

## The Influence of Sowing Period on Spring Pests Attack on Sunflower Using a New Scale of Attack Intensity

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### ABSTRACT

In the context of recent years when the climate is constantly changing, farmers have to determine when to start sowing the spring crops according to the thermal criterion, respectively when thermal conditions are met for seed germination and not following the calendar. The moment of sowing is a technological tool that influences the manifestation of biotic factors. In this paper, it was studied the influence of the moment of sowing (MS) and hybrids on the attack of spring pests: maize leaf weevil (*Tanymecus dilaticollis* Gyll.) and darkling beetle (*Opatrum sabulosum* L.) on sunflower. The paper also proposes a scale of degree attack for these pests, nonexistent so far for sunflower. Six hybrids have been tested and the moment of sowing (MS) had been set taking into account the soil temperature at the depth of 7 cm at 7:00 a.m. as follows: MS1 at 5°C, MS2 at 7°C and MS3 at 9°C. The study was carried out in the experimental field in Beidaud, Tulcea County in South-East Romania, in the years 2021 and 2023, under rainfed conditions. In 2021, the attack rate was 8.4% on MS1, 6.5% on MS2, and 4.2% on MS3. Also, in 2023 the degree of attack decreased with the delay of sowing, but with smaller differences between MSs, from 5.2% (MS1) to 5.1 (MS 2) to 4.6% (MS3). Spring pests attacked sunflower plants less with rising temperatures because early in the spring there are not many sources of food. Among hybrids there were no statistical differences.

**Keywords:** sunflower, spring pests, sowing period, attack intensity scale.

### INTRODUCTION

Sunflower (*Helianthus annuus* L.) is the main oil crop in Romania, being cultivated in 2023 on 1.08 mil. ha. Data from the same year show that in the European Union, Romania was the country with the largest area cultivated with sunflower (NIS, 2024).

Sowing time can influence the attack degree of pests on sunflower like *Passer domesticus* (Killi et al., 2004), *Neotephritis finalis*, *Suleima helianthana* (Knodel et al., 2011), *Zygogramma exclamationis* (Charlet and Knodel, 2003), *Smicronyx fulvus* (Esechie, 1995; Sloderbeck et al., 2009), *Contarinia schulzi* (Knodel and Charlet, 2007), *Homoeosoma nebulellum* (Cao et al., 2010; Szabo et al., 2010; Cheng et al., 2021), *Lygus pratensis* (Zhang et al., 2020).

After abiotic stress, especially drought on yield and quality (Cojocararu et al., 2023), the

pests that cause the most significant damage in Romania on sunflower crop in recent years are spring pests, respectively: maize leaf weevil (*Tanymecus dilaticollis* Gyll.) and darkling beetle (*Opatrum sabulosum* L.).

The maize leaf weevil is the most dangerous pest in Southern and SouthEastern Romania on sunflower (Fatu et al., 2023). After a high attack degree, farmers are forced to sow the attacked plot again (Georgescu et al., 2018). In Romania, the damages due to this pest are the most significant in the whole of the European Union (Meissle et al., 2010) due to the practice of monoculture, climate warming and lack of effective seed treatments with systemic neonicotinoid insecticides (Georgescu et al., 2021, 2024).

Adults of the darkling beetle consume the terminal button and cotyledons at the insertion point or marginally. The attacked plants are getting dried or remain in the form

of rods not exceeding the soil level. Adult activity is favored by sunny days. In cloudy time, they retreat into the soil (Vrânceanu, 2000).

The aim of this research was to examine how different moments of sowing influence the occurrence of spring pests on six sunflower hybrids in the climatic conditions specific for Dobrogea region in South-East Romania in 2021 and 2023.

## MATERIAL AND METHODS

**Plant material and field trials.** The research was carried out in field experiments located in Tulcea county from Dobrogea region in South-East Romania (Beidaud - 44°42' N latitude and 28°34' E longitude) during 2021 and 2023, on a chernozem argiloiluvial soil and under rainfed conditions. Three hybrids included in the study were certified (P64LE99, FD20CL70 and FD15E27) and three were in the process

of certification (DS001, DS002 and DS003). The hybrids were sown at three different moments of sowing (MS) considering the soil temperature at the depth of 7 cm at 7 a.m., respectively: MS1 at 5°C, MS2 at 7°C and MS3 at 9°C. In Table 1, there is presented the calendar date corresponding to the sowing of each MS for both experimental years. The sowing density was 55.000 germinable seeds ha<sup>-1</sup>. The space between rows was 70 cm. The plot size was 210 m<sup>2</sup> (4.2 m x 50 m). The previous crop was winter barley. In 2021 the weeds were controlled with herbicide Pantera 40 EC (40 g/l quizalofop-P-tefuryl) 0.8 L/ha applied at 2-4 leaves stage of the sunflower plants. In 2023 the weeds were controlled with herbicide Express 50 SG (50% tribenuron-methyl) 30 g/ha for hybrids P64LE99, FD15E27, DS002 and DS003 and herbicide Pulsar 40 (40 g/l imazamox) 1.2 L/ha for hybrids FD20CL70 and DS001 both applied at 4-6 leaves stage of the sunflower plants.

Table 1. Sowing date for the three moments of sowing in the experimentation years

Moment of sowing	Sowing date in the experimental years	
	2021	2023
MS 1 - 5°C	01.04.2021	17.03.2023
MS 2 - 7°C	17.04.2021	08.04.2023
MS 3 - 9°C	23.04.2021	15.04.2023

**Attack degree.** The attack degree for spring pests, respectively maize leaf weevil (*Tanymecus dilaticollis* Gyll.) and darkling beetle (*Opatrum sabulosum* L.) was determined after assessments on attack frequency and attack intensity. The assessments were performed on 10 randomly selected sunflower plants in four replicates at 2-4 leaves stage.

The attack frequency (AF %) were calculated using the following formula:

$$AF (\%) = \frac{n}{N} * 100$$

where: n - is the number of plants attacked and N - is the the total number of plants.

The attack intensity was assessed using a scale especially developed for this research of 1-10 points, where (Figure 1):

- 1 = plant with no attack;
- 2 = plant with a quarter of cotyledon eaten;

- 3 = plant with half of cotyledon eaten;
- 4 = plant with quarters of cotyledon eaten;
- 5 = plant with one cotyledon eaten;
- 6 = plant with one cotyledon destroyed + a quarter of cotyledon eaten;
- 7 = plant with one cotyledon destroyed + half of cotyledon eaten;
- 8 = plant with one cotyledon destroyed + three quarters of cotyledon eaten;
- 9 = plant with both cotyledons eaten but with the terminal button visible;
- 10 = plant with both cotyledons and terminal button eaten.

In the case of plants that had both cotyledons consumed in different proportions, the score given for the intensity of the attack was made by summing the attacked part of both cotyledons.

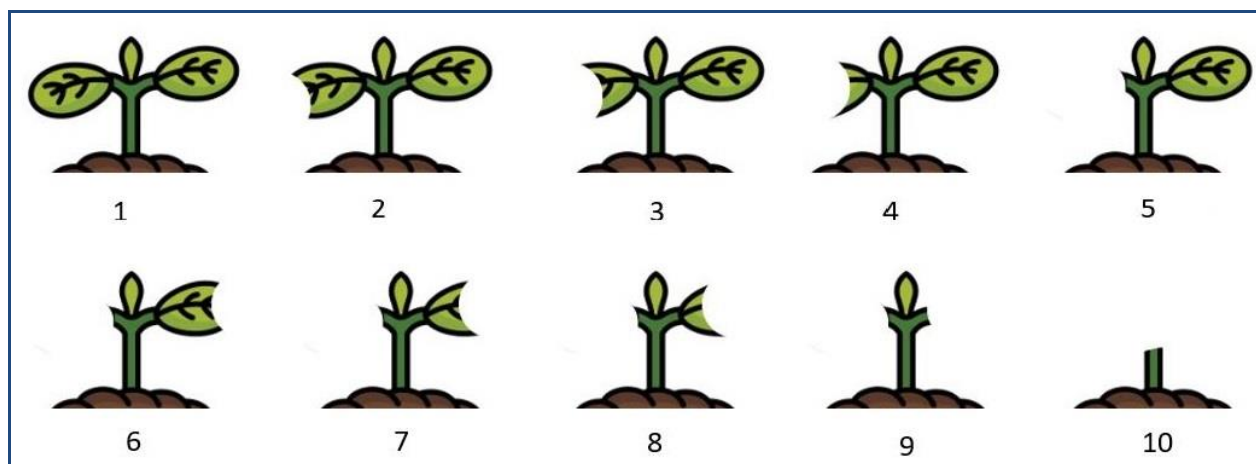


Figure 1. Attack intensity scale

The AI was calculated using the following formula:

$$AI (\%) = \frac{\sum(n \cdot v)}{10 \cdot N} \cdot 100$$

where: n - is the number of plants in each category; v - is the numerical value of the attack category; N - is the total number of plants, and 10 is the maximum numerical value of the attack category.

Based on the attack frequency and attack intensity, the attack degree (AD %) was calculated using the following formula:

$$AD (\%) = \frac{AF (\%) \cdot AI (\%)}{100}$$

**Weather conditions.** In 2021, sunflowers benefited from good precipitation accumulated in the winter months at the beginning of the year, especially in January (76.5 mm). During the vegetation period of the sunflower plants (April-August), the accumulated rainfall were 221.1 mm, which was insufficient for covering the sunflower water requirements for a good development which is over 400 mm (Pejic et al., 2009). The month with the most rainfall was June (100 mm), and the driest month was August (12.3 mm). The highest monthly average temperature was recorded in July (24°C), and the lowest in April (9°C) (Figure 2).

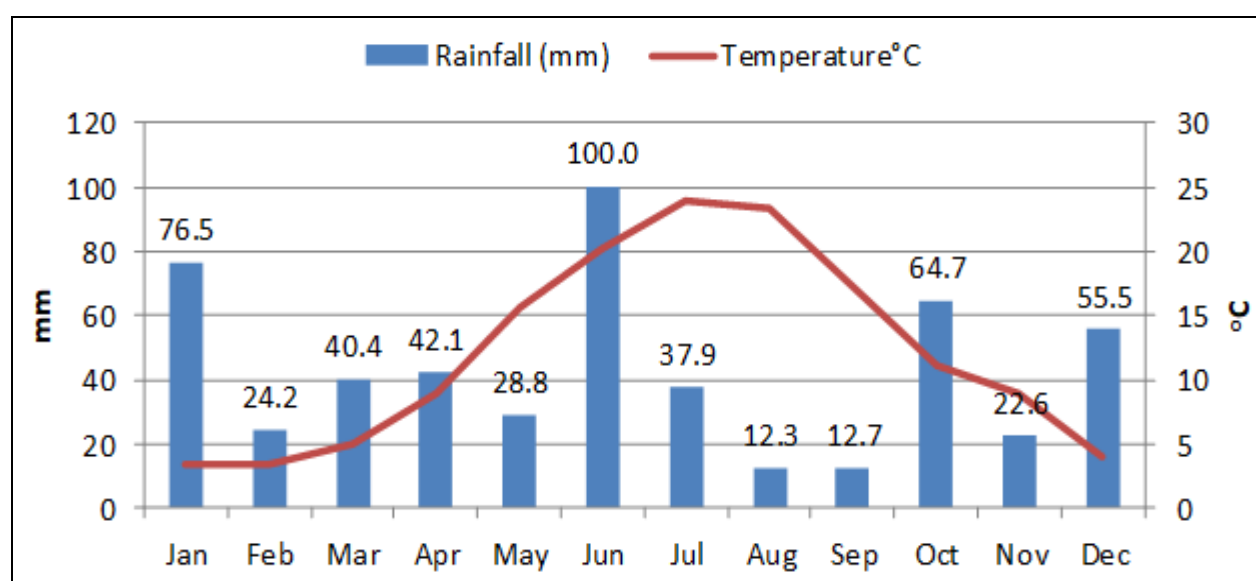


Figure 2. Average monthly temperatures and rainfall of 2021, Beidaud commune, Tulcea County, South-East Romania

In 2023, the sum of rainfall accumulated during the vegetation period of sunflower plants (March-August) was 243.2 mm. Although the value is higher than in 2021, the low rainfall in June (39.6 mm) when flowering occurred had a negative impact on

grain yield. The month with the most rainfall was April (78.1 mm) and the driest month was May. The highest monthly average temperature during the sunflower vegetation period was recorded in August (25.3°C), and the lowest in March (6.9°C) (Figure 3).

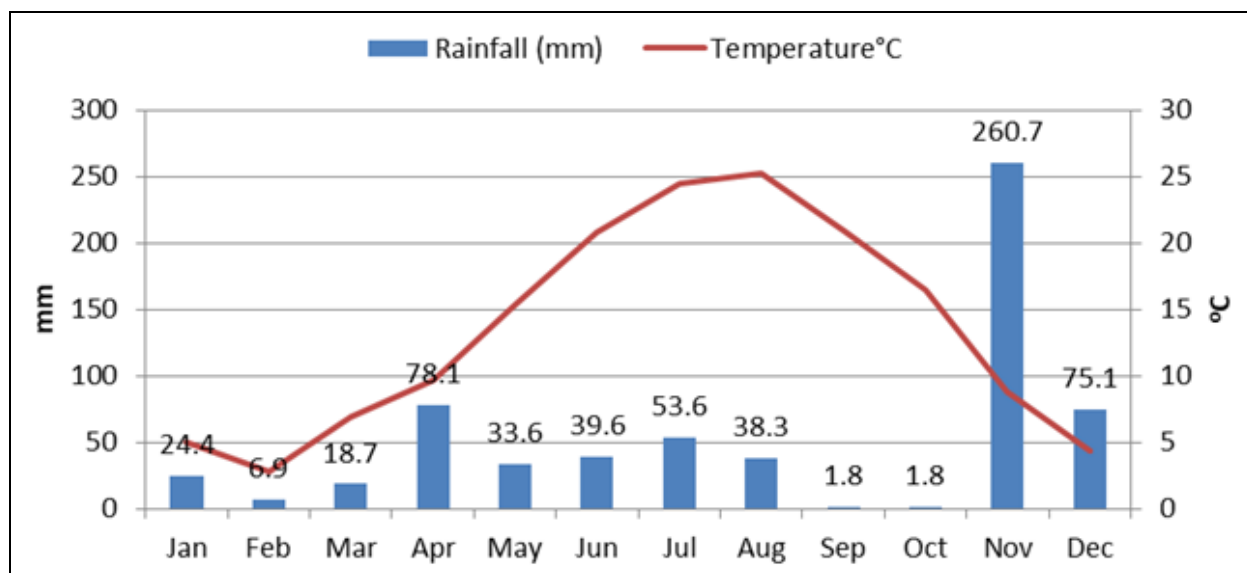


Figure 3. Average monthly temperatures and rainfall of 2023, Beidaud commune, Tulcea County, South-East Romania

## RESULTS AND DISCUSSION

In the context of recent years when the climate is constantly changing, farmers have to determine when to start sowing the spring crops according to the thermal criterion, respectively when thermal conditions are met for seed germination and not following the calendar. In the last years farmers tried to sow sunflower earlier to avoid drought from flowering stage and to benefit from winter precipitation (Radu et al., 2019). Under these conditions, it is important to assess how temperature at sowing influences pest attack.

Spring pests were the only pests that caused damage in the sunflower crop in both experimental years. The assessments were made together for the maize leaf weevil (*Tanymecus dilaticollis* Gyll.) and darkling beetle (*Opatrum sabulosum* L.) because the attack symptoms are very similar.

In 2021, pest attack decreased as sowing was delayed, corresponding to higher soil temperatures at sowing. Early sowing at 5°C resulted in higher pest pressure, likely because adjacent plots had not yet been sown, making

plants from MS1 the only available food source. Differences among hybrids were not statistically significant (Table 2).

Also in the year 2023, the AD decreased with the delay of sowing, respectively with sowing at higher temperatures, but with smaller differences between MSs, from 5.2% to 4.6%. In 2021, the AD of spring pests was with 1.4% higher than in 2023 (Table 3). The difference can be given by the degree of infestation of the plot, because from one year to another the experimental plot was in another physical block on the farm to avoid monoculture.

Previous research by Georgescu et al. (2024) evaluated control methods for *T. dilaticollis* using *Beauveria bassiana* (an entomopathogenic fungus) and neem oil applied before sowing, but these treatments were ineffective. Therefore, coordinated sowing within a region may help reduce pest migration between fields. The sowing period thus represents an important agronomic tool, particularly in organic farming systems, for reducing both pest and disease incidence (Radu and Gurau, 2023).

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Table 2. Influence of sowing date and sunflower hybrid on spring pests degree attack (2021)

Hybrid	AD (%) of spring pests according to the moments of sowing			Average of MSs
	MS 1	MS 2	MS 3	
P64LE99	7.5	5.0	1.5	4.6
DS001	15.4 <sup>OO</sup>	6.8	2.3	8.8
DS002	5.6	4.2	3.8	4.5
DS003	4.1	8.6	5.2	5.9
FD15E27	2.6	6.4	6.3	4.5
FD20CL70	15.2 <sup>O</sup>	7.9	6.0	9.7
<b>Average</b>	<b>8.4</b>	<b>6.5 (control)</b>	<b>4.2</b>	<b>6.3 (control)</b>
<i>DL</i> <sub>5%</sub>		6.60		3.81
<i>DL</i> <sub>1%</sub>		8.79		5.08
<i>DL</i> <sub>0,1%</sub>		11.48		6.63

Table 3. Influence of sowing date and sunflower hybrid on spring pests degree attack (2023)

Hybrid	AD (%) of spring pests according to the moments of sowing			Average of MSs
	MS 1	MS 2	MS 3	
P64LE99	3.9	8.4	-	6.2
DS001	12.9 <sup>OOO</sup>	2.0	3.0	6.0
DS002	5.9	3.7	2.9	4.2
DS003	3.0	4.8	9.4 <sup>O</sup>	5.7
FD15E27	1.5	5.6	3.5	3.5
FD20CL70	4.2	6.1	4.3	4.9
<b>Average</b>	<b>5.2</b>	<b>5.1 (control)</b>	<b>4.6</b>	<b>5.1</b>
<i>DL</i> <sub>5%</sub>		3.69		
<i>DL</i> <sub>1%</sub>		5.09		
<i>DL</i> <sub>0,1%</sub>		6.99		

## CONCLUSIONS

Spring pest attack on sunflower decreased with increasing temperatures at sowing, likely due to the limited availability of food sources early in the season. Differences in attack degree between sowing dates were more pronounced in 2021 than in 2023. Across both years, the average attack degree was 6.3% in 2021 and 5.1% in 2023. No statistically significant differences were observed among the tested sunflower hybrids, indicating that, under the conditions of this study, hybrid selection had a limited effect on reducing pest damage.

These findings highlight that adjusting sowing time according to thermal conditions can serve as an effective agronomic strategy for mitigating spring pest damage,

particularly in systems with limited chemical control options, such as organic agriculture.

## ACKNOWLEDGEMENTS

The study was performed with support of the Doctoral School of Engineering and Management of Plant and Animal Resources and the Faculty of Agriculture of the University of Agronomic Sciences and Veterinary Medicine of Bucharest.

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