Romanian Journal for Plant Protection, Vol. XIII, 2020
ISSN 2248 – 129X; ISSN-L 2248 – 129X

SOYBEAN INTEGRATED PEST MANAGEMENT FOR PROMOTING SUSTAINABLE AGRICULTURE UNDER CLIMATE CHANGE

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http://www.doi.org/10.54574/RJPP.13.02

Abstract: In order to protect agroecosystems and to optimize soybean crop yield from the Transylvanian Plain, the adoption of complex methods of sustainable management with minimal impact on the environment has now become a challenge. Therefore, an experiment was conducted at the Agricultural Research-Development Station Turda in 2018, to provide the best methods for the development of an Integrated Management System (IMS) for phytosanitary soybean crop risks. The field factorial experiment was based on a subdivided parcel design with two replications. Experimental models for soybean crop protection have been developed. Field research was carried out for analyzing the technological (agricultural practices), biological (diseases, insects, pests) and environmental (climate change, methods of improving soil fertility with phytosanitary risk by applying environmentally friendly products) factors affecting soybean crop yield and quality. An entomological sampling strategy (pheromone traps, plant surveys) was used for evaluating the IMS environmental risk and methods for increasing plant resistance to biotic and abiotic stress factors were also studied. The obtained data was correlated with the production values for the 3 experimental factors: the tillage system, fertilization and treatments. The following pests were recorded, soil pests *Coleoptera*, *Agriotes* larvae, *Opatrum*, dipterans *Delia platura* and *D. florilega*, vectors of viruses and phytoplasmoses, cicadas, aphids, trips and the common red spider *Tetranychus urticae*, defoliating omissions *Vanessa cardui*, owls *Autographa gamma*, *Mamestra suasa*, *M. oleracea*, *Agrotis segetum)* etc. In the climatic conditions of 2018, most frequent pathogens were downy mildew (*Peronospora manshurica* and bacterial blight *Pseudomonas glycinae*.

Keywords: soybean, climate change, integrated management, pests

INTRODUCTION

Climate change, microclimatic changes caused by global warming, regional agro-ecological conditions, the changes in tillage technologies and the division into smaller units of the areas belonging to agricultural holdings (Ignea, 2017) cause significant losses to agricultural production worldwide. As a result of all these factors, pest populations, weeds and disease dynamics became unstable and affect the global crop production. In order to ensure increased yield and production security, it is necessary to perform a systemic approach of research regarding integrated control strategies, based on new methods which are efficient and suitable for technological and climate change.

In new farm types, the use of natural environmentally friendly activities, that do not cause imbalances that irreversibly damage the ecosystem, corrected as much as possible the relationship between the plants and the ecosystem. Compared to intensive agricultural holdings, in new farms, the relationships between plant-soil and biotope-biocenosis are analyzed taking into account the complexity of agro-ecological factors. In order to correct or optimize the environmental conditions, non-invasive agrotechnical methods, which consist in the rational use of chemicals, are applied.

The soybean yield, yield elements and nodules development are influenced by the applied tillage system. In some cases no-tillage or minimum tillage system is recommended. By applying these systems on fertile, structured soils, the yield increased with 2-15% compared to the conventional tillage system. On less fertile, compact soils, with humus contents below 2.2%, with a great textural differentiation on the soil profile (preluvosol, luvosol), minimum tillage and no-tillage reduce the production. Conservative agriculture should ensure yields close to conventional agriculture, with a minimum impact on the environment, through optimal energy and economic efficiency. This includes a series of complementary agricultural practices: (i) minimum tillage (through a minimal tillage system or direct seed drill) for improving soil structure, fauna and organic matter; (ii) permanent soil cover (cover crops, residue cover and mulch) to protect the soil, improve drainage and contribute to weed control; (iii) different crop rotations and combinations which stimulate soil microorganisms and support pest, weed and disease control (Cheţan et al., 2014, 2016, 2017).

Soybean shows special sensitivity to weeding in the early growth and at the beginning of maturity. When weeding occurs in the first stages of development, the crop cannot be saved by the subsequent control weeds. Soybean is a small to medium-height plant being easily overcome by weeds with high yield loss (30-80%), sometimes even compromising the crop (Berca, 2004; Avola et al., 2008). The most common weeds in soybean crops are especially the ones that germinate in late spring (Sartorato et al., 1996; Rusu, 2014): *Echinochloa crus-galli*, *Setaria* sp., *Digitaria sanguinalis*, *Sorghum halepense*, *Agropyron repens*, *Solanum nigrum*, *Amaranthus retroflexus*, *Chenopodium album*, *Galinsoga parviflora*, *Xanthium* sp., *Abutilon teophrasti*, *Datura stramonium*, *Polygonum* sp., *Cirsium arvense*, *Convolvulus arvensis* (Cheţan et al., 2019; Gradila, 2016, 2017)

Recent studies highlight that crop rotation, management of diseases and pests seriously affect soybean crops. Soybean diseases can be caused by viruses, bacteria and fungi. Viral diseases such as: soybean mosaic virus, tobacco ringspot virus, yellow mosaic virus can decrease yield with more than 25%. Principal bacterial disease are bacterial blight, bacterial pustule and stem wilt. The most widespread micoses of soybean are downy mildew, brown spot on the leaves, anthracnose, root and stem rot, stem rot or white mold, pod and stem blight or stem canker and purple seed stain (Suciu et al., 2014).

In the agro-ecosystems of soybean crops in central Transylvania, the soil pest attacks were highlighted: worm’s wire and darkling beetle, European mole cricket, sowing owls, earth fleas, mites (Mureșanu et al, 1989, 1998, 2002, 2014; Mureșanu & Tărău, 2013; Georgescu et al., 2016; Ivaș & Mureșanu, 2011, 2013; Malschi et al., 2013, 2017; Popov et al, 2003; Trotuş et al., 2014). In soybean and bean crops, attacks of: dipterans (Mustea & Tătaru, 1970; Malschi, 1980, 2009; Perju & Malschi, 2001), aphids and cicadas (Malschi, 2009; Malschi et al., 2013), painted lady and especially the mite *T. urticae* (with attack frequency between 30-50%) (Mureşanu & Tărău, 2013; Mureşanu et al., 2014), have also been reported. In 2016, the invasive presence of *Vanessa cardui* was reported. This species may be a real danger for the soybean crop, because the larvae are very voracious, consuming the entire leaf language of the leaf, leaving only the nerves intact. The research reveals the existence of a entomophagous arthropods limiting the phytophagous insects, the known groups of entomophageal auxiliaries being reported: *Aranea, Dermaptera, Aeolothripidae, Nabidae, Sylphidae, Coccinellidae, Carabidae, Cicindelidae, Staphylinidae, Cantharidae, Malachiidae, Syrphidae, Scatophagidae, Empididae, Formicidae, Chrysopidae* (Malschi & Mustea, 1995, 1997; Malschi, 2007, 2009, 2014; Malschi et al., 2017, 2018).

MATERIAL AND METHODS

In order to limit the attack of diseases and pests, the conservative agriculture components and technological measures, adapted to climate change, were studied in a polyfactorial experiment. The trials were carried out at Agricultural Research and Development Station Turda (ARDS Turda) in 2018. TEO TD, an early soybean variety developed at ARDS Turda was used as a biological material. To achieve the experiment objectives, following factors were studied:

The tillage system

- ploughing at a depth of 30 cm: 12.11.2017
- chisel plough processing at 30 cm depth: 12.11.2017
- disk harrow processing at 12 cm depth: 12.11.2017
- preparation of seedbed in spring with rotary harrow: 19.04.2018
- sowing: 24.04.2018
- sowing density: 45 bg/m^2
- seed quantity/ha: 69 kg/ha; incorporation depth of seeds: 4 cm
- distance between rows: 18 cm (with Gaspardo Directa 400 seed drill)

Weed, disease and pest control: (i) preemergent herbicide application: 23.04.2018 with Sencor 0,35 l/ha + Frontier 1,4 l/ha + 260l water; (ii) postemergent herbicide application: 30.05.2018 with Corum 1,9 l/ha + 260l water (for dicotiledonate); 01.06.2018 with Agil 1.0 l/ha (for monocotiledonate); (iii) phytosanitary treatments: 02.07.2018: COPFORT 3 l/ha (fungicide) and FASTER 100 ml/ha (insecticide).

Fertilization: (i) fertilization level: $N_{40}P_{40}$ kg s.a./ha at the same time as the sowing; (ii) organic gulle fertilizer before the sowing + $N_{40}P_{40}$ at the same time as the sowing; (iii) green fertilizer, precursory to the soybean crop + gulle before sowing + $N_{40}P_{40,}$ at the same time as the sowing.

Observations and determinations/ conclusions during the vegetation period:

- emergence of the plants occurred at 7.05.2018 at a density of: 11 pl/m^2 (in ploughed land), 9 pl/m^2 (in land processed with chisel plough), 6 pl/m^2 (in land processed with disk harrow), 3 pl/m^2 (in untilled land- drought caused very poor sprouting of the crop). After May rainfalls (between 17th -21st) more seeds germinated and emergence occurred in steps, leading to uneven and staggered soybean emergence; the different development stages of plants (1-3 trifoliate leaves, 2 simple (unifoliate) leaves and in the cotyledon stage), created difficulties in applying post-emergence treatments for weed control.
- the research system, determinations in dynamics and the measurements to be performed were planned;
- plant density before flowering (at 21.05.2018): 37 pl/m^2 in ploughed land, 35 pl/m^2 after chisel plough processing, 31 pl/m^2 in land processed with disk harrow and 24 pl/m^2 in untilled land;
- beginning of flowering occurred at 21.06.2018;
- number of nodules/ plant was determined between 22.06.2018-28.06.2018;
- for monitoring and limiting the attack of some lepidoptera during the soybean growing stages, synthesis sex pheromone traps were placed on 29.05.2018;
- evaluation of disease and of the two-spotted spider mite attack: 01-03.08.2018.

Harvesting and quantitative and qualitative evaluation of the yield was accomplished:

- date of harvesting: 09.10.2018.

RESULTS AND DISCUSSION

From the point of view of pest attack on the soybean crop in 2018, no alarming dangerous levels or significant loss caused by the main pest types were registered. From previous years' observations, the importance of the attack potential of soil-dwelling pest species is well-known: Coleoptera larvae (*Agriotes* spp., *Opatrum* spp.*)*, cook chafer larvae - Scarabeidae, Lepidoptera Noctuidae caterpillars (*Agrotis segetum*), caterpillars of soil-dwelling pests *Gryllotalpa*, *Gryllus*, *Delia platura* and *D. florilega*, some nematodes and important vectors of viruses and phytoplamas - cicadas, aphids, trips and especially the two-spotted spider mite *Tetranichus urticae*, defoliating insects larvae - the thistle caterpillar *Vanessa cardui*, moths larvae of *A. segetum*, *Autographa gamma*, *Mamestra suasa* and *M. oleracea* as well as other flower, pod and grain pests larvae (Curculionidae, Chrysomelidae). Entomophagous arthropods which actively limit soybean crop pests were also reported in central Transylvania.

The climatic and technological crop conditions, abundance, the dynamics and structural interactions of pests and the natural fund of entomphagous auxiliaries from the agroecosystems originating from cereal crop rotation represent influential factors with a high degree of impact on the formation of soybean production.

The main pests reported in 2018 were the species of harmful Lepidoptera: *A. segetum*, *A. gamma*, *M. suasa*, *M. oleracea*, *T. urticae* and *Agriotes* spp.

In the experimental field, the monitoring and limitation of some lepidoptera was performed through the use of pheromone traps, placed when emergence occurred. The pheromone was changed monthly for each species and the tags/ plates were read weekly.

The silver-Y moth *A. gamma* recorded a maximum flight at the end of May (8 adults in the disk harrow processing system) and the second maximum flight in the first decade of September (29 adults in the no tillage system) (Figure. 1).

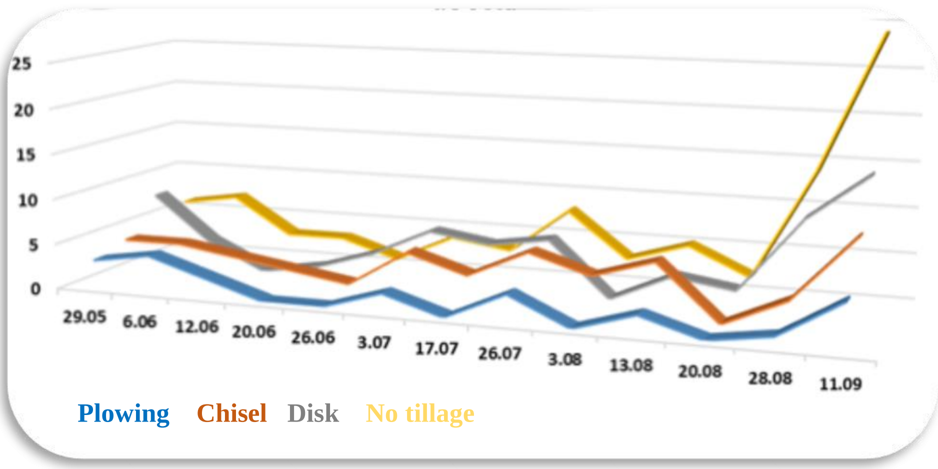

Figure 1. The dynamics of *Autographa gamma* adult flight

The appearance of butterflies of *A. segetum* is mainly recorded in early May and is observed until the beginning of July. The mass flight of butterflies (26 adults in the no tillage system) coincides with the last decade of May. The second-generation of butterfly appears, at the end of July - beginning of August (32 adults in the no tillage system), and at the beginning of September the maximum captured individuals are registered (33 adults in the no tillage system) (Figure 2).

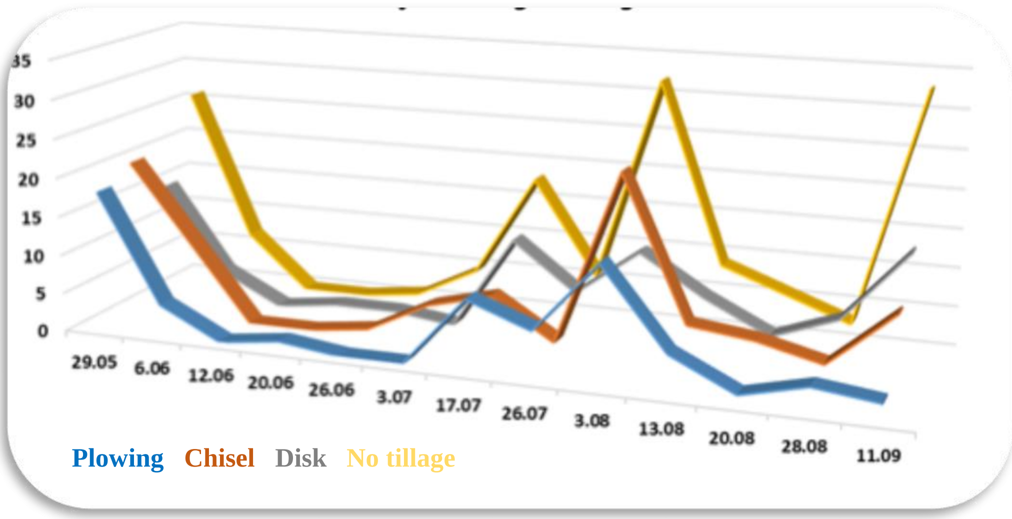

Figure 2. The dynamics of *Agrotis segetum* adult flight

At the pheromone traps for the *M. suasa* species, the adults appeared in the crop starting with May, with a maximum number of adults in the third decade of June (11 adults in the disk harrow processing system), then the flight diminished (Figure. 3).

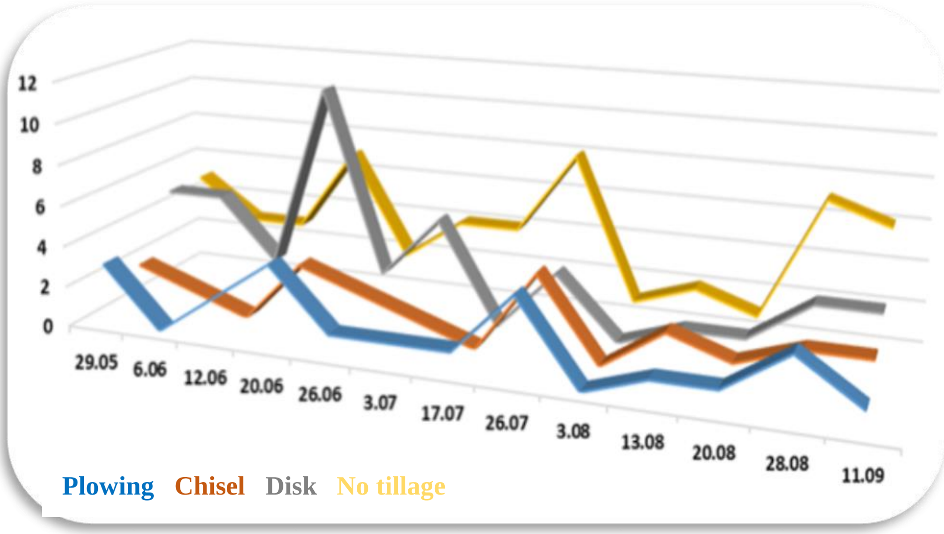

Figure 3. The dynamics of *M. suasa* adult flight

The cabbage moth *M. oleracea* had the following dynamics in the soybean crop: it appeared in the crop in May, with a reduced number of adults during the whole monitored period in 2018, most individuals being captured in the no tillage system (Figure 4).

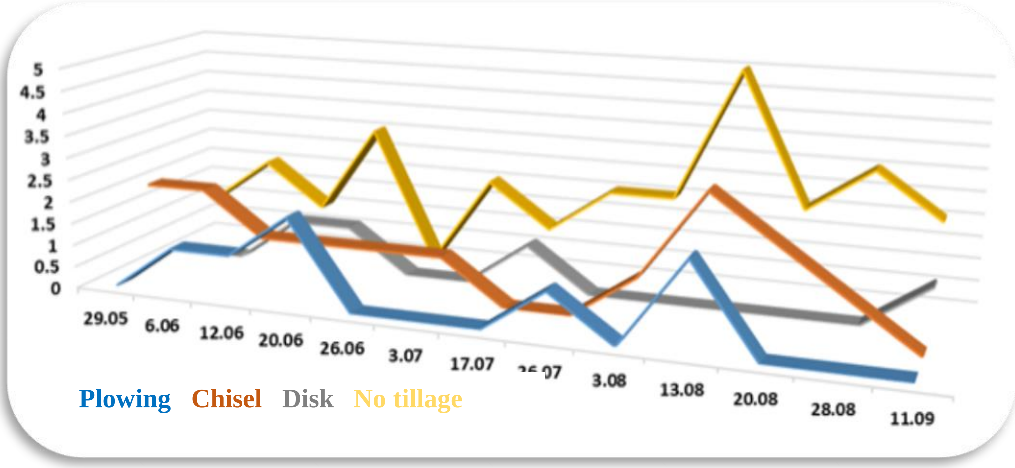

Figure 4. The dynamics of *Mamestra oleracea* adult flight

For the above-mentioned Lepidoptera, the biggest number of captured adults with synthesis sex pheromone traps was recorded in the no tillage system, followed by the disk harrow processing system; from among the studied species, the greatest abundance goes to the *A. segetum* (turnip moth) species.

The spider mite *T. urticae* is one of the most important pests of soybean crop because of the damage it causes. The affected leaves may dry and drop from the plant and plants defoliate with continued two-spotted spider mites pressure. The density of *T. urticae* in the soybean crop was determined by counting the number of insects of the plant. The biggest number of individuals was recorded in the no tillage system where supplementary fertilization with gulle was applied (Table 1).

Table 1. The density of *Tetranichus urticae* in soybean

SOIL TILLAGE SYSTEM	FERTILIZATION	THE AVERAGE NUMBER OF SPIDERS / PLANT			
		TREATMENTS			
		UNTREATED	FUNGICIDE	INSECTICIDE	FUNGICIDE + INSECTICIDE
CLASSIC	$N_{40}P_{40}$	54	65	60	53
	$N_{40}P_{40}$ + GULLE	94	122	76	100
	$N_{40}P_{40}$ + GREEN FERTILIZER	58	67	72	55
	$N_{40}P_{40}$ + GULLE + GREEN FERTILIZER	95	121	78	101
MINIMUM TILLAGE CHISEL	$N_{40}P_{40}$	77	62	50	69
	$N_{40}P_{40}$ + GULLE	140	66	99	130
	$N_{40}P_{40}$ + GREEN FERTILIZER	78	79	50	70
	$N_{40}P_{40}$ + GULLE + GREEN FERTILIZER	138	69	100	129
MINIMUM TILLAGE DISK	$N_{40}P_{40}$	49	60	57	51
	$N_{40}P_{40}$ + GULLE	89	109	81	89
	$N_{40}P_{40}$ + GREEN FERTILIZER	52	62	67	56
	$N_{40}P_{40}$ + GULLE + GREEN FERTILIZER	90	109	83	90
NO TILLAGE	$N_{40}P_{40}$	91	81	76	91
	$N_{40}P_{40}$ + GULLE	150	118	133	168

	$N_{40}P_{40}$ + GREEN FERTILIZER	97	92	80	92
	$N_{40}P_{40}$ + GULLE + GREEN FERTILIZER	148	118	132	165

Disease rating by visual observation indicated that for soybean crop, in 2018, low infection pressure has been reported in all 4 tillage systems, with downy mildew (*Peronospora manshurica)* and bacterial blight (*Pseudomonas glycinae*) attacks.

The highest frequency pathogen in the agricultural year 2018 was *P. manshurica.* From the data obtained we can conclude that the frequency of attack was over 30%, but with an intensity not exceeding 2%, which led to a degree of attack below 2% in all the experimental variants (Table 2).

Table 2. The frequency and intensity of the *P. manshurica* attack

TILLAGE SOIL SYSTEM	FERTILIZATION	TREATMENTS							
		UNTREATED		FUNGICIDE		INSECTICIDE		FUNGICIDE + INSECTICIDE	
		F%	I%	F%	I%	F%	I%	F%	I%
CLASSIC	$N_{40}P_{40}$	50	0.74	44	0.34	57	0.59	48	0.44
	$N_{40}P_{40}$ + GULLE	58	0.94	51	0.54	64	0.79	55	0.64
	$N_{40}P_{40}$ + GREEN FERTILIZER	55	0.69	35	0.19	62	0.44	47	0.29
	$N_{40}P_{40}$ + GULLE + GREEN FERTILIZER	61	1.32	44	0.87	64	1.12	52	0.97
MINIMUM TILLAGE CHISEL	$N_{40}P_{40}$	34	1.23	41	0.68	40	1.63	40	0.73
	$N_{40}P_{40}$ + GULLE	41	1.63	48	0.88	37	1.62	47	0.93
	$N_{40}P_{40}$ + GREEN FERTILIZER	40	1.28	29	0.53	48	1.28	50	0.58
	$N_{40}P_{40}$ + GULLE + GREEN FERTILIZER	41	1.96	39	1.21	43	1.95	49	1.26
MINIMUM TILLAGE DISK	$N_{40}P_{40}$	40	0.97	53	0.43	40	1.03	42	0.43
	$N_{40}P_{40}$ + GULLE	47	1.17	60	0.63	47	1.23	49	0.63
	$N_{40}P_{40}$ + GREEN FERTILIZER	43	0.82	40	0.28	48	0.88	45	0.28
	$N_{40}P_{40}$ + GULLE + GREEN FERTILIZER	46	1.50	51	0.96	48	1.56	48	0.96
NO TILLAGE	$N_{40}P_{40}$	44	1.90	60	0.64	46	1.37	48	0.82
	$N_{40}P_{40}$ + GULLE	51	1.53	67	0.84	53	1.37	40	1.02
	$N_{40}P_{40}$ + GREEN FERTILIZER	58	0.95	55	0.49	55	1.02	60	0.67
	$N_{40}P_{40}$ + GULLE + GREEN FERTILIZER	55	1.74	62	1.17	55	1.70	51	1.35

The highest values were recorded for the minimum tillage system experimental variant. On the other hand, when Copfort was applied, small values correlated with high yield were obtained. In order to increase plant resistance to biotic and abiotic stress factors, Copfort was applied according to the experimental model presented above (doses of 3 l/ ha at the beginning of flowering). The product is a fortifier for plants and protection inductor and acts simultaneously in several areas of the plant as a fortifier and under biotic or abiotic stress circumstances. It is a copper-based aqueous solution complex with gluconic acid which induces natural resistance to the plant. The copper gluconate from Copfort easily permeates the cuticle and induces the synthesis of phytoalexins in the plant which inhibit hyphal growth of fungi or the multiplication of bacteria. The generated phytoalexins are usually terpenoid; due to its systemic effect, the product acts at the whole plant level (including the roots).

Weeds infestation of agricultural crops is a dynamic process and represents the qualitative and quantitative expression of the influence of the soil seeds stock, the changes in plant cultivation technology and the weed control management (Gradila, 2018).

During the experiment, the weeding degree of the soybean crop was determined according to the tillage system. Before the application of postemergent herbicide, the following weeds were identified: monocotiledonate *Echinochloa crus galli*; and dicotiledonate: *Xanthium strumarium, Hibiscus trionum, Chenopodium album, Sonchus arvensis, Cirsum arvense, Polygonum convolvulus, P. aviculare, Rubus caesius, Viola arvensis* (Table 3).

Table 3. Weed species present in soybean culture in 2018

No.	Weed species	Soil system tillage weeds number/ m^2 before treatents (30.05.2018)				Soil system tillage weeds number/ m2 at 14 days after treatments (12.06.2018)			
		Plowing	Chisel	Disk	No tillage	Plowing	Chise l	Disk	No tillage
1.	*X. strumarium*	4	3	0	3	4	3	0	3
2.	*Che. album*	8	9	14	7	8	9	14	7
3.	*P. convolvulus*	3	1	0	1	3	1	0	1
4.	*P. aviculare*	0	0	0	2	0	0	0	0
5.	*S. arvensis*	0	0	0	2	0	0	0	2
6.	*R. caesius*	0	1	0	0	0	1	0	0
7.	*C. arvense*	0	0	0	1	0	0	0	1
8.	*V. arvensis*	0	3	3	6	0	0	0	0
9.	*H. trionum*	0	1	2	0	0	1	2	0
10.	*E. cruss galli*	3	3	4	6	0	0	0	0
11.	*D. carota*	0	0	0	2	0	0	0	0
Total		18	21	23	30	15	15	16	14

The weeding degree of the soybean crop in 2018 before herbicides treatment was higher in the minimum tillage + disk harrow processing (with a number of 23 weeds/m^2) system and in the no tillage system (direct sowing, with a number of 30 weeds/ m^2).

Compared with these two systems, in the chisel plough processing system (minimum tillage) and the classical tillage system the number of weeds was more reduced (21, 18 weeds/m^2, respectively). Two weeks after the use of herbicides, the number of weeds diminished in all the tillage systems, except for the species *X. strumarium* and *Che. album*, that have been affected by herbicides only partially on the edge of the leaves (Table 3).

Nodules have an important role in the atmospheric nitrogen fixation, the quantity of the fixed nitrogen being proportional to the number of nodules. At the beginning of flowering, the number of nodules/ plant and their weight were determined for all the experimental factors (Tables 4).

Table 4. The average of nodules/plant and medium weight nodose/plant (flowering phenophase)

TILLAGE SOIL SYSTEM	FERTILIZATION	TREATMENTS							
		UNTREATED		FUNGICIDE		INSECTICIDE		FUNGICIDE + INSECTICIDE	
		number	weight	number	weight	number	weight	number	weight
CLASSIC	$N_{40}P_{40}$	90	1.20	41	0.54	58	0.44	52	1.03
	$N_{40}P_{40}$ + GULLE	68	1.07	59	0.62	71	0.72	88	0.99
	$N_{40}P_{40}$ + GREEN FERTILIZER	92	1.18	69	1.01	45	0.30	49	0.46
	$N_{40}P_{40}$ + GULLE + GREEN	88	1.05	60	0.58	61	0.67	49	0.44

	FERTILIZER								
MINIMUM TILLAGE CHISEL	$N_{40}P_{40}$	38	0.22	31	0.19	63	0.53	70	1.02
	$N_{40}P_{40}$ + GULLE	25	0.16	40	0.53	47	0.50	24	0.15
	$N_{40}P_{40}$ + GREEN FERTILIZER	47	0.50	40	0.44	51	0.61	52	0.42
	$N_{40}P_{40}$ + GULLE + GREEN FERTILIZER	38	0.32	40	0.46	58	0.44	51	0.39
MINIMUM TILLAGE DISK	$N_{40}P_{40}$	38	0.35	40	0.41	90	0.22	34	0.36
	$N_{40}P_{40}$ + GULLE	59	0.52	20	0.11	43	0.34	73	0.81
	$N_{40}P_{40}$ + GREEN FERTILIZER	48	0.34	27	0.25	20	0.17	73	0.74
	$N_{40}P_{40}$ + GULLE + GREEN FERTILIZER	46	0.35	36	0.44	43	0.53	34	0.36
NO TILLAGE	$N_{40}P_{40}$	34	0.36	25	0.24	44	0.31	45	0.52
	$N_{40}P_{40}$ + GULLE	21	0.21	28	0.15	42	0.49	64	0.53
	$N_{40}P_{40}$ + GREEN FERTILIZER	39	0.35	19	0.12	25	0.09	49	0.47
	$N_{40}P_{40}$ + GULLE + GREEN FERTILIZER	34	1.20	25	0.54	45	0.44	58	1.03

It can be noticed that the number of nodules on the plant is smaller for the experimental variant treated with the extra dose of organic fertilizer compared with the $N_{40}P_{40}$ variant, and the highest number of nodules is reported at the classical tillage system.

The results regarding grain yield are presented in Table 5. The minimum tillage + chisel plough processing appears to improve soybeans yield with an efficiency of 6.5% (173 kg/ha). At no tillage system, the smallest yield was obtained. Supplementary fertilization with gulle can lead to a yield efficiency of up to 237 kg/ha (9.5%), and complex supplementary fertilization with gulle and green manure significantly increased the yield (340 kg/ha - 13.6% higher yield). Compared to the experimental variants without treatments, crop yield was positively affected by pest control during vegetation, production increasing with 221 kg/ha (8.6% higher) being recorded.

Table 5. The influence of the soil system tillage, fertilization and treatments on yield

Variant	Yield kg/ha	Relative yield	Difference	Semnification
A. Soil system tillage				
Classic	2648.91	100.0	0.00	Mt.
Minimum tillage Chisel	2821.63	106.5	172.72	*
Minimum tillage Disk	2714.72	102.5	65.81	-
No tillage	2365.28	89.3	-283.63	00
LDS (p 5%)			102.82	
LDS (p 1%)			188.83	
LDS (p 0.1%)			418.41	
B. Fertilization				
$N_{40}P_{40}$	2493.75	100.0	0.00	Mt.
$N_{40}P_{40}$ + gulle	2730.38	109.5	236.63	**
$N_{40}P_{40}$ + green fertilizer	2492.50	99.9	-1.25	-
$N_{40}P_{40}$ + gulle + green fertilizer	2833.91	113.6	340.16	***
LDS (p 5%)			140.58	
LDS (p 1%)			197.33	
LDS (p 0.1%)			278.59	
Variant	Yield kg/ha	Relative yield	Difference	Semnification

C. Treatments				
Untreated	2586.19	100.0	0.00	Mt.
Fungicide	2566.00	99.2	-20.19	-
Insecticide	2590.72	100.2	4.53	-
Fungicide + Insecticide	2807.63	108.6	221.44	***
LDS (p 5%)			116.60	
LDS (p 1%)			155.70	
LDS (p 0.1%)			203.15	

CONCLUSIONS

The experiment conducted at the Agricultural Research-Development Station Turda, in 2018, provided preliminary results for the development of an Integrated Management System (IMS) for phytosanitary soybean crop risks. Using complex methods of sustainable management with minimal impact on the environment, agroecosystems can be protected and soybean crop yield from the Transylvanian Plain can be optimized.

In 2018, soybean crop was attacked by different pests that decreased crop yield. The main species that attacked the soybean crop, at ARDS Turda, were the mite *Tetranichus urticae* and lepidopterans *Autographa gamma, Mamestra suasa, M. oleracea, Agrotis segetum.* Pathogens *Peronospora manshurica* and *Pseudomonas glycinae* were the most frequently observed.

The tillage system, fertilization and harmful organisms control are differently affecting plant growth and yield production. An increased grain yield was obtained when complex treatments were applied in the experimental variants based on minimum tillage system + chisel plough processing, with organic fertilization.

ACKNOWLEDGEMENTS

This paper was supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI-UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0301, contract no. 28 PCCDI/2018 - *Integrated management system of the agroecosystem resistance against pests in order to promote sustainable agriculture under the conditions of climate change*, within PNCDI III.

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