PhD THESIS

Research on the influence of agrophytotechnical works on the rapeseed production parameters and their impact on the dynamics of the numerical density of the pest complex

(SUMMARY OF Ph.D. THESIS)

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Introduction

Recently, a special emphasis has been placed on the use of alternative methods of control. Among these, agrophytotechnical methods play an important role. These methods are very diverse and aim to ensure the best conditions for plant growth and development, but which also negatively influence pest populations.

It should be mentioned that in rapeseed crops, due to the thermal and water conditions, for the pathogenic agents and the rich complex of pests, the conditions are ensured to become much more dangerous, the damage caused by them being extremely high if an ample prevention fighting strategy is not applied.

1. Structure of the doctoral thesis

The doctoral thesis includes a total of 123 pages and was structured in two parts:

- current state of knowledge – part I (38 pages)
- personal contribution – part II (85 pages)

The second part of the thesis includes 85 pages and is divided into 6 chapters, which present the objectives, the description of the experimental area, materials and methods used, results obtained and discussions, conclusions and recommendations based on the results, as well as the originality and innovative contributions of the research. The thesis includes a total of 81 tables, 14 figures and 188 bibliographic references.

2. Objectives

The main purpose of the research consisted in quantifying the influence of tillage systems on the rapeseed culture, followed by the identification of the pests of the rapeseed culture in correlation with the agrotechnics applied and with the scheme of chemical treatments.

For the elaboration of the doctoral thesis, the following objectives were proposed:

2.1. Location and experimental fields establishment

To achieve this objective, in the period 2022-2023, 4 experimental plots with rapeseed were established in 2 locations in Mureş County, respectively two experimental fields in Grebenişu de Câmpie and two fields in Ungheni.

After the establishment of the fields, the effect of two tillage systems was studied: the conventional tillage system and the minimum tillage system, on the rapeseed production parameters, as well as their impact on the pest complex that attack the crops.

2.2.Impact of soil tillage and seedbed preparation on growth, development and yield per hectare of rapeseed

For this objective, in the four experimental plots established in Grebenişu de Câmpie and Ungheni, the following were studied:

- stubble cultivation and plowing with the conventional plow;

- the impact of minimum tillage technology;
- seedbed preparation with the power harrow with a single pass;
- verification of this works on the growth and development of plants during the vegetation period;

As a result of these works, the following were analyzed: the agronomic components of the production, the yield per hectare in kilograms.

2.3. Identification of rapeseed pests in correlation with agrotechnical works and chemical treatments scheme

For this objective, in experimental rapeseed plots in Mureş county, the following aspects were used:

- establishing the frequency of the attack produced by rape fleas;
- calculation of ecological indices for the identified pest species.

2.4. Monitoring rape fleas during the emergence period and up to the rosette stage

2.5. Establishing the structure of the entomofauna of flea species

2.6. Establishing the effectiveness of control treatments applied in autumn

2.7. Establishing the effect of tillage systems on the species Brassicogethes *(Meligethes) aeneus*

2.8. Monitoring of the main pest species of rape during the vegetation period in correlation with the tillage system and the applied chemical treatments

The following methods were used to collect the entomofauna:

- manual collection of pests;
- the use of visual traps;
- using the entomological net.

3. Material and methods

3.1. The influence of tillage systems on growth and development of rapeseed plants

To carry out the experiment, the rapeseed hybrid studied was tested according to the method of subdivided plots.

For the establishment of the experimental fields, two different work systems were used in two experimental plots each from Grebenişu de Câmpie and Ungheni (Mureş county), during two experimental years, in which the chemical treatments were also carried out.

The biological studied material was the medium-late hybrid DK Expansion from Dekalb. The observations carried out in the field consisted in making certain determinations on the growth and development phases of plants during the vegetation period. The observations in the laboratory consisted in determining the length of the root, the thickness of the stem, the height of the plants and the length of the siliques with

the help of a graduated ruler and expressed in cm, and the weight of the siliques/plant, as well as the mass of 1000 grains, were determined with the analytical balance with a precision of 0.01 g, for better accuracy.

The identification of the collected pest species was carried out in the laboratory with the help of a magnifying glass, an optical microscope, but also with the help of determinants and comparative images from specialized websites.

3.2. Identification of rapeseed pests in correlation with agrotechnical works and chemical treatments scheme

In the period 2021-2023, after the emergence and until the formation of the rosette, in the rapeseed crop we monitored the rape fleas by placing 10 sticky white panels each, in three variants:

- V1=untreated control;
- V2=application of a treatment;
- V3=application of 2 treatments.

In the version with a single treatment, was applied Mospilan 20 SG (0.01%), an insecticide with systemic action, and in the version with 2 treatments, a synthetic pyrethroid, Decis Expert 100 EC (0.02%) in 2021 and 2022, and in 2023 was applied Delmetros 100 SC (0.02%). Sticky traps were used to monitor flea species and were analyzed in the laboratory under a binocular magnifier for identification. Four species have been identified: *Phyllotreta atra, Phyllotreta nemorum, Phyllotreta undulata* şi *Psylliodes chrysocephala.*

Based on the catches made in the three experimental variants, the percentage of reduction of flea populations in the two variants of application of chemical treatments was calculated, compared to the untreated control, and the attack frequency of the three tested variants was also determined.

In the Ungheni and Grebeniş de Câmpie plots with the two tillage systems, their effect on the population of *Brassicogethes (Meligethes) aeneus* was tested. For this, five yellow sticky panels were placed in the monitored plots and two weekly readings of the catches made on the colored panels were carried out.

Also, in the period 2022-2023, in the rapeseed crops from the two localities, the pest complex was monitored and reported on the plots where the two tillage systems were applied. Pest monitoring was carried out using the entomological net. Annually, 8 monitorings were carried out in each plot (between April and June, from the start of vegetation until harvest) through 10 double mowings on the diagonals of the plots.

The biological material collected was analyzed in the laboratory to identify each species collected. For the collected biological material, ecological indices were calculated: abundance, dominance, constancy and indices of ecological significance.

3.3. Statistical-mathematical methods for calculation and interpretation of the results

The data obtained from measurements, determinations and laboratory analysis from 2021-2023 were statistically calculated in Excel (Microsoft, USA) and in the Polifact statistical program.

Analysis of variance (ANOVA), Duncan test and Shapiro-Wilk test were used.

Ecological indices were calculated for the collected entomofauna, the biological material harvested by each method was mathematically processed to obtain a series of ecological indicators, such as: abundance, dominance, constancy and the index of ecological significance, extremely important in the characterization of an ecosystem.

4. Results and discussions

4.1. Results of the influence of tillage systems on the growth and yield parameters of rapeseed plants

From each experimental plot of each location, 10 plants were randomly sampled diagonally throughout the vegetation period. Subsequently, determinations were made for each growth and productivity parameter taken into study, as well as their comparative study.

Regarding the value of the plant root length obtained in the 2 experimental years, no significant difference was determined for the area factor, both in Grebenișu de Câmpie and in Ungheni.

Regarding the experimental years, a significant difference was determined on the root length of the plants, the length being influenced by the years. Tillage system type determined a significant difference in root length values between conventional tillage (control) and minimum tillage. At minimum tillage, the root length recorded higher values than with the conventional tillage system.

For the values of the number of root branches, obtained in the 2 experimental years, regarding the two areas, no significant difference was determined regarding the number of plant root branches.

Regarding the experimental years, no significant difference was determined in the number of root ramifications, as it was not influenced by the years. For the soil tillage type, no significant difference in the number of root ramifications was determined between conventional tillage and minimum tillage. At minimum tillage, the number of root branches recorded higher values than the conventional tillage system.

Regarding the stem thickness values, obtained in the 2 experimental years, no significant difference was determined for the area factor. In Grebenișu de Câmpie, the thickness of the stems of the plants was lower, compared to the control (average), and in Ungheni the thickness of the stems was higher compared to the control.

Regarding the experimental years, no significant difference was determined for the thickness of the plant stem, this not being influenced by the years. In the year 2022, the stem thickness recorded lower values than the average, compared to the year 2023, when higher values of the stem thickness were recorded compared to the control.

In the tillage type, a significant difference was determined for plant stem thickness values between conventional tillage (control) and minimum tillage. At minimum tillage, the stem thickness recorded higher values than with the conventional tillage system.

Regarding the area, for the plant height values obtained in the 2 experimental years, no significant difference was determined.

Regarding the experimental years, no significant difference in height was determined, as height was not influenced by years.

Tillage system type determined a significant difference in height between conventional tillage (control) and minimum tillage. At minimum tillage, the height recorded higher values than with the conventional tillage system.

In the values of the number of branches of the plants obtained in the 2 experimental years, no significant difference was determined between the two experimental locations. Compared to the control, in Grebenişu de Câmpie, the number of ramifications on each plant was lower, compared to the control (average), and in Ungheni the number of ramifications was higher compared to the control.

Regarding the influence of experimental years, no significant difference was determined regarding the number of branches/plant, the number of branches not being influenced by years. Regarding the influence of tillage type, a significant difference in the number of branches/plant was determined between conventional tillage (control) and minimum tillage. At minimum tillage, the number of branches/plant recorded higher values than with the conventional plowing system.

Regarding the number of branches/plant, a difference was identified in the interaction between the Ungheni area, year 2022 and the minimum tillage work system and in the interaction between Ungheni, year 2023 and the minimum system compared to the conventional system, year 2022 and the Grebenişu de Câmpie area.

For the values of the number of siliques/plant obtained in the 2 experimental years, no significant difference was determined between the two areas.

Regarding the experimental years, no significant difference in the number of siliques/plant was determined. For the type of tillage, a significant difference in the number of siliques/plant was determined between conventional tillage (control) and minimum tillage. At minimum tillage, the number of siliques/plant recorded higher values than with the conventional work system.

Regarding the number of siliques/plant, a difference was identified in the interaction between the Ungheni area, year 2022 and the minimum tillage work system and in the interaction between Ungheni, year 2023 and the minimum system compared to the conventional system, year 2022 and the Grebenişu area.

For silique length values obtained in the 2 experimental years, no significant difference was determined between the two areas.

Regarding the experimental years, no significant difference was determined in the length of the siliques of the plants, this not being influenced by the years. In the

year 2022, the silique length of the plants recorded values lower than the average, compared to the year 2023, when higher silique length values were recorded.

In the tillage type, a significant difference in plant silique length was determined between conventional tillage and minimum tillage. At minimum tillage, the silique length had higher values than in the conventional system.

Regarding the length of siliques, no difference was identified in the interaction between zones, years and work systems compared to the conventional system, the year 2022 and the Grebenişu de Câmpie area (control).

No significant difference between the two areas was determined in the values of siliques mass obtained during the 2 experimental years.

Regarding the experimental years, no significant difference in silique mass was determined, their mass not being influenced by years.

In the year 2022, the mass of siliques recorded values lower than the average, compared to the year 2023, when higher values of the mass of siliques were recorded compared to the control.

For the soil tillage type, a significant difference in silique mass was determined between the conventional tillage (control) and minimum tillage. At minimum tillage, silique mass recorded higher values than with the conventional work system.

Regarding silique mass, no interaction difference between zones, years and tillage systems was identified.

For the values of the number of seeds in siliques, obtained in the 2 experimental years, no significant difference was determined between the two areas.

Regarding the experimental years, no significant difference was determined in the number of seeds in the silique, the number not being influenced by the years. In the year 2022, the number of seeds in the silique recorded values lower than the average, compared to the year 2023, when higher values of the number of seeds in the silique compared to the control were recorded.

For the tillage type, no significant difference in the number of seeds was determined between conventional and minimum tillage.

For the values of the mass of 1000 grains, obtained in the 2 experimental years, no significant difference was determined between the two areas and for the experimental years, no significant difference was determined in the seed mass, this not being influenced by years.

For the tillage type, no significant difference in 1000 grains mass was determined between the conventional tillage and minimum tillage. At minimum tillage, the MMG recorded higher values than the conventional tillage system.

Regarding the mass of 1000 grains, no difference was identified in the interaction between zones, years and working systems compared to the conventional system, the year 2022 and the Grebenişu de Câmpie area (control).

4.2. Results of the influence of tillage systems on the yield per hectare

Rapeseed production in kg/ha was significantly influenced by the year. The year 2023 showed a higher production compared to 2022. The interraction of pedoclimatic conditions resulted in a yield of 3977.50 kg/ha in 2022 and 4497.50 kg/ha in 2023.

The Ungheni location presented a higher production compared to the Grebenişu de Câmpie location. In Ungheni in 2022, with the conventional work system, the production was 4400 kg/ha, and in 2023, 4510 kg/ha. In the minimum tillage system, production was 4720 kg/ha in 2022, and 4810 kg/ha in 2023. At Grebenişu de Câmpie, in 2022, with the conventional work system, the production was 3200 kg/ha, and in 2023, 4070 kg/ha. In the minimum tillage system, production was 3500 kg/ha in 2022, and 4500 kg/ha in 2023. The minimum tillage system showed higher production than the conventional tillage system for each location.

Production was highly significantly influenced by the interaction between tillage system and location and was also significantly influenced by the interaction between location and applied tillage system, with production being significantly higher for Ungheni and tillage types and significantly lower for Grebenişu de Câmpie and the types of soil works for this location.

4.3. Results of the monitoring and control measures on the rapeseed crop pests

In 2021 on the 10 sticky panels/variant, in the three experimental variants a total of 441 specimens were captured, of which 338 in the control, 70 in the variant with one treatment, 33 in the variant with two treatments. By applying chemical treatments, compared to the control, the number of catches decreased by 79.3% by applying one treatment and by 90.2% by applying two treatments.

In 2022, a total of 374 specimens were captured in the three experimental variants, of which: 304 in the untreated control, 49 in the variant with one treatment, 21 in the variant with two treatments. This year there were the fewest catches in the research period. Compared to the control, the number of catches decreased by 83.9% by applying one treatment and by 93.1% by applying two treatments.

In 2023, a total of 632 specimens has been captured in the three experimental variants, of which: 524 in the untreated control, 79 in the variant with one treatment, 29 in the variant with two treatments. In this year there were the most catches during the period. Compared to the untreated control, the number of catches decreased by 84.9% by applying one treatment and by 94.5% by applying two treatments.

By applying a single chemical treatment, the number of flea species caught was reduced, their population decreased by a percentage of 79.3% (in 2021) and 84.9% (in 2023) and during the three years of monitoring it was reduced by 83%

By applying two chemical treatments, the number of catches of flea species was reduced, the population decreased in a proportion between 90.2% (in 2021) and 94.5% (in 2023) and over the three years of monitoring reduced by 92.9%.

During the 3 years from the experimental plots, a number of 1447 specimens were collected. For the black flea, *Phyllotreta atra*, there were 951 catches, representing 65.7% of the total catches. The common flea, *Phyllotreta nemorum*, participated with 22.3% of the entomofauna, with 322 specimens. The striped flea, *Phyllotreta undulata*, with 73 specimens represented 5% of the total. The large rape flea, *Psylliodes chrysocephala*, with 101 captures participated with 7% of the collected entomofauna.

For the *Brassicogethes aeneus* species, the total number of specimens collected from the conventional plot was 108 specimens in 2022, respectively 155 specimens in 2023. In the plot with minimum tillage, the total number of catches was 451 specimens in 2022, respectively 512 specimens in the year 2023.

In the period 2022-2023, in the two localities where the two tillage methods were applied, 14 species of pests that are more common in rapeseed crops were monitored. Through the minimum tillage system, the total number of catches was 338 specimens. The most catches were 110 specimens of *Brassicogethes aeneus*, respectively 61 specimens of *Tropinota hirta*, and the fewest were of *Psylliodes chrysocephala,* with 2 specimens.

In the plot with conventional tillage, 165 specimens were captured. The most catches were 60 specimens of *Brassicogethes aeneus*, respectively 42 of *Tropinota hirta*, and the fewest were of *Psylliodes chrysocephala*, with one specimen. It is found that through the conventional work, the catches decreased by 173 specimens.

In rapeseed crops from the two localities, regardless of the method of tillage, the characteristic species with a value between 5.1-10% are: *Ceutorrhynchus napi*, *Phyllotreta atra* and *Phyllotreta nemorum*.

Brassicogethes aeneus and *Tropinota hirta* are characteristic species, over 10%.

5. Conclusions and recommendations

The climatic conditions during the experimental period, as well as the uneven distribution of precipitation during the rapeseed vegetation period, had a considerable impact on the the plants growth and development.

Regarding the climatic conditions of the second experimental year (more abundant precipitation in the 3 months of summer), they determined for the hybrid under study, better growth and development, especially in the critical phases.

Following the studies carried out, it was found that for characteristics such as the height, the number of plant branches, the thickness of the stem, the length of the root, the number of siliques and the mass and length of the siliques, the system of works as a technological element has a considerable implication in their variation .

The number of seeds in the silique and the MMG were not influenced by the factors, year, area and work system, these being characteristics of the hybrid.

Regarding to the production per hectare, the response of the rapeseed hybrid to the year, area and working system applied, also varied depending on the climatic

conditions encountered in the two experimental years but also on the pedological conditions in the two experimental locations.

By applying a single treatment, the reduction percentage of the numerical density of fleas was: 79.3% in 2021, 83.9% in 2022, 84.9% in 2023, with an average over the three years of 83% , compared to the variant without treatments.

By applying two treatments, the reduction percentage of the numerical density of fleas was: 90.2% in 2021, 93.19% in 2022, 94.5% in 2023, with an average over the three years of 92.9%, compared to the variant without treatments.

In Ungheni, the total number of catches from the plot with the conventional system was reduced by 76.1% in 2022, respectively by 69.7% in 2023.

In the rapeseed culture from Grebenişu de Câmpie, the total number of *Brassicogethes (Meligethes) aeneus* specimens collected in the conventional plot was 113 in 2022, respectively 171 specimens in 2023. In the plot with minimum tillage the total number of catches was 528 copies in 2022, respectively 607 copies in 2023.

Recommendations

Establishment of the most efficient agrophytotechnical works in accordance with the available agricultural machines, the best strategies for control and monitoring the dynamics of the density of pest populations is mandatory for obtaining high and quality productions in rapeseed culture.

The use of the minimum tillage system brings significant production increases but when appropriate technology is followed in terms of disease and pest control.

To monitor the complex of specific pests in rapeseed culture, the use of visual and sticky traps is an accessible method for all farmers.

Mureş County remains a favorable area for hybrids of rapeseed, but considering the very pronounced differentiation of conditions in the years of cultivation and soil conditions, we recommend cultivating rapeseed in at least two locations.

To control the pests that attack in autumn, after the emergence of the rapeseed and in the rosette phase, it is recommended that farmers apply two chemical treatments, and in the spring-summer period carry out at least 5 treatments with the approved products.

Monitoring the dynamics of pest population density is essential for determining the most suitable control strategies, especially in organic farming.

6. Originality and innovative contributions of the thesis

For the first time, the study of the influence of two different tillage systems on the growth, development and production per hectare of the rapeseed crop was carried out in two locations in Mureş County, respectively Grebenişu de Câmpie and Ungheni.

The structure of the rapeseed flea complex was studied and the ecological indices of these species were calculated.

The influence of tillage for *Brassicogethes (Meligethes) aeneus* was determined.

The influence of the tillage system and chemical treatments in the dynamics of pest populations was established and their ecological indices were calculated.