seeds more than one percent. It means that the plants did not get enough manganese and molybdenum from the soil and the foliar application had a strong positive effect.

Table 1. Oil content in oilseed rape seeds, % dry matter.

Variant	2002		2003		Average	
	Oil, %	d	*Oil, %*	d	*Oil,* %	d
O	43.1	0.0	40.8	0.0	41.9	0.0
O+Fastac	43.9	0.9	41.6	0.8	42.8	0.8
Opti+Boron	44.2	1.1	40.8	0.0	42.5	0.6
Opti+Hydromag	42.7	-0.3	41.6	0.8	42.2	0.2
Opti+Manganese	43.6	0.5	42.9	2.1	43.2	1.3
Opti+Micro Rape	43.7	0.7	41.7	0.8	42.7	0.8
Opti+Molybdenum	43.4	0.3	43.4	2.5	43.4	1.4
Opti+Copper	43.1	0.0	41.0	0.2	42.0	0.1
Opti+Sulphur	44.5	1.5	40.7	-0.1	42.6	0.7
LSD_{05}		1.9		3.8		2.1

CONCLUSIONS

The mixture of microfertilisers and microfertilisers in the trial had a positive effect on seed oil content. Foliar application of manganese and molybdenum increased the oil content in the seeds more than one percent.

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