GLOBAL WARMING CAN INCREASE FLEA BEETLES ATTACK ON OILSEED RAPE, IN LATE AUTUMN, IN SOUTH-EAST ROMANIA

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Abstract

This is the first reference from the Romanian literature about cabbage flea beetle (*Phyllotreta atra*) attack on oilseed rape crop in late autumn, in November, in the country's south-east. Also, in the same period, it registered a higher attack of the cabbage stem flea beetle adults (*Psylliodes chrysocephala*). The research was carried out in the autumn of 2021 at the NARDI Fundulea experimental field, located in Călărași County, south-east of Romania. Oilseed rape was sowed on 22 September, but full plant emergence was recorded on 27 October because of the drought. The assessments concerning flea beetle attacks were made at the end of October and during November. As a result of the higher temperatures recorded in November, the flea beetle attack at untreated plants, on an OEPP intensity scale from 1 to 5, was 2.69, while at variant with seeds treated with cyantraniliprole (625 g/l) active ingredient, the attack was 2.01. Also, there was recorded high attack of the cabbage stem flea beetle adults, both at treated and untreated plants. On 12 November attack degree of the pest at OSR untreated plants was 29.89%, while at seed treated plants was 19.27%. On 19 November, the attack of the cabbage stem flea beetle adults at OSR untreated plants increased to 31.38%, while in the case of seed treatment plants, the attack degree increased slightly, to 19.66%. The weather conditions from the autumn of 2021 it have recorded high attacks of these two flea beetle species. Seed treatment has consequences in reducing this pest attack after plants' emergence; however, the invasion of the cabbage stem flea beetle adults was high in the treated variant too.

Key words: oilseed rape, pests, autumn, global warming

According to MADR data (2022), oilseed rape (OSR) is one of the most cultivated crops in Romania. In the last years, the area sowed with OSR ranged between 342601 and 632679 hectares, representing the fourth crop in this country, after maize, wheat, and sunflower. The same data reveals that in Romania, OSR yield ranged from 2124 to 2835 kg/ha. The draught from autumn can be a harmful factor for this crop (Popescu A., 2010; Grosz D., Tabără V., 2012; Hăjmăjan H. *et al*, 2012; Hess L. *et al*, 2015; Pepó P., Vincze, É., 2015; Pullens, J.W.M., *et al*, 2019, 2021). At the same time, pests attack can decrease OSR yield or destroy entire crops (Čamprag D., 2007; Popov C., Bărbulescu A., 2007; Wiliams I.H., 2010; Râșnoveanu L., 2010, 2011a,b; Buburuz A.A. *et al*, 2013; Georgescu E. *et al*, 2015; Trotuș E. *et al*, 2001, 2011, 2019; Trașcă F. *et al*, 2019; Zheng X., 2020). According to Trotuș E. *et al* (2009), in Romania, at OSR crop, high pest pressure is in autumn, after the emergence, when plants are in early vegetation stages, and in the spring when plants are in buds formation-flowering stage-early maturity stage. The same authors mentioned that in autumn, flea beetles (*Phyllotreta* spp. and *Psylliodes chrysocephala*) represent more than 25 % of harmful insect species from OSR crops. Buburuz A.A. *et al* (2012) concluded that between 2008 and 2011, at ARDS Secuieni, in North-East of Romania, the average adult density of *Phyllotreta atra* specie was 54.2 insects/m^2, while the average adult's density of *Psylliodes chrysocephala* specie was 12.4 insects/m^2. According to the same author, the average adult density of *Phyllotreta nemorum* specie was 43.0 insects/m^2. More recent research at ARDS Secuieni reveals that, between 2014 and 2017, 77.4 % of the harmful insect species collected from OSR crops belonged to the Coleoptera order (Ursache P.L. *et al*, 2017). A significant percentage of Coleoptera order species in OSR crops belong to *Phyllotreta atra* (8.9 %) and *Psylliodes chrysocephala* (5.5%). According to Trotuș E. *et al* (2019), between 2017 and 2018, in the East of Romania, the cabbage flea beetle (*Phyllotreta*

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atra) was collected from OSR crops from all plant stages. However, there were two peeks at this specie, in autumn between plants' emergence and first leaves stage (before the arrival of the winter) and in the spring, from bud formations till the flowering stage. At the same time, stem flea beetle adults (*Psylliodes chrysocephala*) have reduced density. Only 20 adults were captured in autumn. The situation in the southeast of Romania was quite similar. Several papers from the literature make evidence of the attack of *Phyllotreta atra* and *Psylliodes chrysocephala* on OSR crops during the autumn period, when plants were in early vegetation stages (Popov C., Bărbulescu A., 2007; Bucur A., Roșca I., 2011; Râșnoveanu L., 2011a; Buzdugan L., Năstase D., 2013; Georgescu E. *et al*, 2015; Trașcă F. *et al*, 2019). In Romania, in the last ten years, in many areas, the average air temperatures during the autumn season were higher than multiyear averages while rainfalls amount decreasing (Marinică I., Marinică A., 2013, 2016, 2019; Tudose T., Moldovan F., 2020). Consequently, high temperatures and drought can increase the pest attack on main crops, including flea beetles at OSR (Popov C. *et al*, 2006; Deutsch C.A. *et al*, 2018). In the Romanian literature, there wasn't information concerning OSR flea beetle attacks in warm autumn conditions in the last half of November. In this paper, the author collective presents a study concerning flea beetles attack (*Phyllotreta atra* and *Psylliodes chrysocephala*), in the autumn of 2021, in south-east Romania, at OSR crop emerged at the end of October.

MATERIAL AND METHOD

The field trial was carried out at Agricultural Engineering Laboratory from National Agricultural Research and Development Institute (NARDI) Fundulea, Călărași County, Romania (latitude: 44.46; longitude: 26.32; alt.: 68.00 m), in the autumn of 2021.

OSR crop was sowed on 22 September with Wintersteiger Plotseed TC, A-4910 machine. The previous crop was barley. The explication for delaying the sowing data was drought from summer and September. The distance between rows was 25 cm, the sowing depth was 3 cm, and while sowing density was 60 seeds/m^2. In this experience, it has planted a PT275 hybrid. Because of the drought registered in the first part of the autumn of 2021, oilseed rape full emergence was registered on 27 October, 35 days from the sowing. This study has two variants, untreated and seed treatment with the cyantraniliprole active ingredient, a diamide insecticide from the ryanoid class (Selby T.P. *et* al., 2013). Each variant has an area of 2500 m^2. The experimental variants and active ingredients are presented in *table 1*.

Assessments in the field

Assessments concerning **cabbage flea beetle (*Phyllotreta atra*) adults attack** at the OSR crop were made three times, after complete plants emergence (BBCH 10) on 29 October, when plants were in 1-2 leaves stage (BBCH 11-12) on 5 November, and when plants were in 2-3 leaves stage (BBCH 12-13), on 12 November. It has chosen ten assessment points for each variant on the plot diagonal. At each point, it assessed 100 plants, from 4 rows, in the stair system (25 plants/row). The distance from the first assessment point and plot margins was 10 m. OSR plants were photographed with a Panasonic Tz-200 camera in Macro mode. The camera lens was placed 10 cm from the OSR plants. Photos with all OSR plants from the assessment points were downloaded on a computer and then analyzed. The cabbage flea beetle attack intensity was rated according to EPPO (PP 1/218 (1)) scale, from 1 to 5, as follows:
-Note 1: No attack;
-Note 2: Leaves attacked less than 2 %;
-Note 3: Leaves attacked between 3 and 10 %;
-Note 4: Leaves attacked between 10 and 25;
-Note 5: Leaves attacked more than 25 %.

Table 1
Experimental variants at OSR crop, during autumn, at NARDI Fundulea, 2021

Nr. crt.	Variant	Active ingredient	Dose
1	Untreated (control)	—	—
2	Lumiposa (seed trt.)	cyantraniliprole (625 g/l)	0.114 l/To seeds

Assessments concerning **stem flea beetle adults (*Psylliodes chrysocephala*) adults attack** at OSR plants were made simultaneously with those for cabbage flea beetle (*Phyllotreta atra*) attack at the same assessment point. A supplementary assessment was made when OSR plants were in the 4-5 leaves stage (BBCH 14-15) on 19 November. It has determined the attack degree of the stem flea beetle adults. The attack of the two species of flea beetle (*P. atra* and *P. chrysocephala*) can be easily distinguished using photography and analysis of the photographed plants on the PC screen.

OSR plats density was assessed four times, two in November, when plants were in early vegetation stages (BBCH 11-12 and 12-13), on 5 and 12 November, one on 3 December, when plants were in 5-6 leaves stage (BBCH 15-16) and one at the beginning of spring, on 14 March. At each assessment point, there were observations concerning flea beetles attack; it has counting plants on 10 square metters.

Meteorological data was provided by Meteo station of the NARDI Fundulea, placed at 2000 m from the experimental field. It has monitored daily air temperature and rainfalls during

the autumn period of the year 2021 (September-November).

Data from the field assessments were **statistically analyzed** with Tukey's HSD test (Honestly Significant Difference)(Tukey J., 1949) using ARM 20xx software. The results of this field trial were presented as the mean values for flea beetles' attack intensity or attack degree, plants density, the standard deviation from the average values (SD), and the coefficient of variation (CV).

Table 2

Average air temperatures registered at NARDI Fundulea, during autumn, in 2021

Average air temperature (°C)						**Deviation from the average (°C)**		
September		October		November		September	October	November
Current year	Multiyear average	Current year	Multiyear average	Current year	Multiyear average			
17.3	17.5	**10.2**	11.3	**7.7**	5.4	**-0.2**	**-1.1**	**+2.3**

Table 3

Rainfall amounts registered at NARDI Fundulea, during autumn, in 2021

Rainfall amounts (mm)						**Deviation from the average (mm)**		
September		October		November		September	October	November
Current year	Multiyear average	Current year	Multiyear average	Current year	Multiyear average			
4.0	48.5	**56.4**	42.3	**33.8**	42.0	**-44.5**	**+14.1**	**-8.2**

Table 4

Attack intensity of cabbage flea beetle adults (*Phyllotreta* atra) at OSR trial in the autumn of the year 2021

Nr. crt.	**Variant** (active ingredients)	**Attack intensity scale (1-5)**					
		BBCH 10 29 October		BBCH 11-12 5 November		BBCH 12-13 12 November	
1.	Check (untreated)	1.91	a	2.47	a	2.69	a
2.	cyantraniliprole (625 g/l) seed treatment	1.44	b	1.88	b	2.01	b
Tukey's HSD P=0.05		0.170		0.184		0.174	
Standard deviation (SD)		0.168		0.182		0.172	
Variation coefficient (C.V.)		10.010		8.360		7.310	

Means followed by same letter do not significantly differ (P=.05, Tukey HSD test)

Table 5

Attack intensity of cabbage stem flea beetle adults (*Psylliodes chrysocephala*) at OSR trial in the autumn of the year 2021

Nr. crt.	**Variant** (active ingredients)	**Attack degree (%)**							
		BBCH 10 29 October		BBCH 11-12 5 November		BBCH 12-13 12 November		BBCH 14-15 19 November	
1.	Check (untreated)	15.22	a	24.55	a	29.89	a	31.38	a
2.	cyantraniliprole (625 g/l) seed treatment	7.41	b	15.53	b	19.27	b	19.66	b
Tukey's HSD P=0.05		6.785		9.235		8.720		8.414	
Standard deviation (SD)		6.705		9.126		8.618		8.315	
Variation coefficient (C.V.)		59.270		45.540		35.060		32.580	

Means followed by same letter do not significantly differ (P=.05, Tukey HSD test)

Table 6

OSR plants density in the autumn of the year 2021 and beginning of the spring, 2022

Nr. crt.	**Variant** (active ingredients)	**Plants nr./m^2**							
		BBCH 11-12 5 November		BBCH 12-13 12 November		BBCH 15-16 3 December		BBCH 18-20 14 March, 2022	
1.	Check (untreated)	36.28	a	37.37	b	31.78	b	17.49	b
2.	cyantraniliprole (625 g/l) seed treatment	38.53	a	40.59	a	39.12	a	24.08	a
Tukey's HSD (P=0,05)		4.069		2.896		2.935		2.935	
Standard deviation (SD)		4.021		2.862		2.900		2.900	
Variation coefficient (C.V.)		10.750		7.340		8.180		8.180	

Means followed by same letter do not significantly differ (P=.05, Tukey HSD test)

RESULTS AND DISCUSSIONS

Data from *tables 2* and *3* show that weather conditions registered in the autumn of 2021 at NARDI Fundulea were atypical. In September and October, the average air temperature was below the multiyear average with a negative deviation of 0.2, respectively 1.1 °C, while November was higher than averages with a positive variation of 2.3 °C. At the same time, in September, it registered a high rainfall deficit; the negative deviation compared with the multiyear average was 44.5 mm. It reported a higher rainfall amount in October than the multiyear average, with a positive deviation of 14.3 mm. In November, it registered a negative deviation from the norm of 8.2 mm.

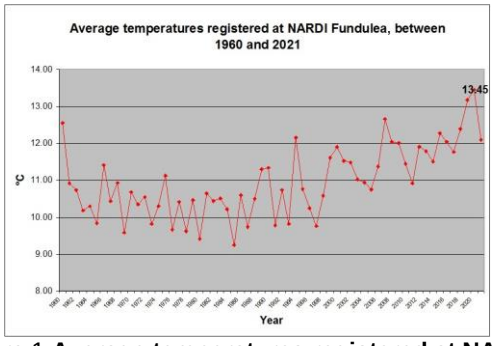

Figure 1 **Average temperatures registered at NARDI Fundulea, between 1960 and 2021**

Because of the severe drought registered in September, OSR plants emerged only at the end of October, while early vegetation stages, from BBCH 11 to BBCH 13, occurred in the first two weeks of November.

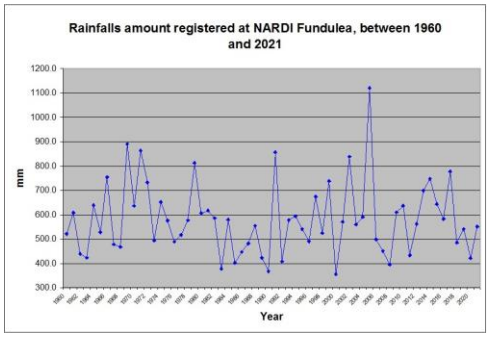

Figure 2 **Yearly rainfalls amount registered at NARDI Fundulea, between 1960 and 2021**

In the last two decades, it has been ascertained that the average year temperature at NARDI Fundulea, located in the southeast of Romania, increased from 11 °C to 13.18 °C in 2019 and 13.45 °C in 2020. The air temperature in 2021 was higher than the multiyear average (T=12.18 °C, *figure* 1). This tendency to increase temperatures is because of global warming. According to Rosenzweig C. *et al* (2001), global warming can produce changes in the dynamics of the main crop pests, exacerbating yield losses. Many pests and diseases can be favored by climate changes, such as increasing the temperature in northern latitudes (Čamprag D., 2007; Olesen J.E. *et al*, 2011). The climate changes will increase the prevalence of insect pests in many agroecosystems (Diffenbaugh N.S. *et al*, 2008). In the case of total rainfall amount during one year, *figure* 2 shows a higher variability of the rainfalls from one year to another, from 1960 to 2021. However, in the last years, it can observe a decrease in rainfalls amount.

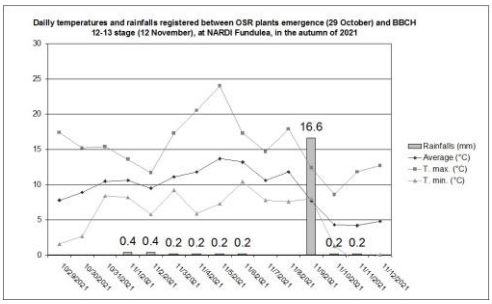

Figure 3 **Dailly temperatures and rainfalls registered between OSR plants emergence (29 October) and BBCH 12-13 stage (12 November), at NARDI Fundulea, in the autumn of 2021**

Analyzing daily weather conditions, when OSR plants were in early vegetation stages (BBCH 10-13), the most susceptible for flea beetles attack, it can be observed that in the first eight days of November (except 2 November), the daily average temperature was higher than 10 °C, while the maximum temperature was higher than 15 °C (even 20 °C in some days) . At the same time, in the first nine days of November, the minimum temperature was higher than 5 °C. The highest rainfall amount was registered on 9 November (16.6 mm) and the last two days of this month (5.8 and 7.2 mm)(*fig*ures 3 and 4). Overall weather conditions for November 2021, at NARDI Fundulea, in southeast Romania were favorable for flea beetles' attack on the OSR crop.

Data from *table* 4 reveal that, on 29 October, when OSR plants were at BBCH 10 stage, the attack intensity of the cabbage flea beetle (*P. atra*) adults, on a scale from 1 to 5, was low. The attack increased on 5 and 12 November due to the warm weather and lowered rainfall that favored this pest. At the same time, on 12 November, OSR plants were in more early stages than usual because of late emergence. Cabbage flea beetle adults were observed feeding on OSR leaves on 12 November (*figure* 5). Until now, in the Romanian literature, there weren't data concerning the presence of *P. atra* adults so late in the autumn, on 12 November.

According to the Tukey HSD test, there was a significant statistical difference concerning cabbage flea beetles' attack intensity at OSR plants from the untreated variant and attack intensity at the seed treatment variant.

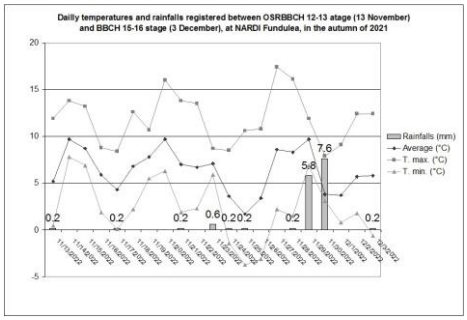

Figure 4 **Dailly temperatures and rainfalls registered between BBCH 12-13 atage (13 November) and BBCH 15-16 stage (3 December), at NARDI Fundulea, in the autumn of 2021**

In the late autumn of 2021, it registered a high attack of the cabbage stem flea beetle adults (*P. chrysocephala*) at OSR plants (*table* 5). At the end of October, the cabbage stem flea beetle attack degree at untreated plants was 15.22 % and 7.41 at the seed-treated variant. On 19 November, when OSR plants were in the 4-5 leaves stage (BBCH 14-15) it registered a high attack degree of the *P. chrysocephala* adults at OSR leaves (31.38 % at the control variant, and 19.66 % at treated variant).

Figure 5 **Cabbage flea beetle (*Phyllotreta atra*) on OSR leaf, at NARDI Fundulea, 12 November, 2021**

In the Romanian literature, it was mentioned the presence of *P. chrysocephala* adults on OSR plants in November, but this is the first mention in the literature concerning the high attack degree of the adults of this pest at OSR plants in the late autumn. Tukey HSD test showed a significant statistical difference concerning stem flea beetle attack degree at OSR plants from untreated variant and attack intensity at treated variant. Plants density was higher in the case of the treated variant, compared with the untreated variant, both in the autumn and beginning of the spring (*Table* 6). However, the plant's density in the spring decreased because of the high flea beetles attack.

CONCLUSIONS

In 2021, high temperatures registered during autumn prolonged the activity of the cabbage flea beetle (*Phyllotreta atra*) adults till the middle of November in the southeast of Romania. Also, it has registered a high attack of the cabbage stem flea beetle adults (*P. chrysocephala*) at OSR plants in the second part of November. Seed treatment with cyantraniliprole active ingredient protects the OSR plants in early vegetation stages against flea beetles attack. Still, in the BBCH 14-16 stage, the attack can be higher and foliar treatment can be necessary, even in the second half of November.

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