



# Influence of Soil Tillage Systems on Rapeseed Production Parameters and on the Numerical Density of Pest Complex

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## RESEARCH ARTICLE

### Abstract

*Brassica rapa* L. is one of the most common plant cultivated in Europe. The farmers from Ungheni area (Mureș, Romania) reported the attack of pest complex in rapeseed culture in the 2021 year. For that, two soil tillage systems were established to reduce the pests complex and to increase the rapeseed production. The results indicated that is recommended to apply two different tillage systems at 5 parcels. First of them was the conventional tillage, with plough and the other one was reduced tillage, with cultivator. For monitoring the growth stage and the pests percentage, 20 rapeseed plants were selected from each parcel. The pests identification took place at the Entomology Discipline and the plants growth stage and production parameters were analyzed at Agrotechnical Discipline, at University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca. In the conventional tillage the average of plants reported with pests was about 55% and the maximum number of adults/plant was 7 (field 2). In the minimum tillage, the average of plants reported with pests was about 15 % and the maximum number of adults/plant was 2. In the fields with plough, the production was about 3200 kg/ha and in those with cultivator, the production was about 4400 kg/ha.

**Keywords:** soil tillage systems; rapeseed; production parameters; pests complex


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## INTRODUCTION

Rapeseed (*Brassica rapa* L.) is an annual plant from the Cruciferae family, cultivated throughout continental Europe, on the North American continent as well as in Asia, due to its oil-rich seeds. As an oleaginous plant, rapeseed is currently in fourth place on the world map, after soy, sunflower and palm (Gourrion et al., 2020). In Europe, large rapeseed-growing countries are Germany, France, Russia, the Baltic States, the Czech Republic and Poland. In the countries of the European Union, approximately one third of the world production of rapeseed is obtained, which is approximately 60 million tons annually (Ferguson et al., 2016). The biochemical composition of rapeseed is extensive. The main chemical compounds are: proteins, carbohydrates, various mineral substances (calcium, iron, phosphorus, potassium, sodium), cellulose, fats, resins, mucilage and vitamin (A, B1, B2, C, niacin, beta carotene). The biological value of rapeseed proteins is about 95% of that of soy proteins, having the same essential amino acids. Compared to soybean, it has less lysine but more methionine. In the production of vegetable oils, rapeseed has a particularly important role worldwide, the seeds contain about 42-48% oil in the varieties, and in the newly created hybrids it can reach over 50% (Metspalu et al., 2015; Zhang et al., 2020). In 2021-year, species of *Dasineura brassicae* Winnertz, *Athalia rosae* Linnaeus,

*Ceutorhynchus napi* Gyll and *Meligethes aeneus* F. were observed in rapeseed fields near Ungheni city, in Mureş County, which are placed in Transylvanian Plain, Romania. The species were identified at Entomology Discipline at University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca. The EU ban on use of neonicotinoid seed treatments and resistance of CSFB to pyrethroid insecticides have left farmers with limited control options resulting in drastic reductions in production. Integrated pest management (IPM) may offer a solution (Ortega-Ramos et al., 2022). For instance, at the European level, it was estimated that 15% of oilseed rape yield is lost by insect pests (Milovac et al., 2017). Yield losses to insect pests are projected to increase due to climate change (Deutsch et al., 2018).

Conventional tillage system methods increase energy costs and lead to the destruction and reduction of water and soil resources, and for a long time, have an adverse effect on soil properties and cause the formation of hard layers. Repeated tillage and deep plowing cause a quick release of carbon dioxide, causing soil and greenhouse effects and, in the long run, undesirable effects on soil characteristics. Compared with conventional tillage, protective tillage reduces the number of agricultural operations, which has many benefits. So that the loss of moisture and destruction of the soil structure would be reduced. Furthermore, the oxidation of organic residues of plants is reduced (Khalili Torghabeh et al., 2022).

Reduced tillage intensity is a management practice that potentially can reduce environmental impacts and improve agricultural outputs (Buckwell et al., 2014). Reducing tillage intensity offers the possibility of moving towards sustainable intensification objectives. Reduced tillage (RT) practices, where the plough is not used, can provide a number of environmental and financial benefits, particularly for soil erosion control (Townsend et al., 2016). Reduced tillage and no-tillage have a high potential to increase soil water content, improve water infiltration, and reduce evaporation; hence, these techniques can offer a strategy for increasing the resilience of agriculture and a means of adapting to projected climate change (Zikeli et al., 2017; Gelybó et al., 2022). Despite the positive effects, reducing the intensity of soil tillage could also have effects on the occurrence of diseases, pests or weeds.

In this context, the research presented in this paper aims to establish the influence of the soil tillage systems on the production parameters of rapeseed, but also on the pest complex. The farmers from Ungheni area reported in rapeseed fields, the presence of pest that attack vegetative and generative organs and produce significant damage in culture. Therefore, to control the dynamics pest population, we decided to use a set of agrotechnical measures in the year 2022.

## MATERIALS AND METHODS

The studies were carried out in five rapeseed fields, located in Mureş County, near Ungheni city, which are placed in Transylvanian Plain, Romania. The average annual air temperature is about 8.2°C. In January the average temperature is -3°C, and that of July is 19°C.

We investigated two soil tillage systems and their impact on pests' dynamics and rapeseed production. First system is the conventional soil tillage with plough at 25 cm depth, power harrow for seedbed preparation and sowing for two parcels with 38 ha total area. The other one system is a reduced soil tillage system and it contains in a cultivator for soil preparing, a power harrow for seedbed preparing and sowing three parcels with a total area of 40 ha. Soil type is a cambic chernoziom and pre-crops were winter wheat. The seeding period was between 20-25 august 2021 and the hybrid was from Pioneer.

For monitoring the turnip sawfly *Athalia rosae* Linné and bladder pod midge *Dasineura brassicae* Wiennertz, in each parcel, 20 plants were randomly selected. Each plant was analyzed individually and the number of adults reported on the plant was noted. Also, at the Agrotechnical Discipline, at University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, the plants grown stage and production parameters were analyzed.

The research was made in the year 2022.

## RESULTS AND DISCUSSIONS

In the conventional soil tillage with plough, the share of plants reported by the turnip sawfly *Athalia rosae* Linné and bladder pod midge *Dasineura brassicae* Wiennert was between 50% and 60%, the average being 55% (Table 1). Regarding the maximum number of pests/plants, it was between 5 and 7.

In the reduced soil tillage with the cultivator, the share of plants with pests was between 10% and 20%. The maximum number of pests/plant was 3.

The number of plants with the turnip sawfly *Athalia rosae* Linné and bladder pod midge *Dasineura brassicae* Wiennert, as well as the maximum number of pests/plant, was lower in the reduced soil tillage.

Also, in the field with conventional soil tillage (plough), the production was about 3200 kg/ha and in the field with reduced soil tillage (cultivator) the production was about 4400 kg/ha.

It should be noted that the work depth was about 25 cm for both soil tillage systems. The pre-crop in the studied parcels was winter wheat and both soil tillage systems started in the end of July 2021. Factors at the local level, such as conservation soil tillage, had an overall positive effect on natural pest control, and their inclusion in the models

typically increased their predictive power (Bonato et al., 2023). At the local level, different factors, such as semi-natural habitats adjacent to target crops, in-field spatial and temporal diversification measures, conservation soil tillage or organic management, can have a positive effect on natural pest control by creating habitats for natural enemies at the soil surface or reducing disturbance to them, as well as acting on pests' life cycle or on plant resistance capacity (Garibaldi et al., 2023; Hatt et al., 2018; Palomo-Campesino et al., 2018; Petit et al., 2020, Petit et al., 2021; Rosa-Schleich et al., 2019; Rusch, Bommarco et al., 2016).

**Table 1.** Monitoring data from the rapeseed plants under two different tillage systems, plants attacked by turnip sawfly *Athalia rosae* Linné and bladder pod midge *Dasineura brassicae* Wiennert in Ungheni, Mureş County, Romania (2022).

Soil tillage system	Field no.	No. of analyzed plants	No. of plants with pests	% of attacked plants	Maximum no. of pests per plant
Conventional soil tillage (plough)	1.	20	10	50	5
	2.	20	12	60	7
Reduced soil tillage (cultivator)	1.	20	4	20	2
	2.	20	2	10	2
	3.	20	4	20	3



(a)



(b)

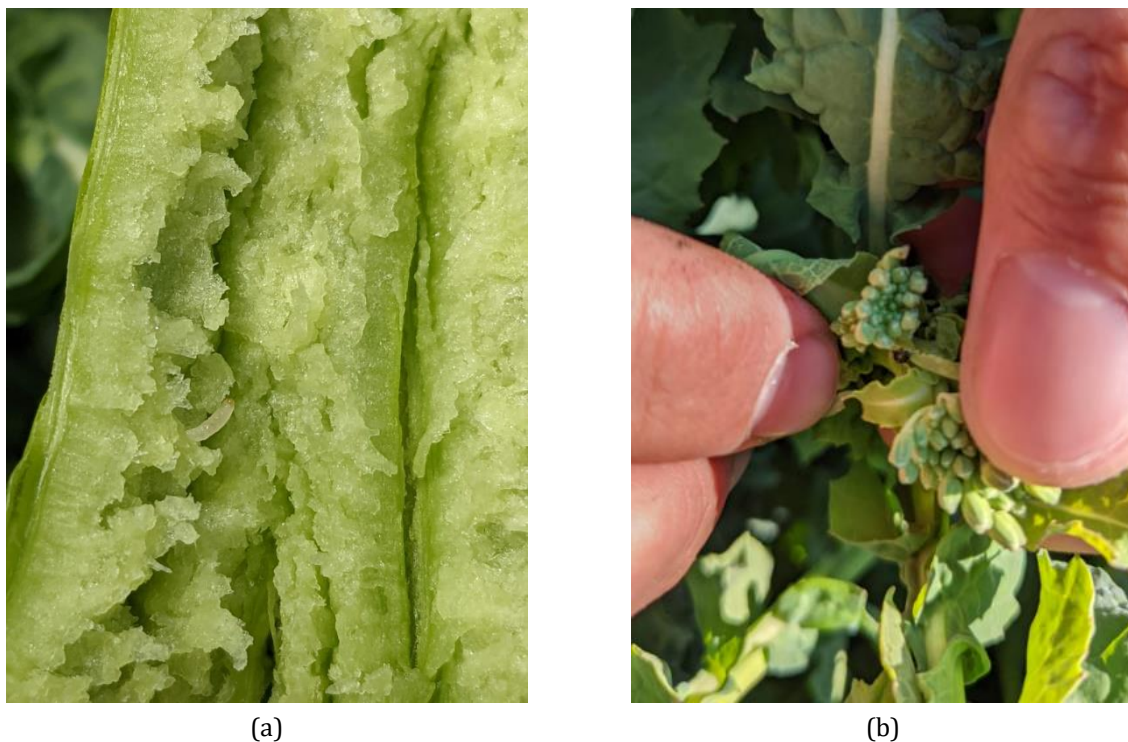
**Figure 1.** Soil tillage system – soil preparation: a) conventional soil tillage, b) reduced soil tillage

In the Ungheni area in 2021, first pests reported in rapeseed culture were larvae of *Athalia rosae* Linnaeus, in September 10 th. In April, May and June 2022, in rapeseed culture has been identified species of *Dasineura brassicae* Winnertz, *Ceutorhynchus napi* Gyll and *Meligethes aeneus* F. Recently, the growing interest in sustainable agriculture has extended its application to diagnose the crop diseases and pests (Bechar et al., 2010). Researches have

highlighted a wide range of insects capable of causing damage since the emergence, such as crucifer flea beetle (*Phyllotreta atra* F.) and cabbage stem flea beetle (*Psylloides chrysocephala* L.) or throughout the vegetation period, of which we mention: Turnip sawfly (*Athalia rosae* L.), Pollen beetle (*Meligetes aeneus* F.), Rape stem weevil (*Ceutorhynchus napi* Gyll.) etc. (Popov, 2004). *Athalia rosae* is one of the species that can cause significant damage to the rapeseed crop, especially in hot and dry autumns (Raicu et al., 2019).



**Figure 2.** Attack of - a) *Dasineura brassicae* Winnertz; b) *Athalia rosae* Linnaeus



**Figure 3.** a) *Ceutorhynchus napi* Gyll; b) *Meligethes aeneus* F.

Larvae of *Dasineura brassicae* Winnertz, enzymatically dissolve the inner tissue of infested pods (Kazda et al., 2005), causing colour change in the pods, their deformation and cracking, which results in premature seeds dropping. Seed loss of oilseed rape caused by attacks of this species amount to 82% (Williams, 2010).

Adults of *Ceutorhynchus napi* Gyll, even if they feed on rapeseed leaves or cause bites on the stem, do not cause damage that could endanger the rapeseed culture. Significant damage of this pest is made by larvae. They migrate inside the stems consuming the marrow (Goga et al., 2020).

Adults of *Meligethes aeneus* F. emerge in the spring, feed on pollen from open flowers, burrow through unopened floral buds for oviposition, and hatched larvae feed on floral pollen and nectar. Such interactions result in floral and pod drop, which can result in yield loss depending on a plant's compensatory response (Williams, 2010).

## CONCLUSIONS

The observations and monitorization from the rapeseed fields of Ungheni showed that agrophytotechnical factors have an influence in pests dynamics. We observed that in the field with conventional soil tillage (plough), the production was about 3200 kg/ha and in the field with reduced soil tillage (cultivator) the production was about 4400 kg/ha at the same rapeseed hybrid. The study shown that the numerical density of *Meligethes aeneus*, *Athalia rosae* and *Dasineura brassicae* was significantly higher in the field with conventional soil tillage than the field with reduced soil tillage. The maximum number of adults/plant was 7 for the conventional soil tillage system and for reduced soil tillage, the maximum number was 3.

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## Conflicts of Interest

The authors declare that they do not have any conflict of interest.

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