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MINERĀLĀ UN ORGANISKĀ MĒSLOJUMA IETEKME UZ KARTUPEĻU BUMBUĻU RAŽU UN KVALITĀTI

Baniuniene A., Zekaite V.

Izmēģinājumi tika veikti Lietuvas Zemkopības institūta Perloja izmēģinājumu stacijā laika periodā no 1994.-2005. gadam. Tie tika plānoti, lai novērtētu organiskā un minerālmēslojuma kombināciju ietekmes uz kartupeļu bumbuļu ražu un kvalitāti. Ilglaicīgais izmēģinājums tika veikts smilšmāla augsnē *Hapli Albic Luvisol* četrū-lauku augu sekā. Kartupeļi tika audzēti bez un ar kūtsmēsliem (40 t ha⁻¹) kombinācijā ar dažādu minerālmēslojuma devu (N₀P₀K₀; N₉₀P₉₀; P₉₀K₁₂₀; N₉₀K₁₂₀; N₉₀P₉₀K₁₂₀).

Dati liecina, ka atkarībā no mēslojuma kombinācijas kūtsmēsli (FYM) palielina kartupeļu bumbuļu ražu par 35 - 82 %. Minerālmēsli iedarbība fonā bez FYM bija līdz 28 % augstāka. Visaugstākie bumbuļu ražas pieaugumi (3.8–6.0 t ha⁻¹) tika iegūti, izmantojot mēslojuma kombinācijas ar slāpekli. Šīs kombinācijas palielināja bumbuļu ražu abos fonos par 32-93 %. Minerālmēsli fonā bumbuļiem bija augstāks cietes un sausnas saturs. Mēslojuma kombinācijas ar kāliju sekmēja cietes un sausnas saturu samazināšanos bumbuļos.

OPTIMIZATION OF ENVIRONMENTALLY FRIENDLY CULTIVATION TECHNOLOGY OF OILSEED RAPE UNDER LATVIA AGROECOLOGICAL CONDITIONS.

Borovko L.

Research Institute of Agriculture of Latvia University of Agriculture, Zemkopības institūts 7, Skrīveri, Aizkraukle distr., Latvia, LV-5125, phone + 371 5197639, e-mail: borovko@inbox.lv

Abstract

Field trials were carried out on the soddy-podzolic sandy clay soil of the Research institute of agriculture in Skrīveri. The effect of increasing the rates of nitrogen and potassium fertilizers (N₆₀K₆₀, N₈₀K₈₀, N₁₀₀K₁₀₀, N₁₂₀K₁₂₀, N₁₄₀K₁₄₀) kg ha⁻¹ on the spring oilseed rape and quality was tested against the phosphorus background P₇₀. During the trial were tested half rates (0.5 t ha⁻¹) of the container mixtures of growth regulators and fungicides: Moddus + Folicur, Moddus + Juventus; Cycocel + Folicur, Cycocel + Juventus, by spraying them throughout plant florescence-bud formation. The results of three-year field trials show that the application of nitrogen and potassium

fertilizers ensured a positive influence on the seed yields and the quality of seeds of spring oilseed rape. The highest seed yield was obtained when introducing $N_{120}K_{120} - 3.25 \text{ t ha}^{-1}$. The use of NK fertilizers promoted the accumulation of protein by 22-24 %, but decreased the content of oil 47-44 % in the seeds. Totally, oil yield made up 977-1341 kg ha^{-1} depending on the rates of mineral fertilizers. The highest oil yield – 1341 kg ha^{-1} was obtained when $N_{120}K_{120}$ was applied. The application of the studied mixtures of preparations ensured the yield increase of seeds 0.62-0.91 t ha^{-1} and oil yield to 282-441 kg ha^{-1} . The best preparation mixture was the Cycocel + Folicur, what provided the oil yield 1389 kg ha^{-1} .

Key words: spring rape, fertilizers, growth regulators, fungicides, yield

Introduction

Beside seed productiveness, during the cultivating of spring rape, of great importance is the biochemical content of the seed rape that characterize the food and nutrient values of the culture. The research made by many scientists proves that the content of the seed rape, to a great extent, depends on weather conditions, the variety, and the agrotechnical cultivation methods (Яковчик, 2006, ЖОЛИК, 2006). Nutrient deficiency quickly causes interruption of growth, yield and seed quality inhibition of spring oilseed rape. Phosphorus is necessary for the formation of the strong assemblage of rootlets, increase of seed yields, and acceleration of maturation. Oilseed rape plants are supplied with phosphorus mainly at the expense of reserves in soil (70-80 %) as oilseed rape assimilates well the background phosphorus from the soil (Schroder, 1992).

There is no consensus of opinion in the scientific literature regarding the influence of potassium on the spring oilseed rape seed yields and seed quality. According to V.P. Savenkov (2000), application of potassium fertilizers has not lead to substantial increase in the seed yields, and had just a slight influence on the protein content and oil content of oilseed rape seeds. The tests carried out in Germany show that full-value nutrition increases both the seed yield, by 0.02-0.03 t ha^{-1} , and the oil content in the seeds.

It is considered that the basic element that affects the yield and the seed quality is the nitrogen fertilizer. Provided that a correctly set dose is applied, nitrogen increases the seed yields while overdosage can promote lodging of plants, outbreak of fungi diseases and the reduction of oil content in seeds (Шпаар и др., 1999). In order to achieve sufficient formation of the seed yields components, a split of the introduced doses of nitrogen fertilizer is recommended. The first dose of fertilizer 60-80 kg ha^{-1} was introduced before sowing, or immediately after it while the second - 40-60 kg ha^{-1} – at the stage of formation of stems (Beer *et al.*, 1990; Cramer, 1990; Feger, Orlovius, 1995; Finck, 1991; Fruchtenicht *et al.*, 1993; Sturm *et al.*, 1994).

The influence of the growth regulators on the yield of seeds was studied, in essence, on the winter rape, for the purpose of the shortening of the stem of plants, the stimulation of the formation of lateral flights and auxiliary buds, reduction of the danger of lodging, guaranteeing the high content of oil and uniform ripening of pods on the main and lateral flights (Makowski, Gienapp, 1998; Vořak a kolektiv, 2000; Шпаар и др., 1999).

There is an assumed hypothesis that the use of nitrogen-potassium fertilizers and container mixtures of growth regulators and fungicides affect the yield and the quality of spring rapeseeds.

Materials and methods

Field trials in 2001– 2004 were conducted in soddy - podzolic sandy clay pH- 6.2, organic matter content 33 g kg^{-1} (method of Turin), P_2O_5 content (high) 195 mg kg^{-1} , K_2O content (medium) 147 mg kg^{-1} (DL method). The clay parameters fit for oilseed rape cultivation. Their predecessor was autumn fallow. Conventional farming techniques were used. Prior to sowing the spring oilseed rape `Olga`, there were applied mineral fertilizers P_2O_5 70 kg ha^{-1} in the form of superphosphate, K_2O in the form of potassium chloride, and nitrogen in the form of ammonium nitrate. The following NK rates were studied: 0, 60, 80 (60+20), 100 (60+40), 120 (60+60) and 140 (60+80) kg ha^{-1} . $N_{60}K_{60}$ was introduced as a basic fertilizer, and at the stage of stem formation 20-80 kg ha^{-1} according to variants.

Field trials were tested using the following preparations with the aim to increase the impact performed by the applied growth regulators/fungicide mixture on the seeds yield and quality and efficiency concerning disease elimination: fungicide Folicur (tebucanazole 125 g l^{-1} , triadimephone

100 g l⁻¹), Juventus (metconazole– 60 g kg l⁻¹), and plant growth regulators. Moddus 250 e.k (trinexapac-ethyl 250 g l⁻¹) and Cycocel 750 (chlormequate chloride 750 g l⁻¹). During the trials preparations were tested applying half doses (0.5 l ha⁻¹), creating the preparation mixtures: Modus + Folicur, Modus + Juventus; Cycocel + Folicur; Cycocel + Juventus, by spraying them throughout plant florescence-bud formation (GS 50). As a rule, preparation effectiveness within mixtures increased. Data analysis was done by ANOVA (Arhipova, Bāliņa, 2003). Interactions between factors were calculated using the dispersion analysis.

Results and Discussions

There is a point of view that that mineral fertilizers had exerted a positive influence on growth and development of spring oilseed rape plants and this, in the end, redounded considerably upon the volume and quality of harvest of seeds (Пилюк, Белявский, 1999; Буряков, 1990). In our research, the seed yields of spring oilseed rape 'Olga' fluctuated from 2.24 – 3.25 t ha⁻¹. The use of nitrogen and potassium fertilizers at the rate of 60 kg ha⁻¹ to 120 kg ha⁻¹ substantially increased the oilseed yield. The further increase of nitrogen and potassium rates did not lead to rise of the spring oilseed rape seed yields (Figure 1). The highest seed yield was obtained when introducing N₁₂₀K₁₂₀ – 3.25 t ha⁻¹ rape oilseeds. The increase of harvest when introducing nitrogen 60-140 kg ha⁻¹ and potassium 60-140 kg ha⁻¹ fertilizers was 0.64-1.01 t ha⁻¹ (LSD_{0,05}= 0.31 t ha⁻¹).

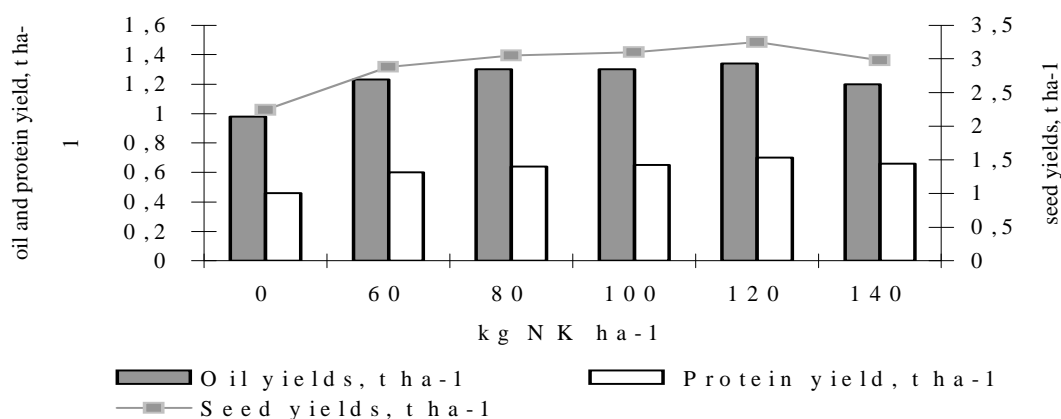


Figure 1. Productivity of spring rape oilseeds in dependence of NK mineral fertilizers

Mineral fertilizers caused a considerable increase in protein content of the spring oilseed rape seed yields and that corresponds to the research results of V.P. Savenkov (Савенков, 2007). As a result of the introduction of nitrogen and potassium fertilizers, crude protein content increased by 0.47-2.10% (Figure 2). The change in crude protein content in spring oilseed rape seeds under the influence of different rates of NK fertilizers can be represented with straight-line regression equation $y = 0.0139x + 21.81$; $R^2 = 0.8841$ (Figure 3). The value of the coefficient of correlation ($r = 0.91$) points to a close linear relationship existing between the searched factors. With the increase of NK fertilizer rate, the oil content gets lower for 0.86 – 3.54 %, and there has been noted a close correlative feedback ($r = -0.97$). The change of oil content is reflected by regression equity $y = -0.0243x + 47.753$; $R^2 = 0.9325$ (Figure 4). The quality indicators are in a close reciprocal reverse correlative dependence ($r = -0.98$).

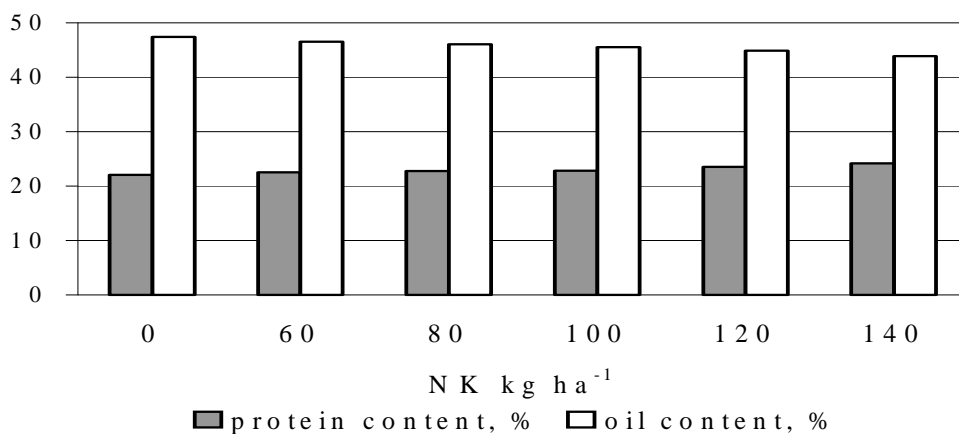


Figure 2. Oil and protein content in spring rape seeds in dependence of NK mineral fertilizers

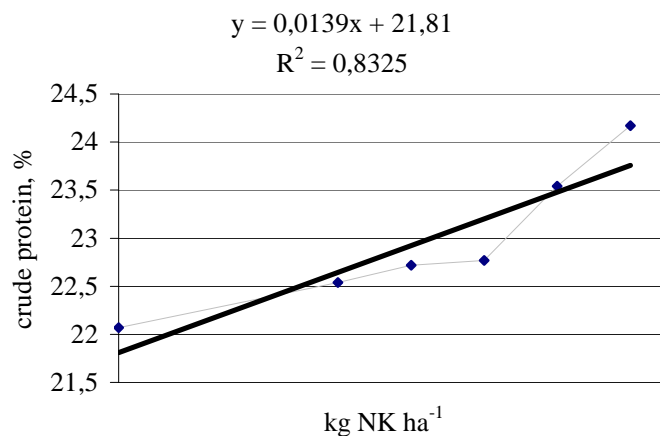


Figure 3. Linear regression interrelation between the content of protein in the seeds of spring rape and the rates of the NK fertilizers

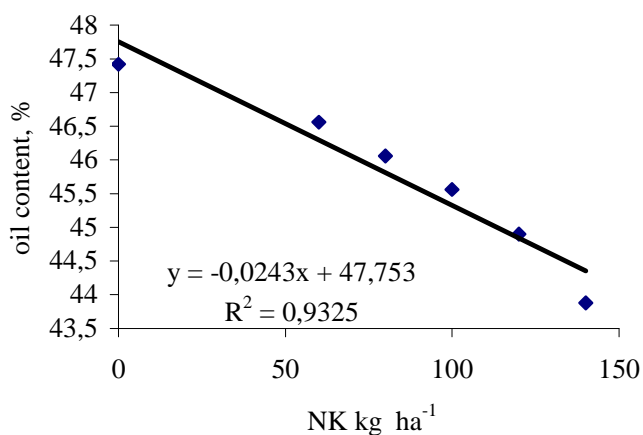


Figure 4. Linear regression interrelation between the content of oil in the seeds of spring rape and the rates of the NK fertilizers

In spite of the reduction in the oil content of the seeds, the total yield of oil made up 977-1341 kg ha⁻¹ depending on rates of mineral fertilizers. The highest yield of oil - 1341 kg ha⁻¹ was obtained when introducing 120 kg ha⁻¹ of nitrogen and 120 kg ha⁻¹ of potassium fertilizers.

The results of field experiences confirm that the application of growth regulators in the mixture with the fungicides had a positive impact on the yields of the seeds and seed quality of spring rape. (Table 1). On average, throughout all the three years, thanks to the application of growth regulators and fungicide mixtures the summer rape seed yields essentially increased ($F=20.16 > F_{crit} = 3.68$; $P = 5.61E-0.5 < 0.05$). The increase of yield was 0.62-0.91 t ha⁻¹ ($LSD_{0,05} 0.35$ t ha⁻¹). The applying of preparations, a full rate, or in mixture with smaller rates, did not cause any important differences. The highest growth within the seed yield 0.91 t ha⁻¹ was ensured when applying the container mixture of Cycocel + Folicur, during the developing of rape (GS 50). Applying the fungicides in a mixture with growth regulators, in the beginning stage of rape budding, a steadier blossoming and ripening of pods on the main and lateral shoots was ensured increasing the accumulation of oil content in the seeds by 0.78 – 2.14 %. The most effective method was the applying of the mixture Cycocel + Juventus, and Cycocel + Folicur when the oil yield made up 1310-1389 kg ha⁻¹. The research results confirmed that applying the mixture of preparations only once, in smaller doses, with the aim to increase the productiveness and quality of rapeseeds simultaneously reduced the chemical load upon one unit of the area, and reduced pollution, therefore the research was justified.

Table 1. The influence of different mixtures of growth regulators and fungicides on the spring rape `Olga` yield and seed quality

Variants	Seed yield, t ha ⁻¹	Protein		Oil	
		content, %	yield, kg ha ⁻¹	content, %	yield, kg ha ⁻¹
Control	2.30	22.75	489	45.08	948
Moddus AS 30 un Folicur AS 70	2.92	22.96	627	45.86	1230
Moddus + Folicur AS 50	3.04	21.16	629	46.40	1288
Moddus + Juventus AS 50	2.96	22.36	619	46.54	1260
Cykocel + Folicur AS 50	3.21	22.54	670	47.22	1389
Cykocel + Juventus AS 50	3.04	22.43	635	47.20	1310
$LSD_{0,05}$	0.35	0.94	74.99	1.02	160.8

Conclusions

The results of the four-year field trials show that the introduction of nitrogen and potassium fertilizers at the rate from N₆₀K₆₀ to N₁₄₀K₁₄₀ kg ha⁻¹ considerably increased the yields of spring oilseed rape. A significant increase of seed yields 1.01 t ha⁻¹ was obtained when introducing N₁₂₀ K₁₂₀ kg ha⁻¹ and oil yield 364 kg ha⁻¹.

The introduction of mineral fertilizers exerts a considerable influence on the qualitative content of the oil seeds of spring oilseed rape. The increase in the rates of nitrogen and potassium fertilizers leads to increases in protein content and a decrease in the oil content of the seeds.

Applying fungicides and growth regulators in mixtures, in minified doses, provides evenness of florescence and legume ripening, and essential increase of rape oilseed yield, improving its quality as well.

The application of the studied mixtures of preparations ensured the yield increase of seeds 0.62-0.91 t ha⁻¹ and oil yield to 282-441 kg ha⁻¹.

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VIDEI DRAUDZĪGU AUDZĒŠANAS TEHNOLOĢIJU OPTIMIZĀCIJA EĻĻAS RAPSIM LATVIJAS AGROEKOĻOĢISKĀJOS APSTĀKĻOS

Borovko L.

LLU Zemkopības zinātniskajā institūtā Skrīveros velēnu vāji podzolētā mālsmilts augsnē vasaras rapša sējumos veikti izmēģinājumi, kuros uz fosfora P₇₀ fona pētīta slāpekļa un kālija mēslojuma devu: (N₆₀K₆₀, N₈₀K₈₀, N₁₀₀K₁₀₀, N₁₂₀K₁₂₀, N₁₄₀K₁₄₀) kg ha⁻¹ ietekme uz sēklu ražu un tās kvalitāti. Izmēģinājumos pārbaudīti sekojoši preparātu maisījumi ar samazinātām devām (0.5 l ha⁻¹): Moddus + Folikūrs, Moddus + Juventus, Cikocels + Folikūrs, Cikocels + Juventus. Maisījumi izsmidzināti augu ziedpumpuru veidošanās fāzē. Trīs gadu lauka izmēģinājumos iegūtie rezultāti rāda, ka NK mēslojums pozitīvi ietekmēja vasaras rapša augšanu un attīstību, sēklu ražu un tās kvalitāti. Vislielāko sēklu ražas pieaugumu – 3.25 t ha⁻¹ nodrošināja N₁₂₀K₁₂₀ deva. NK mēslojuma pielietošana veicināja kopproteīna uzkrāšanos (22-24%), bet koptauku samazināšanos (47-44%) sēklās. Augstāko eļļas iznākumu – 1341 kg ha⁻¹ nodrošināja mēslojuma deva N₁₂₀K₁₂₀. Vidēji trijos gados augšanas regulatoru un fungicīdu maisījumu pielietošanas ietekme uz vasaras rapša sēklu ražu bija būtiska. Salīdzinājumā ar kontroli, ražas pieaugums sastādīja 0.62-0.91 t ha⁻¹. Labākais preparātu maisījums bija Cikocels + Folikūrs, kas nodrošināja 1389 kg ha⁻¹ eļļas iznākumu.

EFFICIENCY ESTIMATION OF SOIL DEEP-TILLAGE FOR WINTER WHEAT BY USING PRECISION TECHNOLOGIES OF CROP CULTIVATION

Dinaburga G., Lapins D., Berzins A., Plume A.

Latvia University of Agriculture, Liela iela 2, Jelgava, Latvia, LV-3001
phone: +371 3005632, e-mail: Dainis.Lapins@llu.lv

Abstract

For the completion of the work the following aim is set: the establishing of soil deep-tillage efficiency in winter wheat industrial areas in conditions of rugged field macro relief using data of the farm management local GIS and soil research. The work was performed at the Latvia University of Agriculture Research and Study farm "Vecauce" from 2005 to 2007. During the research in stationary with GPS established points lightly soil penetration resistance and soil moisture spots were measured to the depth of 50 cm and soil samples were taken to determine its